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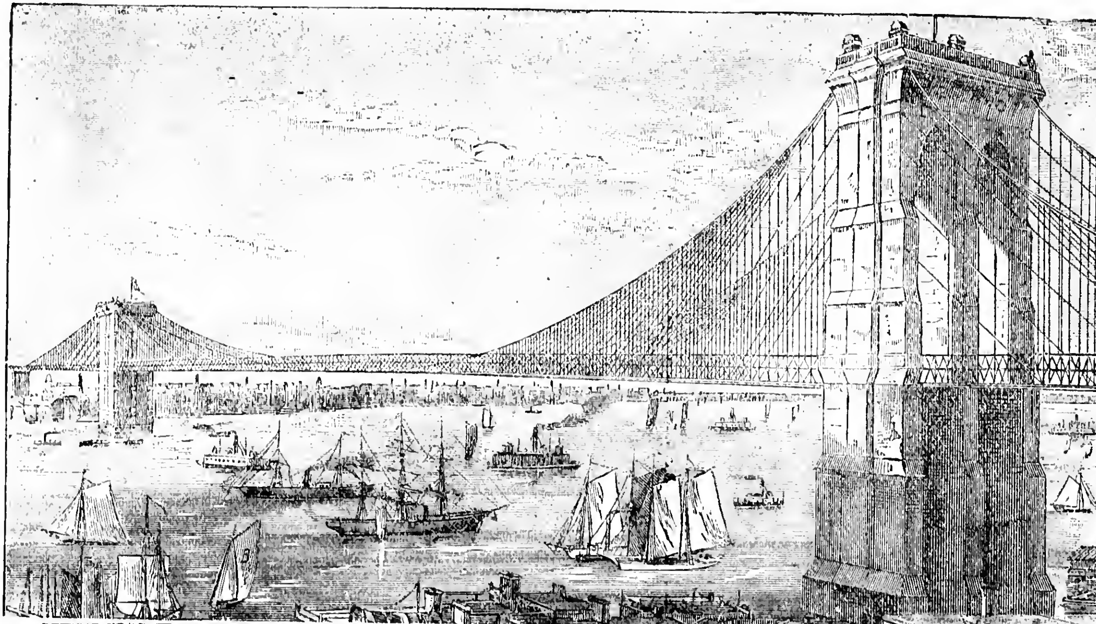

NEW-YORK AND BROOKLYN SUSPENSION BRIDGE.—*Engineer*, W. A. Roebling. *Height of towers above high water mark*, 268 feet. *Height of towers above floor of bridge*, 150 feet. *Elevation of bridge floor above high water mark*, 118 feet. *Total length of bridge between termini*, 5,862 feet. *Length of central span across the East River*, 1,600 feet. *Breadth of bridge*, 80 feet, widening to 100 feet at termini, divided into five spaces for railwa tracks, passenger travel, &c. *Street-crossings*—Ten streets in New York and six in Brooklyn will be crossed with iron girders at high elevation, to clear obstructions. *Intended speed of cars over bridge*, 20 miles per hour. *Motive power*, endless wire rope, impelled by steam engine under the flooring of bridge on the Brooklyn side. *Anticipated traffic*, 109,559 passengers per day *Estimated cost of bridge*, $6,675,337.

THE UNIVERSAL ASSISTANT,

AND

COMPLETE MECHANIC,

CONTAINING OVER

ONE MILLION INDUSTRIAL FACTS,

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BY R. MOORE.

Illustrated with 500 Engravings.

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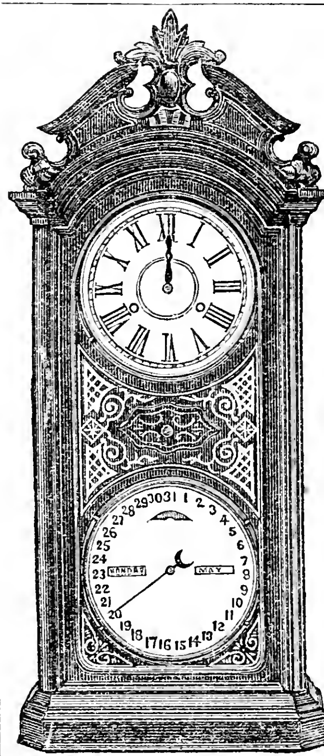
1880.

FOR MEASUREMENT OF TIME SEE PAGE 773.

Table Showing the Time in Various Parts of the World when it is Noon at WASHINGTON, D. C.

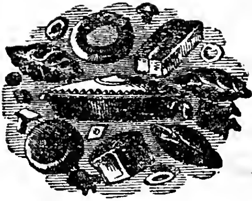


Alaska, 7 23 A.M.	Moncton, N. B., 12 43 P.M.
Albany, 12 13 P.M.	Montreal, Can., 12 14 P.M.
Atlanta, 11 30 A.M.	Nashv'e Tenn., 11 21 A.M.
Augusta, Ga., 11 39 A.M.	N. Haven, Ct., 12 16 P.M.
Baltimore, Md., 12 02 P.M.	N. London, Ct., 12 20 P.M.
Bangor, Me., 12 33 P.M.	New York, 12 12 P.M.
Bath, Me., 12 29 P.M.	N. Orleans, La., 11 08 A.M.
Boston, Mass., 12 24 P.M.	Omaha, Neb., 10 44 A.M.
Buffalo. N. Y., 11 52 A.M.	Ottawa, Can., 12 05 P.M.
Camb'ge, Mass., 12 24 P.M.	Paducah, Ky., 11 16 A.M.
Charlest'n, S.C., 11 43 A.M.	Panama, 11 50 A.M.
Chicago, Ill., 11 17 A.M.	Paris, France, 5 17 P.M.
Cincinnati, O., 11 30 A.M.	Pensacola, Fla., 11 19 P.M.
Cleveland, O., 11 41 A.M.	Philada., Pa., 12 07 P.M.
Columbia, S.C., 11 44 A.M.	Pittsburg, Pa., 11 48 A.M.
Columbus, O., 11 36 A.M.	Port Hope, Can., 11 54 A.M.
Danville, Va., 11 50 A.M.	Pt. Huron, Mch., 11 34 A.M.
Denver, Col., 10 08 A.M.	Portland, Me., 12 27 P.M.
Detroit, Mich., 11 36 A.M.	Portsm'th, Va., 12 03 P.M.
Dubuque, Ia., 11 05 A.M.	Provide'ce, R.I., 12 22 P.M.
Galveston, Tex., 10 49 A.M.	Quebec, Can., 12 23 P.M.
Halifax, N. S., 12 54 P.M.	Quincy, Ill., 11 07 A.M.
Hamilton, Ont., 11 49 A.M.	Richmond, Va., 11 58 A.M.
Hannibal, Mo., 11 07 A.M.	Rome, Ga., 11 32 A.M.
Hartford, Ct., 12 17 P.M.	St. John, N. B., 12 44 P.M.
Havana, Cuba, 11 38 A.M.	St. Johns, N. F., 1 37 P.M.
Houston, Tex., 10 44 A.M.	St. Joseph, Mo., 10 50 A.M.
Indianap's Ind., 11 24 A.M.	St. Louis, Mo., 11 07 A.M.
Jacksonv'e, Ill., 11 07 A.M.	St. Paul, Minn., 10 56 A.M.
Jeff'n City, Mo., 10 59 A.M.	St. Step'n, N.B., 12 39 A.M.
Kalama, W. T., 8 58 A.M.	Salt Lake City, 9 40 A.M.
Kansas City, Mo. 10 49 A.M.	Santa Fe, 10 04 A.M.
Knoxv'e, Tenn., 11 32 A.M.	San Francisco, 8.58 A.M.
Laramie. Wy T., 10 12 A.M.	Sault St. Marie, 11.31 A.M.
Louisville, Ky., 11 26 A.M.	Savannah, Ga., 11 44 A.M.
Lincoln, Neb., 10 41 A.M.	Selma, Ala., 11 20 A.M.
Little Rock, Ak., 10 59 A.M.	Shreveport, La., 10 57 A.M.
London, Eng., 5 08 P.M.	Sioux City, Ia., 10 42 A.M.
Macon, Ga., 11 37 A.M.	Terre Haute, 11 18 A.M.
Memp's, Tenn., 11 03 A.M.	Toronto, Can., 11 51 A.M.
Meridian, Miss., 11 14 A.M.	Vincennes, Ind. 11 17 A.M.
Mexico, 10 32 A.M.	Vera Cruz, 10 43 A.M.
Milwau'e, Wis., 11 16 A.M.	Vicksb'g, Miss., 11 05 A.M.
Minneapolis, 10 55 A.M.	Wilming'n, NC., 11 58 A.M.
Mobile, Ala., 11 16 A.M.	

PREFACE.

This work is issued with the design of supplying very important omissions in the author's antecedent writings and compilations. His most fervid acknowledgments are due for the great encouragement accorded to his previous efforts, and the favorable opinions expressed regarding them. The result has been that, stimulated by the experience of the past, he has in the present work, made special exertions to present an immense array of rare and most valuable information relating to Commerce and the Industrial Arts. The vital concerns of health, home, domestic felicity, and other all-important interests, have also received due attention, and to make the information more comprehensive and complete, he has quoted largely from his previously published works, wherever he judged it necessary to do so. These extracts include a few items for machinists use, and the diagrams for saw-filing, selected from the "Boston Machinist" and Halley's work "On Saw-filing," by permission of the publishers, John Wiley & Son, of New York, together with a few extracts from the "Watchmakers' Manual," by permission of the Publishers, Jesse Haney & Co, New York. In addition to the matter above alluded to, many valuable tables are now published for the first time, together with much new and most important matter specially adapted for the use of commercial, manufacturing, and mechanical men in both hemispheres. A past experience of many years devoted to the welcome task of supplying technical information to business men, mechanics, &c., has qualified the author to judge regarding their wants, and to act intelligently in endeavoring to supply them. His effort has been to act as the harbinger of mechanical improvements and general progress, and he can say without ostentation, that the present work is the result of prolonged and continuous labor; the best authorities have been consulted, and endeavors have been made to make it plain, easily understood, and commensurate with the exacting requirements of this progressive age.

GENERAL INDEX.

BAKING AND COOKING DEPARTMENT.

NOTE.—The observant tradesman will notice that the following formulæ may be adapted for smaller quantities, or for household use, in any desired instance, by a proportionate subdivision of the materials used.

HOP YEAST.—Boil 9 ozs. of hops with 3 pails of water; put 9 lbs. of good flour in a tub, and strain enough of the hop-water over it to make it into a stiff paste; beat it up thoroughly; strain in the rest of the hop-water into the paste; let it stand until lukewarm; then add 4½ qts. stock yeast. It will rise 1 to 3 inches, but do not disturb it until it drops.

STOCK OR MALT YEAST.—Boil 12 ozs. of good hops with 4 pails of water for about 5 minutes; then strain off enough of the liquid among 8 lbs. of good sifted flour in a tub, to render it into a stiff paste, working it up thoroughly with a clean stick; then add the rest of the liquid to the paste; let it stand till lukewarm, and pulverize any remaining lumps with your fingers. Now add about 8 lbs. malt and 6 qts. stock yeast; allow it to work in a warm place till it rises and falls again, which will occupy from 8 to 12 hours; strain through a hair sieve and stand in a cool place. In warm weather 4 gals. cold water might be added to the above, previous to stocking it away.

COMPRESSED YEAST.—This yeast, so extensively used in Europe, is obtained by straining the common yeast in breweries and distilleries until a moist mass is obtained, which is then placed in hair bags, and the rest of the water pressed out until the mass is nearly dry. It is then sewed up in strong linen bags for transportation. It will keep a long time, and is very highly esteemed by bakers. See *Vienna Bread*.

FERMENT.—Boil 2 pecks of good potatoes, strain, and place them in a ferment tub; add 8 or 9 lbs. flour, and, with a masher, intermix all thoroughly together and turn in, say, 6 or 8 gals. water, or enough to make it milkwarm; add 2 gals. stock yeast, set it in a warm place, allowing it to rise and fall, not letting it stand very long after it falls, as it is liable to sour in warm weather; strain, and all is ready.

NOTE.—Good yeast for the purpose of renewing your old stock may be made by boiling a peck of clean potatoes in 4 pails of water; when about done, add 12 ozs. hops, and boil the potatoes until soft; put 12 lbs. flour into a clean tub; make into a stiff paste with part of the hop-water; next add the whole, including potatoes and hops, rubbing the potatoes through a coarse sieve, letting it stand till lukewarm; then stock away. This is for renewing your old malt or hop yeast when the latter runs out, and not for general use; or it may be substituted by yeast from another shop.

SETTING SPONGE.—For a quantity of, say, 3 barrels of flour, put it in the trough; sift it; add 4½ pails of ferment, and about 4½ of water (cold water during warm weather, and warm water during cold); intermix and work it up smooth, allowing it to rise and fall, when it is ready. A delay in the process, for the space of 30 minutes or so, may be effected, if desired, by the addition of a handful of salt when the sponge is being set. The sponge being ready, 9 lbs. of salt, including the last mentioned, are now weighed, dissolved, and turned into the sponge, together with 9 pails of water (of 2½ gals. to each pail); mix all thoroughly and knead the dough, letting it get a good proof, when it will be ready to mix up into loaves. A good method for warm weather to work flour that is new and soft, is to make your dough right up, straining in all your ferment, salt and water, without setting any sponge. When the dough rises well, work it down, turning up the sides, and allow it to rise once more previous to throwing it out of the trough, adding alum if desired. With flour that works soft and clammy, requiring 9 lbs. of salt to the batch, omit 4½ pounds, and substitute 2¼ lbs. alum, 1 lb. of alum being equivalent to 2 lbs. salt. Alum assists inferior flour in making white bread. The rule here laid down is 8 ozs. salt to each pail of water, but a little more might be used occasionally with benefit.

LONDON WHITE BREAD.—The common proportions used by the London bakers, are: Flour, 1 sack; common salt, 4½ lbs.; alum, 5 ozs.; yeast, 4 pts.; warm water for the sponge, about 3 gals. The alum is used for the purpose of *whitening* the bread, but Liebig has demonstrated that this purpose may be better subserved by the use of *clear lime water* in mixing up the dough.

It is the commendable ambition in the English bakers to impart that peculiar tint so highly prized by connoisseurs, and so successfully produced at Vienna and Paris. At Vienna, it has long been known that if the hearth of an oven be cleaned with a moistened wisp of straw, the crust of bread baked in it immediately after presents a rich yellow tint; the theory is that the aqueous vapor retained in the oven has a beneficial effect.

The proper temperature of the oven is between 200° and 225° Centigrade, equivalent to 424° and 480° Fahr., and may be known by the emission of sparks from a piece of wood rubbed on the oven.

The dough loses about 1-7th of its weight if baked in batches, but fully ⅙ if baked in small loaves and placed in the oven separately. The *best bread* contains about 11-16ths of its weight of added water, and *common bread* often much more than ¾. The proportion of water in the London bread has greatly increased of late years, owing to the use of the fraudulent method of making the dough with rice jelly or moss jelly, in which Iceland moss, Irish moss, or other mosses are used, by boiling 7 lbs. of moss in 10 gals. of water, and using the resultant jelly in making 70 lbs. of flour into dough, which is then fermented and baked in the usual way. It is said that flour treated in this way will yield fully double its weight of good bread. According to Heern, 100 lbs. of wheaten flour will yield at least 125 to 126 lbs. of bread—some say 135 lbs.; 100 lbs. of rye meal, 131 lbs. of bread. A ¼ oz. carbonate of magnesia, added to the flour for a

4-lb. loaf, materially improves the quality of the bread even when made from the very worst seconds flour.

PARIS BAKER'S WHITE BREAD.—On 80 lbs. of the dough left from the previous day's baking, as much luke-warm water is poured as will make 320 lbs. flour into a rather thin dough. As soon as this has risen, 80 lbs. are taken out and reserved in a warm place for next day's baking. One pound of *dry yeast* dissolved in *warm water* is then added to the remaining portion, and the whole lightly kneaded. As soon as it is sufficiently "risen," it is then made into loaves, and shortly afterwards baked, the loaves being placed in the oven without touching each other, so that they may be "crusted" all round.

THE SECRETS OF VIENNA BREAD.—The proportions of Vienna bread, confessedly inferior to none in the world, are: Flour 100 lbs.; water and milk, 9 gals.; salt, 6 lbs. 4 ozs.; pressed yeast, 18 lbs. 12 ozs. According to Prof. Horsford, good fresh middlings flour will compare favorably with the average Hungarian flour used in Vienna. The fresh pressed yeast is obtained by skimming the froth from beer mash in active fermentation. This contains the upper yeast, which must be repeatedly washed with cold water until only the pure white yeast settles clear from the water. This soft, tenacious mass, after the water has been drawn off, is gathered into bags and subjected to hydraulic pressure, until there remains a semi-solid, somewhat brittle, dough-like substance, still containing considerable water. This is the pressed yeast, which will keep for eighty days in summer, and much longer on ice. For use it should be fresh and sweet.

The mixing is commenced by emptying the flour sacks into a zinc-lined trough about 2½ feet wide and 8 feet long, half round in form. Then with a pail holding about 5 gals., equal parts of milk and water are poured, and left to stand until the mixture attains the temperature of the room, between 70° and 80° Fahr. It is then poured into one end of the trough and mixed with the bare hand with a small portion of the flour to form a thin emulsion. The pressed yeast is next crumbled finely in the hands, and added in the proportion of 3½ ozs. to every 3 qts. of liquid, and then 1 oz. of salt in same proportion is intermingled through the mass. The trough is now covered and left undisturbed for ¾ of an hour, and after this the rest of the flour is incorporated with the mass in the above-named proportions.

The mass of dough, being allowed to rest for 2½ hours, becomes a smooth, tenacious, puffed mass of yellowish color, which yields to indentation without rupture and is elastic. It is now weighed into pound masses, and each lump is cut by machinery into 12 small pieces, each ¾ inch in thickness. Of each one of these, the corners are brought together in the centre and pinched to secure them. Then the lump is reversed and placed on a long dough board for further fermentation, until the whole batch is ready for the oven. Before being introduced into the latter, the rolls are again reversed and restored to their original position, having considerably increased in volume, to be still farther enlarged in the oven to at least twice the size of the original dough. In the oven they do not touch each other, and the baking occupies about 15 minutes. To glaze the surface they are touched in the process of baking with a sponge dipped in milk, which besides imparting to them a smooth surface, increases the brilliancy of the slightly reddish cinnamon color and adds to the grateful aroma of the crust.

Aerated Bread.—The water used in forming the dough is placed in a vessel capable of withstanding a high pressure, and carbonic acid gas is forced into it to the extent 10 or 12 atmospheres. The water will absorb and retain it whatever may be its density, in quantities equal to its own bulk, so long as it is retained in a close vessel under pressure. The flour and salt, of which the dough is to be formed, is next placed in another powerful vessel of a spheroidal form, constructed with a simple kneading apparatus working from without and operating through a closely packed stuffing-box. Into this vessel is forced a pressure equivalent to that in the aërated water vessel, then by means of a pipe connecting the two vessels, the aërated water is drawn into the flour and the kneading apparatus is operated at the same time, the water acting simply as limpid water among the flour, forming a pasty mass of the requisite tenacity. The pressure is now withdrawn, and the gas escapes from the water, and in doing so, raises the dough in a beautiful and rapid manner, the intermixture being thorough and complete. The mixing vessel may have, say, an internal capacity of 10 bushels; to fill this with the inflated bread dough only 3½ bushels of flour are required. In the intermixture of water with flour the pasty mass measures rather less than half the bulk of the original dry flour, or about 1⅓ bushels instead of 3½, the expanded dough represents nearly 5 parts gaseous to one solid. The subsequent baking expands it to a much greater extent, making the proportions of gaseous to solid in all about 10 to 1. It must be self-evident that this bread is very pure, nothing but flour, water, and salt, being used, and reliable experiments have demonstrated that 118 loaves can be made from the same weight of flour which by fermentation will make only 105 or 106, the loss in the latter being caused by the emission of carbonic acid gas through the dough during the process of fermentation and manufacture. In baking this bread, it has been found necessary to have the heat admitted through the bottom of the oven, with means of regulating the heat of the top, so that the bread is cooked through the bottom, and the heat subsequently admitted above towards the last, in order to perfect the top crust. These precautions are taken owing to the low temperature of the dough when placed in the oven, caused by the use, of cold water in the baking process, and the sudden expansion on rising inducing a temperature of 40° Fahr., lower than ordinary fermented dough. This in connection with its slow springing until it reaches the boiling point, renders it desirable to delay the formation of the top crust until the last moment.

Another Aerated Bread.—1. Dissolve 1 oz. of sesqui-carbonate of ammonia in water, sufficient to make 7 lbs. of flour into a dough, which must be formed into loaves, and baked immediately. 2 Divide 3 lbs. flour into two portions: mix up the first with water, holding in solution 2 ozs. bicarbonate of soda; then mix the second portion of flour with water, to which 1 oz. of muriatic acid has been added; knead each mass of the dough thoroughly. When this is done, mix both portions together as rapidly and perfectly as possible. form the mass into loaves and bake immediately. This bread contains no yeast, and is very wholesome. *Note.*—Carbonate of magnesia and muriatic acid chemically combined, form common salt.

Healthy Mixed Bread.—Boil 3 lbs. of rice to a soft pulp in water; pare and cook by steam 6 lbs. of your best potatoes, mash your potatoes and rub them up with rice pulp; add tc the whole 6 lbs. flour, make all into a dough with water, ferment with yeast, let it stand a proper length of time, and then place it in the oven to bake.

ANOTHER EXCELLENT BREAD.—Knead 21 lbs. flour with 9 lbs of pared and mashed potatoes, from which the water has been well steamed off previous to mashing: mix together while the potatoes are warm, adding about 3 or 4 spoonfuls of salt. Then add about 3 qts. milk-warm water, with 9 large spoonfuls of yeast gradually to the potatoes and flour; knead and work it well into a smooth dough, and let it stand 4 hours before putting into the oven.

FRENCH BREAD.—Take nice rice, ¾ lb.; tie it up in a thick linen bag, giving it enough room for it to swell: boil from three to four hours till it becomes a perfect paste; mix while warm with 7 lbs. flour; adding the usual quantities of yeast, salt, and water. Allow the dough to work a proper time near the fire, then divide into loaves, dust them in, and knead vigorously.

DYSPEPSIA BREAD.—The following receipt for making bread has proved highly salutary to persons afflicted with dyspepsia, viz.:—3 quarts unbolted wheat meal; 1 quart soft water, warm but not hot; 1 gill of fresh yeast; 1 gill molasses, or not, as may suit the taste; 1 teaspoonful of saleratus.

For the sake of the industrious house-wife, and not for bakers, as they are supposed to know already, it may be well to state that 30 minutes' baking will suffice for 1 lb. loaves and cakes; and 15 minutes additional for every lb. after the first for larger ones. Thus a 1 lb. loaf requires ½ hour, a 2 lb. loaf ¾ hour, and a 4 lb. loaf 1¼ hour.

SUPERIOR BREAD FROM BUCKWHEAT MEAL.—To 2 qts. of sifted buckwheat meal, add hot water enough to wet the same, when sufficiently cooled, add 1 teaspoonful or more of salt, half a pint of yeast, and half a teaspoonful of molasses; then add wheat flour enough to make it into loaves (it should be kneaded well); and when risen light, bake or steam it three or more hours. If this should get sour while rising, add a teaspoonful of sugar and a little saleratus, dissolved in water. For bread from Indian meal proceed in the same way, using it instead of buckwheat meal.

CORN-MEAL BREAD, No. 1.—Take 2 qts. of corn meal, with about a pint of (thin) bread sponge, and water enough to wet it; mix in about a half a pint of wheat flour, and a tablespoonful of salt; let it rise and then knead well the second time; bake 1½ hours.

CORN-MEAL BREAD No. 2.—Mix 2 qts. of new corn-meal with three pints of warm water; add 1 tablespoonful of salt, 2 tablespoonfuls of sugar and one large tablespoonful of hop yeast: let it stand in a warm place five hours to rise; then add 1½ teacupfuls of wheat flour. and a half pint of warm water. Let it rise again 1½ hours, then pour into a pan well greased with sweet lard, and let it rise a few minutes. Then bake in a moderately hot oven, 1½ hours.

CORN-MEAL BREAD, No 3.—Take 2 qts. of white corn-meal, 1 tablespoonful of lard, 1 pint of hot water; mix the lard in water, stir it well that it may get heated thoroughly, and add one-half pint of cold water. When the mixture is cool enough, add two well-beaten eggs, and two tablespoonfuls of home-made yeast. Bake 1 hour in a moderately heated oven. If for breakfast make over night.

BEST BOSTON BROWN BREAD.—Take 100 lbs. of Indian meal; 50 lbs. rye meal; and 10 lbs. flour; sift and intermix together in the trough; strain in four gals. molasses; 2 gals. ferment or yeast; dissolve 1 lb. soda and 4 lbs. salt in water and add that. Now add water enough to mix all rather stiff, mixing well and breaking all lumps Now mix in water enough to form a batter sufficiently thin to remain even on top : allow it to stand 2 or 3 hours after mixing, before putting it into the pans and oven, then bake from 6 to 10 hours in a slow oven.

BOSTON, OR SOFT CRACKERS.—First sift in 4 barrels of flour into the trough, add 2 pails of stock-yeast, and about 9 pails of water; mix all into a sponge and allow it to stand until it rises and falls twice. The sponge will require about 6 or 8 hours to become ready, if it sours a little, so much the better. Usually it is set about noon for the work next day, and if set warm, for using stock yeast instead of ferment, it will come less rapidly. The sponge being ready, add to it from 8 to 10 pails more water; mix and break the sponge up well, making a stiff dough, and let it stand until next morning. It is requisite that the dough should be sour, to ensure good crackers. When ready, remove a sample of it sufficient for one ovenful of crackers; take it to another part of the trough, and add to it from 5 to 6 lbs. of butter or lard, the proportion to be added to be estimated by the dimensions of the piece so separated; soda in solution is now to be added, made by dissolving soda, 1 lb. in cold water, 1 qt., and the detached piece of dough may be intermixed with 1 pt. of the liquid, representing 8 ozs. of soda, but the exact quantity required must be ascertained by the acidity or age of the dough. and the judgment of an experienced practitioner. Mix the soda and butter thoroughly into the dough, and put it through the rollers repeatedly or until smooth. Place a sample of this dough in the oven to determine whether or not it contains the proper quantity of soda. When baked, too much soda will induce a yellow appearance, and more dough without soda must be added; a deficiency of soda will be indicated by a sour smell, and in that case more soda must be added. When all is right, the dough is put through the machine, and the succeeding batch of crackers is commenced by selecting another piece of dough and proceeding as above, adding the butter and soda in the required proportion, each batch requiring more soda on account of the increasing acidity acquired by long exposure to the air. ANOTHER WAY.—Set the sponge on the previous night, and the next day instead of making dough of it, select a portion of the sponge, adding it to the butter and soda as above directed, working them well into it, and adding flour enough to make a stiff dough, and it is ready for the break. When you detach part of the sponge to make the batch, add water enough to the sponge, and stir it up with more flour, thus continuing to renew the sponge as fast as it is used.

SODA CRACKERS are made by the same process, of the same dough; after using the scraps, add a little more butter, rolling them thinner and cutting them square.

OYSTER CRACKERS are made of the same dough, using the scraps also. *Butter*, *Sugar*, and other crackers are made the same way, adding respectively butter and sugar.

CREAM CRACKERS.—Rub together 14 lbs. flour and 1 lb. butter; then add 1 lb. pounded sugar, 48 eggs, and flavor; mix thoroughly, and work it quite stiff and smooth; roll out quite thin; cut them with a cutter in the form of a oak leaf; put them into boiling water and boil till they float; remove with a skimmer and dry them on cloths, and bake on clean pans without being buttered, in a warm oven.

CHEAP LADY CAKE.—Break up 2 lbs. butter, mix in 3 lbs. sugar, rubbing well together for 5 or 10 minutes, add 2 pts. whites of eggs, a third at a time, beat all up light, then add 4 lbs. flour, and 1 oz. soda, dissolved in 2 pts. milk, and 2 ozs. cream tartar; intermix all well together, bake in pans about 1½ ins. deep, in loaves that will weigh from 2 to 3 lbs., when baked, take out of the pans and frost on the under side. Mark in slices ¾ of an inch thick.

FROST CAKES.—Beat 2 lbs. butter and 3 lbs. sugar together until quite light, add 30 eggs, 10 at a time, beating after each addition, then a little ext. lemon, add 3 lbs. flour, stir just enough to mix; put in flat, square pans, greased, and bake in a slow oven, when done, frost on the under side and mark in squares.

CITRON FROST CAKE is made similar to the above, with the addition of sliced citron when the flour is added, or preferably put the citron on the batter after it is in the pans. Bake as the last.

SHREWSBURY CAKE.—Rub 2 lbs. butter, and 2 lbs. of sugar together, add 24 eggs, 6 at a time, beating them in, dissolve and add twice as much soda as will lie on a dime in a little water, mix in 4 lbs. flour, roll and cut out with any plain or fancy shaped cutter, put on buttered tins, and bake in a moderate oven.

LEMON CAKE.—Rub together 6 lbs. of light brown sugar, and 2 lbs. of lard or butter, add 16 eggs, 12 qts. of milk with 2 ozs. of soda dissolved therein, 2 ozs. ammonia, a few drops extract of lemon for flavor, and flour sufficient to make a stiff batter; drop them either with the hand or with a spoon, into scalloped pans, and sprinkle a few currants on the top of each, and bake in a moderate oven.

ROCK CAKE.—Rub together 4 lbs. sugar, and 8 lbs. of flour, make a hollow in the middle, and add 6 eggs, 1½ pts. milk, 1 lb. 8 oz. of butter, and 2 oz. ammonia, mix all together. roll out and cut out with a plain cutter, rather thick, put on pans, and with a fork scratch the top of each until it is quite rough. Bake in a moderate oven.

CUP CAKE.—Break up 2 lbs. butter, add 3 lbs. sugar, and 16 eggs, a third at a time, beat up light, add 5 lbs. flour, 2 pts. milk, and ammonia 2 ozs., make all smooth by thorough mixing. Bake in small pans in a moderate oven.

WEDDING CAKE.—Rub 4 lbs. butter and 4 lbs. light brown sugar well together, adding 40 eggs, one quarter at a time, beating well, then add 2 pts. molasses, 2 pts. good brandy, 1 oz. each of mace, nutmeg, cassia, and cloves, all well blended in and mixed with the mass, then add 5 lbs. flour, 8 lbs. currants, 9 lbs. stoned raisins, and 3 lbs. citron, intermix all thoroughly, put it in pans, spread smooth on top, and it is ready for the oven. These materials will make 4 loaves of 9 lbs. each, and will require careful baking for from 4 to 6 hours in a cool oven, otherwise it will be burnt on the outside. To frost this amount of cake beat up the whites of 10 eggs in a bowl, with sufficient pulverized sugar to render the mixture stiff enough to spread on the cake, using a wooden spoon (probably 2½ lbs. will be required), beat all together for 15 or 20 minutes; spread it on the cake, after the latter becomes cool, and set it away until the next day, when another coat of the frosting composition must be applied, and the cake set away until the day following to await the final ornamenting. This is effected with the assistance of ornamenting tubes, &c., together with a frosting composition of a much stiffer consistence than that previously used. NOTE.—One-half, or even one-quarter of the above quantity of cake will be found amply sufficient for most occasions.

Another Wedding Cake.—Use 2 lbs. sugar, 3 lbs. flour, 8 nutmegs, 18 eggs, 1 oz. allspice, 1 oz. cloves, 3 lbs. currants, 2 lbs. citron, 3 lbs. sultana raisins, a little ammonia, and 1 gill brandy. Proceed with the mixture as directed in the foregoing, and bake in a slow oven.

Cocoanut Cakes.—To each lb. of grated cocoanuts add 1 lb. of powdered sugar and the whites of 4 eggs, put all in a kettle and cook on the fire for about 30 minutes, stirring well all the time, and avoid burning, cook to a soft and mushy consistence, turn it out and add to each lb. of cocoanut as previously weighed 2 ozs. of flour, working it well into the mixture. Now put it in well greased pans, selecting a small piece in your hands, rolling it round and laying it on the pans, putting them about 1 inch apart, to allow for spreading, and bake in a cool oven.

Queen Cake.—Rub together 2 lbs. sugar and 2 lbs. butter, next add 16 eggs, 1 pt. milk, 1 oz. of ammonia, stir all well together, then add the flour; bake in square pans with a few currants on top.

Drop Cake.—Rub together 3 lbs. sugar and 1¼ lbs. of butter, add 13 eggs, in 3 different lots, 3 pts. of sour milk, 1½ ozs. soda, 1½ ozs. of ammonia, flavor with ext. lemon, stir all well together, add flour sufficient to make a stiff batter, drop on buttered pans, bake in a quick oven.

Molasses Pound Cake.—Mix together 1 gal. molasses, 3 lbs. butter, 8 eggs, 2 qts. water, 8 ozs. of soda, and add sifted flour sufficient to make a stiff batter. Bake in small scalloped pans, in a cool oven.

Cross Buns.—Work 24 lbs. dough, 2 lbs. sugar, 2 lbs. butter, 12 eggs and a little cinnamon into the dough, and set away to rise; then pinch them off in about 2 oz. pieces; mould them up; pin out; put on pans, and mark them across with a knife, or cross them with strips of dough.

Gold Cake.—Rub together 2 lbs. butter, and 2½ lbs. brown sugar; add the yolks of 30 eggs, a few at a time, beating all well up; add 1 qt. milk with 1 oz. soda dissolved in it, stir well up; and add 4 lbs. flour; 1 oz. cream tartar; a little lemon extract; mix all up lightly, and bake in small pans in a warm oven.

New York Sponge Cake.—Beat 16 eggs and 2 lbs. sugar together about 5 minutes; next add 2 ozs. ammonia, 1 pt. milk, and flavor; mix all; add the flour, stirring carefully, but sufficient to mix. Bake in little round pans, in a warm oven.

Lady Cake.—Rub 2 lbs. butter and 4 lbs. sugar together until it is quite light; then add the whites of 60 eggs, one-fourth at a time, beating well; next flavor with a little oil of almonds; stir slightly; then add 2 lbs. flour and 1 lb. corn starch, and stir up lightly. Bake in a slow oven and turn over and frost on the under side.

Ground-rice Cakes.—Rub together 2 lbs. butter and 4 lbs. sugar; add 16 eggs; beat up thoroughly; add 2 pts. milk, 4 ozs. ammonia, and flavor with lemon; stir all up; add 4 lbs. of rice flour, and mix thoroughly; drop on buttered pans about the size of an egg, and bake.

Cream Cakes.—Take 1 qt. water, and 1 lb. dark coarse-grained lard; boil together in a kettle, and then stir in 17 ozs. of best quality flour; boil all 4 or 5 minutes, or until it is quite smooth; then turn it out on a board, and scrape the kettle with a knife; now put your paste in the kettle again, with 10 eggs; stir well together until all is smooth; then add 18 or 20 more eggs, or until the batter is of the right thickness; next dissolve ¼ oz. soda in a little water, and mix in thoroughly; drop on pans slightly greased; wash them on top with egg, and bake in a quick oven. They will require 16 to 18 minutes to bake with a proper heat. When baked, remove from the fire; split them through the centre and fill them with the following cream: Place on the fire 1 qt. milk in a kettle, mix 4 oz. flour, 8 oz. white sugar, 4 eggs, and a little salt in another vessel; when the milk boils, turn in the mixture, stirring briskly; when it boils, remove from the fire, and flavor with lemon or vanilla as desired.

ROCK CAKES.—Rub well together 6 lbs. flour, and 2 lbs. butter, making a cavity in the middle; put in 2 lbs. sugar, 2 lbs. currants, 8 eggs, dissolved soda, 1 oz., and a little ess. lemon, with milk sufficient to mix up stiff; now take a four-pronged fork and work of pieces of dough the size of walnuts; place on pans, and bake in a cool oven.

SNOW CAKES.—Rub 2 lbs. butter and 2 lbs. sugar well together; then add the whites of 24 eggs, 3 at a time; beat up well; add 12 ozs. flour, 2½ lbs. of arrowroot; add the flavor and mix lightly. Make 6 loaves of this quantity, either round or square; put lemon peel on top, and bake in a cool oven.

MOSS CAKE.—Rub 6 lbs. of flour and 3 lbs. of butter well together; then add 2 lbs. sugar, 8 eggs, and flavor with ess. of lemon; mix well together until smooth and stiff. Now take a piece the size of an egg push it through a sieve, and form it in bunches to resemble moss, put on buttered pans, and bake very carefully in a moderate oven to a delicate brown color.

NEW YORK LUNCH CAKE.—Rub together 14 lbs. flour, 2 lbs. butter; then add 3 qts. milk, 1 oz. soda, 1 oz. tartaric acid, and 8 ozs. arrowroot; mix all quite stiff, break it well, and snap them off about as big as walnuts; pin them out; dock them full of holes, and bake on clean pans in a warm oven.

TEA CAKE.—Rub 12 lbs. of flour and 6 lbs. of butter together; add 6 lbs. sugar, 24 eggs, 2 ozs. of soda, 4 ozs. cream tartar; flavor and add milk sufficient to make a nice, soft dough; mix up lightly, roll out, and cut with any fancy-shaped cutters, bake in a warm oven.

FANCY CAKE.—Rub together 4 lbs. sugar and 3 lbs. butter; add 40 eggs in 4 different lots; add 1 oz. soda dissolved in a little milk; mix well; then stir in 4 lbs. of flour; 1 oz. cream tatar; a little extract of lemon; mixing all well together, bake in a moderate oven.

RAISIN CAKE.—Rub together 1 lb. butter and 1½ lbs. powdered sugar; add 18 eggs, one third at a time, beating well in; add ⅛ oz. dissolved soda, stirring well in; add a little ext. lemon; 2 lbs. 2 ozs. of flour; 1 lb. 1 oz. sultana raisins; and mix all well together. Bake in a slow oven in pans about 1½ inches deep.

POUND CAKE.—Break up and well mix 1 lb. of fresh butter with 1 lb. of powdered sugar; add 10 eggs, a few at a time, beating up lightly; add 1 lb. of flour ; a very little soda ; mix all so as to make the flour smooth; bake in a slow oven.

SILVER CAKE.—Rub together 2 lbs. butter and 4 lbs. powdered sugar; add the whites of 30 eggs, in 3 lots at a time; beat up well; add 2 pts. milk with 1 oz. soda; 6 lbs. flour, 1 oz. cream tartar; with a little vanilla flavor; mix up lightly and bake as the last.

GINGER SNAPS.—Put 2 qts. molasses; 1½ lbs. of lard; 3 ozs. of ground ginger; 2 ozs. of soda, and 1 pt. water, into a bowl. Mix all together; add flour enough to make a stiff dough: then work in 2 lbs. sugar; roll thin; cut in long strips in rolls on the table; cut them off with a knife or cutter the desired size; put on buttered tins; flatten them down a little with the hand, and bake in a slow oven

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Ginger Cake.—Put 12 eggs and 2 pts. cream on the fire in a copper or tin dish; stir until warm; then add 2 lbs. butter; 2 lbs. sugar; 10 ozs. ginger; allow it to stay on a slow fire and continue stirring till the butter is melted; then set off; when cold add 8 lbs. flour; mix up smooth; roll out thin, and cut with a circular cutter; place on paper, and bake in a hot oven.

Cinnamon Cakes.—Put 12 eggs and 6 dessert spoonfuls of rose water into a bowl; whisk together, and add 2 lbs. fine sugar, and 1 oz. of ground cinnamon and flour sufficient to make a nice stiff paste; roll them out; cut into any desired shape, and bake them on paper, in a slow oven.

Seed Cakes.—Rub together 1 lb. butter and 2 lbs. flour; then into a hollow in the centre; put 4 lbs. sugar; 2 qts. milk; 4 ozs. caraway seeds, and a little ammonia; mix up, but do not work it much; roll out; cut with a small cutter, and bake in a warm oven.

Spice Cake.—Mix together 3 lbs. sugar and 1½ lbs. butter; add 1½ pts. milk; 15 eggs, a few at a time; ¾ oz. ammonia; one nutmeg and a half; ¾ lb. currants; 5 lbs. flour. Mix up well and bake in deep, square pans in a slow oven.

New York Fancy Cake.—Rub together 2 lbs. sugar and 1 lb. butter; add 12 eggs a few at a time, beat all up well; add ⅜ qt. of sour milk; 3¾ lbs. flour; ⅜ oz. soda; ⅜ oz. cream tartar, and extract of lemon for flavor. Mix up smooth and bake in scalloped pans.

Machine Jumbles.—Rub together 3 lbs. sugar and 2 lb. 4 ozs. butter; add 12 eggs a few at a time, beat all up well; ¾ oz. of ammonia; 1½ pts. milk; a little ext. lemon, and 5 lbs. 4 ozs. of flour; and stir sufficiently to mix.

Champagne Biscuits.—Work up 2 lbs. butter in a basin to a thick cream; add 2 lbs. of sugar; 2 lbs. flour; 36 yolks of eggs; 1 oz. caraway seeds; a little salt; whisk up the whites of the 36 eggs and add them; get a sheet of strong paper; fold it in reversed plaits like a fan, to form trenches about 1 inch deep; fill a biscuit forcer with part of the batter; force out some finger-like biscuits into the trenches about 3 inches long; sifting sugar over them, and bake them of a light-fawn color in a moderate oven.

Cream Tartar Biscuit.—Work in 3 lbs. sifted flour with 2 ozs. butter; add 2 ozs. cream tartar; dish the middle and pour in 1 pt. milk and 1 pt. water, previously adding 1 oz. soda to the milk; mix all up briskly, but don't make it too stiff. Flatten it out; cut with a biscuit cutter; place them on buttered tins close together and bake in a quick oven.

Washington Cake.—Rub together 4 lbs. sugar and 2 lbs. 8 ozs. of butter; 16 eggs; 2 pts. water and 2 ozs. of ammonia; with flour sufficient to make a suitable dough to roll; cut out with a scalloped cutter, and bake in a warm oven.

Brandy Snaps.—Mix up 1½ pounds flour, ½ lb. butter, ½ lb. sugar, ½ oz. cloves, and ½ pint molasses. Mix all together and bake.

Washington Pie.—Rub together 1 lb. butter, and 1½ lbs. powdered sugar, add 1 pt. of eggs, a little at a time, beat up well, add ½ oz. soda dissolved in ½ pt. milk ; flavor with ext. lemon, stir up, and add 2 lbs. flour and 1 oz. cream tartar ; mix together, put on pans one-eighth of an inch thick and bake in a quick oven.

Another.—Rub together 2 lbs. lard, 3 lbs. powdered sugar, and add 1 qt. eggs, a little at a time, 1 oz. soda dissolved in 1 qt. milk ?

ozs. cream-tartar, a little lemon extract and 4½ lbs. flour; mix all together and bake as above.

FILLING FOR THE ABOVE PIES.—Add to stewed and strained dried apples, ¾ lb. of sugar to each lb. of apples, boil all together for ¾ hour stirring well; fill with this, or use cranberry jelly or currant jelly or raspberry jam, or the latter intermixed with stewed dried apples, or apple filling alone is very good. *A good filling for sliced apple pies* is made by slicing sour apples, bottom your plates add the sliced apples with enough powdered sugar to sweeten, adding cinnamon, salt and a little butter, with water until the plate is two-thirds full, then cover with puff-paste, and trim it round in proper style with a knife.

LEMON PIES.—Rub together 1 lb. butter and 1½ lbs. flour with cold water sufficient to make a good stiff dough to bottom your plates with, rimming them around with puff-paste, and fill with the following mixture: put into a bowl the juice of 3 lemons, the grated rind of 1 with 1½ lbs. of finely powdered sugar and 9 eggs. Mix thoroughly, and fill your plates with the mixture; bake in a moderate oven.

Another filling.—3 lemons, 6 eggs, ¾ lb. sugar, ½ pt. milk, with salt and nutmeg. Mix as the last.

Another without lemons.—1 lb. sugar, ½ lb. flour, 10 eggs, ½ pt. milk, ¼ oz. tartaric acid, a little lemon essence and salt.

Frosting for Lemon Pies.—4 ozs. pulverized sugar, whites of 6 eggs beaten to a stiff froth and the sugar gradually added to it, intermix thoroughly, cover the pies, top them off with this frosting, run them into a moderate oven and bake them to a nice brown.

SHORT PUFF PASTE FOR PIES.—Mix together 4 lbs. flour, 1½ lbs. butter, add 4 eggs, a little salt and 1 pt. water or a little more, work all to a smooth paste, spread out with the hand, put 1½ lbs. more butter in the middle, fold the dough over the butter, so as to cover it, let it stand 5 minutes, sift flour over the paste and on the slab, roll out to the length of 7 feet and 3 feet wide (for half this quantity one half of these dimensions will be required). Fold it over and turn so that the sides will face you, repeating the rolling twice, when the paste will be fit for use.

COMMON PASTE FOR PIES.—Rub together 4 lbs. flour, and 4 lbs. of lard with salt sufficient; add just water enough to mix the dough; it may be better to put flour on the bench, make a set of it, adding the salt, lard, water, and stirring together.

PASTE TO COVER PIES.—Mix togother 1½ lbs. of lard or butter with 2 lbs. flour with sufficient salt and water to mix. Cranberry pies should have strips of puff paste across the top, the edges wet, and a strip of puff paste placed around the rim, keeping this strip ¼ inch outside of the edge of the plate, as it will contract while baking.

CUSTARD FOR PIES.—Put 12 eggs, ½ lb. sugar, ½ oz. salt, and a little ext. lemon into a bowl, beat well together, add 2 qts. milk and strain.

Filling for Squash Pies.—Thoroughly clean 5 lbs. of squash, slice it up and stew it; when thoroughly cooked drain off the water, rub to a mush through a strainer, then add 1¼ lbs. sugar, 6 eggs, 2 qts. milk, ¾ oz. ginger, a little ext. lemon, and salt sufficient.

FILLING FOR MINCE PIES.—Boil 3 lbs. of chopped meat, clear of bones and tough pieces, chop fine; peel, core and chop 9 lbs. of good apples, add 4½ lbs. brown sugar, 3½ qts. molasses, 3 ozs. each of nutmeg, cassia, cloves and allspice, 3 lbs. raisins, 1½ lbs. currants, 1½ pts. brandy, 1 gill cider, ¾ lb. salt. Mix all the ingredients together in a vessel, omitting the apples and brandy, intermix well together; then add them and reduce to the proper consistency with water. Cover with a cloth, tying it down tightly to prevent evaporation and set away in a cool place for use.

ICE CREAM MANUFACTURE.—Beat the required quantity of ice very fine in a stout bag or by any other means, and add fine salt in ratio of one part of salt to four parts of ice, mixing thoroughly with a stick. Pack the compound neatly in the freezer around the cylinder to the top, then put in the cream (which should be cool) you wish to freeze, and, after covering, proceed to turn the crank back and forth alternately 10 or 12 times each way until the cream is sufficiently thick to beat, which will be known by the opposition to the beater, then turn forward quite briskly for a short space in order to impart an even and good appearance to the cream; make thorough work of the beating, then remove the beater, fill the pail with ice and salt, and set away to harden. It will not do to introduce additional ice or salt, or allow it to grow stiff while beating, or beat it too much, or to retard the freezing process by pouring off water from the melted ice. The right time to beat it is when it is dense enough to rise, or about the thickness of light batter, if beaten when rigid the product will not be so satisfactory. As the cream expands in freezing, the cylinder should be filled ¾ full and no more.

Strawberry and Raspberry Cream Ice.—1. Pass 3 lbs. of picked strawberries or raspberries through a coarse hair-sieve, add 1½ qts. double cream, 2½ lbs. sifted sugar, mix well together, freeze as above, and mould it. If a deep red is desired, it may be imparted by a few drops of cochineal.

2. ICE CREAM, BEST QUALITY.—Beat well together 9 eggs with 1½ lbs. sugar; boil 3 qts. good cream, set it off for a short space to cook, then add the sugar and eggs, flavor with vanilla, etc., to suit the taste. Let it cool, place in the freezer and proceed as above.

3. *Substitute for cream.*—Boil 1 qt. of good milk with 1½ ozs. of arrowroot, having first brought the milk to the boiling point and mixed the arrowroot smooth with a little cold milk, remove from the fire; add 2 fresh eggs, 8 ozs. of powdered sugar, stir well, allow it to cool and flavor previous to putting in the freezer.

4. *Chocolate Cream Ice.*—Grate ¾ lb. of the best French chocolate into 1½ qts. of boiling milk, allow it to boil till thick, adding ¾ lb. sugar; add when cool, 1½ qts. cream, stirring well, and empty into the freezer. The addition of 8 eggs and lemon flavor to the above will greatly improve it.

5. *Ginger Ice Cream.*—Boil together 1 qt. milk, 1 lb. sugar, 8 ozs. pulverized ginger, and 4 yolks of eggs, until it commences to thicken.

6. *Orange Cream Ice.*—Mix together in a stew-pan, 1 qt. milk or cream, 1 lb. sugar, the juice of 8 oranges, the rinds of 4 oranges rubbed on the sugar, and 4 yolks of eggs, until the compound begins to thicken; stir briskly, and strain, freezing when cool, as above.

7. *Pine Apple Cream Ice.*—Put on the fire in a copper or tin vessel 1 lb. of strained pine apple pulp, 12 ozs. sugar, 1½ pts. milk or cream, and 3 yolks of eggs; beat sufficiently to thicken, not to boil the cream, strain the mixture into a vessel and set aside to cool previous to freezing. See other formulæ for ice cream under the *Grocers' Dept.*

CREAM TARTAR BISCUIT.—Use 2 qts. flour, 2 teaspoonfuls of soda, 2 ditto cream tartar, 2 pts. milk. Mix, and follow the ditrectons for cream-tartar biscuit given above, and bake in a warm oven.

COCOANUT DROPS.—1 lb. grated cocoanut, ½ lb. white sugar, the whites of 6 eggs, cut to a stiff froth. You must have enough whites of egg to wet the whole mixture. Drop on buttered plates, in pieces the size of an egg.

FRENCH ROLLS.—1 ounce of butter, 1 lb. of flour, 1 gill of home-made yeast, 1 egg, milk enough to make a dough. Rub the butter through the flour, beat the egg and stir in, then add the yeast, milk, and a little salt. Knead the dough ; when it is light, mould it out into large biscuits, and bake them on tins.

MUFFINS.—A quart of milk, 2 eggs, 2 spoonfuls of yeast, 2 lbs. of flour, a lump of butter size of an egg—which is to be melted in the milk—and a little salt ; the milk is to be warmed, and the ingredients added. Let it rise, and then turn the mixture into buttered pans, and bake to a light brown.

BATH CAKES.—Mix well together, 1 lb. flour, ½ lb. butter, 5 eggs and a cupful of yeast, set the whole before the fire to rise ; after it rises, add ¼ lb. white sugar, and 1 ounce caraway seeds well mixed in, and roll the paste into little cakes, bake them on tins.

NO. 1 CRACKERS.—Butter, 1 cup ; salt, 1 teaspoon ; flour, 2 qts. Rub thoroughly together with the hand, and wet up with water ; beat well, and beat in flour to make quite brittle and hard ; then pinch off pieces and roll out each cracker by itself.

SUGAR CRACKERS.—Flour, 4 lbs. ; loaf sugar and butter, of each ½ lb. ; water, 1½ pts. ; make as above.

NAPLES BISCUIT.—White sugar, eggs, and flour, of each 4 lbs.

LEMON BISCUIT.—Take 3½ lbs. white sugar, 4 lbs. flour, ½ ounce saleratus, ½ lb. suet, a little milk to wet the dough, cut them out about the size of marbles, put them on pans a little greased, and bake them in a hot oven and flavor them with essence of lemon.

ABERNETHY BISCUIT.—Take 8 lbs. of flour, 1¼ lb. of butter, 1 quart of sweet milk, 12 ounces of sugar, 1 ounce of caraway seeds, 6 eggs ; mix dough of the above, break them in pieces of about two ounces, mould them off, roll them out, prick them and bake them in a moderate oven.

SAVOY BISCUIT.—Take of sugar the weight of 14 eggs, of flour the weight of 6 eggs, beat the yolks and whites of 12 eggs, separate, grate in the rind of a lemon ; after being in the oven a few minutes grate on some sugar. You may add peach-water, or lemon juice, or any flavoring extract.

GINGER SNAPS.—Take 7 lbs. of flour, 1 qt. of molasses, 1 lb. of brown sugar, 1 lb. butter, 2 ounces ground ginger, and then take 1 gill of water, ¾ of an ounce of saleratus ; mix them all into dough, and cut them out something larger than marbles, and bake them in a moderate oven.

YORK BISCUIT.—3 lbs. flour, ½ lb. butter, ¾ lbs. sugar; wet up, and raise with sour milk and saleratus.

TRAVELLER'S BISCUIT.—2 lbs. of flour, ¾ of a pound of sugar, ¼ lb. butter, 1 teaspoonful of *dissolved* saleratus, milk sufficient to form a dough. Cut up the butter in the flour, add the sugar, and put in the saleratus and milk together, so as to form dough. Knead it till it becomes perfectly smooth and light. Roll it in sheets about ⅛ of an inch thick, cut the cakes with a cutter or the top of a tumbler. Bake in a moderate oven.

BAKING POWDER FOR BISCUIT.—Bicarbonate of soda 4 lbs., cream of tartar 8 lbs. These ingredients should be thoroughly dried and well mixed, and put up proof against dampness. Use about 3 teaspoonfuls to each quart of flour, mix up with cold water or milk, and put it into the oven at once.

BROWN BREAD FOR BISCUITS.—Corn meal 4 qts., rye flour 3 qts., wheat flour 1 qt., molasses 2 tablespoonfuls, yeast 6 tablespoonfuls, soda 2 teaspoonfuls. Mix during the evening for breakfast.

MINCE PIES—Meat 1 lb., suet $3\frac{1}{4}$ lbs., currants, raisins and plums 2 lbs., one glass brandy or wine, allspice, cinnamon and cloves to your taste, sugar sufficient to sweeten. Baked in a short crust.

FRUIT PIES.—For all kinds of fruit pies have your fruit sweetened to your taste, and then put in a short crust. Bake in a hot oven.

PUMPKIN PIE.—Stew the pumpkin dry, and make it like squash pie, only season rather higher. In the country, where this *real Yankee pie* is prepared in perfection, ginger is almost always used, with other spices. There, too, part cream, instead of milk, is mixed with the pumpkin, which gives a richer flavor.

LEMON PIE.—1 lemon grated, 2 eggs, $\frac{1}{2}$ cup of sugar, 1 cup of molasses, 1 of water, and 3 tablespoonfuls of flour. This makes 3 pies.

LEMON PIE WITH THREE CRUSTS.—A layer of crust, a layer of lemon, sliced fine, a little sugar, layer of crust again, and sugar and lemon again, then the upper crust.

Another Way.—1 cup of sugar, 1 cup sweet milk, 1 egg, $1\frac{1}{2}$ lemon the grated peel and juice, 1 tablespoonful of flour; then after baking, the white of an egg beaten, sweetened, and put on the top; then set in the oven and browned.

CRUMB PIE.—Mince any cold meat very finely, season it to taste, and put it into a pie-dish; have some finely-grated bread crumbs, with a little salt, pepper, and nutmeg, and pour into the dish any nice gravy that may be at hand; then cover it over with a thick layer of the bread crumbs, and put small pieces of butter over the top. Place it in the oven till quite hot.

WASHINGTON PIE.—1 cup of sugar, third of a cup of butter, half a cup of sweet milk, 1 and a third cup of flour, 1 egg, half a teaspoonful of soda, 1 of cream of tartar, lemon flavor. Grease 2 round tins, and put in the above. Bake until done. Then put it on a dinner plate, spread with nice apple-sauce, or sauce of any kind; then another layer of cake on top. It is nice without sauce, but sauce improves it.

FRUIT PIE.—1 cup of sugar, 1 of water, tablespoonful of flour, teaspoonful of lemon essence (or lemon grated), 1 teaspoonful of cream of tartar, half a teaspoonful of soda, half a cup of dried currants: mix and boil, stirring to prevent the flour from settling.

CHICKEN PIE.—Take one pair of good young chickens, cut in small pieces, season with pepper and salt and small strips of salt pork, put in saucepan with water to cover it, boil for half an hour, add flour and butter to thicken the gravy, have ready a large dish, served with paste, put all in the dish covered with a good rich paste. Bake for half an hour.

VEAL POT PIE.—Take 2 pounds of best veal, cut in small pieces, half pound of salt pork, sliced thin, four quarts of cold water; pepper and salt all, put on the fire; after boiling for 1 hour have 3 pounds of light bread dough, pick small pieces, say one ounce pieces, put in saucepan, with the veal and pork, and let it boil for twenty minutes. Serve as soon as taken from the fire.

PLUM PUDDING.—Pound 6 crackers, and soak them oven night in milk enough to cover them, then add 3 pints of milk, 4 or 5 eggs, raisins ½ lb., spice with nutmeg and sweeten with sugar and molasses. Bake about 2 hours.

TAPIOCA PUDDING.—Pick and mash a coffee cup full of tapioca, and pour upon it 1 pint boiling milk; after standing ½ an hour, add another pint of cold milk, with sugar and raisins if you desire.

BAKED PUDDING.—5 tablespoonfuls of corn starch to 1 quart of milk, dissolve the starch in a part of the milk, heat the remainder of the milk to nearly boiling, having salted it a little, then add the dissolved starch to the milk, boil 3 minutes, stirring it briskly; allow it to cool, and then thoroughly mix with it 3 eggs, well beaten, with 3 tablespoonfuls of sugar; flavor to taste and bake it ½ an hour. This pudding ranks second to none.

ORANGE PUDDING.—Take 1 lb. of butter, 1 lb. of sugar, 10 eggs, the juice of 2 oranges, boil the peel, then pound it fine and mix it with the juice. Add the juice of 1 lemon, a wineglassful of brandy, wine and rose-water. If you do not have the fruit add the extracts.

COCOANUT PUDDING. To a large grated cocoanut add the whites of 6 eggs, ½ lb of sugar, 6 ounces of butter, ½ a wineglassful of rose-water, and baked in or out of paste.

RICE PUDDING.—Take 1 lb. of rice, boiled well with rich milk, stirring well until it is soft, and then add ½ lb. butter, 12 eggs, well beaten, and spice to your taste, and bake it.

HARD TIMES PUDDING.—½ pint of molasses or syrup, ½ pint water, 2 teaspoonfuls of soda, 1 teaspoonful of salt, flour enough to make a batter; boil in a bag 3 hours. Eat it with sauce.

BAKED APPLE PUDDING.—Pare and quarter four large apples, boil them tender with the rind of a lemon in so little water that when done no water may remain, beat them quite fine in a mortar, add the crumb of a small roll, ¼ lb. butter melted, the yolks of 5 and whites of 3 eggs, juice of ½ lemon, sugar to your taste, beat all well together, all in paste.

GROUND RICE, OR SAGO PUDDING.—Boil a large spoonful of it, heaped, in 1 pint milk with lemon peel and cinnamon; when cold, add sugar, and nutmegs, and 4 eggs well beaten.

CUSTARD PUDDING.—Take 1 pint milk, 4 spoonfuls flour, 6 eggs, spice to your taste and bake.

WINTER PUDDING.—Take the crust of baker's loaf of bread, and fill it with plums, boil it in milk and water.

BAKED POTATO PUDDING.—Baked potatoes skimmed and mashed, 12 oz., suet 1 oz., cheese, grated fine, 1 oz., milk 1 gill. Mix the potatoes, suet, milk, cheese and all together, if not of a proper consistence, add a little water. Bake in an earthen pot.

COLLEGE PUDDING.—¾ lb. of stale bread, grated; the same quantity of beef suet, chopped very fine; 1 lb. of currants, ½ nutmeg, a few cloves, a glass of brandy, 2 or 3 eggs, 2 spoonfuls of cream or milk; mix these well together, and make into a paste in the shape of eggs. Fry them gently over a clear fire, in ½ lb. of butter; let them be of nice brown color all over. You may add blanched almonds and sweetmeats. Serve them up with wine.

FAMILY PUDDING.—1 quart of sweet milk, 1 pint of bread crumbs soaked in the milk, 3 eggs well beaten, 1 teacupful of sugar, little mace, 6 good tart apples, pared, cores *dug* out, and stand them in the pudding, and steam until the apples are well done. An hour will suffice.

COTTAGE PUDDING.—1 egg, 1 cup of sugar, 1 of sweet milk, 1 teaspoonful of soda, 2 of cream of tartar, 1 pint of flour, and a little salt. To be eaten with milk and sugar.

GREEN GOOSEBERRIES make a nice pudding by stirring a pint of them into a pint of batter, and either baking or boiling.

LEMON PUDDING.—Melt 6 oz. of butter, pour it over the same quantity of powdered loaf sugar, stirring it well till cold, then grate the rind of a large lemon, and add it with 8 eggs well beaten and the juice of 2 lemons; stir the whole till it is completely mixed together, and bake the pudding with a paste round the dish.

SAUCES AND CREAMS FOR PUDDINGS.—1. Take equal quantities of sugar and molasses, boil them together, and stir in a little flour. 2. Take the juice of an orange, a cup of sugar and the same of good cream. 3. Good sour cream made very sweet with sugar, with or without seasoning, makes a good sauce. 4. Beat 2 eggs well, then add a cup of stewed apples and a cup of sugar.

BEEF STEAK WITH ONIONS.—Prepare a rump steak by pounding it till quite tender, season with salt, pepper and fresh butter, put in the steak and fry it, when brown on one side turn over, do not let it scorch, when nicely done take it up, put a little flour over the steak, then add gradually a cup of hot water, seasoned with more salt and pepper, if necessary; then put the water over the fire and boil again, and pour over the steak.

Peel 2 dozen onions, put them on to boil with about 2 quarts of water an hour before the steak is put on to fry. When the steak is done, cut them up, put them in the frying pan, season well with salt, pepper, and butter, sprinkle with flour, stir all well together, place over the fire, stir often to prevent scorching; when they are a little brown and soft, turn them over the steak.

SEASONING FOR STUFFING.—1 lb. of salt, dried and sifted; half an ounce of ground white pepper; two ounces of dried thyme; 1 oz. of dried marjoram; and one oz. of nutmeg. When this seasoning is used, parsley only is required to be chopped in sufficient quantity to make the stuffing green. The proportions are—½ pound of bread crumbs; 3 eggs; ¼ lb. of suet; ½ oz. of seasoning; and the peel of half a lemon, grated.

ECONOMICAL SOUP.—Put into a saucepan one-pound pieces of stale bread, three large onions sliced, a small cabbage cut fine, a carrot and turnip, and a small head of celery (or the remains of any cold vegetables), a tablespoonful of salt, a tablespoonful of pepper, a bunch of parsley, a sprig of marjoram and thyme. Put these into two quarts of any weak stock, (the liquor in which mutton has been boiled will do,) and let them boil for two hours; rub through a fine hair-sieve, add a pint of new milk, boil up, and serve at once.

Vegetable Soup.—Take a shin of a beef, 3 large carrots, 3 large yellow onions, 6 turnips, ½ lb. of rice or barley; parsley, leeks, summer savory; put all into a soup-kettle, and let it boil four hours; add pepper and salt to taste; serve altogether. It makes a good family soup.

Pea Soup.—Beef 5 lbs., water 5 qts., 6 large carrots, 6 good turnips, 3 large onions, salt sufficient, put it on a good slow fire, let it boil 3 hours, then strain all the broth from meat and vegetables, and then add 3 lbs. of split peas to the broth; set it on a slow fire for 2 hours, stirring often, so that all the peas will dissolve; take 1 lb. fresh sausage meat, fried to a crisp and fried bread crumbs; put altogether, add a few fine herbs, and serve hot.

Fricassee Chickens.—Take 2 large young chickens, cut in small pieces, put in cold water for 1 hour to take all the blood out, then put in saucepan to parboil for half an hour, then take from saucepan drained well, have ready 1 qt. good fresh cream, 2 oz. good butter, 1 oz. of flour, all well mixed together; put in saucepan with the chickens; put on the fire to boil tender; season with pepper and salt; served with toast bread in the bottom of the dish.

Baked Tomatoes.—Wash the tomatoes, take out the seed, make a dressing of crumbs of bread and onions chopped fine; add salt, butter and pepper. Bake and serve hot.

Stewed Tomatoes.—Scald the tomatoes with hot water, take off the skins, put them in an earthen vessel, strain off the water, and add butter, salt and pepper to taste.

Mashed Turnips.—Wash turnips, boil well, take them up in the colander, press out all the water, mash very fine; season with salt, butter and sugar. Serve hot with trimmings.

Hashed Meat.—Take 2 lbs. of fat corned beef, well boiled and cold; 1 lb. of well boiled potatoes, cold; 1 large white onion; put in chopping tray, mince it fine, put all in saucepan together, add 2 ozs. butter; pepper and salt to taste; add boiling water to make it soft; set it on a slow fire, stirring it often. When well stewed, serve hot. It makes a fine relish for breakfast.

Lobster Salad.—Take inside of large lobster, mince fine, take yolk of 2 eggs boiled hard and mashed fine, with four tablespoonfuls of sweet oil; pepper, salt, vinegar, and mustard to taste; mix well; add celery or lettuce to taste; then when serving, garnish with hard-boiled eggs.

Succotash.—Take 1 doz. ears of corn, cut the grains from the cob, add 1 qt. of Lima beans, and mix with the corn; put it on to boil in 3 qts. of water with 1 lb. of pork cut; add black pepper and salt to taste. When the water has boiled away to ½ the original quantity, serve in a tureen as soup.

Maccaroni Soup.—4 lbs. of lean beef, 4 qts. of water, carrot, turnip, onions; set it for 4 hours till all mix together; strain it all through a sieve; have 2 lbs. of maccaroni broken into pieces of one inch long; put all into a saucepan together, and let it boil for 10 minutes, and serve it hot.

Boiled Custard, or Mock Cream.—Take 2 tablespoonfuls corn starch, 1 qt. of milk, 2 or 3 eggs, ½ a teaspoonful of salt and a small piece of butter; heat the milk till nearly boiling and add the starch, previously dissolved in 1 qt. of milk, then add the eggs, well beaten, with 4 tablespoonfuls of powdered sugar; let it boil up once or twice, stirring it briskly, and it is done. Flavor with lemon or vanilla, or raspberry, or to suit your taste.

LEMON CREAM.—Take a pint of thick cream and put to it the yolks of two eggs, well beaten, 4 oz. of fine sugar and the thin rind of a lemon, boil it up, then stir till almost cold; put the juice of a lemon in a dish or bowl and pour the cream upon it, stirring till quite cold.

FRUIT CREAMS.—Take ½ oz. of isinglass dissolved in a little water, then put 1 pt. of good cream, sweetened to the taste; boil it. When nearly cold lay some apricot or raspberry jam on the bottom of a glass dish and pour it over. This is most excellent.

RASPBERRY CREAM.—Put 6 ozs. of raspberry jam to 1 qt. of cream, pulp it through a lawn sieve, add to it the juice of a lemon and a little sugar, and whisk it till thick. Serve it in a dish or glasses.

To roast fowls the fire must be quick and clear. If smoky it will spoil both their taste and looks. Baste frequently, and keep a white paper pinned on the breast till it is near done.

TURKEY.—A good sized turkey should be roasted 2½ hours or 3 hours—very slowly at first. If you wish to make plain stuffing, pound a cracker or crumble some bread very fine, chop some raw salt pork very fine, sift some sage, (and summer savory, or sweet marjoram, if you have them in the house, and fancy them,) and mould them all together, seasoned with a little pepper. An egg worked in makes the stuffing cut better.

BOILED TURKEY.—Clean the turkey, fill the crop with stuffing, and sew it up. Put it over the fire in water enough to cover it, let it boil slowly—take off all the scum. When this is done, it should only simmer till it is done. Put a little salt into the water, and dredge the turkey in flour before boiling.

ROAST DUCKS AND GEESE.—Take sage, wash and pick it, and an onion; chop them fine, with pepper and salt, and put them in the belly; let the goose be clean picked, and wiped dry with a cloth. inside and out; put it down to the fire, and roast it brown. Duck are dressed in the same way. For wild ducks, teal, pigeons, and other wild fowls, use only pepper and salt, with gravy in the dish.

ROAST CHICKEN.—Chickens should be managed in roasting the same as turkeys, only that they require less time. From an hour to an hour and a half is long enough.

BOILED CHICKEN.—A chicken should be boiled the same as a turkey, only it will take less time—about 35 minutes is sufficient. Use the same stuffing, if any, and serve it up with parsley, or egg-sauce.

BROILED CHICKEN.—Slit them down the back and season with pepper and salt; lay them on a clear fire of coals. the inside next the fire till half done, then turn and broil to a fine brown color. Broil about 35 minutes.

BOILED PIGEONS.—Boil them about 15 minutes by themselves; then boil a piece of bacon; serve with slices of bacon and melted butter.

FISH CHOWDER.—Fry a few slices of salt pork, dress and cut the fish in small pieces, pare and slice the potatoes and onions, then place them in the kettle, a layer of fish, then of the fried pork, potatoes, onions, &c., seasoning each layer with salt and pepper. Stew over a slow fire 30 minutes.

ROAST BEEF.—The sirloin is considered the best for roasting. Spit the meat, pepper the top, and baste it well while roasting with its own dripping, and throw on a handful of salt. When the smoke draws to the fire, it is near enough; keep the fire bright and clear. From 15 to 20 minutes to the lb. is the rule for roasting.

BEEF BOILED.—The round is the best boiling piece. Put the meat in the pot, with water enough to cover it; let it boil very slow at first—this is the great secret of making it tender—take off the scum as it rises. From 2 to 3 hours, according to size, is the rule for boiling.

BEEF STEAK.—The inside of the sirloin makes the best steak; cut about ¾ of an inch thick—have the gridiron hot, put on the meat and set it over a good fire of coals—turn them often. From 8 to 10 minutes is the rule for broiling.

ROAST PORK.—Take a leg of pork and wash it clean—cut the skin in squares—make a stuffing of grated bread, sage, onion, pepper and salt, moistened with the yolk of an egg. Put this under the skin of the knuckle, and sprinkle a little powdered sage into the rind where it is cut; rub the whole surface of the skin over with a feather dipped in sweet oil. 8 lbs. will require about three hours to roast it.

☞ THE SHOULDER, LOIN, OR CHINE, and SPARE-RIB are roasted in the same manner.

ROAST VEAL.—Pursue about the same course as in roasting pork. Roast before a brisk fire till it comes to a brown color; then you lay it down, baste it well with good butter, and when near done, with a little flour.

ROAST MUTTON.—The loin, haunch, and saddle of mutton and lamb must be done the same as beef. All other parts must be roasted with a quick, clear fire; baste it when you put it down, and dredge it with a little flour, just before you take it up. A leg of mutton of six pounds will require 1 hour to roast before a quick fire.

TO BOIL EGGS.—In 3 minutes an egg will boil soft, in 4 the white part is completely cooked, in 10, it is fit for a salad. Try their freshness in cold water, those that sink the soonest are the freshest.

SAUSAGE MEAT.—Take 2 lbs. lean meat, 1 lb. fat pork, chop fine, and mix with 2 tablespoonfuls black pepper, 1 of cloves, 7 of powdered sage, and 5 of salt.

APPLE CUSTARD.—Take apples, pared, cored, and slightly stewed, sufficient to cover the dish, 8 eggs, 1 qt. of milk; spice to your taste; bake it ⅓ of an hour.

NEW-ENGLAND APPLE-SAUCE OR BUTTER.—Boil 2 brls. of new cider down to ½ a brl. Pare, core, and slice up 3 bushels of apples (sweet apples are preferable), and put them into the cider thus reduced, and still kept boiling briskly. Stir the whole mass constantly, to prevent burning, till of the consistence of soft butter. A small quantity of pulverized allspice, added during the boiling, is an improvement. Boil in a brass kettle, and, when done, put it into a wooden firkin, or a small cask, and it will keep for years.

APPLE BUTTER (*Pennsylvania Method*).—Boil new cider down to ½. Pare, cut, and core equal quantities of sweet and sour apples. Put the sweet apples in a large kettle to soften a little first, as they are the hardest. Add enough boiled cider to cook them. After boiling ½ an hour, stirring often, put in the sour apples, and add more boiled cider, with molasses enough to sweeten moderately. Boil until tender, stirring to prevent burning. Pack in firkins or stone pots for winter use.

IRISH STEW.—Take 4 lbs. good breast of fat mutton, cut in small pieces; 2 large white onions; 10 large potatoes, well peeled and sliced; put all in saucepan together, with fine herbs, pepper and salt to suit; a little salt pork is a good addition; ½ lb. of flour; ¼ lb. good fresh butter, well rubbed together, and let it boil for one hour, and have it well cooked.

APPLE DUMPLINGS.—6 eggs, 1½ lbs. of flour, some butter to your taste, and tablespoonful of yeast, and sufficient milk to make a dough to roll out; when raised, cut in small pieces, put in the apples, and cook for ¾ of an hour; serve with white sugar or wine sauce.

BOILED POULTRY.—Take large chickens, well cleaned with cold water, put in saucepan with water to cover, boil 1 hour; served with sauce.

HASHED TURKEY.—Take meat from boiled fowls, chop fine, put in saucepan, with seasonings to suit taste. Served on toast.

BOILED MACCARONI.—Take 2 lbs., break in small pieces, put in warm water to steep 1 hour, drain off, put in saucepan with 2 qts. fresh cream, with grated cheese; seasoned with red pepper.

STRASBURG POTTED MEAT.—Take 1½ lbs. of the rump of beef, cut into dice, put it in an earthen jar, with ¼ lb. of butter, tie the jar close up with paper, and set over a pot to boil; when nearly done, add cloves, mace, allspice, nutmeg, salt, and cayenne pepper to taste, then boil till tender, and let it get cold, pound the meat, with 4 anchovies mashed and boned, add ¼ lb. of oiled butter, work it well together with the gravy, warm a little, and add cochineal to, color then press into snall pots, and pour melted mutton suet over the top of each.

BOLOGNA SAUSAGES.—Take equal quantities of bacon fat and lean beef, veal, pork and beef suet; chop them small, season with pepper, salt, &c., with sweet herbs and sage rubbed fine. Have well washed intestines, fill, and prick them; boil gently for an hour, and lay on straw to dry.

RICH SAUSAGES.—Take 30 lbs. of chopped meat, 8 oz. fine salt, 2½ oz. pepper, 2 teacups of sage, and 1½ cups of sweet marjoram, passed through a fine sieve, or, if preferred, thyme and summer savory can be substituted for the latter.

HOW TO SAVE YOUR ICE BILL.—Get a quantity of empty barrels or boxes during the coldest time in the winter, and put a few inches of water in each; the evening when the cold is most intense is the best time to do this. After the water is frozen solid, fill up again, repeat the process until the barrels are full of solid ice, then roll them into your cellar, cover them up with plenty of sawdust or straw, and your ice crop is safely harvested.

Charlotte Russe.—Take 1 pt. milk, dissolve with heat, 3 oz. isinglass and 1 lb. sugar; add, after it is cool, 1 qt. beaten cream and flour, suit your taste and line out some mould with sponge cake, and put the cream in it and cool.

Wine Jelly.—Take 1 pt. water and 3 oz. isinglass, 1¼ lb. sugar, the juice of 2 lemons, and dissolve that and let it come to a boil, then add wine, brandy and spice to your taste, and strain it through a cotton or flannel cloth and put it in moulds to cool.

To Make Apple Molasses.—Take new sweet cider just from the press, made from sweet apples, and boil it down as thick as West India molasses. It should be boiled in brass, and not burned, as that would injure the flavor. It will keep in the cellar, and is said to be as good, and for many purposes better, than West India molasses.

☞ Acid fruits should be cooked in bright tin, brass, or bell metal, and poured out as soon as they are done. Brown earthen vessels should never be used, as they are glazed with white lead, a poison which very readily unites with an acid.

Jellies.—*Lemon Jelly.*—Isinglass, 2 oz.; water, 1 qt.; boil; add sugar, 1 lb.; clarify; and, when nearly cold, add the juice of 5 lemons, and the grated yellow rinds of 2 oranges and 2 lemons; mix well, strain off the peel, and put it into glasses or bottles; *Hartshorn Jelly.*—Hartshorn, 1 lb.; water 1 gal.; peel off 2 lemons; boil over a gentle fire till sufficiently thick; strain and add loaf sugar, ½ lb.; whites of 10 eggs beaten to a froth; juice of 6 lemons; mix well together, then bottle. *Isinglass Jelly.*—Put 4 oz. isinglass and 2 oz. cloves into 1 gal. water; boil it down to half a gal.; strain it upon 4 lbs. of loaf sugar; add, while cooling a little wine; then bottle. *Apply Jelly from Cider.*—Take of apple juice, strained, 4 lbs.; sugar, 2 lbs.; boil to a jelly, and bottle. *Gooseberry Jelly.*—Sugar, 4 lbs.; water, 2 lbs.; boil together; it will be nearly solid when cold; to this syrup, add an equal weight of gooseberry juice; give it a short boil, cool, then pot it. *Currant Jelly.*—Take the juice of red currants, and loaf sugar, equal quantities; boil and stir gently for three hours; put it into glasses; and in three days it will concentrate into a firm jelly. *Tapioca Jelly.*—Wash 8 oz. of tapioca well; then soak it in 1 gal. fresh water, 5 or 6 hours; add the peels of 8 lemons, and set all on to heat; simmer till clear; add the juice of the 8 lemons with wine and sugar to taste; then bottle.

Blackberry Jelly.—This preparation of the blackberry is more agreeable than the jam, as the seeds, though very wholesome, are not agreeable to all. It is made in the same way as currant jelly; but the fruit is so sweet that it only requires half the weight of the juice in sugar.

Pear Marmalade.—To 6 lbs. of small pears, take 4 lbs. of sugar; put the pears into a saucepan, with a little cold water; cover it, and set it over the fire until the fruit is soft, then put them into cold water; pare, quarter, and core them; put to them three teacups of water, set them over the fire; roll the sugar fine, mash the fruit fine and smooth, put the sugar to it, stir it well together until it is thick, like jelly, then put it in tumblers, or jars, and, when cold, secure it as jelly.

Preserved Citron.—Pare and cut open the citron; clean all out except the rind; boil till soft. To 1 lb. of citron add 1 lb. of sugar, and a lemon to each lb.; put the sugar and lemon together, and boil it till it becomes a syrup, skimming it well; then put the syrup and citron together, and boil it an hour.

SCOTCH MARMALADE.—Take of the juice of Seville oranges 2 pts., yellow honey, 2 lbs. Boil to a proper consistence.

RASPBERRY JAM.—Allow a pound of sugar to a pound of fruit, mash the raspberries and put them, with the sugar, into your preserving kettle. Boil it slowly for an hour, skimming it well. Tie it up with brandy paper. All jams are made in the same manner.

FRENCH HONEY.—White sugar, 1 lb.; 6 eggs, leaving out the whites of 2; the juice of 3 or 4 lemons, and the grated rind of 2, and ¼ lb. of butter; stir over a slow fire until it is of the consistency of honey.

ALMOND BLANC MANGE.—Take four ounce of almonds, six oz. sugar, boil together with a quart of water, melt in this two ounces of pure isinglass, strain in a small tin mould to stiffen it. When wanted, dip the mould in hot water and turn it out.

LEMON BLANC MANGE.—Pour a pint of hot water upon half an ounce of isinglass; when it is dissolved, add the juice of three lemons, the peel of two lemons grated, six yolks of eggs beaten, add about a good wine-glass of Madeira wine to it; sweeten to your taste; let it boil; then strain it and put it in your moulds.

MOLASSES PRESERVES.—Boil 1 qt. of molasses about ten or fifteen minutes to a thickish consistency, then add 6 eggs well beaten, and a spoonful of flour. Boil a few minutes longer, stirring constantly, then set off the fire, and flavor with lemon or allspice as desired.

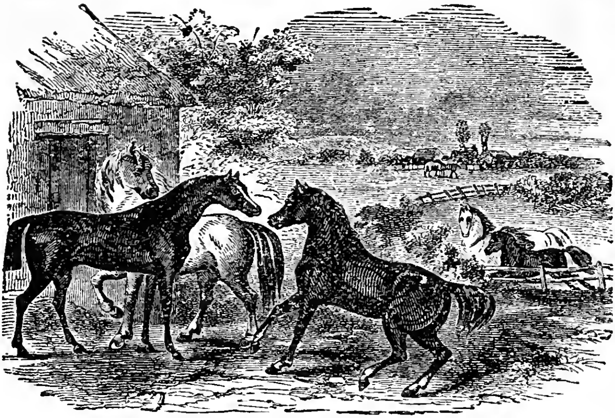
FRUIT EXTRACTS, &c.—Good alcohol, 1 qt., oil of lemon, 2 oz. Break and bruise the peel of 4 lemons, and add to them alcohol for a few days, then filter. For currants, peaches, raspberries, pine apples, strawberries, blackberries, &c., take alcohol and water half and half and pour over the fruit, entirely covering it, and let it stand for a few days. For essence of cinnamon, nutmeg, mace, vanilla, &c., pulverize either article thoroughly, and put about 2 oz. of the resulting powder to each pint of reduced alcohol, agitate the mixture frequently for 2 weeks, then filter and color as desired.

MEASURES FOR HOUSEKEEPERS.

Wheat flour......	1 lb.... is 1 quart.	Best brown sugar............	1 lb. 2 oz. is 1 qt.
Indian meal.......	1 " 2 oz " 1 quart.	Eggs.............	10 eggs are 1 lb.
Butter when soft..	1 ".... " 1 "	Flour..............	8 qts. " 1 peck.
Loaf sugar, broken	1 ".... " 1 "	Flour..............	4 pks. " 1 bush.
White sugar, powd	1 " 1 oz. " 1 "		

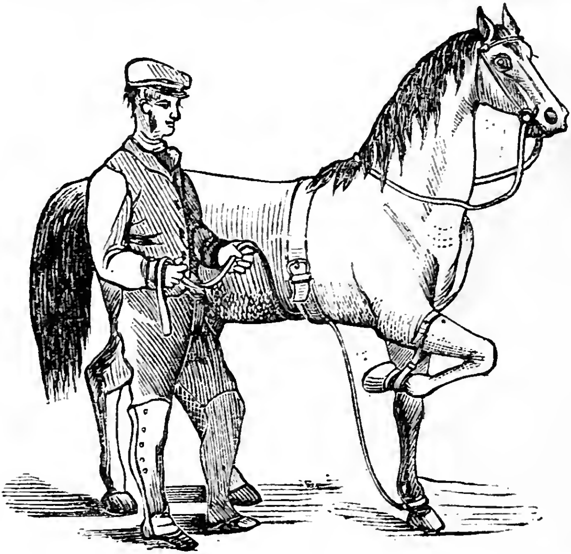
LIQUIDS.

16 large tablespoonfuls are	½ pint.	4 qts. are .... 1 gallon.
8 large tablespoonfuls are	1 gill.	A common sized tumbler holds ½ a pint.
4 large tablespoonfuls are	½ gill.	A common sized wine-glass " ½ a gill.
2 gills are................	½ pint.	25 drops are equal to 1 teaspoonful
2 pints are................	1 qt.	



FARMERS AND STOCK OWNERS' DEPARTMENT.

RAREY'S DIRECTIONS FOR BREAKING AND TRAINING OF HORSES. —In training horses you must remember that there are certain natural laws that govern them. For instance, it is natural for him to kick whenever he gets badly frightened ; it is natural for him to escape from whatever he thinks will do him harm. His faculties of seeing, hearing, and smelling, have been given him to examine everything new that he is brought in contact with. And so long as you present him with nothing that offends his eyes, nose, or ears, you can then handle him at will, notwithstanding, he may be frightened at first, so that in a short time he will not be afraid of anything he is brought in contact with. All of the whipping and spurring of horses for shying, stumbling, &c., is useless and cruel. If he shys, and you whip him for it, it only adds terror, and makes the object larger than it would otherwise be ; give him time to examine it without punishing him. He should never be hit with the whip, under any circumstances, or for anything that he does. As to smelling oil, there is nothing that assists the trainer to tame his horse better. It is better to approach a colt with the scent of honey or cinnamon upon your hand, than the scent of hogs, for horses naturally fear the scent of hogs, and will attempt to escape from it, while they like the scent of honey, cinnamon, or salt. To affect a horse with drugs you must give him some preparation of opium, and while he is under the influence of it, you cannot teach him anything more than a man when he is intoxicated with liquor. Another thing, you must remember to treat him kindly, for there you require obedience from any subject, it is better to have it rendered from a sense of love than fear. You should be careful not to chafe the lips of your colt or hurt his mouth in any way; if you do he will dislike to have the bridle on. After he is taught to follow you, then put on the harness, putting your lines through the shaft straps along the side, and teach him to yield to the reins, turn short to the right and left, teach him to stand still before he is ever hitched up; you then have control over him. If he gets frightened, the lines should be used as a telegraph, to let him know what you want him to do. No horse is naturally vicious, but always obeys his trainer as soon as he comprehends what he would have him do; you must be firm with him at the same time, and give him to understand that you are the trainer, and that he is the horse. The best bits to be used to hold a horse, to keep his mouth from getting sore, is a straight bar-bit, 4½ inches long between the rings; this operates on both sides of the jaw. while the ordinary snaffle forms a clamp and presses the side of the jaw. The curb or bridoon hurts his under jaw so that he will stop before he will give to the rein. To throw a horse, put a rope 12 feet long around his body in a running noose, pass it down to the right fore foot through a ring in a spancil, then buckle up the left or near fore foot, take a firm hold of your rope, lead him around



until he is tired, give him a shove with your shoulder, at the same time drawing up the right foot which brings him on his knees, hold him steady, and in a few moments he will lie down. Never attempt to hold him still, for the more he scuffles the better.

Take your colt into a tight room or pen, and with a long whip commence snapping at the colt's hind leg, taking care not to hit above the hocks, stopping immediately when the colt turns his head towards you; while his head is towards you, approach him with the left hand extended toward him, holding your whip in the right, ready to snap him as soon as he turns his head from you. In this way you can soon get your hands upon him. As soon as you have done this, be careful to caress him for his obedience, and snap him for his disobedience. In this way he will soon learn that he is safest in your presence with his head towards you, and in a very short time you cannot keep him away from you. Speak kindly and firmly to him, all the time caressing him, calling by name, and saying, "Ho, boy," or "Ho, Dina," or some familiar word that he will soon learn.

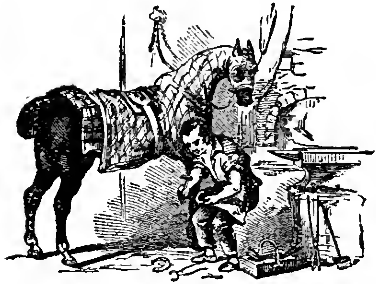
If a colt is awkward and careless at first, you must bear with him, remembering that we, too, were awkward when young; allowing him his own way, until by degrees he will come in. If he is wilful, you must then change your course of treatment, by confining him in such a way that he is powerless for harm until he submits. If he is disposed to run, use my pole check on him; if to kick, fasten a rope around his under jaw, pass it through the collar and attach it to his hind feet. In this way one kick will cure him, as the force of the blow falls on his jaw. If he should be stubborn, lay him down and confine him until you subdue him, without punishing him with the whip.

Colts should be broke without blind-bridles; after they are well broke, then you may put on blinds. Bridles without blinds are the best unless you want to speed your horse, then it will be necessary to keep him from seeing the whip. Colts should be well handled and taught to give readily to the rein before they are hitched up. If you hitch them up the first thing and they become frightened, then you have no control over them; but if you teach them to start, stop, and stand at the word before they are hitched, then you can govern them.

CRUELTY TO HORSES—Besides the cruel punishment inflicted upon horses, by the careless and heartless driver, he is subjected to severe punishment in the winter season, by being compelled to take frozen bits into his mouth in cold weather, tearing the skin from the tongue and the roof of his mouth, producing a heavy inflammation in the mouth and throat; he gets poor, hidebound, and the sympathetic nerves of the head take up the inflammation, carry it to the head and eyes, frequently producing blindness, and a hundred other diseases. The whip should be used as an instrument of pleasure instead of torture; and your bits should be wound with flannel or leather; so that no frozen iron will come in contact with his mouth, lips or tongue.

RAREY'S LINIMENT.—Sulphuric ether, 4 ozs.; hartshorn, 4 ozs., oil of origanum, 4 ozs.; alcohol, 4 ozs.; sweet oil, 4 ozs. Shake well before using. For sprains on horses, &c., apply by rubbing and cover with a tight flannel bandage. For headache, rub a little on the temples and apply a bandage wet with the liniment to the forehead.

RAREY'S WIZARD OIL.—Oil of origanum, 6 ozs.; alcohol, 6 ozs.; spirits turpentine, 1 oz.; camphor, 1 oz. Shake well before using.



RAREY'S DIRECTIONS FOR SHOEING HORSES.—"There are very few blacksmiths that ever once think what a complicated piece of machinery the foot of a horse is, and by one careless blow they frequently stop the working of this machine. The majority of smiths, as soon as they pick up a horse's foot, go to work paring the heel, from the fact that it is the most convenient part of the foot, and thereby destroy the heel and braces of the foot, causing, in many instances, contracted heels. The heels of a horse should be well kept up and the toe down. By lowering the heels you throw the entire weight of your horse upon the back tendon of the legs, and thereby produce lameness from overtaxing a very important set of tendons. By keeping up the heel you throw the weight upon the wall of the foot. In this position you prevent stumbling, clicking, &c. Next the shoer commences to pare away the sole, thins it down until he can feel it spring with his thumb. Ask him why he does this, and he gives you no reason, except from custom ; next comes the bars or braces of the foot, they are smoothed down ; next in his ruinous course, comes the frogs of the feet, they are subjected to the same cutting and smoothing process. All the cutting, paring, and smoothing of the soles, bars, or frogs is a decided injury to the horse as well as to the owner. All the corns in the land are produced by this process of paring. The frogs have been placed in the foot by nature to expand the wall of the foot, and as soon as you commence to cut it, the oily substance commences to leak out, it drys up, becomes hard, losing its oily substance, makes the wall hard and dry, inducing it to crack. The nerves of the feet are very sensitive, and smiths should be very careful not to prick the foot, as it requires quite a time to relieve them. The foot is a very complicated piece of machinery, and if you keep a horse well shod and his foot in good condition, you can then generally manage the balance. The feet suffer from being kept too dry. Horses that stand on board floors should have their feet wet every day, or there should be a vat five inches deep, five feet long, and three wide, filled with water and clay, in which each horse can stand for one hour per week, unless his feet are feverish, then he should be kept in it an hour per day, or until the fever subsides. Another source of injury to horses' feet, is the habit of patronizing cheap blacksmiths. If a man can drive a nail, he then sets up a sign as a farrier or a veterinary surgeon, when in fact he knows nothing of the anatomy of the horse's foot; not having spent any time or money in acquiring the necessary information, he can afford to shoe a few shillings cheaper than a well-informed man, but the patrons of such cheap shoeing are generally the sufferers. All horse-shoers should be well skilled veterinary surgeons, or there should be a skilful surgeon attached to every shop. Another source of poor shoeing and injury is the loss of elasticity of the frog, refusing to perform its proper functions ; the heel contracts, the foot rolls, and you have a sore horse for ten or twelve months, for it requires this long to relieve a horse's suffering from being badly shod.

Under the circumstances, the first thing that touches the road or the floor of the stall, should be the frog, and the wall of the foot should be kept cut so as not to prevent it from touching at every step; and no man that owns a horse should ever allow a blacksmith to cut the soles, bars, or frogs of his horse's feet. Nature has adapted the frogs to all description of roads, climates, and weather, without being pared. So many horses have been ruined by this process of paring, that there are now several establishments in this country that manufacture India rubber pads, thinking thereby to supply the wasted frog and the elasticity of the natural foot. The frog is insensible to pressure, and you may place the whole weight of your horse on the frog and he will suffer no inconvenience, as may be seen from shoeing with one of my corn shoes ; besides, this is the only reliable way to cure contracted feet; by throwing the weight upon the frog, you force them up between the walls ; it acts as a wedge, and soon relieves the contracted feet. Smiths should never have their shoes hot when fitting them, as the application of hot iron extracts the oily substance from the hoof. The amount of cruel punishment inflicted on horses by cross-grain blacksmiths, is another source of poor shoeing. As soon as the horse does not stand the smith gets angry, and commences whipping and jerking the animal, which only adds terror to it, so that he soon refuses to go to the shop if he can avoid it ; it is natural for horses to dislike to be shod, because the hammering shocks the nervous system, until they are accustomed to it. He should be taught to stand, and his feet well handled at home, before he is ever brought to the shop by the owner. You then save the horse pounding, and the smith an immense amount of labor that he never gets any pay for, for no man ever thinks of paying anything extra for shoeing a bad horse. The wall of the foot should never be rasped above the nail holes, and as little below the clenches as possible ; all the rasping and filing but tends to thin and weaken the wall by cutting the fibers of the foot. The nails should be counter sunk into the shoe, so that there will be no chance for the clenches to rise. No horse interferes with the heel or toe ; it is always the side of the foot. The habit of turning the inside of the shoe under causes a number of horses to interfere, that would not if they were shod straight in the inside. Spread the heels as wide as possible ; set the outside a little under ; keep the toes full. For clicking horses, raise the heels high, cut the toes short. For speedy cuts, place your toe corks a quarter of an inch to the inside of the centre of your shoe; keep the heels wide apart. For corns, put on a shoe with a prong, for the main rim, so as to cover the entire frog, pare the wall lower than the frog, so as his entire weight will be thrown on the frog. Have the inner cork not quite so sharp as the outer one, so that if he steps upon the other foot it will not cut it; make the shoes as light as possible consistent with good service, as they are ordinarily made just about ⅓ too heavy."

To Prevent Horses Kicking in the Stall.—Fasten a short trace-chain about 2 feet long, by a strap to each hind foot. A better way is to have the stalls made wide enough so that the horse can turn in them easily. Close them with a door or bars, and turn the animal loose. After a while he will forget the habit, and stand tied without further trouble.

To Cure Broken Legs.—Instead of summarily shooting the horse, in the greater number of fractures it is only necessary to partially sling the horse by means of a broad piece of sail, or other strong cloth placed under the animal's belly, furnished with 2 breechings and 2 breast girths, and by means of ropes and pulleys attached to a cross beam above, he is elevated, or lowered, as may be required. By the adoption of this plan every facility is allowed for the satisfactory treatment of fractures.

Lampas.—This consists in a swelling of the first bar of the upper palate. It is cured by rubbing the swelling 2 or 3 times a day with ½ oz. of alum and the same quantity of double refined sugar mixed with a little honey.

Gravel.—Steep ½ lb. of hops in a quart of water and give it as hot as the horse can stand it.

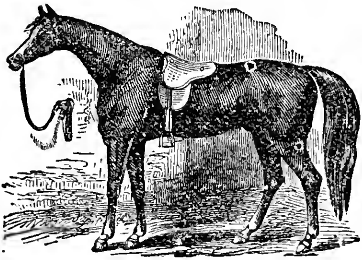
Halter Pulling. A new way to prevent horses pulling at the halter, is to put a very small rope under the horse's tail bringing the ends forward, crossing them on the back, and tying them on the breast. Put the halter strap through the ring, and tie the rope in front of the horse. When the horse pulls, he will, of course, find himself in rather an uncomfortable position, and discontinue the effort to free himself.

Hide Bound.—To recruit a hide bound horse, give nitrate potassa (or saltpetre) 4 oz., crude antimony 1 oz., sulphur 3 oz. Nitrate of potassa and antimony should be finely pulverized, then add the sulphur, and mix the whole well together. Dose, a tablespoonful of this mixture in a bran mash daily.

To Prevent Horses from Jumping.—Pass a good stout surcingle around his body; put on his halter, and have the halter strap long enough to go from his head, between his fore legs, then through the surcingle, and back to one of his hind legs. Procure a thill strap, and buckle around the leg between the foot and joint, fasten the halter strap in this—shorter or longer, as the obstinacy of the case may require. It is also useful to keep colts from running where there is likely to be danger from the result; if the thill strap should cause any soreness on the leg, it may be wound with a woollen cloth, and it would be well to change it from one leg to another occasionally.

Big Leg.—To cure, use the "Blistering Liniment" with regularity every third hour until it blisters. In 3 days wash the leg with linseed oil. In 6 days wash it clean with soap and water. Repeat every 6 days until the swelling goes down. If there should be any callous left, apply spavin ointment.

Sore Breasts.—This generally occurs in the spring, at the commencement of plowing. At times the fault is in having poor old collars, and not having the collar well fitted to the horse's breast; and often, the hames are either too tight or too loose. There is a great difference in horses about getting chafed or galled, and at times it has seemed to be impossible to keep their breasts from getting sore; but a thorough application of strong alum water or white oak bark to the breasts of the animal, 3 days before going to work, toughen them so that they will not get sore. Another excellent plan is, when you let your team rest for a few moments during work, to raise the collar and pull it a little forward, and rub the breast thoroughly with your naked hand.



THE CHECK REIN ON HORSES.—We desire to register an earnest protest against this barbarous appendage to horses' harness. It retards the horse's progress in every position both while he is at work, and while travelling on a journey. It is both useless and cruel in every sense of the word, without any compensating qualities to recommend it. Mr. Angell, of the "Boston Society for the Prevention of Cruelty to Animals," who has travelled over a great part of Europe in the interests of humanity to our dumb servants, says, that the use of the check rein is confined to America alone, being deservedly discarded every where both in England and on the Continent. The reason why it is so discarded, was very graphically explained by an extensive horse owner in Glasgow, as he remarked, in conversation with Mr. Angell, that "We canna get the wark oot o' the horse wi' the check rein." To check rein a horse, is equivalent to trussing a man's head backward towards his back or heels, and compelling him, while bound in this position, to do duty with a loaded wheelbarrow.

FEEDING HORSES ON THE ROAD.—Many persons, in travelling, feed their horses too much, and too often, continually stuffing them, and not allowing them to rest and digest their food; of course they suffer from over-fulness, and carrying unnecessary weight. Horses should be well fed in the evening, and must not be stuffed too full in the morning, and the travelling should be moderate on starting when the horse has a full stomach. If a horse starts in good condition, he can go 20 or 25 miles without feeding. The provender required by horses while travelling or engaged in ordinary farm work, per day, may be stated thus: Hay 20 lbs., oats 3 gals., water 4 gals. Muddy water is the best for horses. Beeves require 20 lbs. of hay and 6 gals. of water per day. Quantity will vary in every case according to the size, condition, breed, &c., together with the kind of work in which they are employed.

ITCH.—To cure a horse affected with itch, first reduce his daily allowance of food, putting him on low diet and then give him a teaspoonful of a mixture of equal parts of sulphur and antimony, and at the end of a week or 10 days the sores will have disappeared and the horse will be covered with a fine coat of new hair.

STOPPAGE OF URINE.—Symptoms : Frequent attempts to urinate, looking round at his sides, lying down, rolling and stretching. To cure, take ½ lb. of hops, 3 drs. oil of camphor; grind and mix. Make this into 3 pills. Give 1 every day, with a drench made of a small spoonful of saltpetre and 2 oz. of water. This will cure as a general thing.

TO CURE BALKY HORSES.—One method to cure a balky horse is to take him from the carriage, whirl him rapidly around till he is giddy. It requires two men to accomplish this,—one at the horse's tail. Don't let him step out. Hold him to the smallest possible circle. 1 dose will often cure him, 2 doses are final with the worst horse that ever refused to stir. Another plan is to fill his mouth with the dirt or gravel from the road, and he will at once go, the philosophy of this being that it gives him something else to think about.

DR. COLE'S KING OF OILS.—1 oz. green copperas ; 2 oz. white vitriol ; 2 oz. common salt ; 2 oz. linseed oil ; 8 oz. molasses. Boil over a slow fire fifteen minutes in a pint of urine ; when almost cold, add 1 oz. of oil of vitriol and 4 oz. of spirits of turpentine. Apply to wounds with a feather. A very powerful liniment.

SLOAN'S HORSE OINTMENT.—4 oz. resin ; 4 oz. bees-wax ; lard, 8 oz. ; honey, 2 oz. Mix slowly and gently, bring to a boil ; then add less than 1 pint spirits turpentine ; then remove and stir till cool. Unsurpassed for horse flesh, cracked hoofs, human flesh, &c.

MEXICAN MUSTANG LINIMENT.—Petroleum, olive oil, and carbonate of ammonia, each equal parts, and mix.

MERCHANT'S GARGLING OIL.—Take 2½ gals. linseed oil ; 2½ gals. spirits turpentine ; 1 gal. western petroleum ; 8 oz. liquor potass. ; sap green, 1 oz. ; mix all together, and it is ready for use.

ARABIAN CONDITION POWDERS.—Ground ginger, 1 lb ; sulphuret of antimony, 1 lb. ; powdered sulphur, 1 lb ; saltpetre, 1 lb. Mix all together, and administer in a mash, in such quantities as may be required. The best condition powder in existence.

BLISTERING LINIMENT.—1 part Spanish flies, finely powdered ; 3 of lard ; and 1 of yellow resin. Mix the lard and resin together, and add the flies when the other ingredients begin to cool. To render it more active, add 1 pint spirits turpentine.

MEDICATED FOOD FOR HORSES AND CATTLE.—Take linseed cake and pulverize or grind it up in the shape of meal, and to every 50 lbs. of this ingredient, add 10 lbs. Indian meal ; 2 lbs. sulphuret of antimony ; 2 lbs. ground ginger, 1¾ lbs. of saltpetre, and 2 lbs. powdered sulphur. Mix the whole thoroughly together, put in neat boxes or packages for sale or otherwise as desired, and you will have an article equal in value to "Thorley's Food," or almost any other preparation that can be got up for the purpose of fattening stock or curing disease in every case when food or medicine can be of any use whatever. This article can be fed in any desired quantity, beginning with a few tablespoonfuls at a time, for a horse, mixing it with his grain, and in the same proportion to smaller animals, repeating the dose and increasing the quantity as the case may seem to require.

LOTION FOR MANGE.—Boil 2 oz. tobacco in 1 quart water; strain; add sulphur and soft soap, each 2 oz.

FOR STRAINS AND SWELLINGS.—Strong vinegar saturated with common salt, used warm, is good for strains and reducing swellings. 1 oz. of white vitriol; 1 oz. of green copperas; 2 teaspoonfuls of gunpowder, all pulverized together, and dissolved in 1 quart of soft water, and used cold, rubbing in thoroughly, is one of the best applications known for reducing swellings.

HOOF-BOUND WASH.—Spirits turpentine. 4 oz.; tar, 4 oz.; whale oil, 8 oz. Mix, and apply to the hoofs often.

TO TOUGHEN HOOFS.—Wash them frequently in strong brine, and turn brine upon the bottoms, and soak a few minutes each time.

SCRATCHES.—Cut off the hair close, and wash the legs in strong soap-suds or urine, or wash with warm vinegar saturated with salt, and afterwards dress over with a small quantity of hog's lard.

COUGH.—Quit feeding musty hay, and feed roots and laxative food. Sprinkle human urine on his fodder, or cut up cedar boughs and mix with his grain; or boil a small quantity of flax-seed, and mix it in a mash of scalded bran, adding a few ounces of sugar, molasses, or honey. Administer lukewarm. If there should be any appearance of *heaves*, put a spoonful of ground ginger once per day in his provender, and allow him to drink freely of lime water.

SPLIT OR BROKEN HOOF.—Let the blacksmith bore two holes on each side of the crack or split; pass long nails through the holes and clinch tight. After anointing with the hoof-bound liquid, it will soon grow together.

COLIC CURE.—Bleed freely at the horse's mouth; then take ½ lb. raw cotton, wrap it around a coal of fire, so as to exclude the air; when it begins to smoke, hold it under his nose till he becomes easy.

TO CURE DISTEMPER.—Take 1¼ gals. of blood from the neck vein; then administer sassafras oil, 1½ oz. Cure, speedy and certain.

FOUNDER CURED IN 24 HOURS.—Boil or steam stout oat-straw for half an hour, then wrap it around the horse's leg quite hot, cover up with wet woollen rags to keep in the steam; in six hours renew the application, take 1 gal. of blood from the neck vein, and give 1 quart linseed oil. He may be worked next day.

CURE FOR STAGGERS.—Give a mess twice a week, composed of bran, 1 gal.; sulphur, 1 tablespoonful; saltpetre, 1 spoonful; boiling sassafras tea, 1 quart; assafœtida, 1½ oz. Keep the horse from cold water for half a day afterwards.

RING-BONE AND SPAVIN CURE.—Venice turpentine and Spanish flies, of each 2 oz.; euphorbium and aqua-ammonia, of each 1 oz.; red precipitate, ½ oz.; corrosive sublimate, ¼ oz.; lard, 1½ lbs. Pulverize all, and put into the lard; simmer slowly over coals, not scorching or burning; and pour off, free of sediment. For ring-bones, cut off the hair, and rub the ointment well into the lumps once in 48 hours. For spavins, once in 24 hours for 3 mornings. Wash well previous to each application with suds, rubbing over the place with a smooth stick, to squeeze out a thick, yellow matter. This has removed very large ring-bones.

ANOTHER CURE.—Take sweet oil, 4 oz. ; spirits turpentine, 2 oz. ; oil of stone, 1 oz. Mix, and apply three times per day. If the horse is over four year old, or in any case when this is not sufficient, in addition to it, you will fit a bar of lead just above it, wiring the ends together, so it constantly wears upon the enlargement ; and the two together will cure nine cases out of every ten, in six weeks.

CURE FOR BONE SPAVINS—$300 RECIPE.—Corrosive sublimate, quicksilver, and iodine, of each 1 oz. Rub the quicksilver and iodine together ; then add the sublimate, and lastly the lard, rubbing them thoroughly. Shave off the hair the size of the bone enlargement ; grease all around it, but not where the hair is shaved off, this prevents the action of the medicine, except on the spavin. Then rub in as much of the paste as will lie on a 3-cent piece, each morning, for 3 or 4 mornings. In from 7 to 8 days, the whole spavin will come out ; then wash the wound with suds for an hour or so, to remove the poisonous effects of the paste ; afterwards heal up the sore with any good healing salve, or Sloan's Horse Ointment, as per recipe above, keeping the sore covered while it is healing up.

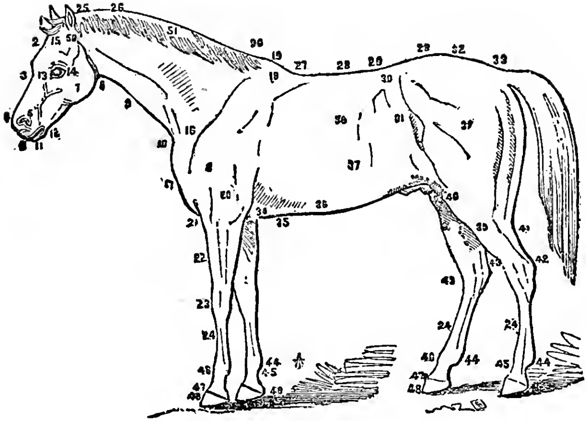
ANOTHER VERY VALUABLE RECIPE FOR RING-BONE.—Pulverized cantharides, oils of spike, origanum, amber, cedar, Barbadoes tar, and British oil, of each 2 oz. ; oil of wormwood, 1 oz. ; spirits turpentine, 4 oz. ; common potash, ½ oz. ; nitric acid, 6 oz. ; sulphuric acid, 4 oz. ; lard, 3 lbs. Melt the lard, and slowly add the acids ; stir well, and add the other articles, stirring till cold ; clip off the hair, and apply by rubbing and heating in. In about 3 days, or when it is done running, wash off with soap-suds, and apply again. In old cases, it may take 3 or 4 weeks ; but, in recent cases, 2 or 3 applications have cured.

ANOTHER.—Pulverized cantharides, oils of origanum and amber, and spirits turpentine, of each 1 oz. ; olive oil, ½ oz. ; sulphuric acid, 3 drams ; put all, except the acid, into alcohol ; stir the mixture, add the acid slowly, and continue to stir till the mixture ceases to smoke; then bottle for use. Apply to ring-bone or spavin with a sponge tied on the end of a stick, as long as it is absorbed into the parts ; twenty-four hours after, grease well with lard ; and in twenty-four hours more, wash off well with soap-suds. One application is generally sufficient for spavins, but may need two ; ring-bones, always two or three applications, three or four days apart, which prevents loss of hair. This will stop all lameness, but does not remove the lump.

SPLINT AND SPAVIN LINIMENT. Oil of origanum, 6 oz. ; gum camphor, 2 oz. ; mercurial ointment, 2 oz. ; iodine ointment, 1 oz. ; melt by putting all into a wide-mouthed bottle, and setting it in a kettle of hot water. Apply it to bone spavins or splints, twice daily, for four or five days, and a cure is guaranteed.

POLL EVIL AND FISTULA.—Common potash dissolved in ½ pint of water, 1 lb. ; add ½ oz. belladonna extract, and 1 oz. gum arabic dissolved in a little water ; work all into a paste with wheat flour, and bottle up tight. Directions : wash the sores well with Castile soap-suds ; then apply tallow all around them. Next, press the above paste to the bottom of all the orifices ; repeat every two days till the callous fibrous base around the poll evil or fistula is completely destroyed ; put a piece of oil-cloth over the sores, and afterwards heal up with Sloan's Horse Ointment.

DIAGRAM OF A SOUND HORSE.



POINTS IN A HORSE.

1. Forehand.
2. Forehead.
3. Face.
4. Nose.
5. Wings of the nose.
6. Muzzle.
7. Jaw.
8. Throat.
9. Windpipe, or Throttle.
10. Point of the Shoulder.
11. Chin.
12. Curb of the Chin.
13. Outer corner of the Eye.
14. Inner corner of the Eye.
15. Foretop.
16. Neck.
17. Breast.
18. Shoulder.
19. Withers.
20. Arm.
21. Fore-arm.
22. Fore-legs.
23. Knee.
24. Cannon-bones.
25. Nape.
26. Crest.
27. Middle-hand.
28. Back.
29. Back-hand.
30. Loin.
31. Hip.
32. Croup, or Rump.
33. Dock.
34. Elbow.
35. Girth.
36. Barrel (the Ribs).
37. Flank.
38. Quarter.
39. Thigh.
40. Stifle.
41. Hamstring.
42. Point of the Hock.
43. Hocks.
44. Fetlocks.
45. Small Pasterns.
46. Large Pasterns.
47. Crown of the Hoof.
48. Hoof.
49. Heels.
50. Head.
51. Mane, or Mane Hair.

Comparative Value of Food for Horses.—100 lbs. of good hay is equivalent in value to 59 lbs. of oats, 57 lbs. of corn, 275 of carrots, 54 lbs. of rye or barley, 105 lbs. of wheat bran, 400 lbs. of green clover, 275 lbs. of green corn, 374 lbs. of wheat straw, 442 lbs. of rye straw, 400 lbs. of dried corn stalks, 45 lbs. of wheat, 59 lbs. of corn, 62 lbs. of sun-flower seeds, 69 lbs. of linseed cake, 195 lbs. of oat straw, 105 lbs. of wheat bran; 1 lb. of oil cake is equal to 14 lbs cabbage.

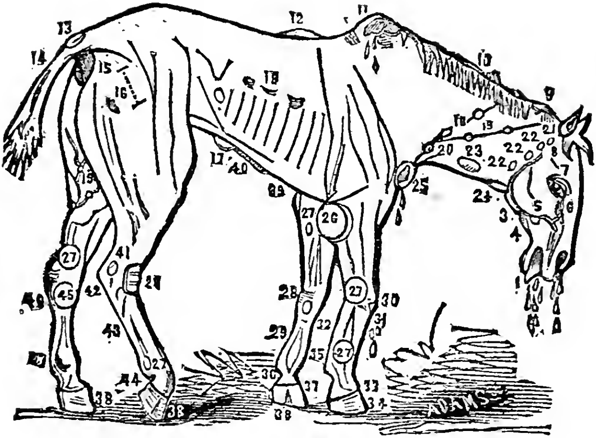


DIAGRAM SHOWING DISEASES OF THE HORSE.

The above diagram, copied from a circular issued by L. W. Warner & Co., manufacturers of Dr. Herrick's Horse Medicines at 67 Murray St., N. Y., is, notwithstanding its lugubrious appearance, of the utmost value to owners of horses; for, taken in connection with the following references descriptive of the various numbers, indications, &c., it will prove of great utility in identifying and locating diseases in many doubtful cases.

1. 2. 3. { Glanders. Discharge from the Nostrils. Membrane. Glandular Swellings.
4. Caries and Diseases of the Jaw.
5. Fistula Parotid Duct.
6. Diseases of the Eye.
7. Scars on Forehead and over the Eyes.
8. Scars from old Fontanels and Brain Diseases. 9. Poll Evil.
10. Prurigo, or Mane Scab.
11. Fistulous Withers.
12. Saddle Galls, Sitfasts, &c.
13. Fistulous Tail. 14. Rat Tail.
15. Falling of the Fundament.
16. Luxation of Patella, or Whirl Bone Displaced.
17. Hernia or Rupture.
18. Broken Ribs. 19. Farcy.
20. Sores from Constant Bleeding.
21. Bridle Swellings.
22. Fistula and Inflammation of Parotid Gland.
23. Phlebitis, or inflamed Jugular Vein.
24. Sore Throat.
25. Tumors caused by Collar.
26. Capped Elbow or Tumor.
27. Wind Galls.
28. Mallenders and Sallenders.
29. Splint. 30. Capped Knee.
31. Broken Knees and Open Joint.
32. Clap of the Back Sinews.
33. Ringbone.
34. Acute and Chronic Founderer. Ring Foot. 35. Grogginess.
36. Quittor.
37. Tread on the Coronet and Overreaches.
38. Sand, Toe, Cow and Quarter Cracks.
39. Girth Swellings.
40. Wind Colic, Fret, Gripes, or Belly-ache.
41. Thorough pin.
42. Capped Hocks.
43. Swelled or Sprung Sinews.
44. Scratches.
45. Spavin.
46. Curb. 47. Swollen Legs.

TO TAME HORSES.—Take finely-grated horse castor, oils of rhodium and cumin; keep them in separate bottles well corked; put some of the oil of cumin on your hand, and approach the horse on the windy side. He will then move toward you. Then rub some of the cumin on his nose, give him a little of the castor on anything he likes, and get eight or ten drops oil of rhodium on his tongue. You can then get him to do anything you like. Be kind and attentive to the animal, and your control is certain.

BEST REMEDY FOR HEAVES.—Balsam of fir and balsam of copaiba, 4 oz. each, and mix with calcined magnesia sufficiently thick to make it into balls; and give a middling-sized ball night and morning for a week or ten days.

CURE FOR BOTS IN HORSES.—Give the horse, first, 2 quarts of new milk, and 1 quart molasses; 15 minutes afterwards, give 2 quarts very strong sage tea; 30 minutes after the tea, give 3 pints (or enough to operate as physic), of curriers' oil. The molasses and milk cause the bots to let go their hold, the tea puckers them up, and the oil carries them completely away. Cure, certain, in the worst cases.

LINIMENT FOR SWEENY.—Alcohol and spirits turpentine, of each 8 oz.; camphor-gum, pulverized cantharides, and capsicum, of each 1 oz.; oil of spike, 3 oz.; mix. Bathe this liniment in with a hot iron, and a cure is sure to follow.

FOR LOOSENESS OR SCOURING IN HORSES OR CATTLE.—Tormentil root, powdered. Dose for a horse or cow, 1 to 1½ oz. It may be stirred into 1 pint of milk, and given; or it may be steeped in 1½ pints of milk, then given from three to six times daily, until cured.

SCOURS AND PIN-WORMS IN HORSES AND CATTLE.—White ash bark burnt into ashes, and made into a rather strong lye; then mix ½ pint of it with 1 pint warm water, and give all two or three times daily. This will certainly carry off the worms, which are the cause, in most instances, of scours and looseness.

ENGLISH STABLE LINIMENT, VERY STRONG.—Oil of spike, aqua-ammonia, and oil of turpentine, each 2 oz.; sweet oil, and oil of amber, each, 1½ oz.; oil of origanum, 1 oz. Mix.

COLIC CURE FOR HORSES AND PERSONS.—Spirits turpentine, 3 ox.; laudanum, 1 ox.; mix; and for a horse give all for a dose, by putting it into a bottle with half a pint of warm water. If relief is not obtained in an hour, repeat the dose, adding half an ounce of the best powdered aloes, well dissolved. Cure, certain.

FOR PERSONS, a dose would be from 1 to 2 teaspoonfuls in warm tea; children or weak persons, less.

LINIMENT FOR FIFTY CENTS PER GALLON.—Best vinegar, 2 qts.; pulverized saltpetre, ½ lb.; mix, and set in a cool place till dissolved. Invaluable for old swellings, sprains, bruises, &c.

SHOEING HORSES.—A smith who shod for the hunt, and who said that he would have to shut up shop if a shoe was lost, as it might cause the loss of a horse worth a thousand pounds, fastened the shoe as follows:—As he drove the nails, he merely bent the points down to the hoof, without twisting them off, as the usual practice is; he then drove the nails home, and clinched them. He then twisted off the nails, and filed them lightly to smooth them, thus having, as he remarked, a clinch and a rivet to hold the nails.

HORSE AIL.—Make a slow fire of old shoes, rags, herbs, &c.

When fired a little, smother so as to make a great smoke and steam, then set a barrel without heads, over the fire, and hold the horse's head down in the barrel, and smoke him well. This will soon produce a copious running at the nose, and he will be so well pleased that he will voluntarily hold his head in the smoke. Continue this half an hour or more daily, meanwhile give him potatoes and warm bran mashes, and gently physic if there be much costiveness which the laxative food will not remove. If he has fever, treat him for it.

SADDLE AND HARNESS GALLS, &c.—White lead and linseed oil, mixed as for paint, is unrivalled for healing saddle, harness, or collar galls and bruises. Try it, applying with a brush. It soon forms an air-tight coating and soothes the pain, powerfully assisting nature.

GREASE HEEL.—Ley made from wood-ashes, and boil white-oak bark in it till it is quite strong, both in lye and bark-ooze; when it is cold, it is fit for use. Wash off the horse's legs with Castile soap; when dry, apply the above ley with a swab fastened on a long stick to keep out of his reach, as the smart caused by the application might make him let fly without much warning; but it is a sure cure, only it brings off the hair. To restore the hair after the cure is effected, make and apply a salve by stewing elder bark in old bacon; then form the salve by adding a little resin, according to the amount of oil when stewed, or ½ lb. resin to each pound of oil.

VALUABLE REMEDY FOR HEAVES.—Calcined magnesia, balsam of fir, balsam copaiba, of each 1 oz.; spirits turpentine, 2 oz.; put them all into 1 pint best cider vinegar; give for a dose, 1 tablespoonful in his feed, once a day for a week; then every other day for 2 or 3 months. Wet his hay with brine, and also his other feed. He will cough more at first, but looser and looser till cured.

TO DISTINGUISH AND CURE DISTEMPER.—Wet up bran with rather strong lye; if not too strong, the horse will eat it greedily. If they have the distemper, a free discharge from the nostrils, and a consequent cure, will be the result, if continued a few days; but if only a cold, with swellings of the glands, no change will be discovered.

REMEDY FOR FOUNDER.—Draw about 1 gal. blood from the neck; then drench the horse with linseed oil, 1 qt.; now rub the fore-legs long and well with water as hot as can be borne without scalding.

PHYSIC-BALL FOR HORSES.—Barbadoes aloes, from 4 to 5 or 6 drams (according to size and strength of the horse); tartrate of potassa, 1 dram; ginger and Castile soap, each 2 drams; oil of anise, or peppermint, 20 drops; pulverize and make all into one ball, with thick gum solution. Feed by giving scalded bran instead of oats, for two days before giving the physic, and during its operation.

PHYSIC FOR CATTLE.—Take *half* only of the dose above for a horse, and add it to glauber-salts, 8 oz.; dissolve all in gruel, 1 quart, and give as a drench.

HOOF-AIL IN SHEEP.—Muriatic acid and butter of antimony, of each 2 oz.; white vitriol, pulverized, 1 oz.; mix. Lift the foot, and drop a little of it on the bottom, only once or twice a week. It kills the old hoof, and a new one soon takes its place.

SUPERPHOSPHATE OF LIME, THE GREATEST AGRICULTURAL DISCOVERY OF THE AGE.—Take a large puncheon, large tub, or barrel, and put into it 200 lbs. water; add, very slowly and cautiously, 100 lbs. of pure sulphuric acid; you must be very careful, while handling this article, not to let it touch your skin or clothing, as it will instantly blacken the skin, and destroy the clothing, wherever it comes in contact; and, when mixed with water, it engenders a very intense heat. Into this mixture throw 200 lbs. of bones, no matter how old or useless they may be. The sulphuric acid instantly attacks and enters into combination with the bones, reducing them to a pasty consistence, and completely dissolving them. Keep under cover, and turn them over occasionally, while the process is going on; and, when completed, dump out the whole contents on the barn floor or on a platform of boards, and thoroughly work into the mass four times its bulk of dry bog-earth or dry road-dust; mix and pulverize completely with a wooden shovel. The bog-earth acts as an absorbent or drier, retaining the fertilizing properties of the compound, and rendering it easy of uniform distribution. If whole bones are used, it will take six or eight weeks to dissolve them; if they are broken with an axe, they will dissolve in about three weeks; if they are ground in a bone mill, four days will be sufficient. This manure is the most powerful fertilizer in existence; and, when made by these directions, it is the cheapest, as one ton is equal to thirty-two tons of barn-yard manure. For top-dressing grass lands, use 300 lbs. per acre; for corn, potatoes, beans, turnips, &c., apply 450 lbs. per acre in the drill, mixing with the soil; for wheat, rye, oats, or barley, 400 lbs. per acre, harrow in with the seed; for buckwheat, 300 lbs. per acre.

SUPERPHOSPHATE IN TWENTY-FOUR HOURS.—Any farmer who has got an apparatus for steaming food for cattle can make superphosphate in quick style by admitting steam from the boiler into the barrel containing the water, acid, and ground bones. The heat thus generated quickens the dissolution of the bones in a wonderful manner; and, if the process is properly conducted, it will not take over twenty-four hours in any case. It is indispensable that the barrel be tightly covered to retain the steam.

FERTILIZER FOR TOBACCO.—Add 40 lbs. of the best Peruvian guano to each 100 lbs. of the superphosphate made by the above receipt, and you will have one of the most powerful fertilizers for tobacco that can be made. If you do not have Peruvian guano, use instead 30 lbs. of hen manure to each 100 lbs. of superphosphate.

HOME-MADE POUDRETTE.—Few fertilizers are wasted with the prodigality of extravagance which attends the use of night soil, while the exercise of a little care and attention is all that is required to secure one of the most powerful fertilizers in existence. Night soil contains phosphate of lime, which is essential to the growth of animals' bones, and which is not supplied from the atmosphere like carbonic acid and ammonia. In order to receive the droppings in a manageable and inoffensive state, the vault should be provided with a large, tight box made of matched plank, placed to slide on scantling, so that it can be drawn out, by attaching a horse, whenever required. Provide plenty of dry, black loam from the woods or swamps; refuse charcoal, dry peat, or alluvial deposits answer first-rate. Keep them dry, in barrels or boxes on the spot, under cover; spread a thick layer on the bottom of the receiving box, and at intervals of a few days throw in a liberal supply of these absorbents on the accumulating deposit. If a few handfuls of plaster are thrown in occasionally, it will suppress unpleasant odors and increase the value of the manure.

The emptying of slops and dish water in the box should be strictly prohibited. When the box is filled, you can remove it, and convert it into poudrette. For this purpose it must be worked over with an additional quantity of muck, or other absorbent, in such proportions that it will form, with what has been previously added, about three-quarters of the entire compound. The working should be done under a shed, and the whole kept perfectly dry. It should be shovelled over and mixed several times at intervals, and finally screened, and made as uniform throughout as possible; the finer it is pulverized, and the drier it is kept, the better.

HOME-MADE GUANO OF UNEQUALLED EXCELLENCE.—Save all your fowl manure from sun and rain. To prepare it for use, spread a layer of dry swamp muck (the blacker it is the better) on your barn floor, and dump on it the whole of your fowl manure; beat it into a fine powder with the back of your spade; this done, add hard wood ashes and plaster of Paris, so that the compound shall be composed of the following proportions: dried muck, 4 bushels; fowl manure, 2 bushels; ashes, 1 bushel; plaster, $1\frac{1}{2}$ bushels. Mix thoroughly, and spare no labor; for, in this matter, the elbow-grease expended will be well paid for. A little before planting, moisten the heap with water, or, better still with urine; cover well over with old mats, and let it lie till wanted for use. Apply it to beans, corn, or potatoes, at the rate of a handful to a hill; and mix with the soil before dropping the seed. This will be found the best substitute for guano ever invented, and may be depended on for bringing great crops of turnips, corn, potatoes, &c.

TO DISSOLVE LARGE BONES FOR MANURE WITHOUT EXPENSE.—Take any old flour barrel, and put into the bottom a layer of hard-wood ashes; put a layer of bones on the top of the ashes, and add another layer of ashes, filling the space between the bones with them; then add bones and ashes alternately, finishing off with a thick layer of ashes. When your barrel is filled, pour on water (urine is better,) just sufficient to keep them wet, but do not on any account suffer it to leach one drop; for that would be like leaching your dungheap. In the course of time they will heat, and eventually soften down so that you can crumble them with your finger. When sufficiently softened, dump them out of the barrel on a heap of dry loam, and pulverize and crumble them up till they are completely amalgamated into one homogeneous mass with the loam, so that it can be easily handled and distributed when required. You may rely on it, this manure will leave its mark, and show good results wherever used.

SUBSTITUTE FOR SUPERPHOSPHATE.—If you have inch bone ground in a bone-mill, and cannot afford to purchase sulphuric acid to work it up into superphosphate of lime, you can reduce your bones into a fine impalpable powder by simply using three barrels of loamy soil to every barrel of inch bones; mix them together. The bones will soon begin to heat and ferment, and continue so for some time; they will then cool off. You will then proceed to chop down and pulverize and work the mass thoroughly; it will begin to reheat and ferment and cool down again; and you will continue working it over till the contents are brought to the proper state of fineness, when you will have a fertilizer of astonishing power. It is only a year or two since a statement appeared in the "Country Gentleman," of the experiments of a Mr. HASKELL with a manure prepared after this method, who found it even superior to superphosphate of lime.

HOW TO DOUBLE THE USUAL QUANTITY OF MANURE ON A FARM.—Provide a good supply of black swamp mould or loam from the woods, within easy reach of your stable, and place a layer of this, one foot thick, under each horse, with litter as usual, on the top of the loam or mould. Remove the droppings of the animals every day, but let the loam remain for two weeks; then remove it, mixing it with the other manure, and replace with fresh mould. By this simple means, any farmer can double not only the quantity but also the quality of his manure, and never feel himself one penny the poorer by the trouble or expense incurred, while the fertilizing value of the ingredients absorbed and saved by the loam can scarcely be estimated.

Josiah Quincy, jun., has been very successful in keeping cattle in stables the year through, and feeding them by means of soiling. The amount of manure thus made had enabled him to improve the fertility of a poor farm of 100 acres, so that in twenty years the hay crop had increased from 20 to 300 tons. The cattle are kept in a well-arranged stable, and are let out into the yard an hour or two morning and afternoon; but they generally appear glad to return to their quarters. By this process, one acre enables him to support three or four cows. They are fed on grass, green oats, corn fodder, barley, &c., which are sown at intervals through the spring and summer months, to be cut as required; but he remarks that his most valuable crop is his manure crop. Each cow produces 3½ cords of solid, and 3 cords of liquid manure, or 6½ cords in all. Five to eight miles from Boston, such manure is worth five to eight dollars a cord. From this estimate, he has come to the conclusion that a cow's manure may be made as valuable as her milk.

TWENTY DOLLARS' WORTH OF MANURE FOR ALMOST NOTHING.—If you have any dead animal,—say, for instance, the body of a horse,—do not suffer it to pollute the atmosphere by drawing it away to the woods or any other out of the way place, but remove it a short distance only, from your premises, and put down four or five loads of muck or sods, place the carcass thereon, and sprinkle it over with quick-lime, and cover over immediately with sods or mould sufficient to make, with what had been previously added, 20 good wagon-loads; and you will have within twelve months a pile of manure worth $20 for any crop you choose to put it upon. Use a proportionate quantity of mould for smaller animals, but never less than twenty good wagon-loads for a horse; and, if any dogs manifest too great a regard for the enclosed carcass, shoot them on the spot.

FISH COMPOST, SUBSTITUTE FOR BONE-DUST, MANURE FROM FISH REFUSE, &c.—The fish owes its fertilizing value to the animal matter and bone-earth which it contains. The former is precisely similar to flesh or blood, consisting of 25 per cent. of fibrin, the rest being water; and their bones are similar in composition to those of terrestrial animals. As fertilizing agents, therefore, the bodies of fishes will act nearly in the same way as the bodies and blood of animals; 100 lbs., in decaying, produce 2½ lbs. of ammonia. Hence 400 lbs. of fish rotted in compost are enough for an acre. The great effect is due to the ammoniacal portion; for it renders the herbage dark-green, and starts it very rapidly. One of the best composts is made as follows: Dried bog-earth, loam, or peat, seven barrels; hardwood ashes, two barrels; fish, one barrel; slaked lime, one bushel. Place a thick layer of the bog-earth on the bottom; on the top of this put a layer of the fish, then a sprinkling of lime, then a a layer of ashes; on top of the ashes put a thick layer of bog-earth, loam, or peat; then another thin layer of fish, lime, and ashes, and so on till your materials are worked in; then top off with a thick layer of the absorbents, to retain the fertilizing gases. The decomposition of the fish will proceed very rapidly, and a very rich compost will be the result. It should be shovelled over and over and thoroughly intermixed and pulverized. Put this on so as to have 400 lbs. of fish to the acre. It may be applied with the greatest benefit to corn, turnips, potatoes, beans, &c., in the drill, and broad cast on the grass.

Superphosphate can be made from pogy-chum, or the refuse of other fish, after the oil is expressed, by dissolving in sulphuric acid, and afterwards mixing with dry loam, precisely as directed for making superphosphate with bones. Whale-oil or the oil of any fish, when made into a compost with loam, and a little lime or wood ashes, yields a very powerful manure, merely mixed with absorbent earth and applied at the end of the month. Impure whale-oil, at the rate of 40 gallons per acre, has produced a crop of 23½ tons of turnips per acre; while on the same soil, and during the same season, it took 40 bushels of bone-dust to produce only 22 tons per acre.

ASHES FROM SOIL BY SPONTANEOUS COMBUSTION.—Make your mound 21 feet long by 10½ feet wide. To fire, use 72 bushels of lime. First a layer of dry sods or parings on which a quantity of lime is spread, mixing sods with it; then a covering of eight inches of sods, on which the other half of the lime is spread, and covered a foot thick, the height of the mound being about a yard. In twenty-four hours it will take fire. The lime should be fresh from the kiln. It is better to suffer it to ignite itself than to effect it by the operation of water. When the fire is fairly kindled, fresh sods must be applied; but get a good body of ashes in the first place. I think it may be fairly supposed that the lime adds full its worth to the quality of the ashes, and, when limestone can be got, I would advise the burning a small quantity in the mounds, which would be a great improvement to the ashes, and would help to keep the fire in.

SUBSTITUTE FOR BARN-MANURE.—Dissolve a bushel of salt in water enough to slack 5 or 6 bushels of lime. The best rule for preparing the compost heap is, 1 bushel of this lime to 1 load of swamp-muck, intimately mixed; though 3 bushels to 5 loads makes a very good manure. In laying up the heap, let the layer of muck and lime be thin, so that decomposition may be more rapid and complete. When lime cannot be got, use unleached ashes,—3 or 4 bushels to a cord of muck. In a month or six weeks, overhaul and work over the heap, when it will be ready for use. Sprinkle the salt water on the lime as the heap goes up.

SHEEP-DIPPING COMPOSITION.—Water, 1 gal.; benzine, 8 ounces; cayenne pepper, 2 ounces. Mix; make what quantity you require, using these proportions. Dip your sheep and lambs in the composition, and it will make short work of the vermin.

OAT OR WHEAT STRAW MADE EQUAL TO HAY.—Bring 10 gallons water to a boiling heat ; take it off the fire, and add to it at once 3 gallons of linseed unground ; let it remain till it gets cold ; then empty the whole into a cask containing 44 gallons of cold water, and let it remain for forty-eight hours. At the end of that time, it will be reduced into a thin jelly, like arrowroot. Spread out ½ ton straw, and sprinkle it over regularly with the whole of the liquid from the cask. The stock will eat it up as clean, and keep as fat on it, quantity for quantity, as they would do on hay.

DEATH FOR VERMIN ON PLANTS OR ANIMALS.—Pour a gallon of boiling water on one pound tobacco leaves, strain it in twenty minutes; for vermin, on animals or plants, this decoction is certain death.

REMEDY FOR CURCULIO IN FRUIT TREES.—Sawdust saturated in coal oil, and placed at the roots of the tree, will be a sure preventive ; or, clear a circle around the tree from all rubbish ; fill up all little holes and smooth off the ground for a distance of at least 3 feet each way from the tree, then place chips or small pieces of wood on the ground within the circle ; the curculio will take refuge in large numbers below the chips, and you can pass around in the mornings and kill them off.

GRAFTING WAX.—Resin, 1 lb.; bees-wax, 1 lb.; with tallow or lard sufficient to soften until it can be readily applied with the hand; melt.

TO CULTIVATE TOBACCO.—To raise tobacco, select a sheltered situation, where the young plants can receive the full force of the sun ; burn over the surface of the ground early in spring (new land is best), rake it well, and sow the seeds : have a dry, mellow, rich soil, and after a shower, when the plants have got leaves the size of a quarter-dollar, transplant as you would cabbage plants, 3½ feet apart, and weed out carefully afterwards. Break off the suckers from the foot-stalks, as they appear ; also the tops of the plants when they are well advanced,—say, about three feet high,—except those designed for seed, which should be the largest and best plants. The ripeness of tobacco is known by small dusky spots appearing on the leaves. The plants should then be cut near the roots, on the morning of a day of sunshine, and should lie singly to wither. When sufficiently withered, gather them carefully together, and hang them up under cover to cure and prepare for market.

TO PRESERVE POTATOES FROM ROT.—Dust over the floor of the bin with lime, and put in about 6 or 7 inches of potatoes, and dust with lime as before, then more potatoes, using about 1 bushel of lime to 40 bushels of potatoes. The lime improves the flavor of the potatoes, and effectually kills the fungi which causes the rot.

An old veteran farmer, with 63 years' experience, has successfully fought the potato rot *in the ground*, as follows: He plants them in the latter part of April, or beginning of May, and in the old of the moon. When six inches high they are plastered and dressed out nicely. Now for the secret. When blossoming, take 2 parts plaster, and 1 part fine salt, mix well together, and put 1 large spoonful of this compound as near the centre of each hill as possible. When ripe, take them out of the ground, have them dry when put in the cellar, and keep them in a dry, cool place.

PACKING FRUITS FOR LONG DISTANCES.—Take a box of the proper size, soft paper, and sweet bran. Place a layer of bran on the bottom, then each bunch of grapes is held by the hand over a sheet of the paper; the four corners of the paper are brought up to the stalk and nicely secured; then laid on its side in the box, and so on until the first layer is finished. Then dust on a layer of bran, giving the box a gentle shake as you proceed. Begin the second layer as the first, and so on until the whole is full. The bloom of the fruit is thus preserved as fresh, at the end of a journey of 500 miles, as if they were newly taken from the tree. Never fails to preserve grapes, peaches, apricots, and other fruit.

THORLEY'S CONDIMENTAL FOOD.—The following is a formula to make 1 ton of the food: take of Indian meal 900 lbs., locust beans finely ground 600 lbs., best linseed cake 300 lbs., powdered turmeric and sulphur of each 40 lbs., saltpetre 20 lbs., licorice 27 lbs., ginger 3 lbs., anise-seed, 4 lbs., coriander and gentian of each 10 lbs., cream of tartar 2 lbs., carbonate of soda and levigated antimony each 6 lbs., common salt 30 lbs., Peruvian bark 4 lbs., fenugreek 22 lbs., mix thoroughly.

CURE FOR SWELLED BAGS IN COWS.—An excellent remedy for swelled bags in cows, caused by cold, etc., is gum camphor ½ oz., to sweet oil 2 ozs.; pulverize the gum, and dissolve over a slow fire.

TO INCREASE THE FLOW OF MILK IN COWS.—Give your cows three times a day, water slightly warm, slightly salted, in which bran has been stirred at the rate of 1 qt. to 2 gals. of water. You will find if you have not tried this daily practice, that the cow will give 25 per cent. more milk, and she will become so much attached to the diet that she will refuse to drink clear water unless very thirsty, but this mess she will drink at almost any time, and ask for more. The amount of this drink necessary is an ordinary water-pail full each time, morning, noon, and night. Avoid giving cows "slops," as they are no more fit for the animal than the human.

HOME-MADE STUMP MACHINE.—Take 3 pieces of common joints, put them together in form like a common harrow, letting the tapering ends lap by each other some 6 inches, making a place for the chain to rest in. Cut off the roots at any distance you please from the stump, place the machine at one side of the stump, tapering end up; hitch the chain on the opposite side and pass it over the machine; then hitch a good yoke of oxen thereto, and you will see the stump rise. Another method is as follows: in the fall of the year bore a 1-inch hole 18 inches deep into the centre of the stump, and put in 1 oz., of saltpetre, filling up with water, and plugging the hole up. In the spring take out the plug, put in half a gill of kerosene and set fire to it. It will burn out the stump, to the farthest root. Here is another plan: in the fall, with an inch auger, bore a hole in the centre of the stump 10 inches deep, and put into it a ½ lb. of vitriol, and cork the hole up very tight. In the spring the whole stump and roots extending all through their ramifications will be found so rotten that they can be easily eradicated.

TO SPROUT ONIONS.—Pour hot water on the seed, let it remain 2 or 3 seconds, and they will immediately sprout, and come up much earlier.

TO RENEW OLD ORCHARDS.—Early in the spring, plough the entire orchard, and enrich the whole soil with a good dressing of compost of manure, swamp-muck, and lime; scrape off the old bark with a deck-scraper, or a sharp hoe; apply half a bushel of lime, and the same of ground charcoal round each tree. Then apply diluted soft soap, or strong soap-suds, on the trunks and limbs, as high as a man can reach. When the trees are in full bloom, throw over them a good proportion of fine slaked lime, and you will reap abundant fruits from your labors.

To Destroy the Moth or Miller.—Dr. Waterman says, "I took two white dishes (because white attracts their attention in the night) or deep plates, and placed them on the top of the hives, and filled them about half-full of sweetened vinegar. The next orning I had about 5C millers caught ; the second night I caught 50 more ; the third night, being cold, I did not get any, the fourth ight, being very warm, I caught about 400; the fifth night I got about 200."

To Keep Milk Sweet, and Sweeten Sour Milk.—Put into the milk a small quantity of carbonate of magnesia.

To Make Cheap and Good Vinegar.—To eight gallons of clear rain-water, add 6 quarts of molasses ; turn the mixture into a clean, tight cask, shake it well two or three times, and add 1 pt. of good yeast. Place the cask in a warm place, and in ten or fifteen days add a sheet of common wrapping-paper, smeared with molasses, and torn into narrow strips; and you will have good vinegar. The paper is necessary to form the " mother," or life of the liquor.

Mr. Culley's Red Salve, to cure the Rot in Sheep.—Mix 4 oz. of the best honey, 2 oz. of burnt alum reduced to powder, and ½ a pound of Armenian bole, with as much train or fish oil as will convert these ingredients into the consistence of a salve. The honey must first be gradually dissolved, when the Armenian bole must be stirred in ; afterwards the alum and train-oil are to be added.

To Improve the Wool of Sheep, by Smearing.—Immediately after the sheep are shorn, soak the roots of the wool that remains all over with oil, or butter, and brimstone ; and, 3 or 4 days afterward, wash them with salt and water. The wool of next season will not be much finer, but the quantity will be in greater abundance. It may be depended upon, that the sheep will not be troubled with the scab or vermin that year. Salt water is a safe and effectual remedy against maggots.

To Mark Sheep without Injury to the Wool.—To 30 spoonfuls of linseed oil, add 2 oz. of litharge, 1 oz. of lampblack ; boil all together, and mark the sheep therewith.

To Prevent the Fly in Turnips.—From experiments lately made, it has been ascertained that lime sown by hand, or distributed by a machine, is an infallible protection to turnips against the ravages of this destructive insect. It should be applied as soon as the turnips come up, and in the same daily rotation in which they were sown. The lime should be slaked immediately before it is used, if the air be not sufficiently moist to render that operation unnecessary.

Coloring for Cheese.—The coloring for cheese is, or at least should be, Spanish annatto ; but, as soon as coloring became general in this country, a color of an adulterated kind was exposed for sale in almost every shop. The weight of a guinea and a half of real Spanish annatto is sufficient for a cheese of fifty pounds' weight. If a considerable part of the cream of the night's milk be taken for butter, more coloring will be requisite. The leaner the cheese is, the more coloring it requires. The manner of using annatto is to tie up in a linen rag the quantity deemed sufficient, and put it into ½ pt. of warm water over night. This infusion is put into the tub of milk in the morning with the rennet infusion; dipping the rag into the milk, and rubbing it against the palm of the hand as long as any color runs out. The yolk of egg will color butter.

THE GREAT SECRETS FOR TRAPPING FOXES AND OTHER GAME.—Musk-rat musk and skunk musk mixed. Can be procured at the druggists, or from the animals themselves. To be spread on the bait of any trap. This receipt has been sold as high as $75. *Another, costing $50, for minks*, &c.—Unslaked lime, ½ lb.; sal-ammoniac, 3 oz., or muriate of ammonia, 3 oz. Mix, and pulverize. Keep in a covered vessel a few days until a thorough admixture takes place. Sprinkle on the bait, or on the ground around the trap. Keep in a corked bottle.

FOOD FOR SINGING BIRDS.—Blanched sweet almonds, pulverized, ½ lb.; pea meal, 1 lb.; saffron, 3 grs.; yolks of 2 hard boiled eggs. Reduce all to a powder by rubbing through a sieve. Place the mixture in a frying pan over a fire, and add 2 oz. butter and 2 oz. honey. Slightly cook for a few minutes, stirring well, then set off to cool, and preserve in a closely corked bottle.

MUCH BUTTER FROM LITTLE MILK.—Take 4 ozs. pulverized alum, ½ oz. pulverized gum-arabic, 50 grs. of pepsin; place it in a bottle for use as required. A teaspoonful of this mixture added to 1 pt. of new milk will, upon churning, make 1 lb of butter. Agents are selling this secret for $5.

COMPOSITION FOR DRIVING OUT RATS, ETC.—Keep on hand a quantity of chloride of lime. The whole secret consists in scattering it dry all around their haunts and into their holes, and they will leave at once, or a liberal decoction of coal tar placed in the entrance of their holes will do as well.

HOW TO FORM SPRINGS.—The finest springs can be made by boring, which is performed by forcing an iron rod into the earth by its own weight, turning it round, and forcing it up and down by a spring-pole contrivance. The water will sometimes spout up several feet above the surface. Iron pipes are put down in the hole after the water is found. Depressed situations, having a southern exposure, with rising ground towards the north, are the best situations in the United States or the Canadas to find water.

TO BURN LIME WITHOUT A KILN.—Make a pyramidal pile of large limestones, with an arched furnace next the ground for putting in the fuel, leaving a narrow vent or funnel at the top; now cover the whole pile with earth or turf, in the way that charcoal heaps are covered, and put in the fire. The heat will be more completely diffused through the pile, if the aperture in the top is partially closed. Produces a superior article of lime.

EYE WATER FOR HORSES AND CATTLE.—Alcohol, 1 tablespoonful; extract of lead, 1 teaspoonful; rain water, ½ pint.

TO DESTROY MOSS ON TREES.—Paint them with white-wash made of quick lime and wood ashes.

TO PROTECT FRUIT-TREES FROM ATTACK OF MICE, ETC.—Tar, 1 part; tallow, 3 parts; mix. Apply hot to the bark of the tree with a paint brush.

POINTS OF A GOOD HORSE.—He should be about $15\frac{1}{2}$ hands high; the head light and clean made, wide between the nostrils, and the nostrils themselves large, transparent and open; broad in the forehead, eyes prominent, clear and sparkling; ears small and neatly set on; neck rather short and well set up; large arm or shoulder, well thrown back, and high; withers arched and high; legs fine, flat, thin and small-boned; body round and rather light, though sufficiently large to afford substance when it is needed; full chest, affording play for the lungs; back short, with the hind-quarters set on rather obliquely. *A good draught horse* should have a rather large, well-shaped head, a clean, long ear, full eye, neck rather long, but not too much arched; strong withers, lying well forward to catch the collar at the proper angle for draught, and broad shoulders, well spread into the back, back very straight, ribs long and well rounded, hind-legs bent at the hock, fore-legs forward, hind-quarters somewhat round, but not sufficiently to make them look short; the mane and tail of short, but not coarse hair, and with a fetlock about two inches long, broad knees, long hocks, short shanks, and hard ankles or fetlock joints, and round hoofs, well opened behind, and the nearer you approach this description the nearer the horse will be to perfection.

THE EPIZOOTIC.—The early symptoms of the disease are a light, hacking cough, with a general dulness, and an indisposition to move; cold legs, with a watery discharge from the nostrils. At first, the nasal membrane is pale, but, as the disease advances, becomes highly colored, and the mucous discharge changes to a greenish yellow color, and the pulse becomes more rapid. As soon as the symptoms appear, the animal should be kept warm in the stable, by blanketing. The following prescriptions are recommended: No. 1 — Linseed oil, $1\frac{1}{2}$ ozs.; turpentine, $1\frac{1}{2}$ ozs.; liquor ammonia fort., 1 oz. Mix all together, and apply to the throat. No. 2 — Nitrate potash, $1\frac{1}{2}$ ozs.; tartarized antimony, $1\frac{1}{2}$ ozs.; digitalis, $1\frac{1}{2}$ ozs. Pulverize all together, and give one night and morning. If not very bad, the digitalis may be omitted. The disease consists of an inflammation of the mucous membrane lining the throat, which gradually extends from the epiglottis downwards till it reaches the lungs, when it assumes a decidedly dangerous character. The following will arrest the disease at once, if taken in time: Boil a handful of smart-weed till all the strength is obtained, and pour the liquid boiling-hot over the usual mess of oats, and, when all is cold, feed them to the horse Repeat till all symptoms disappear. Cure certain. Ground ginger mixed with the oats, has also proved effectual.

AGE OF HORSES.—*By Teeth.*—A horse has 40 teeth, 24 double teeth, or grinders, 4 tushes, or single file teeth, and 12 front teeth, called gatherers. As a general thing, mares have no tushes. Between 2 and 3 years old, the colt sheds his four middle teeth, 2 above and 2 below. After 3 years old, 2 other teeth are shed, 1 on each side of those formerly changed; he now has 8 colt's teeth and 8 horse's teeth; when 4 years of age he cuts 4 new teeth. At 5 years of age, the horse sheds his remaining colt's teeth 4 in number, when his tushes appear. At 6 years of age his tushes are up, appearing white, small and sharp, while a small circle of young growing teeth are observable. The mouth is now complete. At 8 years of age the teeth have filled up, the horse is aged and his mouth is said to be full.

By Eyelid.—After a horse is 9 years old, a wrinkle comes on the eyelid at the upper corner of the lower lid, and every year thereafter he has one well defined wrinkle for each year over 9. If, for instance, a horse has three of these wrinkles, he is 12; if 4, he is 13. Add the number of wrinkles to 9, and you will invariably judge correctly of a horse's age.

Those who manage horses should be careful never to inflict any unnecessary pain, for it is only by the law of kindness that a horse can be trained and managed. No man ever yet struck a horse, but he made the horse the worse for it. Patience and kinduess will accomplish in every instance what whipping will fail to do. Horses having a vicious disposition are invariably made so from cruel treatment. Horses are designed to work, and daily labor for them is as much a necessity to their existence as to that of man's. It is not the hard drawing and ponderous loads that wear out horses and make them poor, balky and worthless; but it is the hard driving, the worry by rough and inhuman drivers, that uses up more horse flesh, fat and muscle than all the labor a team performs. Another great reason why there are so few really sound animals is because of their being put to work too soon. Horses are not developed until they are 5, 6 or 7 years old, and they should do very little work until they reach that period. When a horse is worked hard its food should chiefly be oats; if not worked hard its food should chiefly be hay; because oats supply more nourishment and flesh. making material than any other food; hay not so much.

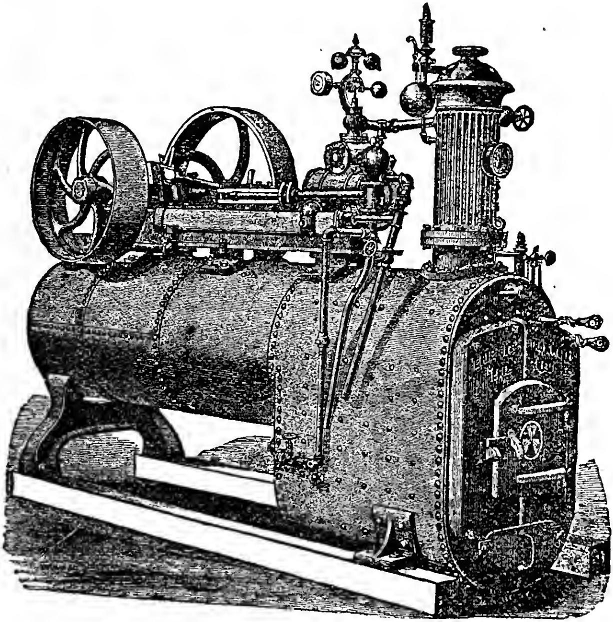
ARTIFICIAL RUBBER FROM MILKWEED.—The juice or sap is expressed from the milk-weed by running it between iron rollers and then allowing it to ferment or evaporate to the consistency of thin molasses. It may then be slowly boiled to reduce it to a thick mass which may be treated in the usual way of manufacturing the genuine rubber. See *Boot, Shoe and Rubber Manufr's Dep't.*

TO PICKLE MEAT IN ONE DAY.—Get a tub nearly full of rain or river water, and put two pieces of thin wood across it and set the beef on them at about the distance of 1 inch from the water. Heap as much salt as will stand on the beef and let it remain 24 hours, then take off the beef and boil it, and you will find it is completely impregnated by the salt, the water having drawn it through the meat.

BARON LIEBIG'S GREAT FERTILIZER.—Dry peat, 20 bushels, unleached ashes, 3 bushels, fine bone dust, 3 bushels, calcined plaster, 3 bushels, nitrate of soda, 40 lbs., sulphate of ammonia, 33 lbs., sulphate of soda, 40 lbs. Mix numbers 1, 2 and 3 together, then mix numbers 5, 6 and 7 in 5 buckets of water. When dissolved, add the liquid to the first, second, and third articles. When mixed, add the fourth article. This is a cheap and efficient fertilizer, and this quantity applied to one or two acres of turnips, beets, oats, corn, wheat, grapes, &c., will bring abundant returns.

ANOTHER CHEAP FERTILIZER.—Ammonia, 60 lbs.; nitrate of soda, 40 lbs.; ground bone, 250 lbs.; plaster, 250 lbs.; salt ½ bushel; wood ashes, 3 bushels; stable manure, 20 bushels. Use the above quantity on 6 acres. Labor included, it will cost about $15, in some places less, and is equivalent in value to some fertilizers which cost $50 or £10 sterling per ton.

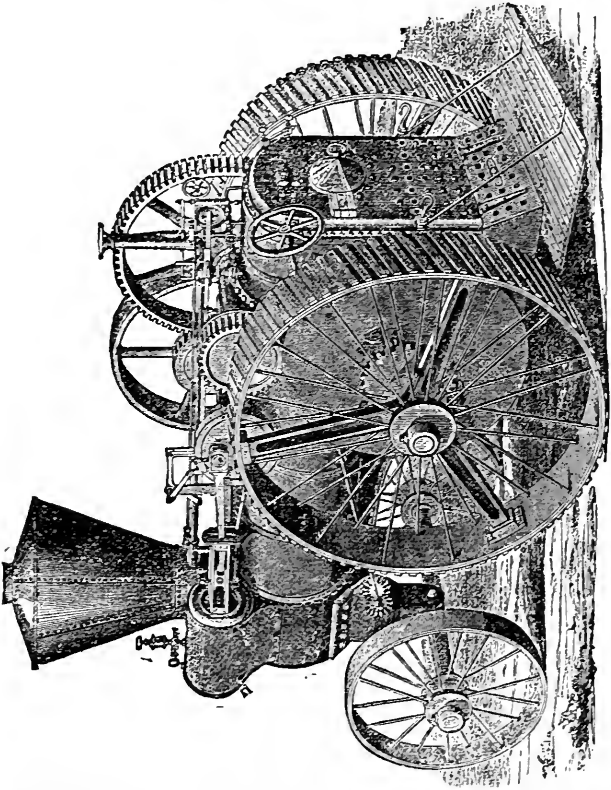
To Protect Sheep from the Gad Fly.—In August and September this fly lays its eggs in the nostrils of sheep, where they are hatched and the worms crawl into the head, and very frequently eat through the brain. In this way many sheep are destroyed. As a protection, smirch their noses with tar. Lay some tar in a trough or on a board, and strew fine salt on it. The sheep will finish the operation. The tar will protect them, and what they eat will promote their health.



PORTABLE STEAM ENGINE.

Threshing by Steam Power.—A 4 horse power Portable Engine with 6 inch cylinder; pressure of steam 45 lbs. per square inch, revolutions 140 per minute, has threshed, under favorable surroundings, 320 bushels per day of 10 hours, coal consumed 3 cwt. Another engine of 5 horse power threshed 400 bushels, coal consumed, 4 cwt. Another of 6 horse power, threshed 480 bushels, coal consumed 5 cwt. Another of 7 horse power, threshed 560 bushels, coal consumed 6 cwt Another of 8 horse power, threshed 640 bushels, coal consumed 7 cwt. Another of 10 horse power threshed 800 bushels per day, coal consumed 9 cwt. The economy of these performances is evident at a glance.

and even if much less work than the above were effected, it is evident that such an engine as the one represented above, would, if mounted on wheels, prove a most valuable acquisition to any neighborhood composed of thrifty farmers, who might, by an equitable arrangement, become both the owners and beneficiaries of the same. Many porta-



MILL'S SELF-PROPELLING ROAD ENGINE.

ble engines are known to be performing excellent service, not only in threshing grain, but in chaffing straw, hay, &c., food for cattle, cutting wood for fuel, and sawing logs into boards. Among other late inventions, we have one as novel as it is meritorious, consisting of a self-propelling engine, capable of moving itself from one locality or farm to another, together with the necessary fuel and water, without the aid of horses. An excellent view of this most useful invention is presented in the cut.

EXCELSIOR AXLE GREASE.—Tallow, 8 lbs.; palm oil, 10 lbs.; plumbago, 1 lb.; heat and mix well.

PLOUGHING TABLE.—SHOWING THE DISTANCE TRAVELLED BY A HORSE IN PLOWING AN ACRE OF LAND; AND THE QUANTITY OF LAND CULTIVATED PER DAY, COMPUTED AT THE RATE OF 16 AND 18 MILES PER DAY OF 9 HOURS.

B'dth of Furrow slice.	Space travelled in Ploughing an Acre.	Extent Ploughed per Day.		B'dth of Furrow slice.	Space travelled in Ploughing an Acre.	Extent Ploughed per Day.	
Inches.	*Miles.*	18 *Miles.*	16 *Miles*	*Inches.*	*Miles.*	18 *Miles.*	16 *Miles.*
7	14 1-2	1 1-4	1 1-8	14	7	2 1-2	2 1-4
8	12 1-2	1 1-2	1 1-4	15	6 1-2	2 3-4	2 2-5
9	11	1 3-5	1 1-2	16	6 1-6	2 9-10	2 3-5
10	9 9-10	1 4-5	1 3-5	17	5 3-4	3 1-10	2 3-4
11	9	2	1 3-4	18	5 1-2	3 1-4	2 9-10
12	8 1-4	2 1-5	1 9-10	19	5 1-4	3 1-2	3 1-10
13	7 1-2	2 1-3	2 1-10	20	4 9-10	3 1-5	3 1-4

RAPID RULE TO RECKON COST OF HAY, COAL, &C.—Multiply the number of pounds by half the price per ton, and remove the decimal point three places to the left. Example: What is the cost of 764 lbs. of coal at $14 per ton ? Ans.: $5.348.

$$\text{Process:}\quad \begin{array}{r} 764 \\ 14 \div 2 = \quad 7 \\ \hline 5.348 \end{array}$$

TO MEASURE GRAIN.—RULE.—Level the grain; ascertain the space it occupies in cubic feet; multiply the number of cubic feet by 8, and point off one place to the left.

Example: A box level full of grain 20 ft. long, 10 ft. wide, and 5 ft. deep, how many bushels does the box contain ? Ans.: 800 bushels.

Process: $20 \times 10 \times 5 = 1000 \times 8 \div 10 = 800$

Or,

$$\begin{array}{r} 1000 \text{ ft.} \\ 8 \\ \hline 800.0 \end{array}$$

Note.—Correctness requires the addition to every 300 bushels of 1 extra bushel.

QUANTITY OF SEED REQUIRED FOR A GIVEN NUMBER OF HILLS, OR LENGTH OF DRILL.—Asparagus, 1 oz. to 60 feet drill; beet, 1 oz. to 50 ft. drill; carrot, 1 oz. to 180 ft. drill; endive, 1 oz. to 150 ft. drill; onion, 1 oz. to 100 ft. drill; parsley, 1 oz. to 150 ft. drill; parsnip, 1 oz. to 200 ft. drill; radish 1 oz. to 100 ft. drill; spinach, 1 oz. to 100 ft. drill, turnip,1 oz. to 150 ft. drill; peas, 1 qt. to 100 ft. drill; dwarf beans, 1 qt. to 150 hills; corn, 1 qt. to 200 hills; cucumber, 1 oz. to 50 hills; watermelon, 1 oz. to 30 hills; muskmelon, 1 oz. to 60 hills; pumpkin,1 oz. to

40 hills; early squash, 1 oz. to 50 hills; marrow squash, 1 oz. to 16 hills cabbage, 1 oz. to 3000 plants; cauliflower, 1 oz. to 3000 plants; celery, 1 oz. to 4000 plants; egg plant, 1 oz. to 2000 plants; lettuce, 1 oz. to 4000 plants, pepper, 1 oz. to 2000 plants; tomato, 1 oz. to 2000 plants.

QUANTITY OF SEED REQUIRED PER ACRE, AND ACTUAL WEIGHT OF EACH TO THE BUSHEL.—Wheat, broadcast, 1¾ to 2 bushels; ditto, in drills, 1½ bushels, weight per bushel, 60 lbs; rye, broadcast, 1¾ bushels, weight 56 lbs.; oats, broadcast, 2 bushels, weight 33 lbs.; timothy, broadcast, 2 gals., 45 lbs. per bushel; red clover, broadcast, 3 to 4 gals., 60 lbs. per bushel; white clover, broadcast, 8 lbs., 50 lbs. per bushel; lucerne, broadcast, 10 lbs., 54 lbs. per bushel; herd or red top, broadcast, 1 to 1½ bushels, 14 lbs. per bushel; bluegrass, broadcast, 1 to 1½ bushels, 14 lbs. per bushel; millet, broadcast, ¾ to 1 bushel, 45 lbs. per bushel; Hungarian, broadcast, ¾ to 1 bushel, 50 lbs. per bushel; corn in hills, 1 to 1½ gals., 56 lbs. per bushel; turnips and ruta baga, 1 lb., 50 lbs. per bushel; onion sets, 28 lbs. per bushel.

THE VITALITY OF SEEDS may be tested by placing almost any of the larger seeds or grains on a hot pan or griddle; when the vitality is perfect the grain will pop, or crack open with more or less noise. Where the vitality is defective, or lost, it remains immovable in the vessel. A celebrated botanist's recipe for improving and fertilizing all kinds of seed, consists in the preparation of a solution of lime, nitre, and pigeon's dung in water, and therein steeping the seed. Tested on wheat, the produce of some of these grains was reported at 60, 70 and 80 stems, many of the ears 5 inches long, and 50 corns each, and none less than 40. The same botanist (Millar) produced 500 plants from 1 grain, and 576,840 grains, weighing 47 lbs. Grains of wheat in different countries yield from 6, 10, 16, and even 30 to 1: Cape wheat 80 to 1. Barley yields from 50 to 120. Oats increase from 100 to 1000. Wheat and millet seed germinate in one day, barley in 7, cabbage in 10, almond and chestnut and peaches require 12 months, and rose and filbert 24. A field of wheat buried under an avalanche for 25 years, proceeded on its growth, &c., as soon as the snow had melted. A bulbous root found in the hand of a mummy, above 2000 years old, lately produced a plant. Potatoes planted below 3 feet do not vegetate; at ½ foot they grow quickest, and at 2, are retarded 2 or 3 months.

COMPOUND FOR REVIVING EXHAUSTED ORCHARDS.—Sulphate of potash, 30 lbs.; sulphate of magnesia, 15 lbs.; salt, 35 lbs.; plaster of Paris, 15 lbs.; chloride of magnesia, 5 lbs. All to be well powdered and mingled with barn manure, and then dug in around the roots at the rate of 10 to 20 lbs. to a tree. This compound is assumed to restore those elements to the soil of which it has been exhausted during many years of fruit bearing, and the secret has been sold to hundreds at extortionate prices.

ARTIFICIAL MANURE.—The composition of Dr. Jeannel's artificial manure for pot plants, as detailed to the Central Horticultural Society of France, is as follows:—Nitrate of ammonia, 400 grammes (a gramme = 15 grains); phosphate of ammonia, 200 grammes; nitrate of potash, 250 grammes; hydrochlorate of ammonia, 50 grammes; sulphate of lime, 60 grammes; and sulphate of iron, 40 grammes. One gramme or 15 grains of this mixture is dissolved in a litre of water, and used once or twice a week.

EQUIVALENT FERTILIZING PROPERTIES OF VARIOUS MANURES.—1 lb. guano equals 38 lbs. cow manure, 33 farm yard do., 22 swine do. 21 horse, 14 human.

SEED OATS.—Place your oats in a heap at the leeward end of the threshing floor on a day when a gentle breeze is blowing through the barn. Take a common wooden flour-scoop and throw the oats against the wind, towards the other end of the floor. A few minutes' experience will enable you to throw them so that they will fall in a semicircle at a nearly uniform distance from where you stand, the oats which fall farthest are the best for seed, and are to be carefully swept together as fast as they accumulate in sufficient quantities.

SEED WHEAT should not only be thoroughly cleaned from the seeds of weeds, but small grains should be taken out with a separator or suitable fanning mill, leaving only the largest, plumpest, and earliest ripened kernels. To prevent *smut*, soak the seed wheat in brine, and then dust it with unslacked lime; this will prove a perfect preventive.

TO PRODUCE THE PEAR IN PERFECTION.—Pears are liable to crack when the trees stand in soil deficient in lime and potash. These essential elements are restored to exhausted soil by the application of wood ashes at the rate of 400 bushels to the acre, which ensures the renewal of the proper proportions necessary to supply the requirements, viz., 40 per cent. of potash and 30 per cent. of lime. This will check the cracking of the fruit. Tested. Applied to the roots of the trees and vegetables, 12 qts. of soot mixed with 1 hogshead of water, is a most powerful stimulant of growth and production. A paint of soot and sweet milk applied to fruit trees will keep rabbits off.

SALT AND ITS USES.—Salt appears to be as necessary for vegetable life as it is to animal life. Applied in combination with other manures at the rate of 2 cwt. to the acre, it never fails to produce wonderful results on all kinds of grain and vegetable productions, and the voracity shown by animals for salted hay is well known.

TO KILL THE POTATO BUG.—Mix 1 lb. Paris green with 10 lbs. poor flour or fine whiting. To use, take a circular piece of wood 4 or 5 inches in diameter (it may be cut out of a 2 inch plank), insert a mop handle in the centre, tack on an old tin can with one end removed for the reception of the block, punch the other end with holes through which to sift the compound on the hills as you pass along the rows, and bore a hole in the wooden end for the reception of the mixture, and fit a plug to secure it. The compound should be sifted on the hills while the vines are wet with dew or rain.

The *Striped Bug on Cucumbers and Melons* may be destroyed, 1st, By sifting charcoal dust over the plants 3 or 4 times in succession. 2nd. Use a solution of 1 peck of henhouse manure to 1½ gals. water, and sprinkle the plants freely with it after sunset. *Chinch-bugs.*—Place any old rags in the crotches of the trees. The worms will take refuge and spin in the old rags, when the latter may be thrown in boiling water. *Caterpillars.*—Use a solution of 1 part in 500 of sulphide of potassium, sprinkle on the tree by means of a hand syringe. *Curculio.*—Make a very strong solution of water and gas tar, so that after standing 48 hours it will be powerful and dark colored like creosote On the appearance of the curculio, drench the tree thoroughly with a hand-forcing pump, repeating it every 3 days for 2 weeks, and destroy all fallen fruit.

To Relieve Choked Cattle.—In choking, the accumulation of gas (chiefly sulphuretted hydrogen) is the cause of the animal's death. This gas can be decomposed by forcing a strong solution of salt and water down the animal's throat; or, force the beast to jump over the bars of a gate or fence. When she touches the ground on the opposite side, the obstruction will be ejected. Another way is to use four or five feet of ¾-inch rubber hose, and push the obstruction down.

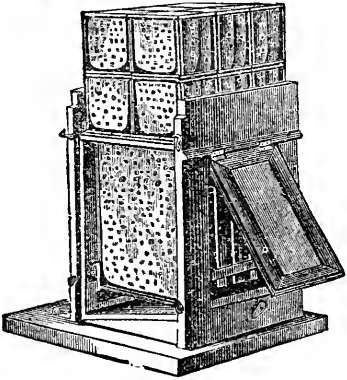
Farrow Cows.—Feed them liberally, and they will give rich milk, though perhaps but little of it. Let them have three or four quarts of meal per day through the winter and spring, and do not stop giving it when the grass comes. As soon as it dries them up, they will be fit for the butcher.

To Cook Food for Cattle.—*To Cook Hay.*—Cut it, wet it well, put it in an upright tank or cask, with a false bottom and tight cover, press it down firmly, and pass the steam in under the false cover. *To Cook Corn.*—Soak as many barrels, half full, as you wish to cook from 15 to 24 hours; turn on steam and cook until done, and the barrels will be full. *To Make Mush.*—Fill as many barrels, half full of water, as you wish to make barrels of mush; bring the water nearly to a boil by passing the steam to the bottom; stir into each barrel from 1½ to 1¾ bushels of meal until well mixed; then cook until done, when the barrels should be full. *To Cook Vegetables.*—Fill the barrels full, and, if no other cover is at hand, chop the top fine with a shovel; then cover them up with meal or provender, and cook until done; have holes in the bottom of the barrels to carry off condensed steam.

To Fatten Sheep.—Sheep will fatten readily on good clover-hay alone, if the hay has been cut in full bloom, so as to retain all its juices before they are turned into woody fibre, and of a good green color. A sheep of, say 120 lbs. live-weight, will consume 21 lbs. of clover-hay per week, and increase in weight 2 lbs. Allowing that it would ordinarily take 14 lbs. to keep it in good stationary condition, an expenditure of 7 lbs. of hay extra will produce 1½ lbs. of mutton, worth in the spring 10 cents, —perhaps more, —so that the hay is literally realizing to the farmer at the rate of $30 or more to the ton. No other stock, we think, will give a return for the trouble of fattening like this. To fatten sheep more rapidly, the daily addition of a small quantity of oats to their feed will produce good effects. Keep their quarters dry, well-ventilated, and abundantly littered with clean straw, with freedom of access to good water, and an occasional taste of salt. The health of sheep during the grazing season will be promoted by giving the sheep tar at the rate of a gill a day for every 20 sheep; and, if given pine boughs once or twice a week, they will create appetite, prevent disease, and increase their health. The best sheep to keep, both for wool and mutton, is the American Merino.

Hay Racks for Sheep.—The cheapest and best rack for sheep can be made of 8 boards, 4 long and 4 short ones, nailed to 4 posts, forming an enclosure 12 or more feet long, as the case may be, and 32 inches wide. The bottom board should be at least 10 inches wide, and the top one need not be over 4, with a space between of from 6 to 8 inches, depending somewhat, upon the size of the sheep that are to eat, with their heads through this aperture.

CONSTRUCTION OF BEE HIVES.—Few departments of economy and use are more productive of utility, profit, and real pleasure than the intelligent management of the honey bee, but perhaps no other subject is less understood by the enormous masses of the vast population who in every grade of society, might be benefited by a correct knowledge of the subject. In order to manage bees with profit it is necessary to discard the old method of suffocation with sulphur, the old barrels, hollow logs, straw hives, boxes, &c., of the past, and keep abreast with the new discoveries of the age. All that is required for success is to plan well, and always work in harmony with, and never against, the *heaven derived* instincts which guide the marvellous operation of this wonderful insect. Foremost among the appliances which benefit man and facilitate the labors of the bees we would mention the American Movable Comb Hive, cuts of which are presented herewith.



Directions for making the American Hive.—The bottom board is 13¼ inches wide, 18 inches long and 1¼ inches thick. The front and back are 14⅓ inches wide and 19½ inches long. The 8 x 10 observation door in the back, is cut out with a buzz-saw, 3 inches from the bottom, and thin strips ¾ in. wide are tacked on the sides and top of the opening even with the outer edge to leave an ⅛ in. rabbet on the inside for the glass. The door is finished by nailing an inch clamp on end and side, beveled and hung to the clamp above. Both front and back have a rabbet for the frames on the inside, across the top 4½ in. wide and ⅜ in. deep, and the same extend down the edge ¼ in. wide, against which the moveable side is to fit. The clamp is nailed on the front 7½ in. up from the bottom, and the 1⅓ in. fly holes are bored 3 ins. from centre to centre just above it.

The stationary side with the 1¼ in. clamp on the upper end is 19½ ins. long and 15 ins. wide. A part of the front is cut off 3 ins. from the bottom, to within $1\frac{5}{8}$ in. of the edge next to the movable side, and the last surface is left beveling out to make the entrance block C, easy of removal, which is $12\frac{3}{4}$ ins. long, to the beveled point, and 2 ins. wide, and beveled each side and between the $1\frac{1}{2}$ pillars, $1\frac{1}{4}$ ins. up on the outside, and $\frac{3}{8}$ in. upon the inside, and the edges rounded off to leave a bee passage $\frac{3}{8}$ of an in. high.—(See entrance block in the first cut.)

The block is held in place by the base of the same button that holds the entrance slide, B. The entrance slide B is $1\frac{5}{8}$ ins. wide, 15 ins. long, and $\frac{3}{8}$ in. thick, having 2 notches $\frac{3}{8}$ in. high and 1 in. long, cut to fit the pillars, C, when closing the hive.

A movable side to fit over the open part of the hive, (as shown wide open in cut) secured by clamps, is $16\frac{1}{4}$ ins. long, and 14 ins. wide at the top and $\frac{1}{8}$ less at the bottom to make it easy to remove.

Before nailing the body of the hive together, nail a clamp 3 ins. wide and $12\frac{3}{8}$ ins. long on the under side of the bottom board, cross-wise to prevent it from warping. Use wrought nails and drive them through upon a heavy iron to clinch them, and nail the clamps on the front and back in the same manner. Fasten the bottom board in a vice and nail the back on the bevelled end just even with the lower part of the observation door, and use two or three long brad nails near the edge next to the moveable side. Next nail on the stationary side firmly to the back and bottom board, especially at the front edge, then to the front having the movable side in place. Nail the clamp on the upper end of the stationary side, nailing through the ends into the front and back. Next, nail the strip under the bottom board next the moveable side, which is 14 ins. long by $2\frac{1}{8}$ ins. wide at the back end, and runs to a point at the other end. Nail the $1\frac{3}{8}$ in. clamps on the ends of the movable side, when the two hooks and metallic buttons are screwed on the edge of the front and back after painting. When finished the movable side is $\frac{1}{4}$ in. shorter than the front and back, to avoid killing bees that may be on the stand when closing the hive. The adjustable bevelled strips rest upon the frame rabbets next the stationary side, and holds the frames over against the movable side.

There are nine of the movable comb frames, and all are made alike. The bees pass up into the honey boxes through slots or mortises. Each of the two slots in the projecting edge of the top bars, is $\frac{1}{2}$ in. wide and 2 ins. long. The side bars are 7-16th of an inch thick, 12 in. long and $\frac{7}{8}$ wide being sawed from lumber that thickness. The top bars lack $\frac{1}{8}$ in. of 14 in. in length, and lack 1-16th of an inch of $1\frac{1}{2}$ ins. in width. They are sawed 7-16th of an inch thick from a plank which should be exactly the right thickness for their width.

The Improved Comb Guide, which the bees invariably follow, is constructed in a manner that secures straight combs. A groove is made in the centre of the lower side of the top bar, into which is inserted a thin strip of wood having its lower edge coated with bees-wax. The projecting nails in the side bars to keep the frames apart should have large heads and be driven through a hole in an iron or hard piece of wood, 9-16th of an inch thick. The frames are held from the walls of the hive by a triangular strip across the front, 5-16th in thick, and the one on the back is not nailed on until the glass is in, when it is dressed to give the frames $\frac{1}{8}$ in. play between the triangular strips.

The tops and bottoms of the 12 small honey boxes are $4\frac{1}{8}$ x $6\frac{5}{8}$ ins. and about $\frac{1}{8}$ in. thick. A slot $1\frac{1}{2}$ x 3 ins. is cut across the tops and bottoms of all except the tops of six of the first set of boxes. The four corner posts are $\frac{3}{8}$ in. square and 5 ins. long. The end glass 4 x 5 and side glass 5 x 6 ins. are held in place by a two prong narrow strip of tin through the corner of the posts and the prongs bent each way over the glass.

The end pieces of the caps are $15\frac{1}{4}$ ins long, $8\frac{1}{4}$ ins. wide at the ends and $10\frac{3}{4}$ ins. wide in the centre, each having a $1\frac{1}{4}$ in. hole, covered with wire cloth on the inside. The side pieces are 17 ins. long and $8\frac{1}{4}$ wide the upper edge sawed beveling to fit the roof boards.

The roof boards are $20\frac{1}{2}$ ins. long, and each 11 ins. wide, with the upper edge beveled to fit, and the lower edge leveled to stand plumb. A $1\frac{1}{2}$ inch half round is nailed on the top to cover the joint.

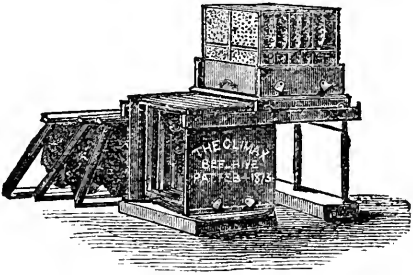
In painting, give the hives one coat of white and when dry, putty and paint the second coat; and while the paint is fresh, cloud, with the hive hanging upon a board projecting from the shop wall, 6 feet from the floor, by passing beneath it a lighted coal oil lamp with a small round wick. When the paint is dry screw on the hooks and buttons, giving each a tap that it may fit the movable side more closely.

By consulting the *Painters Department*, beginning at page 132, the reader will find an immense number of formula for compounding paints of every description at the lowest cost. Many of these will be admirably adapted for painting bee-hives in a beautiful and inexpensive style.

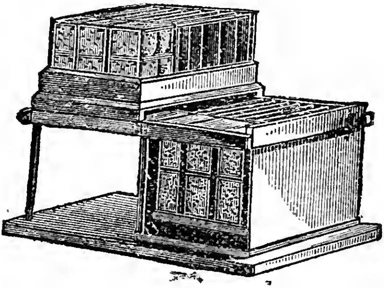
The lumber used should be thoroughly seasoned, and, after both sides are dressed, it should be, for the body of the hive, $\frac{7}{8}$ in. thick. In the cut, the bottom board, projects in front of the hive, making a convenient alighting board, and being inclined, is kept clean by the bees during the working season, By removing the entrance block, C, a large opening is made for brushing out litter in the winter or early spring, and for hiving new swarms. By the use of the small slide, B. held in place by the same button, the entrance can be contracted, if necessary, to the admission of a single bee, thus effectually guarding a weak swarm from robbery, and the entrance may be closed entirely by making notches *d*, *d*, in the slide correspond with the pillars. By means of the movable side and the observation door at the back of the hive every facility is furnished for obtaining honey, observing progress, removing or adding frames to strengthen weak stock, transferring, &c., &c., without injuring the combs or irritating the bees, and the honey boxes on the top may be removed or added at will.

Another hive of intrinsic excellence is called the Climax, and still another, the American, with Climax improvements, see cuts. The Climax is made in two parts. The upper part, which contains the boxes (or frame) is provided with common trunk rollers, and rests on cleats, secured to the lower parts of the hive. These cleats extend far enough beyond the hive to allow the upper to roll off from the lower without *crushing*, *disturbing* or in any way *interfering* with the labors of the bees. The strips forming the track, have drop legs at their outer ends, and are hinged just outside the body of the hive, and when not in use, fold up snugly against the hive. The bottom board of the upper part answers every purpose of a honey board.

It is provided with two slots to admit the bees ; each slot is provided with a zinc strip on the under-side, connected by a wire with a han-



THE CLIMAX BEE HIVE

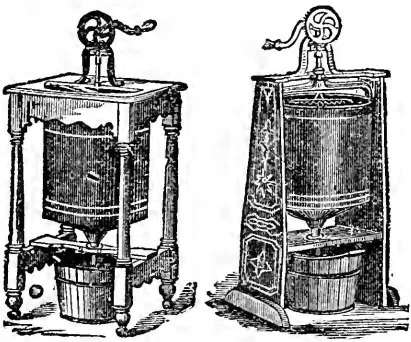


AMERICAN BEE HIVE WITH CLIMAX IMPROVEMENT.

dle on the outside. By this simple contrivance, all communication between the two parts of the hive may be instantly cut off, and dividing or any other operation performed without difficulty.

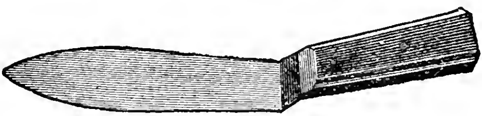
The bottom board of the lower part is made of plank 1¼ ins. thick; and is beveled from the centre to each end, and projects far enough in front and rear to form alighting boards. Along the summit of the bottom board is nailed a triangular strip notched on the upper edge. Corresponding notches are made in the centre of the lower edges of the bottom bars of the frames. Then notches are cut bevelling, so that the frames are easily inserted or withdrawn, but when in place, are *immovable*, and will not shake or jostle, no matter how the hive is turned. Then there is a central rest for the frames, which renders them entirely independent of each other, and of the walls of the hive. The well known propensity of bees to glue every thing together that they can is thus anticipated and prevented, while at the same time a free passage all around, between, above and below the frames, is afforded. The lower part has two entrances on opposite sides, and the bottom board slanting each way is easily kept clean. By removing the entrance block, complete ventilation is effected, and for surplus honey in the comb, twenty-four small frames above, each 5 x 6 and 2 ins. wide are used. Six of these frames are placed together, top and sides close fitting, and a pane of glass, 5 x 6 inches, placed at each end. A strip of tough paper, about 2 ins. wide, is then glued to each side and turned around on the glass, which holds them firmly in place. Twelve frames thus made into *two surplus boxes*, just cover the top, and another tier, above this, furnish room for 50 lbs of honey, in the best shape for market or home use, the cost of these frame boxes being less than half that of the common glass boxes.

Another important auxiliary to the apiculturist will be found in the Honey Extractor, represented herewith. This is a geared machine made of metal, or other suitable material, fitted with an



HONEY EXTRACTORS.

interior arrangement for receiving the movable frames containing the comb and honey from the hive. The centrifugal force generated by the rapid rotary motion of the frame causes the honey to fly



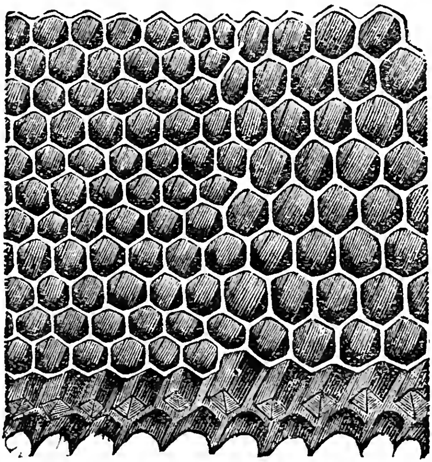
in every direction against the inner side of the machine, and flow down into the vessel beneath. The frame and perfect comb, minus the honey, is then returned to the hive to be again filled with honey. This operation may be repeated with the same comb for twelve or fifteen years, if required and the value of the device may be immagined when it is known that each pound of the comb, so far as the labor of the bees is concerned, is equivalent or equal to the collection of twenty pounds of honey. The knife represented herewith is used for uncapping honey for extracting.

As the utility of the preceding remarks will be greatly enhanced by additional information regarding bees, we herewith append the following excellent representations of the tenants of the hive, together with practical instructions for profitable management.

QUEEN. DRONE. BLACK WORKER. ITAL. WORKER.

The Italian bees are becoming great favorites wherever they have been introduced, and are rapidly supplanting the black bees. They are credited with being very industrious workers, making three flights for every two made by the black bees, and storing much more than double the honey, besides being more prolific, as is evidenced by their more frequent swarming. Besides, the Italian bee is very hardy, working earlier and later in the season and gathering honey from sources not frequented by the common bee.

Useful Hints for Beginners.—1. Work quietly; avoid sudden jars; never fight your bees, and always *keep cool.* 2. If you get stung, remove the sting, squeeze out all the poison you can, and apply hartshorn. 3. Use plenty of smoke; a roll of dry rags or decayed wood makes the best; blow in the entrance and at the top of frames. If you are timid, use rubber gloves on your hands, and, a veil over the face and head; the veil must be long enough to allow the vest or coat to be put on over it. 4. When pasture first becomes plenty in the spring is a good time to transfer bees. Always work among the hives during the middle of the day, when the bees are busy. 5. Stocks without eggs or young brood in June, must be queenless and should be supplied with a queen or queen cell, or they will dwindle away and perish either by robbers or moth. 6. When symptoms of robbing occur, use the utmost caution. Contract the entrance of weak hives, and allow no comb, honey, sugar or syrup to be around. Avoid opening hives as much as possible. 7. Avoid an excess of drone comb by the presence of a queen in swarms where combs are to be constructed. As swarms having young queens seldom swarm that year, less drone comb is built in swarms having young queens. 8. *Quiet* is essentially necessary to the well-being of an apiary. Do not place it near Mills, Steam Works, or Manufactories of any kind. If possible have it in view from the windows of the family room, as much extra trouble may be avoided. 9. As natural talent or business tact, is requisite, with education to success in business, so a careful turn of mind and a love for the business, with an understanding of the subject, is necessary to success in bee-keeping. 10. Put on honey boxes partly filled with comb as soon as the lower part of the hive is well filled with honey and bees, and when they are gathering honey plentifully; commence with only one or two boxes at a time on the most populous stocks. 11. In transferring combs always give those the preference that *contain worker*



DRONE AND WORKER COMB.

brood. Put brood comb near the centre of the hive in the order in which they were in the box hive. Do your transferring where robbers cannot possibly be attracted. 12. Avoid weak swarms, as they gather but little honey, breed slowly, and are in danger of destruction by robbers, the moth, or severity of winter. Weak swarms should always be united in the fall, and should never be made by dividing early in the season. 13. Whenever you notice the bees running about the entrance in the evening in a disturbed condition, mark that hive and notice it the next evening. If the bees run about smelling each other, it is a sign they have lost their queen and should receive attention. 14. In establishing an apiary, select a gentle slope to the south-east; face the hives in the same direction, if possible have running water near ; shade and protection from winds and the heat of the sun are important. Set every hive as perpendicular as a clock—for a stand, take two short pieces of 4 x 6 scantling and lay or nail on a board. 15. To make queen cages, cut wire cloth

3x4 inches; pull out two or three transverse wires from one of the 3 inch edges, and insert the projecting ends thus left in the corresponding meshes of the other three inch edge, and fasten them; stop one end with a cork or wood. When you wish to introduce a queen, put her in the cage and stop the other end with wax. 16. A few inches of drone comb is amply abundant for any hive, as drones consume a great deal of honey and gather none. The movable frame hive renders any preventive operation very easy : the cut will enable the beginner to identify the drone by the large cells. 17. In the Northern States and British Provinces, experiments demonstrated that bees wintered in the open air have consumed about 45 lbs. of honey per hive, while bees wintered in the cellar

COMB SHOWING BROOD AND QUEEN CELL.

during the same period consumed on an average only 5 lbs each In another case 6 hives wintered out of doors lost an average of 29½ lbs, in weight each, during 3 months, while 20 hives in the cellar lost only 5¾ lbs, each, during the same time. Do not place them in the cellar until the severe weather begins ; give them plenty of upward ventilation in order to pass off the vapor generated from the bees ; place the hives in rows on shelves, keep them in a clean dark place, but not in a damp or badly ventilated cellar, for that is certain death to bees, and keep wire cloth tacked over the entrance to each hive; if a dry absorbent material such as cut straw or shavings, can be placed in the upper part of the hive to receive and absorb the unhealthy emanations from the bees, all the better; in out door wintering especially, this is a most desirable plan, as it retains the heat while it absorbs the effluvia. 18. Bees wintered on their summer stands, should always be allowed from 30 to 50 lbs, of honey to each colony and extra protection around the hive if the cold is very intense. 19. When eggs are deposited by the queen in the cells prepared by the workers, in 3 days they hatch into small worms which are nurtured and fed ,until about the eighth day the larvæ become nymphs, and are sealed up in their cells to reappear as perfect bees. The queen bee emerges in from 10 to 17 days, the drone in 24, and the workers in 21 days from the egg. The cut illustrates a comb showing brood and queen cell but the artist has not succeeded very well in representing the royal form with which nature has endowed her majesty. In from 3 to 5 days after emerging, the queen leaves the hive to meet the drones in the air, for fertilization. She never leaves the hive at any other times except when she goes with a swarm, and one copulation is all sufficient to ensure fertility for life. Under favorable circumstances she will deposit 3000 eggs per day. 20. In introducing an Italian queen to a colony of common bees, enclose her in a wire cloth cage and insert the cage in the centre of a comb where the bees will cluster upon it. In 36 hours release the queen, smear her with honey, and allow her to crawl down among the bees. 21. When bees are short of honey a good and cheap food may be provided by using good coffee sugar, 4 lbs, added to water, 1 qt., bring to a boil, skim and allow it to cool. 22. *Another.* Take of the *best quality* of brown sugar, two parts by *measure*, to one part of pure soft water ; boil and skim it ; then to every quart of the mixture, add one even teaspoonful of the best cream tartar ; dissolve the cream tartar before putting it in. Remove the empty comb with the frame from the hive fill them by allowing the syrup to drain through a proper strainer into the cells, and then return the frames to the hive. With box hives, use some good feeder or a dish of proper size to set under the cap on the top of the hive ; fill the dish with the syrup, and throw on fine shavings or cut straw, to prevent the bees from falling into it. 23. The best substitute for bee bread or natural pollen is rye flour unbolted. In the absence of rye, use other flour. 24. The damp air may be drawn from a cellar in which bees are being wintered by connecting the cellar and your stove pipe by means of a 2 inch tin pipe passing up through the floor. 25. In hiving bees, use diluted honey or white sugar syrup, damp the inside of your hive and gently sprinkle the bees with the liquid ; it will render them so happy that you may handle them as you please.

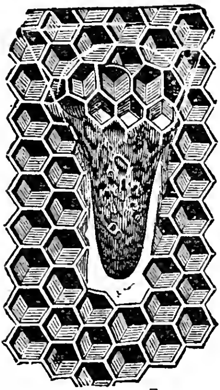
SURPLUS HONEY STORED IN BOXES.—"Those having bees in common hives, and who wish their surplus honey stored in boxes, will obtain the greatest amount and avoid many disappointments by attending to the following conditions : 1. The boxes should be tight and large, but not over four or five inches high, and protected from the changes of the weather by an outer cap. 2. The bees should be induced to commence in them by attaching pieces of clean empty combs to the under side of the top, and placing the boxes directly over the breeding apartment, with large openings under each box to admit the bees. 3. Early in the season select a few populous stocks, giving a box to each, and when the bees have commenced in them, give boxes to the next strongest, being careful not to give too much room until a start has been made. 4. Keep the hives cool by shading from the sun, and if the bees cluster outside, when flowers are plenty, ventilate by enlarging the entrances and giving more room in the boxes if needed. After a populous stock has nearly filled its boxes it will often take long enough time to finish them, to have half filled empty ones, besides the difficulty so often experienced in getting the bees to commence in the boxes after those first filled are removed, which objections are both overcome in the American hive, described in the article on hives." *Bee-Keepers' Text Book.*

HATCHING AND FERTILIZATION OF QUEENS.—"In about eight days after the old queen leaves with the first swarm, the most advanced sealed queen is ready to emerge. During this time the old stock is without a hatched queen, the young queen immediately upon leaving her cell, if not restrained by the workers, commences the work of destruction upon her yet imprisoned sisters. She accomplishes this by biting open the side of each cell near its base, and dispatching the unfortunate inmate with her sting. She is yet incompetent for the maternal duty, and must leave the hive to meet the drones in the air for the purpose of fertilization. This once accomplished, the workers, awaiting her safe return, greet her with a reverence and affection never shown before. They hasten to prepare the cells to receive her tiny eggs, and seem to realize that on her existence the perpetuation of the family depends. There is also a perceptible change in the queen's form, her abdomen being a little swollen and somewhat lengthened, but not as much as at the height of the breeding season. She now remains the fruitful mother of the prosperous and happy colony." *Bee-Keepers' Text Book.*

TO PREVENT NEW SWARMS FROM LEAVING THEIR HIVES.—"Natural swarms occasionally refuse to stay after having been hived, usually in consequence of heat or strong odor about the hive. In nucleus swarming this seldom or never happens, because the bees are never without a comb containing brood and honey; and they will not leave voluntarily. Therefore when hiving a swarm in a moveable comb hive, go to any stock that can spare a comb containing brood and honey. Brush back the bees, being careful not to remove the queen or any queen-cells with comb, and place it in the hive that is to receive the new swarm. It will not only prevent the bees from decamping but will greatly encourage them, and should bad weather confine them to the hive they will be secure from starvation. If the swarm is put in a common hive, place over them a box of honey taken from the parent stock." *Bee-Keepers' Text Book.*

THE NUCLEUS SYSTEM OF SWARMING.—"*The introduction of a mature fertile queen to a colony two weeks sooner than when they swarm naturally is an advantage sufficient to pay for the extra trouble. The time gained in breeding is equivalent to a swarm.* M. QUINBY.

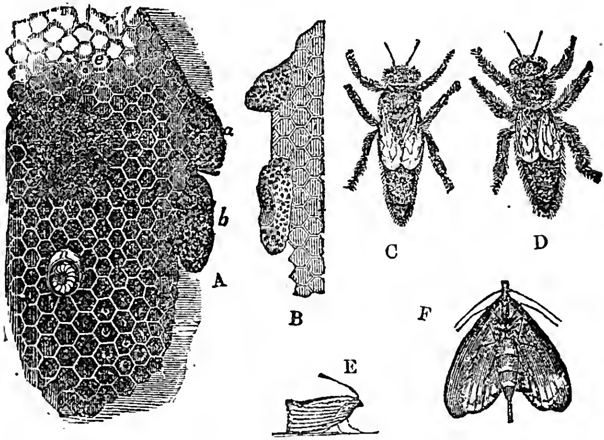
In swarming bees on this system, we first rear a queen in a small cluster nucleus of bees, allowing the nucleus hive to remain in its place until the queen becomes fertile, when we swarm the bees by simply causing the two hives to exchange places. Unlike natural swarming, the old queen remains in the parent stock and its labors go on scarcely interrupted. The system is based upon the well known law, that bees, after luxuriating upon the flowers, will return to the exact spot of their old habitation. Form a nucleus from an Italian or other populous stock by blowing a few whiffs of smoke into the entrance and opening the hive ; select a frame of comb containing capped brood, but especially plenty of eggs and young larvæ. After looking this over carefully, lest the old queen be removed, place it with its adhering bees in the empty hive, and next to it another comb containing honey, which will afford protection to the brood and food for the bees. As many of the old bees will return to the parent stock, give the nucleus hive at least a quart of bees and set it on a new stand two or three rods distant. Contract the entrance so that but one or two bees can pass at the same time, and set a feed pan on the frames, or a sponge filled with sweetened water will supply their wants until the young bees go to work in their new location. In place of the combs removed from the parent-stock, set in empty frames with a full one between. If the frames are put near the centre, the old stock will increase all the faster, as the queen will fill the new comb with eggs as fast as it is built. The removal of the two combs stimulates the bees to great activity by giving them room to work, and detaches just bees enough to prevent their clustering idly about the entrance. The nucleus will construct queen-cells and rear a queen as well as a whole swarm. Besides, the queen is easily found among so few bees. We now wait until the tenth or eleventh day, from the time the nucleus was formed, when we open it, and with a sharp thin bladed knife, cut out all the queen-cells *but one* and use them immediately in forming other nucleus, by attaching one of them to a frame of comb and bees taken from an old stock, as before described, and placed in an empty hive. In transferring queen-cells great care must be taken not to press or dent them, or expose them long to the hot sun or cool air for fear of destroying the royal occupants. The beginners should remove but one at a time, returning the frame from which it is taken to its place in the hive until the royal cell is adjusted in its new location. When practicable have about an inch square of comb attached to the cell, and upon taking the comb or brood from the old stock, make an opening among the eggs and larvæ where bees will be sure to cluster upon it and keep it warm, and carefully insert it as shown in figure, leaving an open space below it. If the first nucleus was formed from the only Italian stock in the yard, and more queen-cells are wanted, remove every queen-cell from it, and add another comb of eggs and brood from its parent



stock. But when no more queen-cells are needed, leave one to hatch, and as by this time the brood will all be capped over, the bees will be liable to follow the young queen on her excursions to meet the drones. To prevent this, exchange one of the combs for one containing eggs and young larvæ. When forming the other nucleus, young queens will return unless lost by birds or other casualties, to which all queens are *once* exposed. Such loss is easily ascertained among so few bees, and we have only to insert another queen-cell, adding a comb containing eggs and brood and repeat the trial. Should the parent stock be very populous it may be swarmed by taking a queen from the nucleus belonging to a less populous stock, and another queen reared there.

When and how to Swarm the Bees.—Every populous stock, from which a nucleus has been formed, should be swarmed, if the weather is favorable, as soon as the queen in the nucleus has become fertile. This is, usually, in from six to ten days after inserting the queen-cell, and is readily determined by examining the combs for eggs. We now, unless the yield of honey is very abundant, confine the young queen in a gauze wire cage. Having filled up the nucleus hives with empty frames, exchange the places of the two hives, bringing the entrance of the nucleus hive where the old stock has stood, and where the mass of the old bees will return from the fields, thus throwing out of the old stock swarms of workers into the nucleus hive while the old bees from the nucleus will enter the old hive and minister to the wants of the numerous brood of the parent stock. The bees *must not* be swarmed between the hatching and the fertilization of the queen, and should they be swarmed when the honey harvest has received a check from a storm or drought, the bees thus empty ot honey and consequently more quarrelsome, being suddenly thrown into the presence of a strange queen (although of the same scent) are inclined to sting her. To prevent this she is caged for thirty-six hours, when the bees from the old stock will mostly have joined the nucleus colony and she may be safely liberated. But, if she was taken from another nucleus, we sometimes let her remain caged a day longer, or smear her well with warm honey, and drop her in among the bees. They immediately commence licking up the honey, and *forget* to sting her. If from any cause the stocks are swarmed when the bees are working but little, and after three or four days the nucleus swarm be found deficient in bees, it may be strengthened by exchanging some of its empty frames for frames of capped brood from the parent stock, or should the flowers yield bountifully within a week, the location of the two hives may again be exchanged. The bees will not quarrel as they are of the same scent. Unless a nucleus has been formed several weeks, or when honey is scarce, it is sometimes necessary to treat both stocks, especially the old one, to tobacco smoke. This precaution, however, is only for the inexperienced, since, in the midst of the swarming season, when the flowers are in profusion, little protection is needed either for the queen or the operator.

HENS MADE TO PROTECT BEES.—A bee raiser has patented an invention for the protection of bees from the attacks of the honey moth, which enters the hives at night, and rifles the stores. The idea arose out of his familiarity with the daily routine, not of bees only, but of hens. Hens, he observed, retire to rest early; but bees seek repose earlier still; no sooner are they sunk into slumber, than the moth steals into their abode and devours the produce of their toil. He has now built a stand of hives with a hen house connected. The bees first betake themselves to their dwelling and settle themselves for the night. The hens then come home to roost on their perch, and as they take their places upon it, their weight sets some simple mechanicism to work, which at once shuts down the doors of all the hives. When the day dawns, however, the hens leave their roost, and the removal of their weight from the perch raises the hive doors, and gives egress to the bees in time for their morning's work.



EXPLANATION OF THE ABOVE CUTS.—The cut A represents brood in various stages from eggs and larvæ in the lower part of the comb to brood capped at *e*, and just emerging at *f*; *n*, is a queen-cell just commenced at from larvæ; *b*, a perfect queen-cell capped over; *a*, a cell from which the queen has just emerged. B represents queen-cells destroyed; C unimpregnated queen; D fertile queen; E male moth or miller; F female miller.

TO KILL BEE MOTHS.—Bee moths can easily be killed by setting a pan of grease on which is placed a floating lighted wick, near the hives after dark: the light will attract the moths in large numbers, when they will be destroyed by falling into the grease.

Many persons are deriving substantial yearly incomes amounting to thousands of dollars from bee-keeping, and it is credibly reported that the late Mr. Quimby left property valued at $100,000, all derived from this source alone. Mr. Quimby wrote that the honey gathered by bees compared with what was lost for the lack of bees to gather it, was but as 1 compared with 1,000, so that it seems as if a careful person, engaged in bee-keeping, and thoroughly equipped with all modern appliances for the business, possesses, as old honest Sam Johnson once expressed himself regarding a different subject, "The potentiality of growing rich beyond the dreams of avarice," and what is of still greater importance, the pleasure derived from the business is almost ineffable in comparison with the satisfaction of being rich.

Limited space forbids the further consideration of this attractive subject in this place, and the author would conclude by expressing his sincere obligations to the editor of the "Bee-Keeper's Magazine" for according permission to make extracts from the varied contents of an excellent little manual called the "Bee-Keeper's Text Book," and other reliable sources of information. For the benefit of parties desiring further light on this fascinating topic, he would state that the "Bee-Keeper's Magazine" will fill the entire bill of their requirements. It is a *first rate illustrated* monthly journal of 32 octavo pages, devoted exclusively to Bee-Culture, edited by Albert J. King, containing monthly contributions from Mrs. E. S. Tupper, and other eminent writers and bee-keepers in both Europe and America. A large space is devoted to Beginners, giving useful information, *just when it is needed*, throughout the year. Terms $1.50 per year. The proprietors will send the Magazine four months on trial, and *include* a 64 page pamphlet (price 50 cents), containing a beautiful life-like chromo of Honey-Plants and Italian Bees in their natural colors; Prize Essay by Mrs. Tupper; Queen Rearing by M. Quimby; instructions for beginners, &c., *all* for 50 cents. Address, King & Slocum, 61 Hudson street, New York.

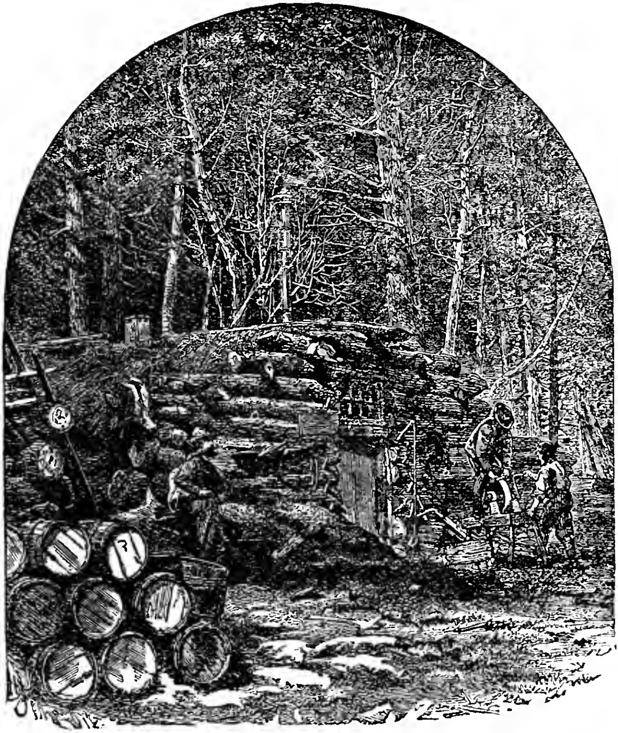
FOOD FOR MOCKING BIRDS.—Mix well together corn-meal, pea meal (made by drying split peas in an oven and then grinding them in a mill), each one part, moss meal, prepared from the moss seed imported from Germany, ½ part, add sufficient melted lard not to make it too fat or greasy, and sweeten with molasses. Fry the mixture in a frying-pan for ½ an hour, stirring it all the time, to avoid burning. Mocking, and other birds of like nature, will leave all other food for this.

FOR LUMBERMEN, BUILDERS, CONTRACTORS, MILL OWNERS, SHIP BUILDERS, SHIP OWNERS, NAVIGATORS, QUARRYMEN, STONE CUTTERS, MERCHANTS, AND BUSINESS MEN GENERALLY.

TO PREVENT WOOD FROM CRACKING.—Place the wood in a bath of fused paraffine heated to 212° Fahr. and allow it to remain as long as bubbles of air are given off. Then allow the paraffine to cool down to its point of congelation, and remove the wood and wipe off the adhering wax: wood treated in this way is not likely to crack.

TO BEND WOOD.—Wood enclosed in a close chamber and submitted to the action of steam for a limited time will be rendered so pliant that it may be bent in almost any direction. The same process will also eliminate the sap from the wood and promote rapid seasoning.

FIRE PROOFING FOR WOOD.—Alum, 3 parts; green vitriol, 1 part; make a strong hot solution with water, make another weak solution with green vitriol in which pipe clay has been mixed to the consistence of a paint. Apply two coats of the first, dry, and then finish with one coat of the last.



LUMBERMAN'S SHANTY OR CAMP.

Many of the honest farmers and sturdy lumbermen of the Northern States, Canada and New Brunswick, will be at no loss to understand the uses of the humble mansion represented in the cut, and many a forest wanderer and weary hunter will identify the modest habitation as the counterpart of another where he has been refreshed by the substantial meal, and invigorated by the peaceful slumber enjoyed under the hospitable roof. However poor the lumberman may be, however numerous his trials and privations, and we are sorry to say they are not few in number, this we will say, that whether you are known or unknown, rich or poor, whether you are bent on business or pleasure, in the lumber camp you are always made to feel at home;

the "best in the house" is at your service, and hospitality is dispensed with a princely generosity. Under such circumstances it is wisdom to accept and folly to refuse the proffered beneficence, and many can attest that they have enjoyed these kind offices to exhausted humanity with a relish (thanks to the pure oxygen so bountifully supplied to their lungs by a forest atmosphere), known to but few in the dwellings of the wealthy, or in the sumptuous and costly hotels of the crowded city, with their bountiful and costly bills of fare, embracing the best in the market.

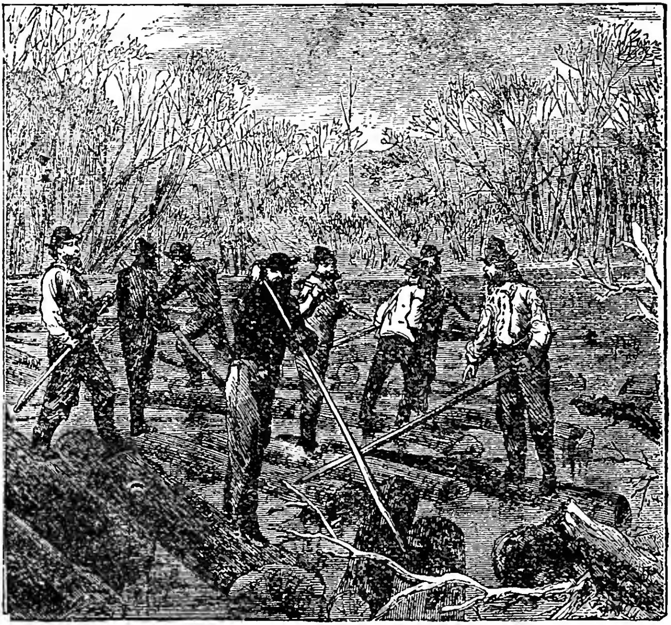
CUTTING LOGS IN THE WESTERN PINE FORESTS.

The usual time for commencing lumbering operations in New-Brunswick and many parts of Canada, is in the fall, soon after the

LOADING PINE LOGS IN THE WESTERN FORESTS.

operators, many of whom are farmers, have safely housed their crops, consisting of hay, oats, buckwheat, potatoes, &c., and the work continues with very little intermission until towards spring. It must be confessed that lumbering pursuits are not well calculated to produce, in the minds of those who follow them, a very strong bias towards scientific agriculture, the tendency being rather to produce derangement in that respect, but there seems to be a fascination in the business which very few who enter upon it seem able to resist, and much of the farming work is considered by many as only of secondary consequence compared with lumbering, being stimulated principally by the necessity arising for agricultural products in the lumber camps, and for family uses at home.

In selecting the site for a camp, the principal object is to obtain a central position within easy reach of water, and an ample supply of timber adapted to the wants of the market. It is also of great consequence that it should be easily accessible for the purpose of transporting, or "portaging," as it is termed, the substantial supplies re-



BREAKING A JAM.

quired by the men and horses engaged in the work, and convenient to a suitable "landing," usually on or near a stream, where the logs are unloaded to await the breaking up of the ice, and the spring floods, which are to convey them to their destination. The work is systematically conducted, every man from the boss to the cook having his post, but the labor is very severe, and taxes the utmost energies of both man and beast, some of the loads drawn by the latter being of enormous bulk and weight. This kind of toil continues during the fall and winter months, only to give place in the spring to another form of labor, which is, if possible, still more arduous, and is certainly more dangerous; that of "driving" the lumber down stream. The driving operations are commenced by rolling the logs into the stream on the breaking up of the ice and guiding them down the current, the poor fellows being often up to the waist in cold water, and when a "jam," or lock of the timber takes place in the stream, owing to obstructions or barriers of any kind, the danger of "breaking" it is positively fearful, many having been killed outright, by the sudden "shoot" taken by the liberated timber as it rushes forward, impelled by the surging floods in the rear.

In lumbering districts the season of active work for cutting timber ranges from November until towards the middle of March; in New Brunswick much of the work performed in *getting out*, or hewing birch timber, is done during the summer months, but the cutting and hauling of spruce logs is the principal object of winter operations. In getting out birch timber, the tree is felled and hewn square to the largest available dimensions, and allowed to remain till sleighing sets in before being hauled to the stream for transportation. Owing to the density of birch timber much of it is lost by submergence in the water, and for the purpose of rendering it more buoyant it is usual to induce floatation by forming connections with spruce logs or other timber of light specific gravity. The rigorous climate of the Northern States and Canada is most favorable for the growth of hardy merchantable timber, such as pine, spruce, &c., but is inimical to mahogany, box, lignumvitæ and other dense tropical woods which require a warm climate.

Timber grown in humid, swampy or wet localities, with the exception of cedar, willow, poplar, &c., is not so firm, sound, and durable as that grown on dry and elevated situations, where the soil is largely composed of loam interspersed with sand, gravel and stones. Trees selected from the midst of the forest possess greater elegance of form and are usually straighter, less knotty, and more merchantable every way, than timber exposed to the ravages of storms, &c., on the confines adjacent to the clearings, or on hill sides and exposed places, sheltered situations being the most favorable for the *growth* of timber, but not so promotive of *hardness* as unprotected localities. A dense, dark, green color in the leaves of trees during June and July indicates a sound, healthy growth, while the sere and yellow leaves, scanty in number, decaying branches, with spotted, streaked, loosened and diseased bark, indicates defective timber. To secure timber in its best condition for long endurance, it should be cut during mid-winter, say in January or February, and during July in summer, and should be worked up as soon as possible by sawing, splitting or hewing, into the desired dimensions.

The nature of the various departments of the work is very well illustrated in the cuts presented herewith, which are engraved in the best style from exceedingly fine photographs of actual scenes in the Western forests, and therefore truthfully depict the various stages of getting out lumber, from the cutting down of the great trees, sawing them into lengths, hauling them out, and finally "landing" the logs on or near the stream, in readiness for the spring freshet to drive them to market. Though many of these streams are too shallow in summer to float an Indian in the lightest bark canoe, yet, when swollen by spring freshets, each one becomes a wide and deep river.

Many ingenious contrivances have been constructed to procure timber from mountains. A novel locomotive has been made in California to run on the long flumes that are used to float lumber down from high elevations. The wheels fit on the edge of the sides of the flume, and at the ends of the car are paddle wheels dipping into the water, and which are turned by the swift current. By a simple arrangement, this power is made to propel the locomotive up the flume, and it runs back itself. Alpnach, in Switzerland, as is well known, was, during war time widely noted for its famous slide, or

UNLOADING LOGS ON THE LANDING.

wooden trough, containing a stream of water, in which the timber was launched with terrific velocity from the forests on Mount Pilatus into Lake Lucerne, a distance of 8 miles.

Spruce forests possess a wonderful recuperative power, it being well known that they may be stripped of merchantable timber during any given year, and ten years subsequently, if nothing happens, another harvest will be ready for the axe. The great bane of all forests is fire, and the loss resulting from this one cause is simply incalculable. While it is true that many forest fires are accidental, it cannot be denied that the majority are purposely set; and, while such atrocious wickedness cannot be too severely denounced, it is equally true that owing to the privacy of the act, and consequent want of proof, the offender too frequently escapes the retribution which his enormities deserve. The recent forest fires in Michigan, Wisconsin, and other places, proved terribly destructive, and the so-called "great Miramichi fire" will be memorable for generations to come, on account of the terrible destruction of human life and property of every kind effected by it. Many of the old settlers on the Miramichi have a vivid remembrance of that awful calamity, and can recount many harrowing narratives of suffering, consternation, death and hair-breadth escapes during that terrible time, when the sky appeared as one sheet of flame, emitting a universal rain of fire, which destroyed everything in its course, even burning the soil from the earth, rendering thousands of acres a barren desert to this day.

A most singular case of forest-destruction occurred many years ago, as related by the *Allemaine Zeitung*, in which a subterranean fire, undoubtedly of volcanic origin, burnt the roots of 250 acres of forest trees at Magland, in Switzerland, which, falling, were also consumed ; flames also, issued near Lausanne.

Seasoning and Preserving Timber.—This may be effected—1st. By piling and completely ventilating under cover for a period of from two to five years, for thorough seasoning. 2nd. By immersion in water for a few weeks. This improves all kinds of timber, both flat, square and round. If a man wishes to season green boards quickly, let him throw them into water, — all the better if it is running water, — and the sap will be withdrawn very rapidly : a short subsequent exposure to the air will be all that is necessary. 3rd. Fell your trees during June and July, while in full leaf, and allow them to lie until every leaf has fallen ; it is said the leaves will exhaust nearly all the sap from the tree, leaving it dry in from one month to six weeks, according to the dryness or wetness of the weather. 4th. Small pieces of non-resinous wood can be seasoned perfectly by boiling four or five hours ; the process taking the sap out of the wood, which shrinks nearly one-tenth in the operation. 5th. *Kiln-drying*, is adapted only for boards and small timber ; it is liable to check, crack, and otherwise injure the wood, unless the process is cautiously conducted. Black walnut cannot be seasoned in this way at all : for this wood use Process No. 1. 6th. *Steaming.*—This process has been adopted by some, and has proved successful in eliminating the sap from the wood. 7th. *Kyanizing* consists in the saturation of the wood with corrosive sublimate, — solution, 1 lb. of chloride of mercury in 4 gals. water. 8th. *Burnettizing.*—By this process, impregnation of the wood is effected by submitting it to an end-ways pressure of 150 lbs. to the square inch, — solution, 1 lb. of the chloride to 10 gals. water. 9th. *Boucheri's Process.*—Impregnation is effected as in the last instance, using a pressure of 15 lbs. to the square inch, — solution, 1 lb. sulphate of copper to 12½ gals. of water. 10th. *Bethol's Process.*—As above, by submitting the wood to an end-ways pressure of 150 to 200 lbs. per square inch, with creosote oil intermixed with bituminous matter. 11th. *Robbins' Process.*—See full description of this process in the Mechanical Department of this work. 12th. *Samuel Wood's Process*, consists in vaporizing and withdrawing the sap from the wood, as described in Robbins' Process, and forcing in a solution of sulphate of iron at a pressure of 175 lbs. per square inch for thirty minutes ; then finishing with another solution of carbonate of lime.

In preserving and seasoning wood by impregnation with coal tar, creosote, etc., it is essential that the juices of the wood should be completely withdrawn and the albumen coagulated, otherwise decay will ensue. Wood treated in this way repels decay, the attacks of worms, etc., and is greatly increased in strength and resilience.

Dr. Feuchtwanger's process for preserving wood consists in steaming the timber, and injecting a solution of silicate of soda for eight hours; afterwards, soak wood for the same period in lime-water.

George Woods, the celebrated organ manufacturer, in Cambridgeport, near Boston, has also discovered and patented a very valuable method of seasoning timber.

Lumber is improved by repiling, and the shifting of its position at proper intervals. Violent currents of heated air cause cracks, etc., in the lumber during natural seasoning; a moderate temperature is the best in every respect. The proportion of water in different woods varies from 26 to 50 per cent. A beam of green oak weighing 972 lbs. lost 342 lbs. by seasoning.

The best results are attained by piling the lumber under shelter in properly arranged piles, elevated on blocks at least 2 feet from the ground, each kind of timber by itself, with 1 inch slats interposed between the boards at short distances, to keep them straight, and permit the air to circulate freely, while square and round logs should be stripped of bark and raised from the ground.

The best timber, is that which has been allowed to *attain full maturity* previous to being felled. The *age of a tree* is easily determined by the number of concentric rings displayed on the stump. Spruce and fir matures very rapidly, pine more slowly, and oak matures in from 75 to 200 years. White oak is said to be favorably influenced by the vicinity of sea water; the growth of many other trees is repressed by it. In Nova Scotia the great valley extending from Cornwallis to Digby, is noted for the enormous quantity and excellent quality of the fruit produced, while on the other side of the mountain fronting the Bay of Fundy, the propagation of fruit trees has proved an entire failure, and no man could form any conception of the prodigious extent of the New Brunswick forests from a steamer's deck, while sailing along the treeless, rock-bound coast of that Province.

The best timber in a tree is always the part near the ground. The quality of the wood may be frequently determined by a healthy, fresh, and uniform appearance, free from white or yellow spots, blending to a deeper shade near the heart. *Yellow stains* indicate the existence of dry rot, caused by the fermentation of the albumen in the wood; and the sapwood, being liable to early decay on account of the putrefactive decomposition of the vegetable juices, should be removed. The loss to lumbermen from this cause, when they are obliged to "hang up," or abandon their drives, owing to the insufficiency of water in the stream to float them to their destination, is very great, and in the event of failure to drive them down with the ensuing fall or spring floods, often proves ruinous.

The excellence of timber is liable to be impaired by many causes, among others, 1. *Wind-shakes* or circular chinks, or rents, involving the separation of the annular layers of wood from each other; a very bad imperfection. 2. *Brash-wood*, caused by deterioration or decay in the timber, induced by age, imparting a brittle crumbling grain to the wood, together with a reddish and porous appearance. 3. *Twisted wood* is very unsafe for long stretches, on account of its liability to break suddenly, owing to the screw like formation of the grain. 4. *Splits, checks, and cracks*, if greatly expanded and enlarged, almost ruin the timber for any useful purpose except the most common kind; the same is true concerning, 5. *Knotty timber*, which though it may be substantial is not well adapted for fine work, but subserves many important uses, such as roofing, fencing, &c. 6. *Belted timber*, consists of trees which were dead and partially decayed previous to being felled; usually very bad. 7. *Common rot.*—Timber and lumber of various kinds, are liable to be affected in this way, whenever exposed to alternate humidity and dryness. It may also be induced by imperfect ventilation in sheds, and manifests itself by yellow decaying spots, and a sulphur colored dust in the apertures and crevices of the timber. 8. *Perforated timber.*—This mischief is caused by worms and insects which infest timber and exist on the albumen, sugar, &c contained in it. Submerged timber is affected in a similar manner by the ravages of the *Teredo navilis*, a genus of testaceous mollusks.

NUMBER OF CUBIC FEET OF TIMBER IN A TON (AVOIRDUPOIS), TOGETHER WITH THE WEIGHT IN LBS. PER CUBIC FOOT.

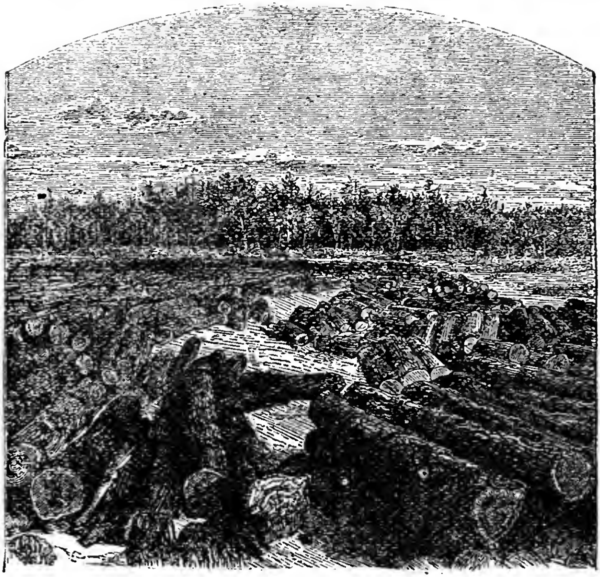
Woods.	Lbs. per Cubic Foot.	Cubic Feet per Ton.
Alder, dry.	50.	44.80
Ash, "	52.812	42.414
	43.125	
Apple, "	49.562	45.18
Bay,	43.601	
" "	51.375	43.601
Beech.	43.8	
" "	53.25	
Birch, common.	43.8	
" American black.	46.9	
Box.	62.5	39.40
Bullet-wood.	58.	
Butternut, dry.	23.5	
Cedar, "	35.62	63.866
Cork, "	15.	149.333
Cherry, "	44.687	
Chestnut, "	38.125	
Ebony, mean of 2 sets.	79.4	
Elm, dry.	41.937	53.25
	35.625	62.97
Fir, white.	35.57	
Fir, New England, dry.	34.4	
Fir, Norway Spruce "	32.	
Fir, Riga.	46.9	
Gum, blue, dry.	52.687	
Hackmatack, "	37.10	60.37
Hazel, "	53.75	
Hemlock, "	23.	
Hickory, pig nut.	49.5	45.252
" shell bark.	43.125	51.942
Holly, dry.	47.5	
Juniper, "	35.375	
Lance wood, dry.	45.	

Woods.	Lbs. per Cubic Foot.	Cubic Feet per Ton.
Larch, dry.	34.	65.8
	35.	
Lignum Vitæ.	83.312	26.866
Logwood.	57.062	39.225
Mahogany.	35.	64.
	66.437	33.714
Maple, dry.	46.876	47.66
Oak, Canadian.	54.5	41.101
" English.	58.25	38.455
" live, seasoned.	66.75	33.558
" " green.	78.75	
" white upland.	43.	52.09
Pear, dry.	41.312	
Plum, "	49.062	47.47
Poplar.	26.31	
Pine, pitch, dry.	41.25	54.303
" red, "	36.875	60.745
" white, "	34.625	64.693
" well seasoned.	29.562	75.773
" yellow.	33.812	66.248
" " dry.	28.812	
Poplar, mean of 2 sorts	28.5	
Rosewood, dry.	45.5	
Satinwood, "	55.312	
Spruce, "	31.25	71.68
Tamarack, "	23.937	
Teak, African oak.	46.9	
Walnut, dry.	41.9	53.42
" black, dry.	31.25	71.68
Willow.	36.562	61.265
" "	30.375	73.744

COMPARATIVE VALUE OF DIFFERENT WOODS, EXHIBITING THEIR CRUSHING STRENGTH AND STIFFNESS.

Teak	6555	Beech	3079	Walnut	2374
English Oak	4074	Quebec Oak	2927	Yellow pine	2193
Ash	3571	Mahogany	2571	Sycamore	1833
Elm	3468	Spruce	2522	Cedar	70C

LOGS ON THE LANDING AWAITING THE SPRING FRESHETS.



AGE, &C., OF TREES.—An oak tree in 3 years grows 2 ft. 10½ ins. A larch 3 ft. 7½ ins.; at 70 years it is full grown: and a tree of 79 years was 102 ft. high, and 12 ft. girth, containing 253 cubic ft. Another of 80 years was 90 ft. and 17 ft., and 300 cubic feet. An elm tree in 3 years grows 8 ft. 3 in. A beech, 1 ft. 8 in. A poplar, 6 ft. A willow, 9 ft. 3 in. An elm is full grown in 150 years and it lives 500 or 600. Ash is full grown in 100, and oak in 200 The mahogany is full grown in 200 years to a vast size. A Polish oak, 40 ft. round had 600 circles. An oak in Dorsetshire in 1755, was 68 ft. round; 2 near Cranborne Lodge are 38 and 36 ft. There are yews from 10 to 20 ft. diam., whose age is from 1000 to 2000 years. A lime in the Crisons is 51 ft. round, and about 600 years old. An elm in the Pays de Vaud is 18 ft. diam. and 360 years old. The African baobab is the patriarch of living organizations; one specimen by its circles is estimated at 5700 years old by Adamson and Humboldt. The trunk is but 12 or 15 ft. to the branches, and often 75 ft. round. A cypress in Mexico is 120 ft. round and is estimated by De Candolle to be older than Adamson's baobab. The cypress of Montezuma is 41 feet round. Strabo wrote of a cypress in Persia, as being 2500 years old. The largest tree in Mexico is 127 ft. round, and 120 high, with branches of 30 ft. A chestnut tree on Mount Etna is 196 ft. round close to the ground, and 5 of its branches resemble great trees. De Candolle says there are oaks in

France 1500 years old. The Wallace oak, near Paisley, is nearly 800 years old. The yew trees at Fountain's Abbey are about 1200 years old. That at Crowhurst, 1500. That at Fortingal, above 2000. That at Braburn, 2500 to 3000. Ivys reach 500 or 600 years. The larch the same. The lime 600 or 700 years. The trunk of a walnut tree, 12 ft. in diam., hollowed out, and furnished as a sitting-room, was imported from America and exhibited in London. The trunk was 80 ft. high, without a branch, and the entire height 150 ft., the bark 12 ins. thick and the branches from 3 to 4 ft. in diam. The California pine is from 150 to 200 ft. high and from 20 to 60 ft. in diam. The forests in watered tropical countries are formed of trees from 100 to 200 ft. high, which grow to the water's edge of rivers, presenting a solid and impenetrable barrier of trunks 10 or 12 ft. in diam. The dragon tree is in girth from 40 to 100 ft. and 50 or 60 feet high; and a misosa in South America is described, whose head is 600 ft. round.

TENSILE STRENGTH OF DIFFERENT KINDS OF WOOD, SHOWING THE WEIGHT OR POWER REQUIRED TO TEAR ASUNDER 1 SQUARE INCH.

	Lbs.		Lbs.
Lance	23,000	Pitch Pine	12,000
Locust	25,000	White Pine, (American)	11,800
Mahogany	21,000	White Oak, "	11,500
Box	20,000	Lignum Vitæ	11,800
African Oak	14,500	Beech	11,500
Bay	14,500	Chestnut, sweet	10,500
Teak	14,000	Maple	10,500
Cedar	14,000	White Spruce	10,290
Ash	14,000	English Oak	10,000
Oak, seasoned	13,600	Pear	9,800
Elm	13,400	Larch	9,500
Sycamore	13,000	Mahogany, Spanish	8,000
Willow	13,000	Walnut	7,800
Christiana Deal	12,400	Poplar	7,000
Spanish Mahogany	12,000	Cypress	6,000

BUYING AND SELLING TIMBER.—Inch boards, plank, joists and scantling are generally sold by board measure, the dimensions of one foot of board measure being 1 ft. long, 1 ft. wide and 1 in. thick. Round timber is sold by the cubic foot, and when squared by hewing or sawing is estimated to lose one-fifth, hence a ton of round timber is estimated to contain only 40 cubic feet. Square timber, hewn or sawn, is also sold by the cubic foot and rated at 50 cubic feet to the ton, but as usually surveyed, a ton of timber contains 50 92-100ths cubic feet.

Pine and spruce spars, from 10 to 4½ in. diam. are estimated by taking the diameter, minus the bark, at ⅓ of their length at the large end; they are generally bought and sold by the inch diameter, all under 4 ins. being considered poles.

The soundness of timber may be tested by applying the ear to the middle of one of the ends, while another party strikes the other end. The blow will be clearly and distinctly heard, however long the beam may be, if the wood is sound and of good quality, but if decay has set in, the sound will be muffled and indistinct. The toughest part of a tree will always be found on the side next the north.

BRITISH CARPENTRY.—The fir timber in general use is imported from Memel, Riga, Dantzic, and Sweden. Memel timber is the most convenient for size, Riga the best in quality, Dantzic the strongest, and Swedish the toughest. Riga timber can always be depended upon; red pine may be used whenever durability and strength are objects; and Quebec yellow pine for light dry purposes. Deals are from Norway, Sweden, Prussia, Russia and New Brunswick. For framing, the best deals are the Norway, particularly the Christiana battens; for pannelling, the Christiana white deals; for ground floors, Stockholm and Gefle yellows; for upper floors, Dram and Christiana whites; Archangel and Onega planks for warehouse floors and staircases, and for best floors, &c., Petersburg, Onega and Christiana battens.

100 Superficial ft. make 1 square of boarding, flooring, &c.
120 deals are denominated one hundred.
50 cubic ft. of timber equal 1 load. Also,
600 superficial ft. of inch boards equal 1 load.

Battens are from 6½ to 7 ins. in breadth, deals, 8½ to 10 ins., and planks 11 to 12 ins.

12¼ 12-feet boards to 1 square of rough boarding or flooring.
12½ " edges shot.
13 " wrought and laid folding.
13½ " " " straight joint.
14 " " " ploughed and tongued.
17 12-ft. battens to 1 square of wrought folding door.
18 " yellow to a straight joint floor.

The duration of well seasoned wood, when kept dry, is very great, as beams still exist which are known to be nearly 1100 years old. Piles driven by the Romans, and used in the formation of bridges prior to the Christian era, have been examined of late, and found to be perfectly sound after an immersion of nearly 2000 years.

Russian Way of Stopping Holes in Ships.—In that country, there has lately been invented and successfully applied, a ready means for stopping holes made in ships by collision or otherwise. It consists of a plaster made of two rectangular sheets of canvas sewed together, bordered with a rope, and containing a water-proof material. A sounding-line has to be passed under the keel, and brought up on the other side: then the plaster can be lowered to the hole, and made fast. Several cases are çited in which this invention has been employed with advantage; and a large number of Russian ships are now furnished with such plasters. It is proposed that men be specially trained and ready for the manœuvring of the apparatus.

To Raise the Body of a Drowned Person.—In a recent failure to recover the body of a drowned person in New Jersey, a French-Canadian undertook the job, and proceeded as follows: Having supplied himself with some glass gallon-jars, and a quantity of unslaked lime, he went in a boat to the place where the man was seen to go down. One of the jars was filled half full of lime, then filled up with water, and tightly corked. It was then dropped into the water, and soon after exploded at the bottom of the river, with a loud report. After the third trial, each time at a different place, the body rose to the surface, and was secured.

To Get Rid of Rats, &c.—Get a piece of lead pipe and use it as a funnel to introduce about 1½ ozs. of sulphide of potassium into any outside holes tenanted by rats; not to be used in dwellings. *To get rid of Mice*, use tartar emetic mingled with any favorite food; they will eat, sicken, and take their leave.

HYDRAULIC CEMENT.—Powdered clay, 3 lbs.; oxide of iron, 1 lb.; and boiled oil to form a stiff paste.

ENGINEERS' CEMENT.—Equal parts of red and white lead, with drying oil, spread on tow or canvas. An admirable composition for uniting large stones in cisterns.

STONE CEMENT River.—Sand, 20 parts; litharge, 2 parts; quicklime, 1 part: mix with linseed oil.

GLUE.—Powdered chalk added to common glue strengthens it. A glue which will resist the action of water is made by boiling 1 lb. of glue in 2 qts. of skimmed milk.

CHEAP WATERPROOF GLUE.—Melt common glue with the smallest possible quantity of water; add, by degrees, linseed oil, rendered drying by boiling it with litharge. While the oil is being added, the ingredients must be well stirred, to incorporate them thoroughly.

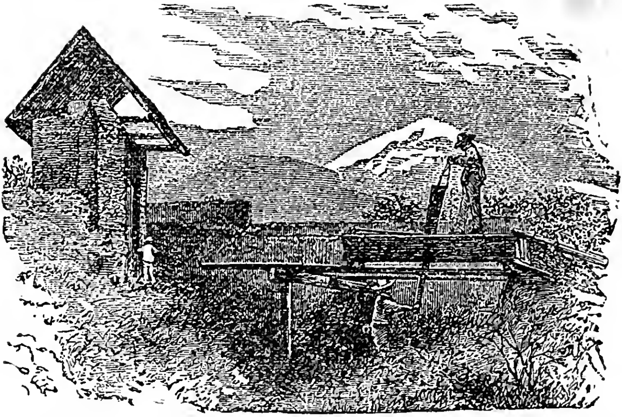
FIRE AND WATERPROOF GLUE.—Mix a handful of quick-lime with 4 oz. of linseed oil; thoroughly lixiviate the mixture; boil it to a good thickness, and spread it on thin plates in the shade: it will become very hard, but can be dissolved over a fire, like common glue, and is then fit for use.

PREPARED LIQUID GLUE.—Take of best white glue, 16 oz.; white-lead, dry, 4 oz.; rain-water, 2 pts.; alcohol, 4 oz. With constant stirring dissolve the glue and lead in the water, by means of a water-bath. Add the alcohol, and continue the heat for a few minutes. Lastly, pour into bottles, while it is still hot.

TO MAKE GRINDSTONES FROM COMMON SAND.—River sand 32 lbs.; shellac, 10 parts; powdered glass, 2 parts; melt in an iron pot, and cast into moulds.

POLISHING POWDER FOR SPECULA.—Precipitate a dilute solution of sulphate of iron by ammonia in excess; wash the precipitate; press it in a screw press till nearly dry; then expose it to heat until it appears of a dull red color in the dark.

ON SAW-MILLS.—TO GET THE MOST LUMBER FROM SAW-LOGS.—Experience has abundantly proved to our satisfaction that this can be done only by the use of the circular saw. Some parties are in favor of the mulay saw. Human ingenuity has been so prolific in the invention and construction of this kind of machinery, that the principal difficulty with the intending purchaser seems to be an inability to decide whose machine is really the best. Every builder or inventor appears to claim for his machine such a perfect constellation of valuable features, that a certain amount of hesitation in coming to a decision seems to be inevitable. In the stationary form of saw mills, the saws are arranged either single or in gangs. Some of the portable kind (circular saw mills) have an upper saw to complete the cut made but partially through large logs by the lower saw. See diagram. By the single movement of a lever, the head-blocks on which the log rests, are simultaneously moved up, moving the log a distance nearer the saw, adequate to the thickness of board desired, with an overplus the width of the cut made by the saw. By moving another lever, a pinion meshing into a rack beneath the log-carriage is made to impel the log against the saw, and run the log backwards after the board is cut. These movements, on the best constructed machines, are made with surprising velocity, some of them being accredited with having cut over 60,000 feet of lumber in one day.



The performance of a 36 horse-power steam engine attached to a modern saw-mill, is equivalent to that of 75 saw-pits requiring the labor of 150 men.

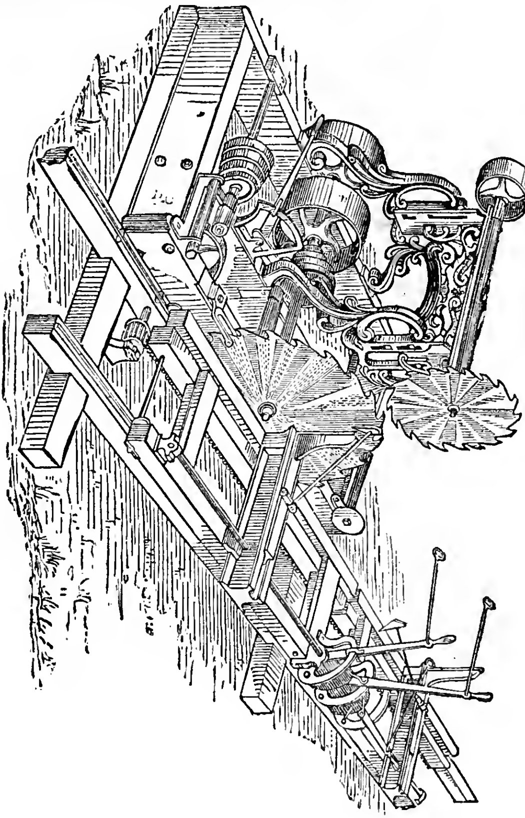
COMPARATIVE RESILIENCE OF VARIOUS KINDS OF TIMBER, ASH BEING 1, Fir ·4, Elm ·54, Pitch Pine ·57, Teak ·59, Oak ·63, Spruce ·64, Yellow Pine ·64, Cedar ·66, Chestnut ·73 Larch ·84, Beech ·86. By resilience is understood the quality of springing back, or toughness.

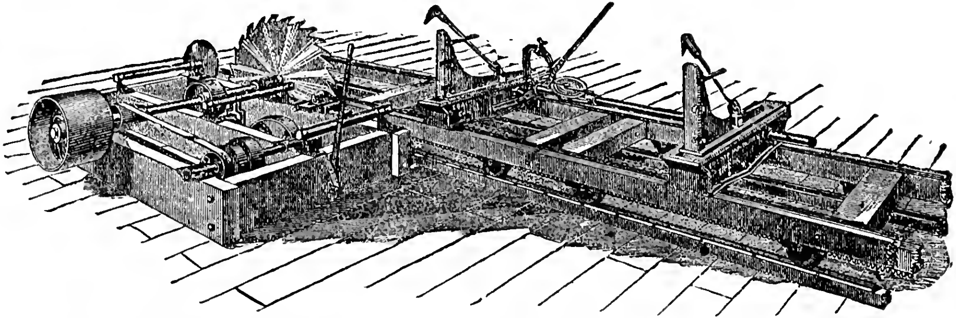
PERCENTAGE OF INCREASE IN STRENGTH OF DIFFERENT WOODS BY SEASONING.—White pine, 9 per cent., Elm 12·3 per cent., Oak 26·6 per cent., Ash 44·7 per cent., Beech 61·9 per cent.

TRANSVERSE STRENGTH OF WOODS, SHOWING THEIR BREAKING WEIGHT FOR A THICKNESS OF ONE INCH SQUARE AND ONE FOOT IN LENGTH, WITH WEIGHT SUSPENDED FROM ONE END.

	BREAKING WEIGHT.	VALUE FOR USE.		BREAKING WEIGHT.	VALUE FOR USE.
	Lbs.			Lbs.	
Locust	295	80	Oak, Canadian	146	36
Hickory	250	55	" live American	245	55
Oak, live American	245	55	" English	140	35
" white "	230	50	Deal Christiana	137	45
" African	208	50	Pine pitch	136	45
Teak	206	60	Beech	130	32
Maple	202		Pine white American	130	45
Oak, English, best	188	45	Elm	125	30
Ash	168	55	Pine Norway	123	40
Pine, American	60	50	Oak Dantzic	122	20
Birch	160	40	White wood	116	38
Chestnut	160	53	Riga Fir	94	30
			Pine, white	92	30

Occasionally we listen to a great deal of rant regarding the beatitudes of "the good old times," during the lives of our forefathers. These times proved very disastrous to the enterprising Dutchman, who, in 1663 started the first saw-mill in England, which he was finally obliged to abandon, and fly to save his life. In 1767 another saw-mill, at Lime-house, near London, was demolished by a mob of sawyers, who considered that their business would be ruined to a dead certainty if things were allowed to go on.





CIRCULAR SAW MILL WITH PATENT HEAD BLOCKS AND INDICATOR. ERIE CITY IRON WORKS, ERIE, PA.

SAW-MILL PERFORMANCES. *Gang Saw*, 34 square ft. of dry oak or 47 ft. of spruce per hour, 1 horse power.
CIRCULAR SAW. The Waterous Engine Co., Brantford, Ont., guarantee to cut, with their 20 H. P. Portable Engine, using saw 50 to 56 ins. diam., 1500 ft. in 1 hour, or 8 to 10,000 ft. in 10 hours, and with their 25 H. P. Semi-Portable Engine, using 60 to 66 inch Saw, 2,000 feet in a single hour, or 8 to 12,000 ft. in 10 hours.

Diameter of Saw in inches.	Revolutions per minute. for American or thick Saws.	Revolutions per minute for English or thin Saws.
30	1800	1200
25	2100	1400
20	2400	1500
15	2700	1800
10	3000	2900
6	3700	3600
4	4900	4800

The old method of manufacturing lumber and dimension stuff by ripping logs lengthways on the sawpit, is still fresh in the remembrance of many. One man mounted the log and pushed the saw downwards and pulled it upwards, assisted by another man in the pit below, with a veil over his face to keep the sawdust out of his eyes. We hail with gratitude the modern improvements which enable us to dispense with every such form of labor.

Having tried the up and down saw and the circular saw also, we would again repeat our conviction that the last mentioned is the best for manufacturing lumber, and should any person act on this expression of opinion, let them in the first place be very careful to get, if possible, the best machine, bring it to the mill, and set it perfectly level and true. When you get it in operation, see that you handle it carefully. If you have been used to running the up and down saw only, you will soon find out that your former experience avails almost nothing in the management of the rotary machine; but when you get the hang of running it, the compensation in the way of convenience, rapidity, and quantity of work, is immense. Some prefer to use the inserted tooth saws, and will use no other. They seem to possess many advantages, and are entirely safe. A late invention of *spreading* the *upper part* of the tooth *towards the point* during the process of manufacture, spreading it out so as to make the point of the tooth the *thickest* part of the circumference of the saw, enables the sawyer to dispense in a great measure with the use of the swage. Those inserted tooth saws which do not possess this improvement must be carefully swaged and filed at least twice per day, and sometimes as often as six or seven times per day, depending upon the kind of lumber being cut. In filing or swaging the saw, be careful to form the point of the teeth absolutely square, and even across, the slightest deviation from perfect truth in this respect being apt to cause the saw to *run*, as it is termed, or vary from its proper course while passing through the log. Some prefer to form the point of the tooth a little hooking, just enough so as to be barely perceptible, and in swaging to use *that part* of the die belonging to the swage, which gives the tooth of the saw a slightly curved or rainbow form, something in this shape ⌒, or scarcely so much curved. One sawyer of 20 years' experience in running machinery, informed us that he never did better or more rapid work with his mill than when he kept his saw exactly right on these *two points* just stated. If you can run a No. 7 gauge saw on your mill, the loss resulting from sawdust will be very slight, and as large saws are generally thickest at the centre, tapering off towards the circumference, this size or No. 6 will, as a general rule, be found sufficiently strong for most purposes. Make sure at all times, especially during frosty weather, that the dogs have a secure hold of the log before the saw enters it. It is only a few days ago that a case came to my knowledge of a firm near Fredericton, N.B., having sustained a severe loss by a log (insufficiently secured of course) canting over on the saw as it was passing through it. The effect was to break off the saw from the mandril, twist off the nut at the end near the saw, and break away the two iron pins used for securing the saw in the collar, causing a stoppage of the mill, and the consequent expense of repair and delay. When you get the mill in operation, see that you handle it carefully, and maintain unceasing watchfulness over it while in operation. Give it *plenty of power*; if you *don't*, you may as well shut up shop at once; *good attendance*, and with a good machine, the attendants will not have much time to play themselves, I can assure you. Keep all the parts well *oiled*—that has a great deal to do with the smooth and successful running of the machine; and, by the way, I would remark that saw-mills are not the only things in this world that run all the better for being oiled. If that kind, loving, gentle, and affectionate spirit of which *oil* is the symbol, pervaded the hearts and the minds of our race, and found universal expression in every thought, word, and deed during our daily intercourse with each other, it would be a very different world from what it is—better for ourselves, and better for our neighbors. Let us all carry on *this* branch of the *oil business* as extensively as possible, and we shall soon see a brotherhood "dwelling together in unity." In order to facilitate calculations regarding the velocity of saws, herewith is appended a reliable table to serve as a guide in ascertaining the proper speed for running:—

TABLE OF SPEED FOR CIRCULAR SAWS.

36	inches	in diameter,	1000	revolutions	per minute
38	"	"	950	"	"
40	"	"	900	"	"
42	"	"	870	"	"
44	"	"	840	"	"
46	"	"	800	"	"
48	"	"	760	"	"
50	"	"	725	"	"
52	"	"	700	"	"
54	"	"	675	"	"
56	"	"	650	"	"
58	"	"	625	"	"
60	"	"	600	"	"
62	"	"	575	"	"
64	"	"	560	"	"
66	"	"	545	"	"
68	"	"	530	"	"
70	"	"	515	"	"
72	"	"	500	"	"
74	"	"	485	"	"
76	"	"	475	"	"
Shingle machine saws			1400	"	"

The march of improvement in the manufacture of shingle machines has been truly wonderful, and they can now be procured from the manufacturer, of almost any capacity and power, at very reasonable rates. Shingle machines are now in use, which cut out over 30,000 shingles per day, carrying two or more bolts. Some of them possess very complex machinery and are positively dangerous to operate unless continual vigilance is maintained. One gentleman well known to the writer, was crippled for life by having his hand terribly lacerated during an unguarded moment by one of these machines. As a rule the less gearing and the more simplicity there is about the mechanism of a shingle machine the more satisfaction will be derived from it.

In the manufacture of shingles, as well as in anything else, it is the wisest policy to use the best materials. Get good rift, free from knots, sand, bark, &c., and you will inevitably get good merchantable stuff, with less waste and more pleasure every way, both with the machinery in the first place, and the satisfactory state of your exchequer in the last. It is all the better if you can lay in a good stock one year ahead, as it cuts much easier when properly seasoned, to say nothing of the saving in weight during transportation. In edging shingles, many prefer the saw to the revolving knives, as it enables the operator in many cases to get a shingle of extra quality by trimming a poor shingle down, and selecting the best part. This can be done by a smart hand with marvellous rapidity, but still, to use a modern phrase, many persons can't see it, and so they use the knives, giving what they conceive to be good reasons for so doing.

VELOCITIES OF WOOD WORKING MACHINERY.—*Circular Saws* at periphery, 6000 to 7000 ft. per minute, *Band Saws*, 2500 feet; *Gang Saws*, 20 inch stroke, 120 strokes per minute; *Scroll Saws*, 300 strokes per minute; *Planing Machine Cutters* at periphery, 4000 to 6000 feet. Work under plaining machine 1-20th of an inch for each cut. *Moulding Machine Cutters*, 3500 to 4000 feet; *Squaring-up Machine Cutters*, 7000 to 8000 feet; *Wood Carving Drills*, 5000 revolutions; *Machine Augers*, $1\frac{1}{2}$ in. diam., 900 revolutions; ditto, $\frac{3}{4}$ in. diam., 1200 revolutions; *Gang Saws*, require for 45 superficial feet of pine per hour, 1 horse-power. *Circular Saws* require 75 superficial feet per hour, 1 horse-power. In oak or hard wood $\frac{3}{4}$ths of the above quantity require 1 horse-power; *Sharpening Angles of Machine Cutters.* Adzing soft wood across the grain, 30°; *Planing Machines*, ordinary soft wood, 35°; *Gauges and Ploughing Machines*, 40°; *Hardwood Tool Cutters*, 50° to 55°.

FILING SAWS.—The grand secret of putting any saw in the best possible order, consists in filing the teeth at a given angle to cut rapidly, and of a uniform length so that the points will all touch a straight edged rule without showing a variation of the hundredth part of an inch. Besides this, there should be just set enough in the teeth to cut a kerf as narrow as it can be made, and at the same time allow the blade to work freely without pinching. On the contrary, the kerf must not be so wide as to permit the blade to rattle when in motion. The very points of the teeth do the cutting. If one tooth is a twentieth of an inch longer than two or three on each side of it, the long tooth will be required to do so much more cutting than it should, that the sawing cannot be done well, hence the saw goes jumping along, working hard and cutting slowly; if one tooth is longer than those on either side of it, the short teeth do not cut although their points may be sharp. When putting a cross-cut saw in order, it will pay well to dress the points with an old file, and afterwards sharpen them with a fine whetstone; much mechanical skill is necessary to put a saw in prime order; one careless thrust with a file will shorten the point of a tooth so much that it will be utterly useless, so far as cutting is concerned; the teeth should be set with much care, and the filing done with the greatest accuracy. If the teeth are uneven at the points, a large flat file should be secured to a block of wood in such a manner that the very points only may be jointed, so that the cutting edge of the same may be in a straight line, or circle, if it is a circular saw; every tooth should cut a little as the saw is worked. The teeth of a hand saw for all kinds of work should be filed fleaming, or at an angle on the front edge, while the back edges may be filed fleaming or square across the blade. The best way to file a circular saw for cutting wood across the grain, is to dress every fifth tooth square across, and apart one twentieth of an inch shorter than the others, which should be filed fleaming at an angle of about forty degrees.

As regards such saws as are used for cutting up large logs into lumber it is of the utmost importance to have them filed at such an angle as will ensure the largest amount of work with the least expenditure of power. The following diagrams will help to illustrate our meaning. Fig. 1 shows the shape of teeth which nearly all experienced

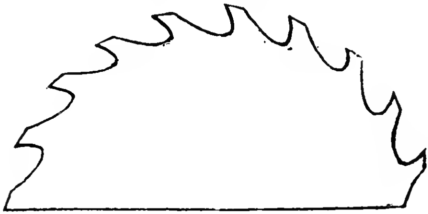


FIG. 1.

mill-men consider as that standard form which combines the greatest amount of strength and capacity for rapid work, with the minimum of driving power while doing the work.

Figure No. 2 represents a passable form of teeth which are capable of doing a good deal of work, but their great weakness lies in their slender points. Look out for "breakers" when teeth of this description are passing through dry spruce or hemlock knots.

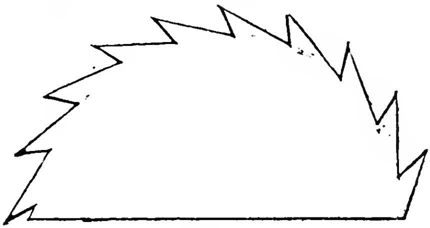


FIG. 2.

Fig. No. 3 illustrates the appearance of one of those intolerable wood rasps which are altogether too common in saw-mills. Only think what an appalling waste of valuable power is required to drive a "jigger" like this through a large log!

FIG. 3.

Fig. 4, at *a*, is intended to show the method of ascertaining the proper-angle, that of sixty degrees, at which such saws *should* be filed. The diagram being self-explanatory requires but little further elucidation here. A quarter circle with lines radiating from the centre towards the circumference is represented near the verge of the segment of a circular saw. The lower part corresponds with the level of the horizon, and the higher part at 90° corresponds with the zenith or meridian, where the sun appears at noon-day. Exactly half-way up is 45°; look up a little higher and you will find 60°, indicated by the radiating line which runs parallel with the angle of the tooth of the saw and this is the guide you must follow in filing. The same rule is seer applied to a straight mill saw at *b*.

Many good authorities contend that mill saws should in no case be set with the instrument commonly used for that purpose, but that in lieu thereof the teeth should be spread out at the points with the swage or upset to a sufficient extent to permit the body of the saw to operate without binding. Both instruments require to be skilfully handled, and the swage, when used in this way, has proved itself equal to every emergency without the risk of breaking the teeth. It would be quite safe to say that the saw-set should only be used on saws of this description with the most extreme caution and care. Every manufacturer, however, has his own opinion, and consequent practice on the subject, some contending that one way is right and the other directly the reverse.

TO REPAIR FRACTURED CIRCULAR SAWS.—The best way to do this is to drill a small round hole at the termination of the crack, which effectually prevents its further extension. I have seen some circular saws very neatly repaired by riveting thin clamps to each side of the fracture, both clamps and rivets being countersunk so they will be level with the surface of the saw, and placed in such a position across the crack as to impart the greatest possible strength to the weakest place.

TO MEND BROKEN CROSS-CUT SAWS.—In the first place scarf off the broken edges in such a manner that when lapped over each other they will be about the same thickness as the rest of the plate, and rivet them together loosely with iron rivets inserted through holes which must be punched for that purpose ; the ends must be united

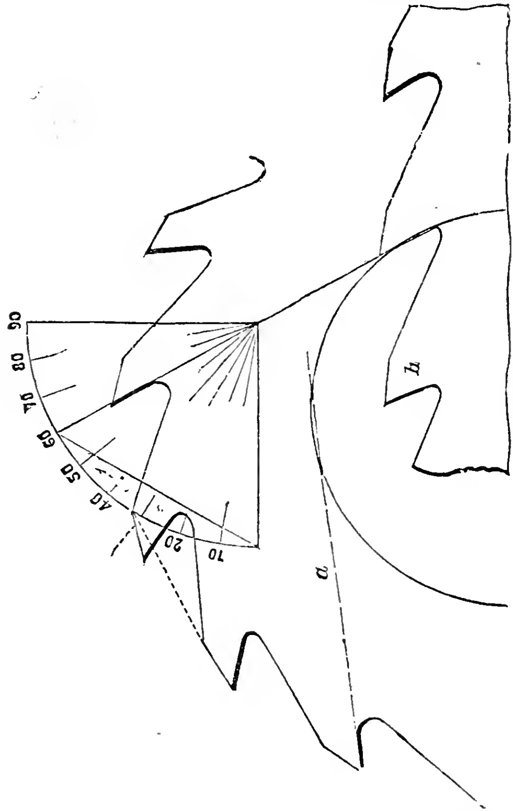


FIG. 4.

with great accuracy so that the teeth, &c., of the saw may range truly. Now place the saw in the fire, then a flux of powdered borax and sal ammoniac is flowed all over it after having it raised to the proper heat. See page 270 for preparing and using the composition. Return the saw to the fire and when it is raised to the proper welding heat, place it on the anvil and unite the joint as rapidly as possible with the hammer ; be careful not to heat so hot as to injure the steel. When the job is well done, and the part properly tempered, it will be found as strong as the rest of the plate. I know one blacksmith in Canada who told me that this class of work was the best paying part of his business.

QUANTITY AND COST OF SUPPLIES FOR HORSES AND LUMBERING CREWS IN THE WOODS.—The following figures have been kindly furnished for this work by the obliging manager of Messrs. Gilmour's mill on the Gatineau, near Ottawa, Canada, and are most valuable as affording a basis for calculating the quantity and quality of the supplies required for men and horses engaged in this branch of industry. These calculations are the result of long experience in the business, and are based on actual consumption.

Quantity of Oats for each span of horses,			51 lbs.	per day.
"	Hay	" "	40	"
"	Flour used by each man		1.80	"
"	Pork	" "	1.22	"
"	Beef	" "	0.85	"
"	Beans	" "	0.33	"
"	Fish	" "	0.12	"
"	Onions	" "	0.13	"
"	Potatoes	" "	0.47	"
Total daily consumption per man			4.92	
Quantity of Tea used		"	1½ lbs.	per month.

The daily allowance of oats for each span of horses may appear large, but it must be remembered that the labor is extremely severe, and more hay will be required if any part of the oats is withheld. On making inquiry with reference to the item of molasses, so largely used by our lumbering friends in New Brunswick and Maine, the answer returned was that owing to the heavy cost of the commodity, it was entirely omitted from the list of supplies. The following exhibits the comparative value of Mess and Prime Pork, calculated from actual consumption :—

Mess Pork.	*Prime Mess.*	*Mess Pork.*	*Prime Mess.*
$26	$18 80	$17	$12 24
25	18 08	16	11 51
24	17 35	15	10 78
23	16 62	14	10 05
22	15 89	13	9 32
21	15 16	12	8 59
20	14 43	11	7 86
19	13 70	10	7 13
18	12 97	9	6 40

1 Barrel Mess averages 37 lbs. grease, 6 lbs bones, when cooked.
1 " Prime Mess 24 " 13 " "

TO MEND BROKEN SAWS.—Pure silver, 19 parts ; pure copper, 1 part ; pure brass, 2 parts ; all to be filed into powder, and thoroughly mixed ; place the saw level on the anvil, broken edges in contact, and hold them so ; now put a small line of the mixture along the seam, covering it with a larger bulk of powdered charcoal; now with a spirit lamp and a jewellers' blow-pipe hold the coal dust in place, and blow sufficient to melt the solder mixture; then with a hammer set the joint smooth, and file away any superfluous solder, and you will be surprised at its strength; the heat will not injure the temper of the saw.

VELOCITY OF WHEELS, PULLEYS, DRUMS, &C.—When wheels are applied to communicate motion from one part of a machine to another, their teeth act alternately on each other; consequently, if one wheel contains 60 teeth, and another 20 teeth, the one containing 20 teeth will make 3 revolutions while the other makes but 1; and if drums or pulleys are taken in place of wheels, the effect will be the same; because their circumferences, describing equal spaces, render their revolutions unequal; from this the rule is derived. namely:—

Multiply the velocity of the driver by the number of teeth it contains, and divide by the velocity of the driven. The quotient will be the number of teeth it ought to contain; or, multiply the velocity of the driver by its diameter, and divide by the velocity of the driven.

Example 1. If a wheel that contains 75 teeth makes 16 revolutions per minute, required the number of teeth in another, to work into and make 24 revolutions in the same time. According to rule, you multiply 16 by 75, and divide the product, which is 1200, by 24, and you have the answer, 50 teeth.

Example 2. Suppose a drum, 30 inches in diameter, to make 20 revolutions per minute, required the diameter of another to make 60 revolutions per minute. According to rule, you multiply 20 by 30, and divide the product, which is 600, by 60, and you have the answer, 10 inches.

Example 3. A wheel 64 inches in diameter, and making 42 revolutions per minute, is to give motion to a shaft at the rate of 77 revolutions in the same time; find the diameter of a wheel suitable for that purpose. According to rule, multiply 42 by 64, and divide the product, which is 2688, by 77, and you will have for the answer 35 inches nearly.

```
77)2688(34 10-12
   231
   ---
    378
    308 70
    ---
```

Example 4. Suppose a pulley 32 inches diameter to make 26 revolutions; find the diameter of another to make 12 revolutions in the same time.

According to rule, $26 \times 32 \div 12 = 69\frac{1}{3}$—

```
26 and 12) 832.  This will be seen to be 69⅓
32          ---
---       69 4-12=⅓
832
```

Example 5. Find the number of revolutions per minute made by a wheel or pulley 20 inches in diameter, when driven by another 48 inches in diameter, and making 45 revolutions in the same time. According to rule, $48 \times 45 \div 20 = 108$. That is, 48 multiplied by 45 = 2160, divided by 20, gives the answer, 108 revolutions.

CONSTRUCTION OF TRUSSED ROOFS.—In roofs of the ordinary construction, the roof covering is laid upon *rafters* supported by horizontal *purlins*, which rest on upright *trusses* or frames of timber, placed on the walls at regular distances from each other. Upon the framing of the trusses depends the stability of the roof, the arrangement of the rafters and purlins being subordinate matters of detail. In *Trussed Roofs, exerting no side thrust on the walls*, each truss consists essentially of a pair of principal rafters or *principals*, and a horizontal *tie beam*, and in large roofs these are connected and strengthened by *king and queen posts and struts*. (See figs. 2. and 3.)

Fig. 1. shows a very simple truss in which the tie is above the bottom of the feet of the principal, which is often done in small roofs for the sake of obtaining height. The tie in this case is called a *collar beam*. The feet of both common and principal rafters rest on a *wall plate*. The purlins rest on the collar, and the common rafters but against a ridge running along the top of the roof. This kind of truss is only suited to very small spans, as there is a cross strain on that part of the principal below the collar, which is rendered harmless in a small span by the extra strength of the principal, but which in a large one would be very likely to throw out the walls.

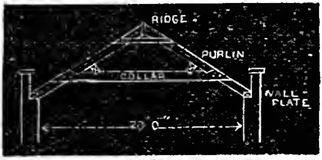


Fig. 1.

In roofs of larger span the tie beam is placed below the feet of the principal, which are tenoned into and bolted to it. To keep the beam from *sagging*, or bending by its own weight, it is suspended from the head of the principals by a king post of wood or iron. The lower part of the king post affords abutments for sturts supporting the principal immediately under the purlins, so that no cross strain is

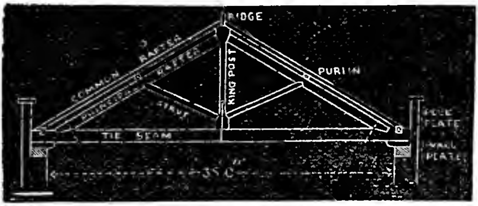


Fig. 2.

exerted on any of the timbers in the truss, but they all act in the direction of their length, the principal and struts being subjected to compression, and the king post and the tie beam to tension. Fig. 2 shows a sketch of a king truss. The common rafters but on a *pole plate*, the tie beams resting either on a continuous plate, or on short templates of wood and stone.

Where the span is considerable, the beam is supported at additional points by suspension pieces called queen posts (fig 3), from the bottom of which spring additional struts; and, by extending this

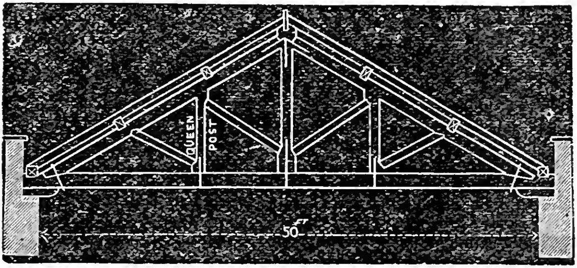


Fig. 3.

principle *ad infinitum*, we might construct a roof of any span were it not that a practical limit is imposed by the nature of the materials. Sometimes roofs are constructed without king posts, the queen posts being kept apart by a straining piece. This construction is shown in

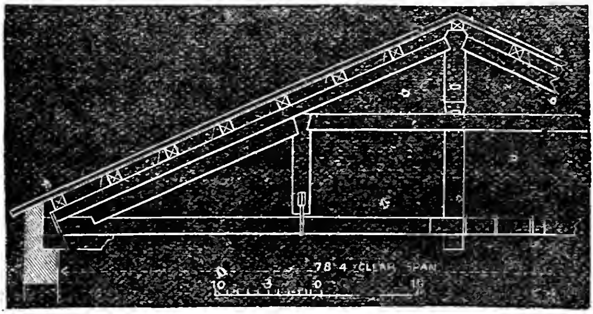


Fig. 4.

fig. 4, which shows the design of the old roof (now destroyed) of the church of St. Paul, outside the walls, at Rome. This truss is interesting from its early date, having been erected about 400 years ago: the trusses are in pairs, a king post being keyed in between each pair to support the beams in the centre.

Of late years iron has been much used as a material for the trusses of roofs, the tie beams and suspending pieces being formed of light rods, and the principals and struts of rolled T or angle iron, to which sockets are riveted to receive the purlins.

DURABLE INSULATION FOR ELECTRIC WIRES.—Tin the wires and then cover with pure rubber.

The following tabulated form shows the results of Mr. Hodgkinson's experiments on the crushing strengths of different woods per square inch of section. The samples crushed were short cylinders 1 inch diameter, and 2 inches long, flat at the ends. The results given in the first column are those obtained when the wood was moderately dry. The samples noted in the second column were kept seasoning 2 months longer than the first. The third column is appended by the author, to illustrate the resilience or toughness of certain woods.

Kind of Wood.	Crushing strength per square inch of section.	Length in feet of a rod 1 inch square that would break by its own weight.
Alder,	6831 to 6960	
Ash,	8683 to 9363	42,080
Bay,	7518 to 7518	
Box,	10300	
Beech,	7733 to 7363	38,940
Birch,	10300	
English Birch,	3297 to 6402	
Cedar,	5674 to 5863	
Deal, Christiana,	....	55,500
Red Deal,	5748 to 6586	
White Deal,	6781 to 7293	
Hornbeam,	7300	
Elder,	7451 to 9973	
Elm,	7451 to 10331	39,050
Fir (Memel),	....	40,500
Fir (Spruce),	6499 to 6819	
Larch,	....	42 160
Mahogany,	8198 to 8198	
Lignum Vitæ,	9900	
Oak (Quebec),	4231 to 5982	
Oak (English),	6484 to 10058	32,900
Pine (Pitch),	6790 to 6790	
Pine (Red),	5395 to 7518	
Poplar,	3107 to 5142	
Plum (Dry),	8241 to 10493	
Sycamore,	....	35,800
Teak,	8241 to 12101	36,049
Walnut,	6063 to 7227	
Willow,	2898 to 6128	

It was also found that in pillars of the same dimensions, but of different materials, taking the strength of cast iron at 1,000, that of wrought iron was 1,745, cast steel 2,518, Dantzic Oak 108.8, and Red Deal 78.5.

Beams of timber, when laid with their concentric layers vertical, are stronger than when laid horizontal, in the proportion of 8 to 7.

Anti-Fouling Composition for Ships.—Melt, mix and grind together into an impalpable powder, 1 part copper, 4 of zinc, and 1 of tin: mix thoroughly with red lead or Torbay mineral red, and apply to the ship's bottom. (See "Marine Paint for Metals in Salt Water," under Painters' Department.)

MEASUREMENT AND CALCULATIONS OF THE TONNAGE OF VESSELS AND SHIPS OF THE UNITED STATES, UNDER THE ACT OF CONGRESS OF MAY 6, 1864.

The *tonnage deck*, in vessels having 3 or more decks to the hull, shal be the *second deck from below*, in *all other cases the upper deck of the hull* is to be the tonnage-deck. The length from the *forepart of the outer planking, on the side of the stem*, to the *after part of the main stern post of screw steamers*, and to the *after part of the rudder-post of all other vessels, measured on the top of the tonnage deck*, shall be accounted the vessel's length. The *breadth of the broadest part on the outside of the vessel* is accounted the vessel's *breadth* of beam. A measure from *the under side of tonnage deck plank, amidships, to the ceiling of the hold* (average thickness), shall be accounted the *depth* of hold. If the vessel has a *third deck*, then the height from the top of the tonnage deck plank to the under side of the upper deck plank shall be accounted as the *height* under the spar-deck. All measurements to be taken in feet and fractions of feet; and all fractions of feet shall be expressed in decimals. The *Register tonnage* of a vessel is her entire internal cubical capacity in tons of 100 cubic feet each, to be determined as follows: *Lengths*. Measure the length of the vessel in a straight line along the upper side of the tonnage deck from the inside of the inner plank (average thickness) at the side of the stem to the inside of the plank on the stern timbers (average thickness), deducting from this length what is due to the rake of the bow in the thickness of the deck, and what is due to the rake of the stern timber in one-third of the round of the beam; divide the length so taken into the number of equal parts required by the following table, according to the class in such table to which the vessel belongs:

TABLE OF CLASSES.

Class 1. Vessels of which the tonnage length according to the above measurement is 50 feet or under, into 6 equal parts.

2. Over 50 feet and not over 100, feet into 8 equal parts.
3. Over 100 feet and not over 150 feet, into 10 equal parts.
4. Over 150 feet and not over 200 feet, into 12 equal parts.
5. Over 200 feet and not over 250 feet, into 14 equal parts.
6. Over 250 feet, into 16 equal parts.

The extent of the areas is found by measurement and calculation, and if there be a break or poop or any other permanent closed in space on the upper decks, or on the spar deck, available for cargo, or stores, or for the berthing or accomodation of passengers or crew, the tonnage of such space shall be computed. If a vessel has a third deck, or spar deck, the tonnage between it and the tonnage deck is also computed.

In ascertaining the tonnage of open vessels, the upper edge of the upper strake is to form the boundary line of measurement, and the depth shall be taken from an athwartshipline, extending from the upper edge of said strake at each division of the length.

The register of the vessel must express the number of the decks, the tonnage under the tonnage deck, that of the between decks, above the tonnage deck; also that of the poop or other enclosed spaces above the deck, each separately. In every registered U. S. ship or vessel the number denoting the total registered tonnage shall be deeply carved or otherwise permanently marked on her main beam, and shall be so continued, and if at any time cease to be so continued such vessel shall no longer be recognized as a registered U. S. vessel.

By a subsequent Act, approved Feby. 28, 1865, the preceding Act was so construed that "no part of any ship or vessel shall be admeasured or registered for tonnage that is used for cabins or state-rooms, and constructed entirely above the first deck which is not a deck to the hull."

CARPENTERS' MEASUREMENT FOR A SINGLE-DECK VESSEL.—*Rule.* Multiply the length of keel, the breadth of beam and the depth of hold together, and divide by 95.

FOR A DOUBLE DECK VESSEL.—*Rule.* Multiply as above, taking half the breadth of beam for the depth of the hold, and divide by 95.

BRITISH MEASUREMENT.

The British mode for measuring vessels, authorized by Act of Parliament in 1854, has been substantially copied into the above noted Act to regulate the admeasurement of tonnage in the United States, the main difference being a reduced number of areas or sections by the British method, which stands as follows.

1. Vessels of which the tonnage length is 50 feet or under are divided into	4 equal parts.
2. Over 50 and not over 120 feet, into	6 " "
3. " 120 " " " 180 " "	8 " "
4. " 180 " " " 225 " "	10 " "
5. " 225 ft. into	12 " "

Divide the length of the upper deck between the after part of the stem and the forepart of the stern-post into 6 *equal parts*, and note the foremost, middle, and aftermost points of division. Measure the *depths* at these three points in feet and tenths of a foot, also the *depths* from the under side of the upper deck to the ceiling at the timber strake; or, in case of a break in the upper deck, from a line stretched in continuation of the deck. For the *breadth*, divide each depth into 5 equal parts, and measure the inside breadths at the following points, viz.: at 2 and 8 from the upper deck of the foremost and aftermost depths, and at 4 and 8 from the upper deck of the midship depth. Take the *length*, at half the midship depth, from the afterpart of stem to the forepart of the stern-post. Then, to twice the midship depth, add the foremost and aftermost depths for the *sum* of the depths; and add together the foremost upper and lower breadths, 3 times the upper breadth with the lower breadth at the midship, and the upper, and twice the lower breadth at the after division for *sum of the breadths.*

Multiply together the sum of the depths, the sum of the breadths, and the length, and divide the product by 3500, which will give the number of tons or register. If the vessel has a poop or half deck, or a break in the upper deck, measure the inside mean length, breadth and height of such part thereof as may be included within the bulkhead; multiply these three measurements together, and divide the product by 92.4. The quotient will be the number of tons to be added to the result, as above ascertained.

For Open Vessels.—The depths are to be taken from the upper edge of the lower strake.

For Steam Vessels.—The tonnage due to the engine room is deducted from the total tonnage computed by the above rule.

To determine this, measure the inside length of the engine-room from the foremost to the aftermost bulkhead; then multiply this length by the midship depth of the vessel and the product by the inside midship breadth at .4 of the depth from the deck, and divide the final product by 92·4.

SELF-ACTING NAUTICAL PUMP.—Captain Leslie, in a voyage from North America to Stockholm, adopted an excellent mode of emptying water from his ship's hold when the crew were disabled from performing that duty. About ten or twelve feet above the pump, he rigged out a spar, one end of which projected overboard, while the other was fastened as a lever to the machinery of the pump. To the end which projected overboard was suspended a water-butt half full, but corked down, so that when the coming wave raised the water-butt, the other end depressed the piston of the pump; but, at the retiring of the wave, this was reversed; for, by the weight of the butt, the piston came up again, and with it the water. Thus, without the aid of the crew, the ship's hold was cleared of water in a few hours.

ENGLISH FREIGHT TABLE.

GOODS PROPORTIONED IN STOWAGE.

The following Table is from "*Harrison's Freighters' Guide*," London Edition, 1848. The 1st column shows the Quantities, in Numbers and Decimal parts; the 2d column the character, or kind of Goods; the 3d column the Gross Weight of the Goods in Tons and Decimal parts of a ton; and the 4th column the number of Cubic Feet required for Stowing the same. [850 *Cubic Feet equal* 21.2 *Tons, or* 1 *Keel.*]

Quantities in Numbers & Decimals.	Articles of Freight.	Tons Weight	Cub. Feet.
*97.	Quarters of Wheat, 61.2 lbs. per Bushel, equal	21.2	850
88.	do. Tares, Beans, & Peas 63 do. do.	20.	do
105.	do. Rye,.................. 57 do. do.	21.	do.
108.	do. Seed,................. 52 do. do.	20.	do.
114.	do. Barley,............... 52 do. do.	21.	do.
125.	do. Oats,................. 37 do. do.	16.5	do.
10.	Tons Clean Hemp and Flax,................do.	10.	do.
9.107	do. Outshot do. do..................do.	9.107	do.
7.760	do. Half-clean do. do..................do.	7.76	do.
5.825	do. Codilla do. do..................do.	5.825	do.
4.444	do. Wool,................................do.	4.444	do.
5.257	do. Wool, compressed,....................do.	5.257	do.
7.2727	do. Dried Skins,.........................do.	7.2727	do.
17.	do. Tallow,..................... } do.	17.	do.
17.	do. Ashes,...................... } do.	17.	do.
17.	do. Hides (Salted),............. } do.	17.	do.
17.	Loads of Timber (Baltic squared Fir),.... } do.	18.5	do.
17.	do. do (N. American do.),...... } do.	13.5	do.
17.	do. do (Birch do.),............ } do.	22.	do.
14.923	do. Masts (round),.......................do.	17.5	do.
	Pieces. Ft. In. In.		
5.1515	Stand. Hund. Deals, 120 12 11 1½ do.	17.	do.
4.857	do. do Battens, 120 12 7 2½ do.	17.75	do.
† 1.275	Mille Baltic Staves reduced............... } do.	15.25	do.
	Viz. 1200 *pieces,* 66 *in. long by* 1½ *thick,*		
† 1.300	do. Odessa do. do............ } do.	15.25	do.
† 1.200	do. Quebec do. do............ } do.	15.25	do.
† 0.840	do. Baltic Staves rough .... } do.	15.25	do.
	1200 *pieces* 72 *inches by* 3½........		
† 0.708	do. Odessa do. do............... } do.	15.25	do.
	1200 *pieces* 76 *inches by* 3½........		
† 1.054	do. Quebec do. do .... } do.	15.25	do.
	1200 *pieces* 66 *inches by* 2¾........		
† 3.885	do. West India do. do.............. } do.	15.25	do.
	1200 *pieces* 42 *inches by* 1¼.........		
80.	Casks Pot and Pearl Ashes,............... do.	16.	do.
8.	Tons Bones (calcined), in Bulk, ...do.	8.	do.
12.	do. do. (manure, &c.), do..............do.	12.	do.
16.	do. do. (best quality), do..............do.	16.	do.

* Wheat is the standard, 8 imperial bushels of Wheat equal 1 Quarter, and 1 English Quarter equal 8¼ United States bushel.

† The Staves average 6 inches in breadth.

ENGLISH FREIGHT TABLE.

Quantities in Numbers & Decimals.	Articles of Freight.		Tons Weight	Cub. Feet
9.414	Tons Mats of 400 pieces (Archangel), equal		8.5	850
107.	Barrels Tar....................do.........do.		16.	do.
100.	do. Pitch ....do.........do.		20.	do.
100.	do. Tar..................(Stockholm), do.		16.	do.
136.	do. Tar and Rosin........(American), do.		17.	do.
140.	do. Flour 220 lbs. each.....(196 nett), do.		13.75	do
160.	Sacks do. 280 do..................do.		20.	do.
	ON COTTON.			
8.333	Tons New Orleans and Mobile, all compressed,............................	do.	8.333	do.
9.166	do. best carrying ships, do..............	do.	9.166	do.
4.75	do. Charleston and Savannah, not compressed,..............................	do.	4.75	do.
7.	do. Pernambuco and Maranham ☞ Vessels from these ports generally stow 10 per cent. more than ½ the register tonnage, part compressed, say 7 tons as above	do.	7.	do.
9.7	do. Alexandria, all compressed.........do.		9.7	do.
5.	do. do. not compressed, ...do.		5.	do.
17.	Hogsheads Tobacco,.......................do.		10.	do.
20.	do. Sugar 16½ cwt. average,............do.		16.5	do.
40.	Tierces Coffee, 7 cwt. do................do.		14.	do.
230.	Bags do. 1½ cwt. do................do.		17.25	do.
17.	Tuns of Oil of 252 gals. each,................do.		18.5	do.
17.	do. Wine, Brandy, or any other Spirit reckoning the full gauge of the Casks,	do.	20.	do.
8.	Tons Oranges and Lemons of 10 Chest or 20 Boxes per Ton,................	do.	10.	do.
4.500	do. Cork, (Faro),..........................do.		4.5	do.
10.	do. Bark, (Tree),..........................do.		10.	do.
8.	do. do. (Coppice).......................do.		8.	do.
110.	Tierces Beef, 3 cwt. each, ...do.		16.5	do.
156.	Barrels Pork, 2 cwt. each,..................do.		15.5	do.
120.	Bags Bread, 1 cwt. each,..... ....do.		6.	do.
535.	Firkins Butter, 70 lbs. each,................do.		16.5	do.
180.	Barrels Red Herrings,......................do.		11.	do.
144.	do. White do. ....do.		21.5	do.
20.	Hogsheads Copperas,.......................do.		17.	do.
20.	do. Lamp Black, ...do.		7.	do.
120.	Bags do. ... .do.		6.	do.
16.	Tons Soda & other Alkalies, in Casks,......do.		16.	do.
21.	do. do. in Bulk,.......................do.		21.	do.
150.	Carboy, Oil Vitriol,........................do.		8.	do.
40.	Crates Glass, 18 Tables, ...do.		4.5	do.
50.	do. do. 15 do......................do.		5.	do.
60.	Crates Glass, 12 Tables,....................do.		5.5	do.
100.	Gross of Bottles = 6 per Gallon = 19 lbs. Weight per dozen, in Bulk, (Glass),	do.	10.	do.
200.	do. ½ Bottles = 12 per Gallon = 11 lbs. weight per Dozen, in Bulk,..........	do.	11.75	do.

ENGLISH FREIGHT TABLE.

Quantities in Numbers & Decimals.	Articles of Freight.		Tons Weight.	Cub. Feet
80.	Crts. Bottles (Glass) 10⅔ cubic ft. each, equal		10.	850
28.	do. Earthenware, small size,............do.		10.	do.
22.	do. do. mixed sorts or middling size,.do.		9.	do.
16.	do. do. largest size,..................do.		7.	do.
7000.	Fire Bricks,....................in Bulk,	¾	21.	638
8000.	Common do., also Tiles,............do.	do.	21.	do.
26.	Chaldrons Grindstones,.............do.	½	21.	425
17.	Tons Potatoes,......................do.	do.	17.	do.
20.	do. Oil Cake,......................do.	do.	20.	do.
21.	do. Slates,.........................do.	⅔	21.	567
300.	Pigs of Lead,........................do.	⅓	22.	283
* 8.	Wagons of Coal, 53 cwt. each, ...do.	do.	21.200	850

* The Contents of each Wagon of Coals is 126 Cubic Feet, 8 Wagons 1008 Feet, but when stowed in bulk on board a ship, from the spreading out and pressure, become closer packed, and are proved, from practice, to stow in the space of 850 Cubic Feet.

NOTE.—As wheat is the standard equally for weight and measurement, it will be necessary to explain how it is so. The imperial corn bushel is 2218.192 cubic inches: this multiplied by 776 (the number of bushels in 97 qrs. of wheat), and divided by 1728 (the cubic inches in one foot), gives 996 cubic feet; but, when stowed in bulk on board a ship, is reduced in measurement nearly 15 per cent., viz., to 850 cubic feet; 1st, about 8 per cent. by the ship stowing it in spaces where no measurement goods can be stowed, and the immense pressure on the lower parts of the cargo; and 2d, about 7 per cent. difference between the bushel being filled in the customary way, and what it can be made actually to hold; this, by several trials of wheat, 61 lbs. to the bushel, average nearly 5 pints, or 5-64ths, making, in all, about 15 per cent. as above. This seeming paradox, which I have taken some pains to clear up, although well known to exist in practice, by me and every one acquainted with the stowage of goods, applies to every sort of grain, and in fact, to every thing in bulk, according to its weight and elasticity; and 97 qrs. of wheat, is equal to 850 cubic feet.

TREENAILS.—5333 pieces of 9 inches equal 1 load of timber; 4000 do. 12 do. do.; 3200 do. 15 do. do.; 2666 do. do. 18 do. do.; 2285 do. 21 do. do.; 2000 do. 24 do. do.; 1777 do. 27 do. do.; 1600 do. 30 do. do.; 1454 do. 33 do do.; 1333 do. 36 do. do.; 1142 do. 42 do. do.

FIR AND OAK PLANK.—1200 pieces of ½ inch equal 1 load of timber; 600 do. 1 do. do.; 400 do. 1½ do. do.; 300 do. 2 do. do.; 240 do. 2½ do. do.; 200 do. 3 do. do.; 150 do. 4 do. do.; 120 do. 5 do. do.; 100 do. 6 do. do.

FREIGHT TABLE.—The foregoing Table gives about 100 different descriptions of goods, proportioned in stowage.

RULE.—If 97 Quarters of wheat equal a keel (21.2 tons *or* 850 cubic ft.) then how many quarters of Barley, *or* how many tons of Hemp, Wool, *or* Cotton, *or* barrels of Flour can be stowed in a vessel whose carrying capacity is 294 tons?

EXAMPLE.—294 tons multiplied by 40 (the number of cubic feet in a ton) equals 11.760 cubic feet, which *divided* by 850 and the quotient *multiplied* by 140 (the number of barrels which can be stowed in 850 cubic feet, as stated in the table) gives 1936 barrels of Flour, as the quantity which such vessel can carry.

LIGHTNING CALCULATOR FOR MERCHANTS, SEAMEN, CONTRACTORS, &c.,

showing the SOLID CONTENTS or CUBIC FEET of Timber, Stones, Boxes, Bales, Barrels, Casks, Hogsheads, &c., according to their several lengths, breadths and thicknesses. *Condensed from Blunt's Expeditious Measurer.*

EXAMPLE.—Required the cubic contents of a Box, Stone, Bale or Package, 6 feet long, 36 ins. thick or deep, and 46 ins. broad; turn to 36 inches thick, among the running titles over the tables, and opposite 6 ft. and under 46 ins. (indicated by B, denoting breadth), you will find the answer 69, the number of cubic feet.

If there should be a package exceeding the extent of the tables in length, breadth or thickness, its solid contents may, however, easily be found by halving the dimension so exceeding, and doubling the solid content; or, double any suitable number, add any two together, or subtract, as may be required.

Sizes in feet and inches may be determined by applying the scale for inches under each table, adding or deducting as may be required.

In measuring casks and hogsheads, it is customary to deduct one-fifth on account of the bulge. Thus supposing the square or solid contents of a cask should be by the table 20 cubic ft., the 5th off would leave it but 16 ft.

Length		5 Inches Thick,—By										
ft.	*in.*	5 B	6 B	7 B	8 B	9 B	10 B	11 B	12 B	13 B	14 B	15 B
1	—	0 2	0 3	0 3	0 3	0 4	0 4	0 5	0 5	0 5	0 6	0 6
2	—	0 4	0 5	0 6	0 7	0 8	0 8	0 9	0 10	0 11	1 0	1 1
3	—	0 6	0 8	0 9	0 10	0 11	1 1	1 2	1 3	1 4	1 6	1 7
4	—	0 8	0 10	1 0	1 1	1 3	1 5	1 6	1 8	1 10	1 11	2 1
5	—	0 10	1 1	1 3	1 5	1 7	1 9	1 11	2 1	2 3	2 5	2 7
6	—	1 1	1 3	1 6	1 8	1 11	2 1	2 4	2 6	2 9	2 11	3 2
—	1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
—	2	0 0	0 0	0 0	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1
—	3	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1
—	6	0 1	0 1	0 1	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 4

Length		6 Inches Thick,—By										
ft.	*in.*	6 B	7 B	8 B	9 B	10 B	11 B	12 B	13 B	14 B	15 B	16 B
1	—	0 3	0 4	0 4	0 5	0 5	0 6	0 6	0 7	0 7	0 8	0 8
2	—	0 6	0 7	0 8	0 9	0 10	0 11	1 0	1 1	1 2	1 3	1 4
3	—	0 9	0 11	1 0	1 2	1 3	1 5	1 6	1 8	1 9	1 11	2 0
4	—	1 0	1 2	1 4	1 6	1 8	1 10	2 0	2 2	2 4	2 6	2 8
5	—	1 3	1 6	1 8	1 11	2 1	2 4	2 6	2 9	2 11	3 2	3 4
6	—	1 6	1 9	2 0	2 3	2 6	2 9	3 0	3 3	3 6	3 9	4 0
—	1	0 0	0 0	0 0	0 0	0 0	0 0	0 1	0 1	0 1	0 1	1 0
—	2	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	1 0
—	3	0 1	0 1	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 2	2 0
—	6	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 4	0 4	4 0

Length		7 Inches Thick,—By										
ft.	*in.*	7 B	8 B	9 B	10 B	11 B	12 B	13 B	14 B	15 B	16 B	17 B
1	—	0 4	0 5	0 5	0 6	0 6	0 7	0 8	0 8	0 9	0 9	0 9
2	—	0 8	0 9	0 11	1 0	1 1	1 2	1 3	1 4	1 6	1 7	1 8
3	—	1 0	1 2	1 4	1 6	1 7	1 9	1 11	2 1	2 2	2 4	2 6
4	—	1 4	1 7	1 9	1 11	2 2	2 4	2 6	2 9	2 11	3 1	3 4
5	—	1 8	1 11	2 2	2 5	2 8	2 11	3 2	3 5	3 8	3 11	4 2
6	—	2 1	2 4	2 8	2 11	3 3	3 6	3 10	4 1	4 5	4 8	5 0
—	1	0 0	0 0	0 0	0 0	0 1	0 1	0 1	0 1	0 1	0 1	1 0
—	2	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 2	0 2
—	3	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 3
—	6	0 2	0 2	0 3	0 3	0 3	0 4	0 4	0 4	0 5	0 5	0 5

Length ft.	in.	8 Inches Thick,—By 8 B	9 B	10 B	11 B	12 B	13 B	14 B	15 B	16 B	17 B	18 B
1	—	0 5	0 6	0 7	0 7	0 8	0 9	0 9	0 10	0 11	0 11	1 0
2		0 11	1 0	1 1	1 3	1 4	1 5	1 7	1 8	1 9	1 11	2 0
3		1 4	1 6	1 8	1 10	2 0	2 2	2 4	2 6	2 8	2 10	3 C
4		1 9	2 0	2 3	2 5	2 8	2 11	3 1	3 4	3 7	3 9	4 0
5		2 3	2 6	2 9	3 1	3 4	3 7	3 11	4 2	4 5	4 9	5 0
6	—	2 8	3 0	3 4	3 8	4 0	4 4	4 8	5 0	5 4	5 8	6 0
—	1	0 0	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1
—	2	0 1	0 1	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 2	2 0
—	3	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 3	0 3	0 3	3 0
—	6	0 3	0 3	0 3	0 4	0 4	0 4	0 5	0 5	0 5	0 6	0 6

Length ft.	in.	9 Inches Thick,—By 9 B	10 B	11 B	12 B	13 B	14 B	15 B	16 B	17 B	18 B	19 B
1	—	0 7	0 8	0 8	0 9	0 10	0 11	0 11	1 0	1 1	1 2	1 3
2	—	1 2	1 3	1 5	1 6	1 8	1 9	1 11	2 0	2 2	2 3	2 5
3	—	1 8	1 11	2 1	2 3	2 5	2 8	2 10	3 0	3 2	3 5	3 7
4	—	2 3	2 6	2 9	3 0	3 3	3 6	3 9	4 0	4 3	4 6	4 9
5	—	2 10	3 2	3 5	3 9	4 1	4 5	4 8	5 0	5 4	5 8	5 11
6	—	3 5	3 9	4 2	4 6	4 11	5 3	5 8	6 0	6 5	6 9	7 2
—	1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	1 0
—	2	0 1	0 1	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2
—	3	0 2	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 3
—	6	0 3	0 4	0 4	0 5	0 5	0 5	0 6	0 6	0 6	0 7	0 7

Length ft.	in.	10 Inches Thick,—By 10 B	11 B	12 B	13 B	14 B	15 B	16 B	17 B	18 B	19 B	20 B
1	—	0 8	0 9	0 10	0 11	1 0	1 1	1 1	1 2	1 3	1 4	1 5
2	—	1 5	1 6	1 8	1 10	1 11	2 1	2 3	2 4	2 6	2 8	2 9
3	—	2 1	2 4	2 6	2 9	2 11	3 2	3 4	3 7	3 9	4 0	4 2
4	—	2 9	3 1	3 4	3 7	3 11	4 2	4 5	4 9	5 0	5 3	5 7
5	—	3 6	3 10	4 2	4 6	4 10	5 3	5 7	5 11	6 3	6 7	6 11
6	—	4 2	4 7	5 0	5 5	5 10	6 3	6 8	7 1	7 6	7 11	8 4
—	1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1
—	2	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 3	0 3	0 3
—	3	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4
—	6	0 4	0 5	0 5	0 5	0 6	0 6	0 7	0 7	0 8	0 8	0 9

Length ft.	in.	11 Inches Thick,—By 11 B	12 B	13 B	14 B	15 B	16 B	17 B	18 B	19 B	20 B	21 B
1	—	0 10	0 11	1 0	1 1	1 2	1 3	1 4	1 5	1 5	1 6	1 6
2	—	1 8	1 10	2 0	2 2	2 4	2 5	2 7	2 9	2 11	3 1	3 3
3	—	2 6	2 9	3 0	3 3	3 5	3 8	3 11	4 2	4 4	4 7	4 10
4	—	3 4	3 8	4 0	4 3	4 7	4 11	5 2	5 6	5 10	6 1	6 5
5	—	4 2	4 7	5 0	5 4	5 9	6 1	6 6	6 11	7 3	7 8	8 0
6	—	5 1	5 6	6 0	6 5	6 11	7 4	7 10	8 3	8 9	9 2	9 8
—	1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 2	0 2
—	2	0 2	0 2	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 3
—	3	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4	0 5	0 5
—	6	0 5	0 6	0 6	0 6	0 7	0 7	0 8	0 8	0 9	0 9	0 10

Length ft.	in.	12 Inches Thick,—By 12 B	13 B	14 B	15 B	16 B	17 B	18 B	19 B	20 B	21 B	22 B
1	—	1 0	1 1	1 2	1 3	1 4	1 5	1 6	1 7	1 8	1 9	1 10
2	—	2 0	2 2	2 4	2 6	2 8	2 10	3 0	3 2	3 4	3 6	3 8
3	—	3 0	3 3	3 6	3 9	4 0	4 3	4 6	4 9	5 0	5 3	5 6
4	—	4 0	4 4	4 8	5 0	5 4	5 8	6 6	6 4	6 8	7 0	7 4
5	—	5 0	5 5	5 10	6 3	6 8	7 1	7 6	7 11	8 4	8 9	9 2
6	—	6 0	6 6	7 0	7 6	8 0	8 6	9 0	9 6	10 0	10 6	11 0
—	1	0 1	0 1	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 2	0 1
—	2	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 3	0 4	0 2
—	3	0 3	0 3	0 4	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 4
—	6	0 6	0 7	0 7	0 8	0 8	0 9	0 9	0 10	0 10	0 11	0 15

Length ft.	in.	13 Inches Thick,—By 13 B	14 B	15 B	16 B	17 B	18 B	19 B	20 B	21 B	22 B	23 B
1	—	1 2	1 3	1 4	1 5	1 6	1 8	1 9	1 10	1 11	2 0	2 1
2	—	2 4	2 6	2 9	2 11	3 1	3 3	3 5	3 7	3 10	4 0	4 2
3	—	3 6	3 10	4 1	4 4	4 7	4 11	5 2	5 5	5 8	6 0	6 3
4	—	4 8	5 1	5 5	5 9	6 2	6 6	6 10	7 3	7 7	7 11	8 4
5	—	5 10	6 4	6 9	7 3	7 8	8 2	8 7	9 0	9 6	9 11	10 5
6	—	7 1	7 7	8 2	8 8	9 3	9 9	10 4	10 10	11 5	11 11	12 6
—	1	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 3
—	2	0 2	0 3	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4
—	3	0 4	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 6	0 6	0 6
—	6	0 7	0 8	0 8	0 9	0 9	0 10	0 10	0 11	0 11	1 0	1 0

Length ft.	in.	14 Inches Thick,—By 14 B	15 B	16 B	17 B	18 B	19 B	20 B	21 B	22 B	23 B	24 B
1	—	1 4	1 6	1 7	1 8	1 9	1 10	1 11	2 1	2 2	2 3	2 4
2	—	2 9	2 11	3 1	3 4	3 6	3 8	3 11	4 1	4 3	4 6	5 10
3	—	4 1	4 5	4 8	5 0	5 3	5 7	5 10	6 2	6 5	6 9	7 0
4	—	5 5	5 10	6 3	6 7	7 0	7 5	7 9	8 2	8 7	8 11	9 4
5	—	6 10	7 4	7 9	8 3	8 9	9 3	9 9	10 3	10 8	11 2	11 8
6	—	8 2	8 9	9 4	9 11	10 6	11 11	11 8	12 3	12 10	13 5	14 0
—	1	0 1	0 1	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2
—	2	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 4	0 5
—	3	0 4	0 4	0 5	0 5	0 5	0 6	0 6	0 6	0 6	0 7	0 7
—	6	0 8	0 9	0 9	0 10	0 11	1 0	1 0	1 0	1 1	1 1	1 1

Length ft.	in.	15 Inches Thick,—By 15 B	16 B	17 B	18 B	19 B	20 B	21 B	22 B	23 B	21 B	25 B
1	—	1 7	1 8	1 9	1 11	2 0	2 1	2 2	2 4	2 5	2 6	2 7
2	—	3 2	3 4	3 7	3 9	4 0	4 2	4 5	4 7	4 10	5 0	5 3
3	—	4 8	5 0	5 4	5 8	5 11	6 3	6 7	6 11	7 2	7 6	7 10
4	—	6 3	6 8	7 1	7 6	7 11	8 4	8 9	9 2	9 7	10 0	10 5
5	—	7 10	8 4	8 10	9 5	9 11	10 5	10 11	11 6	12 0	12 6	13 0
6	—	9 5	10 0	10 8	11 3	11 11	12 6	13 2	13 9	14 5	15 0	15 8
—	1	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 3	0 3
—	2	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 5	0 5	0 5	0 5
—	3	0 5	0 5	0 5	0 6	0 6	0 6	0 7	0 7	0 7	0 8	0 8
—	6	0 9	0 10	0 11	0 11	1 0	1 1	1 2	1 2	1 2	1 3	1 3

Length ft.	in.	16 Inches Thick,—By 16 B	17 B	18 B	19 B	20 B	21 B	22 B	23 B	24 B	25 B	26 B
1	—	1 9	1 11	2 0	2 1	2 3	2 4	2 5	2 7	2 8	2 9	2 10
2	—	3 7	3 9	4 0	4 3	4 5	4 8	4 11	5 1	5 4	5 7	5 10
3	—	5 4	5 8	6 0	6 4	6 8	7 0	7 4	7 8	8 0	8 4	8 8
4	—	7 1	7 7	8 0	8 5	8 11	9 4	9 9	10 3	10 8	11 1	11 7
5	—	8 11	9 5	10 0	10 7	11 1	11 8	12 3	12 9	13 4	13 11	14 5
6	—	10 8	11 4	12 0	12 8	13 4	14 0	14 8	15 4	16 0	16 8	17 4
—	1	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 3
—	2	0 4	0 4	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 6	0 6
—	3	0 5	0 6	0 6	0 6	0 7	0 7	0 7	0 8	0 8	0 8	0 8
—	6	0 11	0 11	1 0	1 1	1 1	1 2	1 3	1 3	1 4	1 5	1 6

Length ft.	in.	17 Inches Thick,—By 17 B	18 B	19 B	20 B	21 B	22 B	23 B	24 B	25 B	26 B	27 B
1	—	2 0	2 2	2 3	2 4	2 6	2 7	2 9	2 10	2 11	3 1	3 2
2	—	4 0	4 3	4 6	4 9	5 0	5 2	5 5	5 8	5 11	6 2	6 5
3	—	6 0	6 5	6 9	7 1	7 5	7 10	8 2	8 6	8 10	9 3	9 7
4	—	8 0	8 6	9 0	9 5	9 11	10 5	10 10	11 4	11 10	12 3	12 9
5	—	10 0	10 8	11 3	11 10	12 5	13 0	13 7	14 2	14 9	15 4	15 11
6	—	12 1	12 9	13 6	14 2	14 11	15 7	16 4	17 0	17 9	18 5	19 2
—	1	0 2	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 4
—	2	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 6	0 6	0 6	0 6
—	3	0 6	0 6	0 7	0 7	0 7	0 8	0 8	0 9	0 9	0 9	0 10
—	6	1 0	1 1	1 1	1 2	1 3	1 4	1 4	1 5	1 6	1 6	1 7

Length ft.	in.	18 Inches Thick,—By 18 B	19 B	20 B	21 B	22 B	23 B	24 B	25 B	26 B	27 B	28 B
1	—	2 3	2 5	2 6	2 8	2 9	2 11	3 0	3 2	3 3	3 5	3 6
2	—	4 6	4 9	5 0	5 3	5 6	5 9	6 0	6 3	6 6	6 9	7 0
3	—	6 9	7 2	7 6	7 11	8 3	8 8	9 0	9 5	9 9	10 2	10 6
4	—	9 0	9 6	10 0	10 6	11 0	11 6	12 0	12 6	13 0	13 6	14 0
5	—	11 3	11 11	12 6	13 2	13 9	14 5	15 0	15 8	16 3	16 11	17 6
6	—	13 6	14 3	15 0	15 9	16 6	17 3	18 0	18 9	19 6	20 3	21 0
—	1	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 4
—	2	0 5	0 5	0 5	0 5	0 6	0 6	0 6	0 6	0 7	0 7	0 7
—	3	0 7	0 7	0 8	0 8	0 8	0 9	0 9	0 9	0 10	0 10	0 11
—	6	1 2	1 2	1 3	1 4	1 5	1 5	1 6	1 7	1 8	1 8	1 9

Length ft.	in.	19 Inches Thick,—By 19 B	20 B	21 B	22 B	23 B	24 B	25 B	26 B	27 B	28 B	29 B
1	—	2 6	2 8	2 9	2 11	3 0	3 2	3 4	3 5	3 7	3 8	3 10
2	—	5 0	5 3	5 7	5 10	6 1	6 4	6 7	6 10	7 2	7 5	7 8
3	—	7 6	7 11	8 4	8 9	9 1	9 6	9 11	10 4	10 8	11 1	11 6
4	—	10 0	10 7	11 1	11 7	12 2	12 8	13 2	13 9	14 3	14 9	15 4
5	—	12 6	13 2	13 10	14 6	15 2	15 10	16 6	17 2	17 10	18 6	19 2
6	—	15 1	15 10	16 8	17 5	18 3	19 0	19 10	20 7	21 5	22 2	23 0
—	1	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4
—	2	0 5	0 5	0 6	0 6	0 6	0 6	0 7	0 7	0 7	0 7	0 8
—	3	0 8	0 8	0 8	0 9	0 9	0 10	0 10	0 10	0 11	0 11	1 C
—	6	1 3	1 4	1 5	1 5	1 6	1 7	1 8	2 9	1 9	1 10	1 11

Length ft.	Length in	20 Inches Thick,—By 20 B	21 B	22 B	23 B	24 B	25 B	26 B	27 B	28 B	29 B	30 B
1	—	2 9	2 11	3 1	3 2	3 4	3 6	3 7	3 9	3 11	4 0	4 2
2	—	5 7	5 10	6 1	6 5	6 8	6 11	7 3	7 6	7 9	8 1	8 5
3	—	8 4	8 9	9 2	9 7	10 0	10 5	10 10	11 3	11 8	12 1	12 8
4	—	11 1	11 8	12 3	12 9	13 4	13 11	14 5	15 0	15 7	16 1	16 [illegible]
5	—	13 11	14 7	15 3	16 0	16 8	17 4	18 1	18 9	19 5	20 2	20 [illegible]
6	—	16 8	17 6	18 4	19 2	20 0	20 10	21 8	22 6	23 4	24 2	25 [illegible]
—	1	0 3	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4	0 [illegible]
—	2	0 6	0 6	0 6	0 6	0 7	0 7	0 7	0 8	0 8	0 8	0 [illegible]
—	3	0 8	0 9	0 9	0 10	0 10	0 10	0 11	0 11	1 0	1 0	1 1
—	6	1 5	1 6	1 6	1 7	1 8	1 9	1 10	1 11	1 11	2 0	2 1

Length ft.	Length in.	21 Inches Thick,—By 21 B	22 B	23 B	24 B	25 B	26 B	27 B	28 B	29 B	30 B	31 B
1	—	3 1	3 3	3 4	3 6	3 8	3 10	3 11	4 1	4 3	4 5	4 7
2	—	6 2	6 5	6 9	7 0	7 4	7 7	7 11	8 2	8 6	8 9	9 0
3	—	9 2	9 8	10 1	10 6	10 11	11 5	11 10	12 3	12 8	13 2	13 7
4	—	12 3	12 10	13 5	14 0	14 7	15 2	15 9	16 4	16 11	17 6	18 1
5	—	15 4	16 1	16 9	17 6	18 3	19 0	19 8	20 5	21 2	21 11	22 7
6	—	18 5	19 3	20 2	21 0	21 11	22 9	23 8	24 6	25 5	26 3	27 2
—	1	0 3	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4
—	2	0 6	0 6	0 7	0 7	0 7	0 8	0 8	0 8	0 8	0 9	0 9
—	3	0 9	0 10	0 10	0 11	0 11	0 11	1 0	1 0	1 1	1 1	1 2
—	6	1 6	1 7	1 8	1 9	1 10	1 11	2 0	2 1	2 1	2 2	2 3

Length ft.	Length in.	22 Inches Thick,—By 22 B	23 B	24 B	25 B	26 B	27 B	28 B	29 B	30 B	31 B	32 B
1	—	3 4	3 6	3 8	3 10	4 0	4 2	4 3	4 5	4 7	4 9	4 11
2	—	6 9	7 0	7 4	7 8	7 11	8 3	8 7	8 10	9 2	9 6	10 0
3	—	10 1	10 7	11 0	11 6	11 11	12 5	12 10	13 4	13 9	14 3	17 1
4	—	13 5	14 1	14 8	15 3	15 11	16 6	17 1	17 9	18 4	18 11	19 7
5	—	16 10	17 7	18 4	19 1	19 10	20 8	21 5	22 2	22 11	23 8	24 5
6	—	20 2	21 1	22 0	22 11	23 10	24 9	25 8	26 7	27 6	28 5	29 4
—	1	0 3	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 5	0 5	0 5
—	2	0 7	0 7	0 7	0 8	0 8	0 8	0 9	0 9	0 9	0 9	0 10
—	3	0 10	0 11	0 11	0 11	1 0	1 0	1 1	1 1	1 2	1 2	1 2
—	6	1 8	1 9	1 10	1 11	2 0	2 1	2 2	2 3	2 4	2 4	2 5

Length ft.	Length in.	23 Inches Thick,—By 23 B	24 B	25 B	26 B	27 B	28 B	29 B	30 B	31 B	32 B	33 B
1	—	3 8	3 10	4 0	4 2	4 4	4 6	4 8	4 10	4 11	5 1	5 2
2	—	7 4	7 8	8 0	8 4	8 8	8 11	9 3	9 7	9 11	10 3	10 7
3	—	11 0	11 6	12 0	12 6	12 11	13 15	13 11	14 5	14 10	15 4	15 10
4	—	14 8	15 4	16 0	16 7	17 3	17 11	18 6	19 2	19 10	20 5	21 1
5	—	18 4	19 2	20 0	20 9	21 7	22 4	23 2	24 0	24 9	25 7	26 4
6	—	22 1	23 0	24 0	24 11	25 11	26 10	27 10	28 9	29 9	30 8	31 8
—	1	0 4	0 4	0 4	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 5
—	2	0 7	0 8	0 8	0 8	0 9	0 9	0 9	0 10	0 10	0 10	0 11
—	3	0 11	1 0	1 0	1 0	1 1	1 1	1 2	1 2	1 3	1 3	1 4
—	6	1 10	1 11	2 0	2 1	2 2	2 3	2 4	2 5	2 6	2 7	2 8

24 Inches Thick,—By

Length ft.	in.	24 B		25 B		26 B		27 B		28 B		29 B		30 B		31 B		32 B		33 B		34 B	
1	—	4	0	4	2	4	4	4	6	4	8	4	10	5	0	5	2	5	4	5	6	5	8
2	—	8	0	8	4	8	8	9	0	9	4	9	8	10	0	10	4	10	8	11	0	11	4
3	—	12	0	12	6	13	0	13	6	14	0	14	6	15	0	15	6	16	0	16	6	17	0
4	—	16	0	16	8	17	4	18	0	18	8	19	4	20	0	20	8	21	4	22	0	22	8
5	—	20	0	20	10	21	8	22	6	23	4	24	2	25	0	25	10	26	8	27	6	28	4
6	—	24	0	25	0	26	0	27	0	28	0	29	0	30	0	31	0	32	0	33	0	34	0
—	1	0	4	0	4	0	4	0	5	0	5	0	5	0	5	0	5	0	5	0	6	0	6
—	2	0	8	0	8	0	9	0	9	0	9	0	10	0	10	0	10	0	11	0	11	0	11
—	3	1	0	1	1	1	1	1	2	1	2	1	3	1	3	1	4	1	4	1	5	1	5
—	6	2	0	2	1	2	2	2	3	2	4	2	5	2	6	2	7	2	8	2	9	2	10

25 Inches Thick,—By

Length ft.	in.	25 B		26 B		27 B		28 B		29 B		30 B		31 B		32 B		33 B		34 B		35 B	
1	—	4	4	4	6	4	8	4	10	5	0	5	3	5	5	5	7	5	9	5	11	6	1
2	—	8	8	9	0	9	5	9	9	10	1	10	5	10	9	11	1	11	6	11	10	12	2
3	—	13	0	13	7	14	1	14	7	15	1	15	8	16	2	16	8	17	2	17	9	18	3
4	—	17	4	18	1	18	9	19	5	20	2	20	10	21	6	22	3	22	11	23	7	24	4
5	—	21	8	22	7	23	5	24	4	25	2	26	1	26	11	27	9	28	8	29	6	30	5
6	—	26	1	27	1	28	2	29	2	30	3	31	3	32	4	33	4	34	5	35	5	36	6
—	1	0	4	0	5	0	5	0	5	0	5	0	5	0	5	0	6	0	6	0	6	0	6
—	2	0	9	0	9	0	9	0	10	0	10	0	10	0	11	0	11	0	11	1	0	1	0
—	3	1	1	1	2	1	2	1	3	1	3	1	4	1	4	1	5	1	5	1	6	1	7
—	6	2	2	2	3	3	4	2	5	2	6	2	7	2	8	2	9	2	10	2	11	3	0

26 Inches Thick,—By

Length ft.	in.	26 B		27 B		28 B		29 B		30 B		31 B		32 B		33 B		34 B		35 B		36 B	
1	—	4	8	4	11	5	1	5	3	5	5	5	7	5	9	6	0	6	2	6	4	6	6
2	—	9	5	9	9	10	1	10	6	10	10	11	2	11	7	11	11	12	3	12	8	13	0
3	—	14	1	14	8	15	2	15	9	16	3	16	10	17	4	17	11	18	5	19	0	19	6
4	—	18	9	19	6	20	3	20	11	21	8	22	5	23	1	23	10	24	7	25	3	26	0
5	—	23	6	24	5	25	3	26	2	27	1	28	0	28	11	29	10	30	8	31	7	32	6
6	—	28	2	29	3	30	4	31	5	32	6	33	7	34	8	35	9	36	10	37	11	39	0
—	1	0	5	0	5	0	5	0	5	0	5	0	6	0	6	0	6	0	6	0	6	0	7
—	2	0	9	0	10	0	10	0	10	0	11	0	11	1	0	1	0	1	0	1	1	1	1
	3	1	2	1	3	1	3	1	4	1	4	1	5	1	5	1	6	1	6	1	7	1	8
—	6	1	4	2	5	2	6	2	7	2	9	2	10	2	11	3	0	3	1	3	2	3	3

27 Inches Thick,—By

Length ft.	in.	27 B		28 B		29 B		30 B		31 B		32 B		33 B		34 B		35 B		36 B		37 B	
1	—	5	1	5	3	5	5	5	8	5	10	6	0	6	2	6	5	6	7	6	9	6	11
2	—	10	2	10	6	10	11	11	3	11	8	12	0	12	5	12	9	13	2	13	6	13	10
3	—	15	2	15	9	16	4	16	11	17	5	18	0	18	7	19	2	19	8	20	3	20	10
4	—	20	3	21	0	21	9	22	6	23	3	24	0	24	9	25	6	26	3	27	0	27	9
5	—	25	4	26	3	27	2	28	2	29	1	30	0	30	11	31	11	32	10	33	9	34	8
6	—	30	5	31	6	32	8	33	9	34	11	36	0	37	2	38	3	39	5	40	6	41	8
—	1	0	5	0	5	0	5	0	6	0	6	0	6	0	6	0	6	0	7	0	7	0	7
—	2	0	10	0	11	0	11	0	11	1	0	1	0	1	0	1	1	1	1	1	2	1	2
—	3	1	3	1	4	1	4	1	5	1	5	1	6	1	7	1	7	1	8	1	8	1	9
—	6	2	6	2	8	2	9	2	10	2	11	3	0	3	1	3	2	3	3	3	5	3	7

Length ft.	in.	28 Inches Thick,—By 28 B	29 B	30 B	31 B	32 B	33 B	34 B	35 B	36 B	37 B	38 B
1	—	5 5	5 8	5 10	6 0	6 3	6 5	6 7	6 10	7 0	7 2	7 4
2	—	10 11	11 3	11 8	12 1	12 5	12 10	13 3	13 7	14 0	14 5	14 10
3	—	16 4	16 11	17 6	18 1	18 8	19 3	19 10	20 5	21 0	21 7	21 11
4	—	21 9	22 7	23 4	24 1	24 11	25 8	26 5	27 3	28 0	28 9	29 7
5	—	27 3	28 2	29 2	30 2	31 1	32 1	33 1	34 0	35 0	36 0	36 11
6	—	32 8	33 10	35 0	36 2	37 4	38 6	39 8	40 10	42 0	43 2	44 4
—	1	0 5	0 6	0 6	0 6	0 6	0 6	0 7	0 7	0 7	0 7	0 7
—	2	0 11	0 11	1 0	1 0	1 0	1 1	1 1	1 2	1 2	1 2	1 2
—	3	1 4	1 5	1 6	1 6	1 7	1 7	1 8	1 8	1 9	1 10	1 11
—	6	2 9	2 10	2 11	3 0	3 1	3 3	3 4	3 4	3 6	3 7	3 8

Length ft.	in.	29 Inches Thick,—By 29 B	30 B	31 B	32 B	33 B	34 B	35 B	36 B	37 B	38 B	39 B
1	—	5 10	6 1	6 3	6 5	6 8	6 10	7 1	7 3	7 5	7 8	7 11
2	—	11 8	12 1	12 6	12 11	13 4	13 8	14 1	14 6	14 11	15 4	15 9
3	—	17 6	18 2	18 9	19 4	19 11	20 7	21 2	21 9	22 4	23 0	23 8
4	—	23 4	24 2	25 0	25 9	26 7	27 5	28 2	29 0	29 10	30 7	31 5
5	—	29 2	30 3	31 3	32 3	33 3	34 3	35 3	36 3	37 3	38 3	39 3
6	—	35 1	36 3	37 6	38 8	39 11	41 1	42 4	43 6	44 9	45 11	47 2
—	1	0 6	0 6	0 6	0 6	0 7	0 7	0 7	0 7	0 7	0 8	0 8
—	2	1 0	1 0	1 0	1 1	1 1	1 2	1 2	1 3	1 3	1 3	1 4
—	3	1 6	1 6	1 7	1 7	1 8	1 9	1 9	1 10	1 10	1 11	1 11
—	6	2 11	3 0	3 1	3 3	3 4	3 5	3 6	3 8	3 9	3 10	3 11

Length ft.	in.	30 Inches Thick,—By 30 B	31 B	32 B	33 B	34 B	35 B	36 B	37 B	38 B	39 B	40 B
1	—	6 3	6 6	6 8	6 11	7 1	7 4	7 6	7 9	7 11	8 2	8 4
2	—	12 6	12 11	13 4	13 9	14 2	14 7	15 0	15 5	15 10	16 3	16 8
3	—	18 9	19 5	20 0	20 8	21 3	21 11	22 6	23 2	23 9	24 5	25 1
4	—	25 0	25 10	26 8	27 6	28 4	29 2	30 0	30 10	31 8	32 6	33 4
5	—	31 3	32 4	33 4	34 5	35 5	36 6	37 6	38 7	39 7	40 8	41 8
6	—	37 6	38 9	40 0	41 3	42 6	43 9	45 0	46 3	47 6	48 9	50 0
—	1	0 6	0 6	0 7	0 7	0 7	0 7	0 8	0 8	0 8	0 8	0 5
—	2	1 1	1 1	1 1	1 2	1 2	1 3	1 3	1 3	1 4	1 4	1 1
—	3	1 7	1 7	1 8	1 9	1 9	1 10	1 11	1 11	2 0	2 0	2 2
—	6	3 2	3 3	3 4	3 5	3 7	3 8	3 9	3 10	4 0	4 1	4 9

Length ft.	in.	31 Inches Thick,—By 31 B	32 B	33 B	34 B	35 B	36 B	37 B	38 B	39 B	40 B	41 B
1	—	6 8	6 11	7 1	7 4	7 6	7 9	8 0	8 2	8 5	8 7	8 8
2	—	13 4	13 9	14 3	14 8	15 1	15 6	15 11	16 4	16 10	17 3	17 8
3	—	20 0	20 8	21 4	22 0	22 7	23 3	23 11	24 7	25 2	25 10	26 6
4	—	26 8	27 7	28 5	29 3	30 2	31 0	31 10	32 9	33 7	34 5	35 4
5	—	33 4	34 5	35 6	36 7	37 8	38 9	39 10	40 11	42 0	43 1	44 2
6	—	40 1	41 4	42 8	43 11	45 3	46 6	47 10	49 1	50 5	51 8	53 0
—	1	0 7	0 7	0 7	0 7	0 8	0 8	0 8	0 8	0 8	0 9	0 9
—	2	1 1	1 2	1 2	1 3	1 3	1 4	1 4	1 4	1 5	1 5	1 5
—	3	1 8	1 9	1 13	1 10	1 11	1 11	2 0	2 1	2 1	2 2	2 2
—	6	3 4	3 5	3 80	3 8	3 9	3 11	4 0	4 1	4 2	4 4	4 4

32 Inches Thick,—By

Length ft.	in.	32 B	33 B	34 B	35 B	36 B	37 B	38 B	39 B	40 B	41 B	42 B
1	—	7 1	7 4	7 7	7 9	8 0	8 3	8 5	8 8	8 11	9 1	9 4
2	—	14 3	14 8	15 1	15 7	16 0	16 5	16 11	17 4	17 9	18 3	18 9
3	—	21 4	22 0	22 8	23 4	24 0	24 8	25 4	26 0	26 8	27 4	28 0
4	—	28 5	29 4	30 3	31 1	32 0	32 11	33 9	34 8	35 7	36 5	37 4
5	—	35 7	36 8	37 9	38 11	40 0	41 1	42 3	43 4	44 5	45 7	46 8
6	—	42 8	44 0	45 4	46 8	48 0	49 4	50 8	52 0	53 4	54 8	56 0
—	1	0 7	0 7	0 8	0 8	0 8	0 8	0 8	0 9	0 9	0 9	0 9
—	2	1 2	1 3	1 3	1 4	1 4	1 4	1 5	1 5	1 6	1 6	1 7
—	3	1 9	1 10	1 11	1 11	2 0	2 1	2 1	2 2	2 3	2 3	2 4
—	6	3 7	3 8	3 9	3 11	4 0	4 1	4 3	4 4	4 5	4 7	4 8

33 Inches Thick,—By

Length ft.	in.	33 B	34 B	35 B	36 B	37 B	38 B	39 B	40 B	41 B	42 B	43 B
1	—	7 7	7 10	8 0	8 3	8 6	8 9	8 11	9 2	9 5	9 8	9 11
2	—	15 2	15 7	16 1	16 6	17 0	17 5	17 11	18 4	18 10	19 3	19 9
3	—	22 8	23 5	24 1	24 9	25 5	26 2	26 10	27 6	28 2	28 11	29 7
4	—	30 3	31 2	32 1	33 0	33 11	34 10	35 9	36 8	37 7	38 6	39 5
5	—	37 10	39 0	40 1	41 3	42 5	43 7	44 8	45 10	47 0	48 2	49 3
6	—	45 5	46 9	48 2	49 6	50 11	52 3	53 8	55 0	56 5	57 9	59 2
—	1	0 8	0 8	0 8	0 8	0 8	0 9	0 9	0 9	0 9	0 10	0 10
—	2	1 3	1 4	1 4	1 5	1 5	1 5	1 6	1 6	1 7	1 7	1 8
—	3	1 11	1 11	2 0	2 1	2 1	2 2	2 3	2 4	2 4	2 5	2 5
—	6	3 9	3 11	4 0	4 2	4 3	4 4	4 6	4 7	4 8	4 10	5 0

34 Inches Thick,—By

Length ft.	in.	34 B	35 B	36 B	37 B	38 B	39 B	40 B	41 B	42 B	43 B	44 B
1	—	8 0	8 3	8 6	8 9	9 0	9 3	9 5	9 8	9 11	10 2	10 4
2	—	16 1	16 6	17 0	17 6	17 11	18 5	18 11	19 4	19 10	20 4	20 10
3	—	24 1	24 10	25 6	26 3	26 11	27 8	28 4	29 1	29 9	30 6	31 2
4	—	32 1	33 1	34 0	34 11	35 11	36 10	37 9	38 9	39 8	40 7	41 7
5	—	40 2	41 4	42 6	43 8	44 10	46 1	47 3	48 5	49 7	50 9	51 11
6	—	48 2	49 7	51 0	52 5	53 10	55 3	56 8	58 1	59 6	60 11	62 4
—	1	0 8	0 8	0 9	0 9	0 9	0 9	0 9	0 10	0 10	0 10	0 10
—	2	1 4	1 5	1 5	1 5	1 6	1 6	1 7	1 7	1 8	1 8	1 9
—	3	2 0	2 1	2 2	2 2	2 3	2 4	2 4	2 5	2 6	2 6	2 7
—	6	4 0	4 2	4 3	4 4	4 6	4 7	4 9	4 10	5 0	5 1	5 2

35 Inches Thick,—By

Length ft.	in	35 B	36 B	37 B	38 B	39 B	40 B	41 B	42 B	43 B	44 B	45 B
1	—	8 6	8 9	9 0	9 3	9 6	9 9	10 0	10 3	10 5	10 8	10 10
2	—	17 0	17 6	18 0	18 9	19 0	19 5	19 11	20 5	20 11	21 5	21 11
3	—	25 6	26 3	27 0	27 9	28 5	29 2	29 11	30 8	31 4	32 1	32 9
4	—	34 0	35 0	36 0	36 11	37 11	38 11	39 10	40 10	41 10	42 9	43 9
5	—	42 6	43 9	45 0	46 2	47 5	48 7	49 10	51 1	52 3	53 6	54 8
6	—	51 1	52 6	54 0	55 5	56 11	58 4	59 10	61 3	62 9	64 2	65 8
—	1	0 9	0 9	0 9	0 9	0 9	0 10	0 10	0 10	0 10	0 11	0 11
—	2	1 5	1 6	1 6	1 6	1 7	1 7	1 8	1 8	1 9	1 9	1 10
—	3	2 2	2 2	2 3	2 4	2 4	2 5	2 6	2 7	2 7	2 8	2 8
—	6	4 3	4 5	4 6	4 7	4 9	4 10	5 0	5 1	5 3	5 4	5 6

36 Inches Thick,—By

Length ft.	in.	36 B		37 B		38 B		39 B		40 B		41 B		42 B		43 B		44 B		45 B		46 B	
1	—	9	0	9	3	9	6	9	9	10	0	10	3	10	6	10	9	11	0	11	3	11	6
2	—	18	0	18	6	19	0	19	6	20	0	20	6	21	0	21	6	22	0	22	6	23	0
3	—	27	0	27	9	28	6	29	3	30	0	30	9	31	6	32	3	33	0	33	9	34	6
4	—	36	0	37	0	38	0	39	0	40	0	41	0	42	0	43	0	44	0	45	0	46	0
5	—	45	0	46	3	47	6	48	9	50	0	51	3	52	6	53	9	55	0	56	3	57	6
6	—	54	0	55	6	57	0	58	6	60	0	61	6	63	0	64	6	66	0	67	6	69	0
—	1	0	9	0	9	0	10	0	10	0	10	0	10	0	11	0	11	0	11	0	11	1	0
—	2	1	6	1	7	1	7	1	8	1	8	1	9	1	9	1	10	1	10	1	11	1	11
—	3	2	3	2	4	2	5	2	5	2	6	2	7	2	8	2	8	2	9	2	10	2	11
—	6	4	6	4	8	4	9	4	11	5	0	5	2	5	3	5	6	5	6	5	8	5	9

37 Inches Thick,—By

Length ft.	in.	37 B		38 B		39 B		40 B		41 B		42 B		43 B		44 B		45 B		46 B		47 B	
1	—	9	6	9	9	10	0	10	3	10	6	10	10	11	1	11	4	11	7	11	10	12	1
2	—	19	0	19	6	20	1	20	7	21	1	21	7	22	1	22	7	23	2	23	8	24	2
3	—	28	6	29	4	30	1	30	10	31	7	32	5	33	2	33	11	34	8	35	6	36	3
4	—	38	0	39	1	40	1	41	1	42	2	43	2	44	2	45	3	46	3	47	3	48	4
5	—	47	6	48	10	50	1	51	5	52	8	54	0	55	3	56	6	57	10	59	1	60	5
6	—	57	1	58	7	60	2	61	8	63	3	64	9	66	4	67	10	69	5	70	11	72	6
—	1	0	10	0	10	0	10	0	10	0	11	0	11	0	11	0	11	1	0	1	0	1	0
—	2	1	7	1	8	1	8	1	9	1	9	1	10	1	10	1	11	1	11	2	0	2	0
—	3	2	5	2	5	2	6	2	7	2	8	2	8	2	9	2	10	2	11	2	11	3	0
—	6	4	9	4	11	5	0	5	2	5	3	5	5	5	6	5	8	5	9	5	11	6	0

38 Inches Thick,—By

Length ft.	in.	38 B		39 B		40 B		41 B		42 B		43 B		44 B		45 B		46 B		47 B		48 B	
1	—	10	0	10	4	10	7	10	10	11	1	11	4	11	7	11	11	12	2	12	5	12	8
2	—	20	1	20	7	21	1	21	8	22	2	22	8	23	3	23	9	24	3	24	10	25	5
3	—	30	1	30	11	31	8	32	6	33	3	34	1	34	10	35	8	36	5	37	3	38	0
4	—	40	1	41	2	42	3	43	3	44	4	45	5	46	5	47	6	48	7	49	7	50	8
5	—	50	2	51	6	52	9	54	1	55	5	56	9	58	1	59	5	60	8	62	0	63	4
6	—	60	2	61	9	63	4	64	11	66	6	68	1	69	8	71	3	72	10	74	5	76	0
—	1	0	10	0	10	0	11	0	11	0	11	0	11	1	0	1	0	1	0	1	0	1	1
—	2	1	8	1	9	1	9	1	10	1	10	1	11	1	11	2	0	2	0	2	1	2	2
—	3	2	6	2	7	2	8	2	8	2	9	2	10	2	11	3	0	3	0	3	1	3	1
—	6	5	0	5	2	5	3	5	5	5	7	5	8	5	10	5	11	6	1	6	2	6	3

39 Inches Thick,—By

Length ft.	in.	39 B		40 B		41 B		42 B		43 B		44 B		45 B		46 B		47 B		48 B		49 B	
1	—	10	1	10	10	11	1	12	5	11	8	11	11	12	2	12	5	12	9	13	0	13	3
2	—	21	2	21	9	22	3	22	9	23	4	23	10	24	5	24	11	25	6	26	0	26	7
3	—	31	8	32	6	33	5	34	2	34	11	36	9	36	7	37	5	37	2	39	0	39	10
4	—	42	3	43	4	44	5	45	6	46	7	47	8	47	9	49	10	50	11	52	0	52	0
5	—	52	10	54	2	55	6	56	11	58	3	59	7	60	11	62	4	63	8	65	0	66	4
6	—	63	5	65	0	66	8	68	3	69	11	71	6	73	2	74	9	76	5	78	0	78	8
—	1	0	11	0	11	0	11	0	11	1	0	1	0	1	0	1	0	1	1	1	1	1	1
—	2	1	6	1	10	1	10	1	11	1	11	2	0	2	0	2	1	2	1	2	2	2	2
—	3	2	8	2	9	2	9	2	10	2	11	3	0	3	1	3	1	3	2	3	3	3	4
—	6	5	3	5	5	5	7	5	8	5	10	6	0	6	1	6	3	6	4	6	6	6	7

Mr. Moorsom's Formula to Approximate Register Tonnage under any proposed Dimensions.—To shipbuilders who may wish to know, before the construction of an intended design, the approximate register tonnage under any proposed principal dimensions, the following *formula* (which has received the approbation of Messrs. Martin and Ritchie, the two chief surveyors at Lloyd's, who, from their great experience and intelligence, are authorities on the subject) will be found useful, as it gives the tonnage, on an average, generally speaking, within about 2½ per cent.

Let L represent the inside length on upper deck from plank at bow to plank at stern.
" B represent the inside main breadth from ceiling to ceiling.
" D represent the inside midship depth from upper deck to ceiling at timber strake.

Then the register tonnage of any ship will be equal to $\frac{L \times B \times D}{100}$ multiplied by the decimal factor opposite the class in the following table to which she belongs:

Sailing Ships.	Cotton and Sugar Ships, old form	.8
	Ships of the present usual form	.7
Steam Vessels and Clippers.	Ships of two Decks	.65
	Ships of three Decks	.68
Yachts.	Vessels above 60 tons	.5
	Vessels, small	.45

Cost of English Merchantmen per ton.—1. *Tonnage*, 650. *Material*, wood; date, 1865. Wood in hull, masts and spars, \$41; yellow metal, iron-bolts and labor, \$10.30; joiner work and labor. \$5.15; labor on hull, \$20; boats, etc.—outfit, \$12.30; rope and sails, \$8; anchors, chains and tanks, \$4.25; yellow metal sheathing, \$4. Total, \$105. 2. *Iron Merchantman*, of 500 Tons: Cost, \$88 per ton. 3. *Iron-Passenger Ship, or Steamer*, 800 Tons: Cost, \$125 per ton. 4. *Another Iron-Steamer, or Ship*, of 1500 Tons: Cost, \$147 per ton. 5. *Another Iron-Passenger Steamer*, of 1500 Tons: Cost, \$122 per ton, as follows: Material for hull, \$29.50; labor, \$14.50; rent, machinery, tools, etc., \$14.50; fittings and launching, \$14.25; wood, work, \$12.25; equipment, \$17; cabins and fitting, \$20. Total, as above, \$122.

In the case of *steam* vessels, the vessel built of *iron* is more buoyant than the vessel built of wood by about 16 per cent. of the weight of the wood hull, or nearly 9 per cent. of the weight of the cargo. In the case of *sailing* vessels, the iron hull is still more buoyant than the wood hull by about $14.9 + 8.33$ per cent. $= 23.2$ per cent., or about 23 per cent. of the weight of the wood hull, or 13 per cent. of the weight of the cargo.

To Find the Meridian.—Take a piece of board, or any similar material, and describe on it a number of concentric circles. Place this in the sun, over the centre of a plummet. Observe the shortest shadow from the plummet; the sun will then be on the meridian; draw a line to the centre of the circle, and that will be the true meridian line. This will do to mark the apparent time, or to correct the compass for variation.

Captain Boyton's New Devices to Save Life from the Piers, and to Throw a Line from a Ship.—The following are Captain Boyton's statements, as extracted from the New York *Sun*: "My invention is simply this: Here is a wooden bobbin, to which 60 feet of the strongest Manilla line is attached by one end, and a four-pronged steel grappling iron fits in the hollow part of the wood. The whole is enclosed in a leather case, and does not weigh a pound. If every policeman on duty had one of these, the saving of persons from drowning in the rivers would be lessened 80 per cent. If the person in the water accidentally fell in, the officer could hold the grappling iron in his hand, and throw the bobbin, which floats, out to the struggling person. If the case was one of attempted suicide, or where the person was too drunk to make any effort to save himself, he could throw out the grapple, and haul him in. I propose to give the police force of this city and Philadelphia the right to manufacture these for themselves; and, I suppose, they can make them for fifty cents a piece.

"My other invention is equally simple: When a ship is driven on a lee-shore, and her back is being broken by the sea beating against her, the efforts of the coast-guard to throw a rope on board by means of a rocket or mortar frequently fail, owing either to the wind coming into the shore blowing the rocket back or to one side. Now, here is a box, four feet by three, which can be easily placed under the table in the cabin of any vessel. It contains a long, fine, strong line attached to a rocket, of peculiar construction. The ship is driven on shore, and the coast-guard men are there, unable to establish communication between the vessel and the land. The captain brings this box on deck, opens it, and adjusts the rocket to the angle of the box-cover, and fires it off. The rocket, by its own force, and that of the wind blowing in shore, is carried to land. In addition to the tail of fire shown by it passing through the air, the rocket on falling on the ground bursts, and burns a brilliant red light for ten minutes. This is seen by the coast-guard men, who fix the cable to the line, and it is thus hauled aboard, and the crew saved." A common felt-hat may be made use of as a life-preserver. Place the hat upon the water rim downwards, and with the arm around it, pressing it slightly to the breast, the compressed air within will sustain a man for hours.

Natural, Mechanical, and Scientific Facts.

Comparative Yield of Various Vegetables. Productions in Pounds Weight Per Acre.

	Lbs. per ac.		Lbs. per ac.		Lbs. per ac.
Hops	442	Cherries	2 000	Apples	8 000
Wheat	1 260	Onions	2 800	Turnips	8 420
Barley	1 600	Hay	4 000	Cinque-foil grass	9 600
Oats	1 840	Pears	5 000	Vetches, Green	9 800
Peas	1 920	Grass	7 000	Cabbages	10 900
Beans	2 000	Carrots	6 800	Parsnips	11 200
Plums	2 000	Potatoes	7 500	Mangel Wurzel	22 000

One acre will produce 224 lbs. mutton, 186 lbs. beef, 2900 lbs. milk, 300 lbs. butter, and 200 lbs. cheese. A fair crop of potatoes, from 16 bushels of seed, is 340 bushels.

Paris Green, for potato bugs, and other enemies of the farmer, may be made as follows: Dissolve 2 lbs. sulphate of copper in 1 gal. hot water, in a stone jar. In another jar put 1 lb of white arsenic and 2 lbs. pearlash in 44 lbs. hot water, and stir till dissolved. Mix when required in the proportion of 1 part of the former to 5 of the latter, and use with a sprinkler. It is certain death to vermin.

The average growth of trees during 12 years, as determined by a committee of the Illinois Horticultural Society, when planted in belts and groves, is as follows: White maple, 1 ft. diam. and 30 ft. high; Ash-leaf maple, 1 ft. diam. and 20 ft. high; White willow, 1½ ft. diam. and 40 ft. high; Yellow willow, 1½ ft. diam. and 35 ft. high; Lombardy poplar, 10 ins. diam. and 40 ft. high; Blue and White Ash, 10 ins. diam. and 20 ft. high; Chestnut, 10 ins. diam. and 20 ft. high; Black Walnut and Butternut, 10 ins. diam. and 20 ft. high; Elm, 10 ins. diam. and 20 ft. high; Birch (varieties), 10 ins. diam. and 25 ft. high; Larch, 8 ins. diam. and 24 ft. high. The different varieties of evergreens will make an average growth of 18 to 20 ins. in height annually. The longevity of various trees, as estimated by Mr. Don, Secretary and Librarian of the Linnæan Society, are as follows: The Dragon's blood tree, 4,000 years; Baobab tree, of Senegal, 5,150 years; Deciduous Cypress, 6,000; Ash, 400; Yew, 3,000; Oak, 1,600; Cedar of Lebanon, 3,000; Juniper, 380; Lime, 583; Olive, 2,500; Apple tree, 80 to 175; Pear tree, 260; Orange, 1,500; Oriental plane, 1,200; Scotch fir, 90 to 120; Larch, 270; olive, 2,500; Ivy, 600; Balm of Gilead, 30 to 50; Brazil vine palm, 150; Brazil cabbage palm, 600 to 700; Date palm, 200 to 300; Cocoa nut palm, 330; Oriental plane, 1,200. 1 lb. of catechu is equivalent for tanning purposes to 7 to 8 lbs. of oak bark. Terra japonica is mimosa catechu.

Relative Hardness of Woods.—Taking shell bark hickory as the highest standard of our forest trees, and calling that 100, other trees will compare with it for hardness as follows:—

Shell bark Hickory,	100	Red Oak,	69	Wild Cherry,	55
Pignut Hickory,	96	White Beech,	65	Yellow Pine,	54
White Oak,	84	Black Walnut,	65	Chestnut,	52
White Ash,	77	Black Birch,	62	Yellow Poplar,	51
Dogwood,	75	Yellow Oak,	60	Butternut,	43
Scrub Oak,	73	Hard Maple,	56	White Birch,	43
White Hazel,	72	White Elm,	58	White Pine,	30
Apple Tree,	70	Red Cedar,	56		

Timber intended for posts, is rendered almost proof against rot by thorough seasoning, charring, and immersion in *hot* coal tar.

The slide of Alpnach, extending from Mount Pilatus to Lake Lucerne, a distance of 8 miles, is composed of 25,000 trees, stripped of their bark, and laid at an inclination of 10° to 18°. Trees placed in the slide rush from the mountain into the lake in 6 minutes.

The Alps comprise about 180 mountains, from 4000 to 15,732 feet high, the latter being the height of Mont Blanc, the highest spot in Europe. The summit is a sharp ridge, like the roof of a house, consisting of nearly vertical granite rocks. The ascent requires 2 days, 6 or 8 guides are required, and each guide is paid 100 francs (£4). It was ascended by 2 natives, Jacques Belmat and Dr. Packard, Aug. 8, 1786, at 6 a.m. They staid up 30 minutes, with the thermometer at 14° below the freezing point. The provisions froze in their pockets; their faces were frostbitten, lips swollen, and their sight much weakened, but they soon recovered on their descent. De Saussure records in his ascent, August 2, 1760, that the color of the sky was deep blue; the stars were visible in the shade; the barometer sunk to 16.08 inches (being 27.08 in Geneva); the thermometer was 26½°, in the sun, 29° (being 87° at Geneva). The thin air works the blood into a high fever you feel as if you hardly touched the ground, and you can scarcely make yourself heard. A Frenchwoman, Mademoiselle d'Angeville, ascended in September, 1840, being dragged up the last 1200 feet by the guides, and crying out, "If I die, carry me to the top." When there, she made them lift her up, that she might boast she had been higher than any man in Europe. The ascent of these awful solitudes is most perilous, owing to the narrow paths, tremendous ravines, icy barriers, precipices, etc. In many places every step has to be cut in the ice, the party being tied to each other by ropes, so that if one slips he may be held up by the rest, and silence is enforced, lest the noise of talking should dislodge the avalanches of the Aiguille du Midi. The view from the mountain is inexpressibly grand. On the Alps, the limit of the vine is an elevation of 1600 feet; below 1000 feet, figs, oranges, and olives, are produced. The limit of the oak is 3800 ft., of the chestnut 2800 ft., of the pine 6500 feet, of heaths and furze to 8700 and 9700 ft.; and perpetual snow exists at an elevation of 8200 feet.

On the Andes, in lat. 2°, the limit of perpetual snow is 14,760 ft. In Mexico, lat. 19°, the limit is 13,800 ft.; on the peak of Teneriffe, 11,454 ft.; on Mount Etna, 9000 ft.; on Caucasus, 9900 ft.; on the Pyrenees, 8400 ft.; in Lapland, 3100 ft.; in Iceland, 2890 ft. The walnut ceases to grow at an elevation of 3600 ft.; the yellow pine at 6200 ft.; the Ash at 4800 ft.; and the Fir at 6700 ft. The loftiest inhabited spot on the globe is the Port House of Ancomarca, on the Andes, in Peru, 16,000 feet above the level of the sea. The 14th peak of the Himalayas, in Asia, 25,659 feet high, is the loftiest mountain in the world.

Lauterbrunnen is a deep part of an Alpine pass, where the sun hardly shines in winter. It abounds with falls, the most remarkable of which is the Staubbach, which falls over the Balm precipice in a drizzling spray from a height of 925 feet; best viewed in the morning sun or by moonlight. In general it is like a gauze veil, with rainbows dancing up and down it, and when clouds hide the top of the mountain, it seems as if poured out of the sky.

In Canada, the falls of Montmorenci are 250 feet high, the falls of Niagara (the Horse Shoe Falls) are 158 feet high and 2000 feet wide, the American Falls are 164 feet high and 900 feet wide. The Yosemite Valley Falls are 2600 feet high, and the Ribbon Falls of the Yosemite are 3300 feet high. The water-fall of the Arve, in Bavaria, is 2000 feet.

THE PERIODS OF GESTATION are the same in the horse and ass, or 11 months each; camel, 12 months; elephant, 2 years; lion, 5 months; buffalo, 12 months; in the human female, 9 months; cow, 9 months; sheep, 5 months; dog, 9 weeks; cat, 8 weeks; sow, 16 weeks; she wolf, from 90 to 95 days. The goose sits 30 days, swans 42, hens 21, ducks 30, peahens and turkeys 28, canaries 14, pigeons 14, parrots 40.

AGES OF ANIMALS, &c.—Elephant, 100 years and upwards; Rhinoceros, 20; Camel, 100; Lion, 25 to 70; Tigers, Leopards, Jaguars, and Hyenas (in confinement), about 25 years; Beaver, 50 years; Deer, 20; Wolf, 20; Fox, 14 to 16; Llamas, 15; Chamois, 25; Monkeys and Baboons, 16 to 18 years; Hare, 8; Squirrel, 7; Rabbit, 7; Swine, 25; Stag, under 50; Horse, 30; Ass, 30; Sheep, under 10; Cow, 20; Ox, 30; Swans, Parrots and Ravens, 200; Eagle, 100; Geese, 80; Hens and Pigeons, 10 to 16; Hawks, 30 to 40; Crane, 24;

Blackbird, 10 to 12 ; Peacock, 20 ; Pelican, 40 to 50 ; Thrush, 8 to 10 ; Wren, 2 to 3 ; Nightingale, 15 ; Blackcap, 15 ; Linnet, 14 to 23 ; Goldfinch, 20 to 24 ; Redbreast, 10 to 12 ; Skylark, 10 to 30 ; Titlark, 5 to 6 ; Chaffinch, 20 to 24 ; Starling, 10 to 12 ; Carp, 70 to 150 ; Pike, 30 to 40 ; Salmon, 16 ; Codfish, 14 to 17 ; Eel, 10 ; Crocodile, 100 ; Tortoise, 100 to 200 ; Whale, estimated, 1,000 ; Queen Bees live 4 years ; Drones, 4 months ; Worker Bees, 6 months.

The melody of singing birds ranks as follows : The nightingale first, then the linnet, titlark, sky lark, and wood lark. The mocking bird has the greatest powers of imitation ; the robin and goldfinch are superior in vigorous notes. Gardner's notation of the music of birds affords conclusive proof that most of the best ideas of the great composers were derived from these melodious warblers. One well known bird in the Canadian woods takes great delight in calling out, *Whip poor Will, Whip poor Will ;* the red-eyed fly-catcher seems to say, *Tom Kelly! Whip! Tom Kelly!*

The condor of Peru has spread wings 40 feet, feathers 20 feet, quills 8 inches round.

In England, a quarter of wheat, comprising 8 bushels, yields 14 bushels 2½ pecks, divided into seven distinct kinds of flour, as follows : Fine flour, 5 bushels 3 pecks ; bran, 3 bushels ; twenty-penny, 3 bushels ; seconds, 2 pecks ; pollard, 2 bushels ; fine middlings, 1 peck ; coarse ditto, 1 peck.

Fourteen pounds of oats produce 8 lbs. of oatmeal.

In America, 1 bushel of buckwheat, or 50 lbs., will produce 25 lbs. of buckwheat meal ; more may be obtained, but the quality will be impaired.

A 20-inch Harrison light vertical burr-mill will grind 54 bushels of corn per hour. *Revolutions per minute,* 1300 ; 20 horse power will drive two such run of stones.

In England, 2 bushels of seed will produce 18 of wheat in fair crops.

The ancient Greek phalanx comprised 8000 men, forming a square battalion, with spears crossing each other, and shields united.

The Roman legion was composed of 6000 men, comprising 10 cohorts of 600 men each, with 300 horsemen.

The ancient battering ram was of massive timber, 60 to 100 feet long, fitted with an iron head. It was erected under shelter to protect the 60 or 100 men required to work it. The largest was equal in force to a 36-lb. shot from a cannon.

Pile Driving on Sandy Soils.—The greatest force will not effect a penetration exceeding 15 feet.

Various Sizes of Type.—It requires 205 lines of Diamond type to make 12 inches ; of Pearl, 178 ; of Ruby, 166 ; of Nonpareil, 143 ; of Minion, 128 ; of Brevier, 112½ ; of Bourgeois, 102½ ; of Long Primer, 89 ; of Small Pica, 83 ; of Pica, 71½ ; of English, 64.

To supply a population estimated at over 40,000,000, there were in existence in the United States and Territories during July, 1876, the enormous number of 8129 newspapers and periodicals, embracing 738 daily, 70 tri-weekly, 121 semi-weekly, 6235 weekly, 33 bi-weekly, 105 semi-monthly, 714 monthly, 13 bi-monthly, and 67 quarterly publications. Of these, the New York Sun has the largest circulation, having circulated 46,799,769 copies during the year ending March, 1876 ; weight of white paper consumed, 3,426,610 pounds. Its daily circulation is over 138,000, weekly 85,000. To supply this demand it requires the combined results of the labor and brains of 249 men, a weekly expenditure of about $16,000, and the services of seven ponderous Bullock printing presses, having a capacity of 1400 copies per minute. Another press, of double size, with a capacity of 50,000 copies per hour, has been ordered. Each press prints two complete copies at one impression, not from type, but from cylindrical stereotype plates which revolve with the press cylinder.

Wire ropes for the transmission of power vary in size from $\frac{3}{8}$ to $\frac{7}{8}$ inch diam. for from 3 to 300 horse power ; to promote flexibility, the rope, made of iron, steel, or copper wire, as may be preferred, is provided with a core of hemp, and the speed is 1 mile per minute, more or less, as desired. The rope should run on a well-balanced, grooved, cast iron wheel, of from 4 to 15 feet diam., according as the transmitted power ranges from 3 to 300 horse ; the groove should be well cushioned with soft material, as leather or rubber, for the formation of a durable bed for the rope. With good care the rope will last from 3 to 5 years.

In paper making, 10 cylinders for preparing the pulp, making 200 revolutions per minute, 1 paper making machine, cutting machines, pump and accessories, consumed 50 horse power. The machine made 13 yards of paper per minute, and the produce was 1 ton of paper per day of 24 hours. In another instance, 28 pulping cylinders and 3 paper making machines produced 2 to 3 tons of paper per day of 24 hours, and consumed 113 horse-power. A Leffel Turbine Wheel, 10 ins. in diameter, strongly built of fine brass and steel, with German silver buckets, is now performing the work of a 120 horse power engine which it superseded ; it has a head of 228 feet.

The St. Gothard Tunnel, under the Helvitic Alps, will be, when finished, 9.3 miles long, and will cost 289,000,000 francs.

Coathupes Rule for Length of Gun Barrels. For the best shooting, the length of the barrel, measured from the vent hole, should be not less than 43 times the diameter of its bore, nor more than 47.

Proportions of Gunpowder as made by the English Government, is, nitre, 75; charcoal, 15; sulphur, 10. That of the French, nitre, 77; charcoal, 14, sulphur, 9. A 13 inch Armstrong gun, with a charge of 90 lbs., ball 344.5 lbs., velocity 1760 ft. per second, penetrated 11 inches of solid iron plates at a range of 200 ft. No field piece should be loaded with more powder than a fifth or sixth of the weight of its ball. A 32 pounder with a charge of 8 lbs. will penetrate 15.25 ins. of hard brick, or 12 ins. of hard freestone, or 3·5 ins. of granite, at a range of 200 feet.

Cannon balls go furthest at an elevation of 30°, and less as the balls are less ; the range is furthest when fired from west to east in the direction of the earth's motion, which for the diurnal rotation on its axis, is at the rate of 1037 miles per hour, and in its orbit, 66,092 miles.

The air's resistance is such, than a cannon ball of 3 lbs. weight, diameter, 2.78 ins. moving with a velocity of 1800 ft. per second, is resisted by a force equal to 156 lbs.

Estimated Thrust of Screw Propeller with engines of 1000 Horse Power, 20,000 lbs.

Brick-layers ascend ladders with loads of 90 lbs., 1 foot per second. There are 484 bricks in a cubic yard, and 4356 in a rod.

A power of 250 tons is necessary to start a vessel weighing 3000 tons over greased slides on a marine railway, when in motion, 150 tons only is required.

A modern dredging machine, 123 ft. long, beam 26 ft., breadth over all, 11 ft., will raise 180 tons of mud and clay per hour, 11 feet from water-line.

In tanning, 4 lbs. of oak bark make 1 lb. of leather.

Flame is quenched in air containing 3 per cent. of carbonic acid ; the same per centage is fatal to animal life.

100 parts of oak make nearly 23 of charcoal; beech, 21; deal, 19; apple, 23.7; elm 23; ash, 25; birch, 24; maple, 22.8; willow, 18; poplar, 20 ; red pine, 22.10 ; white pine, 23. The charcoal used in gunpowder is made from willow, alder, and a few other woods. The charred timber found in the ruins of Herculaneum has undergone no change in 1800 years.

Four volumes of nitrogen, and one of oxygen compose atmospheric air in all localities on the globe.

Air extracted from pure water, under an air pump, contains 34.8 per cent. of oxygen. Fish breathe this air, respiring about 35 times per minute. The oxyhydrogen lime light may be seen from mountains at the distance of 200 miles round.

Lightning is reflected 150 to 200 miles.

1000 cubic feet of 13 candle gas is equivalent to over 7 gals. of sperm oil; 52.9 lbs. of tallow candles; and over 44 lbs. of sperm candles.

The time occupied by gas in travelling from a gas well (in Pennsylvania) through 32 miles of pipe was 22 minutes, pressure at the well was 55 lbs. per inch. pressure at discharge 49 lbs.

The flight of wild ducks is estimated at 90 miles per hour, that of the swift at 200 miles, carrier pigeons 38 miles, swallows 60 miles, migratory birds have crossed the Mediterranean at a speed of 120 miles per hour.

Were it not for dry rot, ships would last on the average about 30 years, as it is their average duration, when built of ordinary timber, is 7, 8 and 9 years.

Calomel is composed of 50 grs. of mercury and 10½ of chlorine gas.

Carbon is the base of organic structures, and *Silica* of mineral.

At birth, the beats of the pulse are from 165 to 104, and the inspirations of breath, from 70 to 23. From 15 to 20, the pulsations are from 90 to 57, the inspirations, from 24 to 16, from 29 to 50, the pulsations are 112 to 56, the inspirations, 23 to 11. In usual states it is 4 to 1. The action of the heart distributes 2 ozs. of blood from 70 to 80 times in a minute.

Daniell makes the heat in a common parlor fire 1141°. Solids become incandescent in the dark, at 600° or 700°, but not in daylight till 800° or 1000°.

Sea water is seldom below 40°, springs about 45°; and pools and small rivers are as the atmosphere. The lowest heat for fermentation is 57.5, the highest 77°. The lowest for drying herbs, etc., 77° and the highest 122°.

The mean heat of the human body is 98° and of the skin 90° Tea and coffee are usually drank at 110°.

The explosion of nitro-glycerine is so sudden that it acts against the air as against a solid body, thus forming a deep chasm in the earth.

DECIMAL NOTATION, &c.—The *first* figure to the right of the point is always *tenths*, the *second* figure from the point is always *hundredths*, the *third* is thousandths, &c., thus 4.5, is 4 units and 5 *tenths;* 9.24 is 9 units and 24 hundreths; or 8.610 is 8 units and 610 thousandths. Again, .1 is 1-10, .01 is 1-100, and .001 is 1-1000. The Arithmetical Signs and their signification can be formed by consulting the Tabular part of this work.

VALUE OF METALS.—The following table, transcribed from the *Iron Age*, may be considered as showing the value of 44 different kinds of metal during July, 1876. The prices of the rarer metals have been taken from Trommsdorff's and Schuehardt's last price list, and the initials indicate the authorities consulted. The avordupois lb. is assumed as being equal to 453 grammes, and the mark to 24c. gold:—

Metal.	Value in gold per lb. Avord.	Price in gold per gramme.	Authority.
Vanadium, cryst. fused	$4,792.40	$10.80	S
Rubidium, wire	3,261.60	7.20	S
Calcium, electrolytic	2,466.20	5.40	S
Tantalum, pure	2,446.20	5.40	S
Cerium, fused globules	2,446.20	5.40	S
Lithium globules	2,228.76	4.92	S
Lithium, wire	2,935.44	6.48	S
Erbium, fused	1,671.57	3.96	S
Didgmium, fused	1,630.08	3.60	S
Strontium, electrolytic	1,576.44	3.48	S
Indium, pure	1,522.08	3.36	T
Ruthenium, pure	1,304.64	2.88	T
Columbium, fused	1,250.28	2.76	S
Rhodium	1,032.84	2.28	T
Barium, electrolytic	924.12	2.04	S
Thallium	738.39	1.63	T
Osmium	652.32	1.44	T
Palladium	498.30	1.10	T
Iridium	466.59	1.03	T
Urarium	434.88	96	T
Gold	299.72	..	..
Titanium, fused	239.80	52	..
Tellurium, fused	196.20	43	..
Chromium, fused	196.20	43	..
Platinum, fused	122.31	27	..
Manganese, fused	108.72	24	T
Molybdenum	54.34	12	T
Magnesium, wire and tape	45.30	10	T
Potassium, globules	22.65	05	T
Silver	18.60	..	..
Aluminum, bar	16.30	036	S
Cobalt, cubes	12.68	028	S
Nickel, cubes	3.80	008	T
Cadmium	3.26	007	T
Sodium	3.26	007	T
Bismuth, crude	1.95	0043	S
Mercury	1.00	....	..
Antimony	36	....	T
Tin	25	....	
Copper	22	....	Prices taken from recent quotations
Arsenic	15	....	
Zinc	10	....	
Lead	6	....	
Iron	1½	....	

ARSENICAL SOAP FOR THE SKINS OF WILD ANIMALS.—The skins must be well scraped and divested of all fat, and well rubbed with the following soap. Lime, 1 oz.; camphor, 1 oz.; arsenic, 1 oz.; alum, 1 oz. Mix all thoroughly with 1 lb. of yellow soap. This will prove a good preservative.

POSITIVE CURE FOR FOOT ROT IN SHEEP.—This is caused by exposure to bad weather, more especially to wet pasturage, etc. When lame, pass them through a trough containing a warm solution of arsenic, of nearly the following strength: 4 ozs. arsenic, 4 ozs. of soda ash or potash, 1 gal. of water. Boil till dissolved; keep it about three inches deep, so as to cover the foot as the sheep walk through; the trough should be about 20 feet long, and just wide enough to admit one sheep walking after the other.

A 74 gun ship consumes 2000 tons or trees, the produce of 57 acres for a century.

The deepest coal mine in England is, or was, at Killingworth, near Newcastle, and the mean annual temperature, at 400 yards below the surface, is 77°, and at 300 yards, 70°, while at the surface it is but 48°, being 1° of increase for every 15 yards. This explains the origin of hot springs, for, at 3300 yards, the heat would be equal to boiling water, taking 20 yards to a degree. The heat of the Bath waters is 116°, hence they would appear to rise 1,320 yards.

Peron relates, that at the depth of 2144 feet in the sea, the thermometer falls to 45°, when it is 86° at the surface.

Swemberg and Fourier calculate the temperature of the celestial spaces at 50 deg. centigrade below freezing.

In Northern Siberia, the ground is frozen permanently to the depth of 660 feet, and only thaws to the extent of 3 or 4 feet in summer. Below 660 feet internal heat begins.

River water contains about 30 grs. of solid matter in every cubic foot. Fresh water springs of great size abound under the sea. Perhaps the most remarkable springs exist in California, where they are noted for producing sulphuric acid, ink, and other remarkable products.

St. Winifred's Well, in England, evolves 120 tons of water per minute, furnishing abundant water power to drive 11 mills within little more than a mile.

The Nile has a fall of 6 ins. in 1000 miles. The rise of the river commences in June, continuing until the middle of August, attaining an elevation of from 24 to 26 ft. and flowing the valley of Egypt, 12 miles wide. In 1829 it rose to 26 cubits, by which 30,000 persons were drowned. It is a terrible climate to live in, owing to the festering heat, and detestable exhalations from the mud, etc., left on the retiring of the Nile, which adds about 4 inches to the soil in a century, and enroaches on the sea 16 feet every year. Bricks have been found at a depth of 60 feet, showing the vast antiquity of the country. In productiveness of soil it is excelled by no other in the world.

Belzoni considered the tract between the first and second cataracts of the Nile, as the hottest on the globe, owing to there being no rain. The natives do not credit the phenomenon of water falling from above. Hence it is, that all monuments are so nicely preserved Buckingham found a building left unfinished about 4000 years ago and the chalk marks on the stones were still perfect.

Pompey's Pillar is 92 ft. high, and 27½ round at the base.

The French removed a red granite column 95 ft. high, weighing 210 tons, from Thebes and carried it to Paris. The display of costly architectural ruins at Thebes is one of the most astonishing to be seen anywhere in the world. The ruins and costly buildings, in old Eastern countries, are so vast in their proportions and so many in number, that it would require volumes to describe them.

Babel, now called *Birs Nimroud*, built at Babylon by Belus, was used as an observatory, and as a temple of the Sun. It was composed of 8 square towers, one over the other, in all 670 ft. high, and the same dimensions on each side, on the ground.

The Coliseum at Rome, built by Vespasian for 100,000 spectators, was in its longest diameter 615.5 feet, and in the shortest 510, embraced 5½ acres, and was 120 feet high.

Eight aqueducts supplied ancient Rome with water, delivering 40 millions of cubic feet daily. That of Claudia was 47 miles long, and 100 feet high, so as to furnish the hills. Martia was 41 miles, of which 37 were on 7000 arches, 70 feet high. These vast erections would never have been built had the Romans known that water always rises to its own level.

The Temple of Diana, at Ephesus, was 425 feet long, and 225 broad, with 127 columns, 60 feet high, to support the roof. It was 220 years in building.

Solomon's Temple, built B. C. 1014, was 60 cubits, or 107 feet in length, the breadth, 20 cubits, or 36 feet, and the height, 30 cubits, or 54 feet. The porch was 36 feet long and 18 feet wide.

The largest of the Egyptian pyramids is 543 feet high, 693 feet on the sides, and its base covers 11 acres. The layers of stones are 208 in number ; many stones are over 30 feet long, 4 broad, and 3 thick.

The Temple of Ypsambul, in Nubia, is enormously massive, and cut out of the solid rock. Belzoni found in it 4 immense figures 65 ft. high, 25 ft. over the shoulders, with a face of 7 ft. and the ears over 3 ft.

Sesostris erected in the temple in Memphis, immense statues of himself and his wife, 50 ft. high, and of his children, 28 ft.

In the Temple of the Sun, at Baalbec, are stones more than 60 ft. long, 24 ft. thick, and 16 broad, each embracing 23,000 cubic feet, cut, squared, sculptured, and transported from neighboring quarries. Six enormous columns are each 72 ft. high, composed of 3 stones, 7 ft. in diameter. Sesostris is credited with having transported from the mountains of Arabia, a rock 32 feet wide, and 240 ft. long.

The engineering appliances used by the ancients in the movement of these immense masses are but imperfectly understood at the present day.

During modern times, a block of granite weighing 1217 tons, now used as the pedestal of the equestrian statute of Peter the Great, at St. Petersburg, was transported 4 miles by land over a railway and 13 miles in a vast caisson by water. The railway consisted of two lines of timber furnished with hard metal grooves ; between these grooves were placed spheres of hard brass about 6 ins. diameter. On these spheres the frame with its massive load was easily moved by 60 men working at capstans with treble-purchase block.

In 1716, while yet but 28, the illustrious SWEDENBORG contrived to transport (on rolling machines of his own invention), over valleys and mountains, 2 galleys, 5 large boats, and 1 sloop, from Stromstadt to

Iderfjol (which divides Sweden from Norway on the South), a distance of 14 miles; by which means, Charles XII. was able to carry on his plans, and, under cover of the galleys and boats, to transport on pontoons, his heavy artillery to the very walls of Fredericksnall.

As an exponent of the laws of friction, it may be stated that a square stone, weighing 1080 lbs. which required a force of 758 lbs. to drag it along the floor of a quarry, roughly chiselled, required only a force of 22 lbs. to move it when mounted on a platform and rollers over a plank floor.

Water is the absolute master, former, and secondary agent of the power of motion in every thing terrestrial. It is the irresistible power which elaborates everything, and the waters contain more organized beings than the land.

Rivers hold in suspension 100th of their volume (more or less) of mud, so that if 36 cubic miles of water (the estimated quantity) flow daily into the sea, 0.36 cubic miles of soil are daily displaced. The Rhine carries to the sea every day 145.980 cubic feet of mud. The Po carries out the land 228 ft. per annum, consequently Adria, which 2500 years ago, was on the sea, is now over 20 miles from it.

The enormous amount of alluvium deposited by the Mississippi is almost incalculable, and renders necessary the extensive engineering operations, which are now (1876) being prosecuted in order to remove the impediments to navigation.

FRENCH MEASURES WITH THE ENGLISH EQUIVALENTS. MEASURES OF LENGTH.—*Myrimeter*, equivalent to 10,000 meters, or to 6 miles, 1 furlong, 28½ poles. *Kilometer*, 1,000 meters, or to 3,280 ft. and 10 ins. *Hectometer*, 100 meters, 328 ft. and 1 inch. *Decameter*, 10 meters, equal to 32 and 4-5ths ft. *Meter*, the unit of the French measure of length, equal to 39.36 inches. *Decimeter*, 1-10 of a meter, equal to 3.97 inches. *Centimeter*, 1-100 of a meter, or .39371 inch (nearly 2-5ths inch). *Millimeter*, 1-1000th of a meter, or .0394 inch.

SURFACE MEASURES.—*Myriare*, 100,000 square meters, equal to 246 acres, 3 roods, and 20 poles. *Hectare*, 10,000 square meters, equal to 11.960 English square yards, or to 2.471 acres. *Are*, 100 square meters, or 119.6 square yards. *Centare*, 1 square meter, or 1550 square inches.

MEASURES OF VOLUME.—*Kiloliter or Steere*, the unit of measure for solid bodies, 1,000 liters, or 1 cubic meter, equal to 35.3171 cubic ft., or to 1.308 cubic yards, or to 264.17 gallons. *Hectoliter*, 100 liters, or 1-10th cubic meter, equal to 2 bush., and 3.35 pecks, or 26.417 gals. *Decaliter*, 10 liters, or 10 cubic decimeters, equal to 610.28 cubic inches, or to 9.08 qts., or to 2 and 1-5 Imperial gals. *Liter*, 1 cubic decimeter, a unit of capacity, equal to a little less than an English quart, or precisely .908 qt. *Deciliter*, 1-10th liter, or 1 cubic decimeter, 6.1022 cubic inches, equal to 0.176 pint, or .845 gill. *Centiliter*, 1-100th liter, or 10 cubic decimeters, equal to .6102 cubic inch, or .338 fluid oz. *Milliliter*, 1-1000th liter, or 1 cubic centimeter, equal to .061 cubic inch, or .27 fluid drm.

MEASURES OF WEIGHT.—*Millier or Tonneau*, 1,000,000 grains, or 1 cubic meter of water at its maximum density, equal to 2204.6 lbs. avoirdupois. *Quintal*, 100,000 grains, or 1 hectoliter of water, equal to 220.46 lbs. avoirdupois. *Myrigram*, or 10,000 grains, or 10 liters of water, equal to 22.046 lbs. avoirdupois. *Kilogram or Kilo*, 1000 grains, or 1 liter of water, equal to 2 lbs. 3 ozs. 65 drs. (2.206 lbs.) avoirdupois. *Hectogram*, 100 grains, or 1 deciliter of water, equal to 3.5277 ozs. avoirdupois. *Gram*, the unit of weight, being the weight of 1 cubic centimeter of water, or about 15½ grains troy. *Decigram*, 1-10 grain, or 1-10 of a cubic centimeter of water, equal to 1.5432 grains troy. *Centigram*, 100th gram, or 10 cubic millimeters of water, or equal to 1.543 grains troy. *Milligram*, 1-1000 gram, or 1 cubic millimeter of water, equal to .0154 grains troy.

For surface measurement, the square dekameter is used under the term of ARE.

NUMBER OF CUBIC FEET IN A TON (AVOIRDUPOIS) OF DIFFERENT MATERIALS.—Cast Iron, 4·98 ; Wrought Iron, 4.59 ; Bar Iron, 4·69 ; Steel, Soft, 4·57 ; Steel, Hard, 4·59 ; Copper, Sheet, 4·62 ; Copper, Cast, 4·04 ; Brass, 4.17 ; Lead, 3·15 ; Tin, Cast, 4·91 ; Zinc, Cast, 49·8 ; Granite, 13·514 ; Marble, 13·343 ; Paving Stone, 14·83 ; Millstone, 14·42 ; Grindstones, 17 ; Common Stone, 14·22 ; Fire Brick, 16.284 ; Brick, Mean, 21·961 ; Anthracite Coal, 21·284 and 24·958 ; Cannel Coal, 23·609 ; Cotton Bale, Mean, 154·48 ; Pressed ditto, from 89·6 to 1·14 ; Hay, Bale, 23·517 ; Bale, Mean, 154·48 ; Hay, Pressed 89·6 ; Clay, 158·69; Common Soil, 16·335 ; Mud, 21·987 ; Loose Sand, 23·893 ; Earth with Gravel, 16·742 ; India Rubber, 39.69 ; Plaster of Paris, 21·3 ; Glass 12·44 ; Ice, 38·58 ; Chalk (British), 17·92 ; Tallow, 38 ; Oil, 39 ; Fresh Water, 35·84 ; Salt Water, 34·931.

WEIGHT OF VARIOUS MATERIALS IN LBS. (AVOIRDUPOIS) PER CUBIC FOOT.—Pure Gold, 1203·6 ; Standard Gold, 1102·9 ; Hammered Gold, 1210·11 ; Pure Silver, 654·6 ; Hammered Silver, 656·9 ; Standard Silver, 658·4 ; Cast Brass, 524·8 ; Brass Wire, 534 ; Bismuth, Cast, 613·9 ; Antimony, 418·9 ; Bronze, 513·4 ; Cobalt, Cast, 488·2 ; Copper, Cast, 549·3 ; Copper, Sheet, 557·2; Copper, Wire, 554·9 ; Wrought Iron, 486·75 : Iron Plates, 481·5 ; Cast Iron, 450·4 ; Gun Metal, 543·75 ; Cast Lead, 709·5 ; Rolled do., 711·75 ; Red Lead, 558·75 ; Tin, 455·7 ; Platinum, Pure, 1218·8 ; Hammered do., 1271, Mercury, 60°, Fluid, 848 ; mercury, Solid, 977 ; Nickel, Cast, 487·9 ; Steel, Plates, 480·75; Steel, Soft, 489·6; Type Metal, 653·1; Zinc, Cast, 439; Granite, 165·75; Millstone, 155·3; Marble, Mean, of nineteen kinds, 180; Grindstones, 133·9 ; Firebrick, 137·5; Tile, 114·44; Brick, Mean, 102; Clay, 120; Limestone, Mean, of seven sorts, 184·1; Loose Earth or Sand, 95; Coarse Sand, 112·5; Ordinary Soil, 124; Mud, 102; Clay and Stones, 160; Slate, 167 to 181·25; Plaster of Paris, 73·5; Plumbago, 131·35; Anthracite Coal, from 89·75 to 102·5; Cannel Coal, from 77·33 to 82·33; Charcoal from Hard Wood, 18·5; ditto from Soft Wood, 18; Port Wine, 62·31 ; Fresh Water, 62·5; Sea Water, 64·3; Dead Sea Water, 77·5; Vinegar, 67·5 ; Alum, 107·10; Asbestos, Starry, 192·1; Ice at 32°, 57·5; Sulphur, 127·1; Peat, 375 to 83·1; Marl, Mean, 109·33; Hydraulic Lime, 171·60; quartz, 166·25 ; Rock Crystal, 170·94; Salt, Common, 133.12 ; Lard, 59·20; Whale Oil, 57·70; Olive Oil, 57·19.

WEIGHT OF A CUBIC INCH OF VARIOUS METALS IN POUNDS.—Hammered Gold, .701 lbs ; Cast do. (pure), .698 ; 20 Carats Fine do., .567 ; Hammered Silver, .382 ; Pure do., .378 ; Cast Steel, .287 ; Cast Iron, .263 ; Sheet Iron, .279 ; Rolled Platinum, .797; Wire do., .762; Hammered do, .735 ; Sheet Copper, .323 ; Sheet Brass, .304 ; Lead, .410 ; Cast Tin, .264 ; Cast Zinc, .245.

SUNDRY COMMERCIAL WEIGHTS.—A ton of wool is 2 stones of 14 lbs. each. A pack of wool is 240 lbs. A sack of wool is 22 stone of 14 lbs., or 308 lbs. In Scotland, it is 24 of 16 lbs. A keel of 8 Newcastle chaldrons is 15½ London chaldrons. 56 or 60 lbs. is a truss of hay, 40 lbs. a truss of straw ; 36 trusses a load. A bushel of rock salt is 65 lbs. ; of crushed salt, 56 lbs.; of foreign salt, 84 lbs. A tierce of beef, in Ireland, is 304 lbs.; and of pork, 320 lbs. A fodder of lead is 19½ cwt. in London and 21 cwt. in the North. A man's load is 5 bushels, a market load 40, or 5 quarters. A last is 10 quarters of corn, or 2 cart loads, 12 sacks of wool, 24 barrels of gunpowder, 12 barrels of ashes, herring, soap, &c., and 18 barrels of salt. A hundred of salt is 126 barrels.

SUNDRY MEASURES OF LENGTH.—The hair's breadth is the smallest, of which 48 are an inch. Four barley-corns laid *breadthways*, are ¾ of an inch, called a *digit*, and 3 barley-corns *lengthways* are an inch. An inch is divided into 12 lines and by mechanics into 8ths. A nail used in cloth measure, is 2¼ ins. or the 16th of a yard. A palm is 3 ins. and a span 9 ins. (See Table of Measures of length, for other designations.) An English Statute mile is 1760 yds. or 5280 ft., an Irish mile 2240 yds., a Scotch mile 1984 yds. ; 80 Scotch miles being equivalent to 91 English, and 11 Irish to 14 English.

MEASURES OF LENGTH.

4 In. make	1 Hand.	3 Feet make	1 Yard.
7.92 In. "	1 Link.	$5\frac{1}{2}$ Yds. "	1 Rod or Pole.
18 In. "	1 Cubit.	40 Poles "	1 Furlong.
12 In. "	1 Foot.	8 Fur. "	1 Mile.
6 Ft. "	1 Fathom.	69 1-12 Miles make	1 Degree.

60 Geographical Miles makes 1 Degree.

MEASURES OF SURFACE.

144	Square Inches make	1 Square Foot.
9	Square Feet "	1 Square Yard.
$30\frac{1}{4}$	Square Yards "	1 Rod, Perch or Pole.
40	Square Rods "	1 Square Rood.
4	Square Roods "	1 Square Acre, or 43,560 sq. ft.
10	Square Chains "	1 Square Acre.
640	Square Acres "	1 Square Mile.

Gunter's Chain equal to 22 Yards or 100 Links.

MEASURES OF SOLIDITY.

1728 Cubic Inches make 1 Cubic Foot.
27 Cubic Feet " 1 Cubic Yard.

AVOIRDUPOIS WEIGHT.

$27\frac{11}{32}$	Grains make	1 Drachm (dr.) or	$27\frac{11}{32}$ Grains.
16	Drachms "	1 Ounce (oz.) or	$437\frac{1}{2}$ "
16	Ounces "	1 Pound (lb.) or	7000 "
28	Pounds "	1 Quarter (qr.)	
4	Quarters "	1 Hundred-Weight (cwt.)	
20	Cwts. "	1 Ton.	

TROY WEIGHT.

24 Grains	make 1 Pennyweight,	or 24 Grains.	
20 Pennywts "	1 Ounce,	or 480 "	
12 Ounces "	1 Pound,	or 5760 "	

APOTHECARIES' WEIGHT.

20 Grains make	1 Scruple.	8 Drachms make	1 Ounce.
3 Scruples "	1 Drachm.	12 Ounces "	1 Pound.

45 Drops=1 teaspoonful or a fluid Drachm; 2 tablespoonfuls=1 oz.

DIAMOND WEIGHT.

16 Parts make 1 Grain (8-10ths Grain, Troy).
14 Grains " 1 Carat (3 1-5th Grains, Troy).

LIQUID MEASURE.

4 Gills make	1 Pint.	2 Gallons make	1 Peck.
2 Pints "	1 Quart.	$31\frac{1}{2}$ Gallons "	1 Barrel.
4 Quarts "	1 Gallon.	54 Gallons "	1 Hhd.

DRY MEASURE.

8 Quarts make	1 Peck.	8 Bushels make	1 Quarter.
4 Pecks "	1 Bushel.	36 Bushels "	1 Chaldron.

1 Bushel equal to $2815\frac{1}{2}$ cubic in. nearly.

A bushel of Wheat is on an average 60 lbs.; Barley or Buckwheat, 46 lbs.; Indian Corn or Rye, 56 lbs.; Oats, 30 lbs.; Salt, 70 lbs. 14 lbs. of Lead or Iron make 1 Stone; $21\frac{1}{2}$ Stone, 1 Pig. 1 Bbl. of Flour contains 196 lbs.; Beef or Pork, 200 lbs. The Imperial Gallon is 10 lbs. avoirdupois of pure water; the Pint 1 1-4 lbs. 1 Gal. Sperm Oil weighs, $7\frac{1}{4}$ lbs.; 1 do. of Whale Oil, 7 lbs. 11 ozs.; 1 do. of Linseed, $7\frac{3}{4}$ lbs.; 1 do. of Olive, $7\frac{1}{2}$ lbs.; 1 do. Spts. of Turpentine, 7 lbs. 5 ozs. Proof Spirits 7 lbs. 15 ozs.; 1 do. of Ale, 10.5 lbs.

SCRIPTURE MEASURES OF LENGTH.—The great Cubit was 21·888 ins. =1.824 ft. and the less 18 ins. A Span the longer=½ a cubit=10.944 ins.= .912 ft. A span the less=⅓ of a cubit=7.296 ins.=.608 ft. A hand's breadth=⅙ of a cubit=3.684 ins.=.304 ft. A finger's breath=1.24 of a Cubit=.912 ins.=·076 ft. A fathom=4 cubits=7.296 ft. *Ezekiel's* Reed= 6 cubits=10.944 ft. The mile=4000 cubits=7296 ft. The Stadium, 1-10 of their mile=400 cubits=729.6 ft. The Parasang, 3 of their miles=12,000 cubits, or 4 English miles and 580 ft. 33.164 miles was a day's journey—some say 24 miles; and 3500 ft. a Sabbath day's journey; some authorities say 3648 ft.

SCRIPTURE MEASURES OF CAPACITY.—The Chomer or Homer in King James' translation was 75.625 gals. liquid, and 32·125 pecks dry. The Ephah or Bath was 7 gals. 4 pts., 15 ins. sol. The Seah, ⅓ of Ephah, 2 gals. 4 pts., 3 in. sol. The Hin=⅙ of Ephah, 1 gal., 2 pts., 1 in. sol. The Omer=1-10 of Ephah, 5 pts., 0.5 ins. sol. The Cab=1-18 of Ephah, 3 pts., 10 ins. sol. The Log=$7\frac{1}{72}$ of Ephah, ½ pt., 10 ins. sol. The metretes of *Syria* (*John* ii. 6)=Cong. Rom. 7⅛ pts. . The Cotyla Eastern=1-100 of Ephah, ½ pt. 3 in. sol. This Cotyla contains just 10 ozs. Avordupois of rain water. Omer, 100; Ephah, 1000; Chomer or Homer, 10,000.

SCRIPTURE WEIGHTS AND COINS.—The following are the Hebrew weights and their equivalents in *Troy* weight; also their value in pure Gold and Silver:—

					Pure Gold.		Pure Silver.		English Money.			
	lbs.	ozs.	dwt.	gr.	$	cts.	$	cts.	£	s.	d.	f.
The Gerah=$\frac{1}{20}$ of a Shekel..........	..	..	..	11	0	47	0	03	0	0	1	½+
The Bekah = ½ Shekel..........	..	..	4	13¼	4	69	0	30	0	1	2	½+
The Shekel........	..	..	9	2½	9	38	0	59	0	2	4	1
The Maneh, or Mini=60 Shekels	2	3	6	10¼	562	84	35	32	7	1	5	
The Talent = 3000 Shekels..........	113	10	1	10¾	28,142	25	1,766	23	353,1110 *ob.*			

Roman money mentioned in the New Testament reduced to English and American Standard:—

	£	s.	d.	far.		$	cts.
A Mite........................	0	0	0	0.75	....	0	00.343
A Farthing, about......... ...	0	0	0	1.50	....	0	00.687
A Penny, or Denarius	0	0	7	2.	....	0	13.75
A Pound, or Mina	3	2	6	0.	....	13	75.

NOTE.—The above determinations of Scripture Measures, Weights, &c., are principally by the Rt. Rev. Richard, Bishop of Peterborough.

GUNTER'S CHAIN, LAND MEASUREMENT, &c.—7·92 inches constitute 1 link; 100 links 1 chain, 4 rods or poles, or 66 feet, and 80 chains 1 mile. A square chain is 16 square poles, and 10 square chains are 1 acre. Four roods are an acre, each containing 1210 square yards, or 34.785 yards, or 34 yards 28 inches each side.

Forty poles of 30.25 square yards each is a rood, and a pole is 5½ yards each way.

An acre is 4840 square yards, or 69 yds. 1 ft., 8½ ins. each way; and 2 acres, or 9680 square yds. are 98 yds. 1 ft., 2 ins. each way; and 3 acres are 120½ yds. each way. A square mile, or a U. S. section of Land, is 640 acres; being 1060 yds. each way; half a mile, or 880 yds. each way, is 160 acres; a quarter of a mile or 440 yds. each way, is a park or farm of 40 acres; and a furlong, or 220 yds. each way, is 10 acres.

Any length or breadth in yds. which multiplied make 4840 is an acre; any which makes 12·10 is a rood, and 30.25 is a pole.

An English acre is a square of nearly 70 yds. each way, a Scotch, of 77⅛ yds. and an Irish of 88½ yds.

NAUTICAL DISTANCES, LOG LINES.—A nautical mile, the 60th of a degree, is 2026.5 yards; a marine league, or 20 to a degree, is 6079.5 yards. Log-lines are divided into spaces of 50 feet, and the way measured by a half minute sand-glass, which bears nearly the same proportion to an hour, which 50 feet bears to a mile, the number of knots which run off the reel in half a minute showing the number of miles the vessel sails in an hour. The line should be about 150 fathoms long, having 10 fathoms between the ship and first knot for stray line. Estimating a mile at 6139.75 feet, and using a 30″ glass, 1 knot=51 ft. 1.95 ins. and 1 fathom, 5 ft. 1.395 ins. Or if a 28″ glass is used, and 8 divisions, the result will be thus; 1 knot=47 ft. 9.024 ins. and 1 fathom=5 ft. 11.627 ins.

BOWDITCH'S NAVIGATOR computes 6120 ft. to a sea mile, which if taken as the length with a 28″ glass, will make the divisions 47.6 ft. and 5.95 ft.

TENSILE STRENGTH OF MATERIALS, SHOWING THE STRENGTH OR FORCE REQUIRED TO TEAR ASUNDER 1 SQUARE INCH.

	Lbs.		Lbs.
Iron Wire, wrought,	103,000	Copper Bolts,	38,000
Swedish bar Iron,	72,000	" Wire,	60,000
Russian " "	59,500	Brass,	42,000
Mean of English Iron,	53,900	Gold,	20,490
Gun Metal, mean of Iron,	37,232	Gold, 5 pts., copper, 1 pt.,	50,000
Clyde, No. 1, "	16,125	Silver cast,	40,997
" " 2, "	23,468	Bronze,	17,698 to 56,788
Stirling, mean of "	25,764	Tin cast, block,	5,000
American, mean of "	45,970	" Banca,	2,122
Low Moor, No. 2, cast "	14,076	Platinum Wire,	5,300
Crank Shaft "	44,750	Zinc,	7,000
American boiler, plates, Iron,	48,000 / 62,000	Sheet Lead,	3,000
		Antimony,	1,060
English plates, mean,	51,000	Bismuth, cast,	3,120
" " lengthwise,	53,800	Ivory,	16,070
" " crosswise,	48,800	Manilla Rope,	9,300
German piano steel Wire,	268,800	Tarred Hemp Rope,	15,000
Cast Steel, maximum,	142,000	Wire, Rope,	37,000
" " mean,	88,000	Whalebone,	7,600
Steel,	100,000 to 130,000	Leather Belting,	333
Chromo Steel, mean,	170,980	Gutta-percha,	3,500
Shear "	124,000	Slate,	12,000
American Tool Co.,	179,980	Well-burned Brick,	750
Blistered Steel, soft,	133,000 / 104,000	Inferior "	100 to 290
		Portland Stone,	857 to 1,000
Razor "	15,000	Crown Glass,	42,346
Steel plates, lengthwise,	96,300	Limestone,	670 to 2,800
" " crosswise,	93,700	Hydraulic Lime,	140
Yellow metal,	48,700	" Cement,	234
Cast Copper,	19,000	Portland " 6 mos.	414
American Copper,	24,250	Plaster of Paris,	72
Brass Wire,	50,000		

REMARKS.—Owing to the damage inflicted by the hot tar, tarred ropes are 25 per cent. weaker than white ropes. Hemp rope is stronger than Manilla, but tarred hemp and manilla are nearly of equal strength. Manilla ropes are from 25 to 30 per cent. weaker than white ropes. Twisted hempen cords will sustain the following weights per square inch of their section: ¼ inch to 1 inch thick, 8746 lbs.; 1 to 3 ins. thick, 6860 lbs.; 3 to 5 ins. thick, 5345 lbs.; 5 to 7 ins. thick, 4,860 lbs. Ropes of 4 strands up to 8 ins. are about 17 per cent. stronger than those having but 3 strands. One-eighth of an inch in diameter of iron will sustain more than 1 inch in circumference of hemp rope. In Tredgold's and Duleau's experiments, a piece of the best bar iron, 1 inch square, bore a weight of 77,373 lbs., while a similar piece of cast iron would be torn asunder by a weight of from 16,243 to 19,464 lbs., and 1 square inch of iron wire would sustain a mean weight of 126,340 lbs. In sixteen experiments by Mr. Fairbairn and Mr. Hodgkinson, on cast iron, the average strain that one square inch sustained was 7½ tons, the weakest bearing 6 tons, and the strongest 9¾ tons. Telford's and Brown's experiments show that malleable iron will bear, on an average, 27 tons, the weakest being 24 and the strongest 29 tons.

Hodgkinson's and Fairbairn's experiments prove that cast iron can sustain a compression of from 36⅓ to 60 tons to the square inch. In this respect malleable iron is inferior to cast. With 12 tons to the square inch it yields, contracts in length, and expands laterally, though it will bear 27 tons, or more, without actual fracture. Rennie crushed cast iron with a weight of 93,000 lbs.

STRENGTH OF SHAFTS.—44 lbs., acting at a foot radius, will twist off the neck of a shaft of lead 1 inch diam., and the relative strengths of other materials, lead being 1, is as follows:—Tin, 1·4, copper, 4·3; yellow brass, 4·6; gun metal, 5; cast iron, 9; Swedish iron, 9·5; English iron, 10·1; blistered steel, 16·16; shear steel, 17; cast steel, 19·5. The strength of a shaft increases as the cube of its diameter.

A weight of 36,000 lbs. attached to a bar of iron 1 inch square and 1,000 inches in length, will draw it out 1 inch; 45,000 will stretch it 2 inches; 54,000 lbs., 4 inches; 63,000, 8 inches; and 72,000, 16 inches, where it will finally break.—*Prof. Leslie.*

STRENGTH OF CAST IRON BEAMS.—*Rule.* Multiply the sectional area of the bottom flanges in square inches by the depth of the beam in inches, and divide the product by the length between the support also in inches. Then 514 times the quotient will be the breaking weight in pounds.

TABLE SHOWING THE CRUSHING STRENGTH OF VARIOUS MATERIALS ON A BASIS OF 1 SQUARE INCH.

Materials.	Crushing Weight.	Materials.	Crushing Weight.
	Lbs.		Lbs.
Quincy Granite,	15,300	Marble, Baltimore, small,	8,057
Aberdeen "	10,360	Stock Brick,	2,167
Arbroath "	7,884	Portland Cement, 1 sand 1,	1,280
Portland Cement,	15,000	" " 1 sand 4,	1,244
" Mean,	8,300	Gneiss,	19,600
Stourbridge Firebrick,	1,717	Good Mortar,	240
Hard Brick,	{ 4,368 / 2,000	Common "	120
		Roman Cement,	342
Common "	{ 4,000 / 800	Sandstone, Seneca,	10,762
		" Acquia Creek,	5,340
" " Masonry,	{ 800 / 500	" Adelaide,	2,800
		Brick, Sydney,	2,228
Marble, Lee, Mass.,	22,702	Clay, fine, rolled and baked,	400
" Italian,	12,624	Portland Oolite,	3,850
" Baltimore, small,	18,061		

Nearly all granites commence to crumble under a superstructure of 200 feet elevation.

1 cask of lime (240 lbs.), will make from 7·8 to 8·15 cubic ft. of stiff paste. Bricks should be thoroughly wet previous to use. Brick walls should be washed down with diluted sulphuric acid when finished.

A good *Mastic* is burnt clay, 93 parts, litharge, 7 parts, all ground very fine, and thoroughly dried by artificial heat, mix with linseed oil and apply, after giving the surface to which it is to be applied 2 or 3 coats of oil.

Soot will not adhere to chimneys coated with mortar to which salt has been added in the proportion of 1 peck of salt to 3 of mortar while tempering.

TABLE TO FIND THE NUMBER OF BRICK REQUIRED TO CONSTRUCT ANY BUILDING, EMBRACING WALLS, FROM 4 INCHES TO 20 INCHES THICK, RECKONING 7 BRICKS TO EACH SUPERFICIAL FOOT.

Example.—Required the number of bricks in 100 superficial feet of wall 12 inches thick. Under 12 inch, and opposite 100, you will find the answer, 2250, the number of bricks required.

Superficial feet of Wall.	Number of Bricks to Thickness of					
	4-inch.	8-inch.	12-inch.	16-inch.	20-inch.	24-inch.
1	7	15	23	30	38	45
2	15	30	45	60	75	90
3	23	45	68	90	113	135
4	30	60	90	120	150	180
5	38	75	113	150	188	225
6	45	90	135	180	225	270
7	53	105	158	210	263	315
8	60	120	180	240	300	360
9	68	135	203	270	338	405
10	75	150	225	300	375	450
20	150	300	450	600	750	900
30	225	450	675	900	1125	1350
40	300	600	900	1200	1500	1800
50	375	750	1125	1500	1875	2250
60	450	900	1350	1800	2250	2700
70	525	1050	1575	2100	2625	3150
80	600	1200	1800	2400	3000	3600
90	675	1350	2025	2700	3375	4050
100	750	1500	2250	3000	3750	4500
200	1500	3000	4500	6000	7500	9000
300	2250	4500	6750	9000	11250	13500
400	3000	6000	9000	12000	15000	18000
500	3750	7500	11250	15000	18750	22500
600	4500	9000	13500	18000	22500	27000
700	5250	10500	15750	21000	26250	31500
800	6000	12000	18000	24000	30000	36000
900	6750	13500	20250	27000	33750	45000
1000	7500	15000	22500	30000	37500	45000

FACTS FOR BUILDERS.—1000 shingles, laid 4 ins. to the weather, will cover 100 sq. ft. of surface, and 5 lbs. of shingle nails will fasten them on.

One-fifth more siding and flooring is needed than the number of sq. ft. of surface to be covered, because of the lap in the siding and matching.

1000 laths will cover 70 yards of surface, and 11 lbs. of lath nails will nail them on. 8 bushels of good lime, 16 bushels of sand, and 1 bushel of hair, will make enough good mortar to plaster 100 sq. yds.

A cord of stone, 3 bushels of lime, and a cubic yard of sand, will lay 100 cubic ft. of wall.

5 courses of brick will lay 1 ft. in height on a chimney, 16 bricks in a course will make a flue 4 ins. wide and 12 ins. long, and 8 bricks in a course will make a flue 8 ins. wide and 16 ins. long.

Cement, 1 bush., and sand, 2 bush., will cover 3½ sq. yds. 1 in. thick, 4½ sq. yds. ¾ inch thick, and 6¾ sq. yds. ½ inch thick. 1 bush. cement and 1 of sand will cover 2¼ sq. yds. 1 in. thick, 3 sq. yds. ¾ inch thick, and 4½ sq. yds. ½ inch thick.

8 lbs. of *Asphalte Flooring* composition will cover 1 superficial ft. ¾ inch thick. 308 pounds of finely ground cement will make from 3·7 to 3·8 cubic feet of stiff paste. 1 cwt. of mastic and 1 gal. of oil will cover 1½ yds. at ¾, or 2½ at ½ inch in thickness. *Pointing Mortar* consists, by weight, of finely ground cement, 1 part to from 3 to 3⅓ parts of fine silicious sand, mix under cover, in small quantities at a time.

EXPANSION AND CONTRACTION OF BODIES.—The following table exhibits the linear dilatation of various bodies from 32° to 212°, according to Laplace, Smeaton, Roy, etc.

	Laplace.	Smeaton.	Petit.	Troughton.	Roy.
Flint glass	$\frac{1}{1232}$	....	$\frac{1}{1161}$	....	....
Glass (barometer tubes)	$\frac{1}{1000}$	$\frac{1}{1200}$ to	....	....	$\frac{1}{1285}$
" solid rod	....		....	....	$\frac{1}{1237}$
" cast, prism of	....	$\frac{1}{923}$	....	....	$\frac{1}{901}$
Platinum, per Borda	$\frac{1}{1167}$	....	$\frac{1}{1131}$	$\frac{1}{1008}$	....
Palladium, per Wollaston	$\frac{1}{1000}$	....	....	....	....
Gold (French standard)	$\frac{1}{661}$	....	....	....	....
Silver (French standard)	$\frac{1}{524}$	....	....	$\frac{1}{480}$	....
Copper 8 parts, tin 1	....	$\frac{1}{550}$	....	....	....
Copper	$\frac{1}{584}$	$\frac{1}{588}$	....	$\frac{1}{521}$	....
Copper 2, zinc 1	....	$\frac{1}{486}$	....	....	....
Brass 16, tin 1	....	$\frac{1}{524}$	....	....	....
Brass wire	....	$\frac{1}{517}$	....	....	....
Brass cast	$\frac{1}{535}$	$\frac{1}{533}$	....	....	$\frac{1}{528}$
Solder, tin 1, lead 2	....	$\frac{1}{399}$	....	....	....
Bismuth	....	$\frac{1}{719}$	....	....	....
Speculum metal	....	$\frac{1}{517}$	....	....	....
Iron	$\frac{1}{819}$	$\frac{1}{795}$	$\frac{1}{846}$	....	....
Steel (yellow temper)	$\frac{1}{807}$	$\frac{1}{816}$	....	$\frac{1}{840}$	$\frac{1}{874}$
Tin, Falmouth	$\frac{1}{460}$	$\frac{1}{438}$	....	....	....
Lead	$\frac{1}{351}$	$\frac{1}{349}$	....	....	....
Zinc	....	$\frac{1}{340}$	....	....	....
Mercury, in volume	$\frac{100}{5550}$	....	....	....	....
Water	$\frac{1}{23}$	....	....	....	....
Alcohol	$\frac{1}{9}$	....	....	....	....
All the gases	$\frac{100}{287}$	....	....	....	....

Mercury freezes at 40° below zero, and melts at 39°. Ether freezes at 47° below zero; wine freezes at 20°; sea water freezes at 28°3. Alcohol has been exposed to 110° and 120° below zero without freezing. Granite decomposes at a red heat. The second's pendulum, of 39.139 ins., is lengthened by 30° of temperature 128th of an inch, or 8 vibrations in 24 hours.

The heat conducting powers of metals, etc., are as follows: Gold, 1000°; platinum, 981°; silver, 973; copper, 898.2; iron, 374.3; zinc, 363; tin, 303·9; lead, 179.6; marble, 23.6; porcelain, 12.2; fine clay, 11.4.

1 lb. of coke melts 94 lbs. of ice; 1 lb. of coal, 90 lbs.; 1 lb. of wood, 52 lbs.; 1 lb. of charcoal, 95 lbs.; 1 lb. of peat, 19 lbs. The capacity of the solar heat all over the globe is the ability to melt an icy covering 46 feet in thickness.

6 lbs. white lead added to 1 gal. tar varnish, and applied as paint, will prevent damp coming through walls.

To Prevent Decay of Farm Implements.—When not in use have them sheltered from the sun, wind, rain, and snow. By this means, sleighs, wagons, carts, ploughs, threshing-machines, harrows, and the like, would last twice as long as they would if left in the open air, swelling from moisture one week, and shrinking the next from the influence of the sun and wind.

Oiling or Cleaning old Carriage-tops.—Enamel leather-tops should be first washed with Castile soap and warm water, then oiled with neat's-foot oil; or sweet oil and a coat of enamel varnish put on, the leather will look like new. Dashes may be cleaned in the same manner, but varnish color is not very beneficial to patent leather; however, when old and cracked, it may be colored to improve the appearance.

DYERS, BLEACHERS, AND CLOTHIERS' DEPARTMENT.

In accommodation to the requirements of dyers, many of the following receipts describe dyes for large quantities of goods, but to make them equally adapted for the use of private families they are usually given in even quantities, so that it is quite an easy matter to ascertain the quantity of materials required for dyeing, when once the weight of the goods is known; the quantity of materials used being reduced in proportion to the smaller quantity of goods.

Use soft water for all dyeing purposes, if it can be procured, using 4 gals. water to 1 lb. of goods; for larger quantities, a little less water will do. Let all the implements used in dyeing be kept perfectly clean. Prepare the goods by scouring well with soap and water, washing the soap well out and dipping in warm water, previous to immersion in the dye or mordant. Goods should be well aired, rinsed, and properly hung up after dyeing. Silks, and fine goods should be tenderly handled, otherwise injury to the fabric will result.

Saxon Blue.—For 100 lbs. thibet or comb yarn, use alum, 20 lbs., cream of tartar 3 lbs., mordant 2 lbs.; extract of indigo 3 lbs., or carmine 1 lb., makes a better color. When all is dissolved cool the kettle to 180° Fahr.; enter and handle quickly at first, then let it boil ½ hour, or until even. Long boiling dims the color. Zephyr worsted yarn ought to be prepared, first by boiling it in a solution of alum and sulphuric acid. then the indigo is added afterwards.

Green Fustic Dye.—For 50 lbs. of goods use 50 lbs. of fustic with alum 11 lbs. Soak in water until the strength is extracted, put in the goods until of a good yellow color, remove the chips, and add extract of indigo in small quantities at a time, until the color is satisfactory.

Purple Blue on Wool.—100 lbs. of wool are first dipped in the blue vat to a light shade, then boiled in a solution of 15 lbs. of alum, and 3 lbs. of half refined tartar, for 1½ hours, the wool taken out, cooled, and let stand 24 hours. Then boil in fresh water 8 lbs. of powdered cochineal for a few minutes, cool the kettle to 170° Fahr.; handle the prepared wool in this for 1 hour, when it is ready to cool, rinse, and dry. By coloring first with cochineal, as aforesaid, and finishing in the blue vat, the fast purple or dahlia, so much admired in German broadcloths, will be produced. Tin acids must not be used in this color.

BLUE DYE FOR HOSIERY.—100 lbs. of wool are colored with 4 lbs. Guatemala or 3 lbs. Bengal indigo, in the soda or wood vat; then boil in a kettle a few minutes, 5 lbs. of cudbear or 8 lbs. of orchil paste; add 1 lb. of soda, or better, 1 pail of urine, then cool the dye to about 170° Fahr.; and enter the wool. Handle well for about 20 minutes, then take it out, cool, rinse, and dry. It is all the same if the cudbear is put in before or after the indigo. 3 ozs. of analine purple dissolved in alcohol, ½ pt., can be used instead of the cudbear. (Wood spirit is cheaper than alcohol, and is much used now by dyers for the purpose of dissolving analine colors). It produces a very pretty shade, but should never be used on mixed goods which have to be bleached.

LOGWOOD AND INDIGO BLUE DYE FOR CLOTH.—100 lbs. of cloth, color the cloth first by one or two dips in the vat of indigo blue, and rinse it well, then boil it in a solution of 20 lbs. of alum, 2 lbs. of half refined tartar, and 5 lbs. of mordant, for 2 hours, then take it out and cool. In fresh water boil 10 lbs. of good logwood for half an hour in a bag or otherwise; cool off to 170° Fahr. before entering; handle well over a reel, let it boil for half an hour, then take it out, cool, and rinse. This is a very firm blue.

DYE FOR WOOL OR SILK.—*Color between Purple and Blue.* For 40 lbs. of goods, take bi-chromate of potash 8 ozs., alum 1 lb., dissolve all and bring the water to a boil, and put in the goods; boil 1 hour; then empty the dye, and make a new dye with logwood 8 lbs., or extract of logwood 1 lb. 4 ozs., and boil in this 1 hour longer. Grade the color by using more or less logwood, as you wish it dark or light in the color.

NEW BLEACH FOR WOOL, SILK, OR STRAW.—Mix together 4 lbs. oxalic acid, 4 lbs. table salt, water 50 gals. The goods are laid in this mixture for 1 hour, they are then generally well bleached, and only require to be thoroughly rinsed and worked. For bleaching straw it is best to soak the goods in caustic soda, and afterwards to make use of chloride of lime or Javelle water. The excess of chlorine is afterwards removed by hyposulphite of soda.

TO FIX DYES.—*New Process.* Mr. Kipping, of Manchester, England, has a new process of fixing dyes. He dissolves 20 ozs. of gelatine in water, and adds 3 ozs. of bichromate of potash. This is done in a dark room. The coloring matter is then added and the goods submitted thereto; after which they are exposed to the action of light; the pigment thus becomes insoluble in water and the color is fast.

SCARLET WITH LAC DYE.—For 100 lbs. of flannel or yarn, take 25 lbs. of ground lac dye, 15 lbs. of scarlet spirit (made as per directions below), 5 lbs. of tartar, 1 lb. of flavine, or according to shade, 1 lb. of tin crystals, 5 lbs. of muriatic acid. Boil all for 15 minutes, then cool the dye to 170° Fahr.; enter the goods, and handle them quickly at first. Let them boil 1 hour, rinse them while yet hot, before the gum and impurities harden. This color stands scouring with soap better than cochineal scarlet. To this dye, a small quantity of sulphuric acid may be used, as it dissolves the gum.

MURIATE OF TIN OR SCARLET SPIRIT.—Take 16 lbs. muriatic acid, 22° B., 1 lb. feathered tin, water 2 lbs. The acid should be put in a stone ware pot, and the tin added, and allow to dissolve; the mixture should be kept a few days before using. The tin is feathered or granulated by melting in a suitable vessel, and pouring it from a height of about 5 feet into a pailful of water. This is a most powerful agent in certain colors, such as scarlets, oranges, pinks, &c.

SCARLET DYE WITH COCHINEAL.—For 50 lbs. of wool, yarn, or cloth, use cream of tartar 1 lb. 9 ozs.; cochineal pulverized, 12½ ozs., muriate of tin or scarlet spirit 8 lbs.; after boiling the dye, enter the goods, work them well for 15 minutes, then boil them 1½ hours, slowly agitating the goods while boiling, wash in clean water, and dry out of the sun.

PURPLE DYE.—For 40 lbs. of goods, use alum 3 lbs., muriate of tin 4 tea cups, pulverized cochineal 1 lb., cream of tartar 2 lbs. Boil the alum, tin, and cream of tartar, for 20 minutes, add the cochineal and boil 5 minutes, immerse the goods 2 hours, remove and enter them in a new dye composed of Brazil wood 3 lbs., logwood 7 lbs., alum 4 lbs., muriate of tin 8 cupfuls, adding a little extract of indigo, made as follows:

CHEMIC BLUEING OR EXTRACT OF INDIGO.—Take oil of vitriol 2 lbs., and stir into it finely, pulverized indigo 8 ozs., stirring briskly for the first ½ hour, then cover it up, and stir 4 or 5 times daily for a few days, then add a little pulverized chalk, stirring it up, and keep adding it as long as it foams; it will neutralize the acid. Keep it closely corked.

LIGHT SILVER DRAB.—For 50 lbs. of goods use logwood ½ lb., alum, about the same quantity; boil well, enter the goods, and dip them for 1 hour. Grade the color to any desired shade, by using equal parts of logwood and alum.

CHROME BLACK FOR WOOL.—For 40 lbs. of goods, use blue vitriol 3 lbs., boil it a short time, then dip the wool or fabric ¾ of an hour, airing frequently; take out the goods, and make a dye with logwood 24 lbs.; boil ½ hour, dip ¾ of an hour, air the goods, and dip ¼ of an hour longer, wash in strong soap suds. A good fast color.

BLACK DYE ON WOOL, FOR MIXTURES.—For 50 lbs. of wool take bi-chromate of potash 1 lb. 4 ozs., ground argal 15 ozs., boil together and put in the fabric, stirring well, and let it remain in the dye 5 hours; take it out, rinse slightly in clean water, then make a new dye, into which put logwood 17½ lbs. Boil 1¼ hours, adding chamber lye 5 pts. Let the fabric remain in all night, and wash out in clean water.

RED MADDER.—This color is mostly used for army uniforms, &c. To 100 lbs. of fabric use 20 lbs. of alum, 5 lbs. of tartar, and 5 lbs. of muriate of tin. When these are dissolved, enter the goods, and let them boil for 2 hours, then take them out, let cool, and lay over night. Into fresh water, stir 75 lbs. of good madder, and enter the fabric at 120° Fahr. and bring it up to 200° in the course of an hour, handle well to secure evenness, then rinse and dry.

DARK SNUFF BROWN ON WOOL.—For 50 lbs. of goods, take camwood 10 lbs., boil for 20 minutes, then dip the goods for ¾ of an hour, then take them out, and add to the dye, fustic 25 lbs.; boil 12 minutes and dip the goods ¾ of an hour, then add blue vitriol 10 ozs., copperas 2 lbs. 8 ozs., dip again 40 minutes; add more copperas if the shade is required darker.

WINE COLOR DYE.—For 50 lbs. of goods use camwood 10 lbs., boil

20 minutes, dip the goods ½ hour, boil again, and dip 40 minutes, then darken with blue vitriol 15 ozs., and should you wish it darker, add 5 lbs. of copperas.

PINK DYE FOR WOOL.—For 60 lbs. of goods, take alum 5 lbs. 12 ozs., boil and immerse the goods 50 minutes, then add to the dye cochineal well pulverized, 1 lb. 4 ozs., cream of tartar, 5 lbs., boil and enter the goods while boiling, until the color is satisfactory.

DARK BLUE DYE.—*Suitable for Thibets and Lastings.* Boil 100 lbs. of the fabric for 1½ hours in a solution of alum 25 lbs., tartar 4 lbs., mordant 6 lbs., extract of indigo 6 lbs.; cool them as usual. Boil in fresh water from 8 to 10 lbs. of logwood, in a bag or otherwise, then cool the dye to 170° Fahr.; reel the fabric quickly at first, then let it boil strongly for 1 hour. This is a very good imitation of indigo blue.

ORANGE DYE.—For 50 lbs. of goods, use argal 3 lbs., muriate of tin 1 qt., boil and dip 1 hour; then add to the dye, fustic 25 lbs., madder 2½ qts., and dip again 40 minutes. If preferred, cochineal 1 lb. 4 ozs. may be used instead of the madder, as a better color is induced by it.

SKY BLUE ON COTTON.—60 lbs. of goods, blue vitriol 5 lbs. Boil a short time, then enter the goods, dip 3 hours, and transfer to a bath of strong lime water. A fine *brown* color will be imparted to the goods if they are then put through a solution of prussiate of potash.

A BROWN DYE ON WOOL may be induced by a decoction of oak bark, with variety of shade according to the quantity employed. If the goods be first passed through a mordant of alum the color will be brightened.

BROWN ON COTTON.—Catechu or terra japonica gives cotton a brown color, blue vitriol turns it on the *bronze*, green copperas *darkens* it, when applied as a mordant and the stuff boiled in the bath boiling hot. Acetate of alumina as a mordant, brightness it. The French color named "*Carmelite*" is given with catechu 1 lb., verdigris 4 ozs., and sal-ammoniac 5 ozs.

BROWN ON WOOL AND SILK.—Infusion or decoction of walnut peels dyes wool and silk brown color, which is brightened by alum. Horse-chestnut peels also impart a brown color; a mordant of muriate of tin turns it on the *bronze*, and sugar of lead the *reddish brown*.

SOLITAIRE.—Sulphate or muriate of manganese dissolved in water with a little tartaric acid imparts this beautiful bronze tint. The stuff after being put through the solution must be turned through a weak lye of potash, and afterwards through another of chloride of lime, to brighten and fix it. *Prussiate of copper* gives a *bronze* or *yellowish brown* color to silk. The piece well mordanted with blue vitriol, may be passed through a solution of *prussiate of potash*.

FULLER'S PURIFIER FOR CLOTHS.—Dry, pulverize, and sift the following ingredients: Fuller's earth 6 lbs., French chalk 4 ozs., pipe clay 1 lb.; make into a paste with rectified oil of turpentine 1 oz., alcohol 2 ozs., melted oil soap 1½ lbs. Compound the mixture into cakes of any desired size, for sale if required, keeping them in water, or small wooden boxes.

GREEN ON COTTON.—For 40 lbs. of goods, use fustic 10 lbs., blue vitriol 10 ozs., soft soap 2½ qts., and logwood chips 1 lb. 4 ozs. Soak the logwood over night in a brass vessel, put it on the fire in the morning adding the other ingredients. When quite hot it is ready for dyeing; enter the goods at once, and handle well. Different shades may be obtained by letting part of the goods remain longer in the dye.

Pink Dye for Cotton.—For 40 lbs. of goods, use redwood 20 lbs., muriate of tin 2½ lbs. ; boil the redwood 1 hour, turn off into a large vessel, add the muriate of tin, and put in the goods, let it stand a few minutes (5 or 10), and a nice pink will be produced. It is quite a fast color.

Purple Dye for Silk.—For 10 lbs. of goods, enter your goods in blue dye bath, and secure a light blue color, dry, and dip in a warm solution containing alum 2½ lbs. Should a deeper color be required, add a little extract of indigo.

Yellow on Silk.—For 10 lbs. goods, use sugar of lead 7½ ozs., alum 2 lbs., enter the goods and let them remain 12 hours, remove them, drain, and make a new dye with fustic 10 lbs. Immerse until the color suits.

Purple on Cotton.—Get up a tub of hot logwood liquor, enter 3 pieces, give them 5 ends, hedge out ; enter them into a clean alum tub, give them 5 ends, hedge out; get up another tub of logwood liquor, enter, give them 5 ends, hedge out ; renew your alum tub, give them 5 ends in that, and finish.

Black on Cotton.—For 40 lbs. goods, use sumac 30 lbs., boil ¾ hour, let the goods steep over night, and immerse them in lime water 40 minutes, remove, and allow them to drip ¾ hour, now add copperas 4 lbs. to the sumac liquor, and dip 1 hour more ; next work them through lime water for 20 minutes, next make a new dye of logwood 20 lbs., boil 2½ hours, and enter the goods 3 hours, then add bi-chromate of potash 1 lb. to the new dye, and dip 1 hour more. Work in clean cold water and dry out of the sun.

Red Dye for Wool.—For 40 lbs. of goods, make a tolerably thick paste of lac dye and sulphuric acid, and allow it to stand for a day. Now take tartar 4 lbs., tin liquor 2 lbs, 8 ozs., and 3 lbs. of the above paste, make a hot bath with sufficient water, and enter the goods for ¾ hour, afterwards carefully rinse and dry.

Yellow on Cotton.—For 40 lbs. goods, use sugar of lead 3 lbs. 8 ozs., dip the goods 2 hours. Make a new dye with bi-chromate of potash 2 lbs., dip until the color suits, wring out and dry, if not yellow enough repeat the operation.

Violet Dye on Silk or Wool.—A good violet dye may be given by passing the goods first through a solution of verdigris, then through a decoction of logwood, and lastly alum water. A *fast violet* may be given by dyeing the goods crimson with cochineal, without alum or tartar, and after rinsing, passing them through the indigo vat. *Linens or Cottons* are first galled with 18°|ₒ of gall nuts, next passed through a mordant of alum, iron liquor, and sulphate of copper, working them well, then worked in a madder bath made with an equal weight of root, and lastly brightened with soap or soda.

Slate Dye on Silk.—For a small quantity, take a pan of warm water, and about a teacupful of logwood liquor, pretty strong, and a piece of pearlash the size of a nut ; take gray colored goods and handle a little in this liquid, and it is finished. If too much logwood is used, the color will be too dark. A *Straw color* on silk.—Use smartweed, boil in a brass vessel, and set with alum.

Lilac Dye on Silk.—For 5 lbs. of silk, use archil 7½ lbs., mix it well with the liquor; make it boil ¼ hour, dip the silk quickly, then let it cool, and wash it in river water, and a fine half violet, or lilac, more or less full, will be obtained.

GREEN DYE ON SILK.—Take green ebony, boil it in water, and let it settle; take the clear liquor as hot as you can bear your hands in it and handle your goods in it until of a bright yellow; then take water and put in a little sulphate of indigo; handle your goods in this till of the shade desired. The ebony may previously be boiled in a bag to prevent it sticking to the silk.

BROWN ON SILK.—Dissolve annatto 1 lb., pearlash 4 lbs., in boiling water, and pass the silk through it for 2 hours, then take it out, squeeze it well and dry; next give it a mordant of alum, and pass it first through a bath of Brazil-wood, and afterwards through a bath of logwood to which a little green copperas has been added, wring it out and dry, afterwards rinse well.

BROWN DYE ON COTTON OR LINEN.—Give the pieces a mixed mordant of acetate of alumina and acetate of iron, and then dye them in a bath of madder, or madder and fustic, when the acetate of alumina predominates the dye has an *amaranth* tint. A *cinnamon* tint is obtained by first giving a mordant of alum, then a madder bath, then a bath of fustic, to which a little green copperas has been added.

MULBERRY ON SILK.—For 5 lbs. of silk, use alum 1 lb. 4 ozs., dip 50 minutes, wash out, and make a dye with Brazil-wood 5 ozs., and logwood 1¼ ozs. by boiling together; dip in this ½ hour, then add more Brazil-wood and logwood, equal parts, until the color suits.

GREEN DYE ON WOOL AND SILK.—Equal quantities of yellow oak and hickory bark, make a strong yellow bath by boiling, shade to the desired tint by adding a small quantity of extract of indigo.

ORANGE DYE.—For 40 lbs of goods, use sugar of lead 2 lbs., boil 15 minutes, when a little cool, enter the goods, and dip for 2 hours, wring them out, make a fresh dye with bi-chromate of potash, 4 lbs., madder 1 lb., immerse until of the desired color. The shade may be varied by dipping in lime water.

BLUE ON COTTON.—For 40 lbs. of goods, use copperas 2 lbs., boil and dip 20 minutes, then dip in soap suds, and return to the dye 3 or 4 times; then make a new bath with prussiate of potash ½ lb., oil of vitriol 1¼ pts.; boil ½ hour, rinse out and dry.

SOLFERINO AND MAGENTA DYES ON WHITE WOOLLEN, SILK, OR COTTON AND WOOLLEN MIXTURES.—For 1 lb. of woollen goods, *Magenta shade*, 96 grs. apothecaries' weight, of aniline red, will be required; dissolve in a little warm alcohol; using say 6 fluid ozs. of alcohol, or about 6 gills alcohol per oz. of aniline. Many dyers use wood spirit because of its cheapness. For a *Solferino shade*, use 64 grs. aniline red, dissolved in 4 ozs. alcohol, to each 1 lb. of goods. Cold water 1 qt. will dissolve these small quantities of aniline red, but the cleanest and quickest way will be found by using the alcohol, or wood spirit. Clean the cloth and goods by steeping at a gentle heat in weak soap suds, rinse in several messes of clean water and lay aside moist. The alcoholic solution of aniline is to be added from time to time to the warm or hot dye bath, till the color on the goods is of the desired shade. The goods are to be removed from the dye bath before each addition of the alcoholic solution, and the bath is to be well stirred before the goods are returned. The alcoholic solution should be first dropped into a little water, and well mixed, and the mixture should then be strained into the dye bath. If the color is not dark enough after working from 20 to 30 minutes, repeat the removal of the goods from the bath, and the addition of the solution, and the re-immersion of the goods from 15 to 30 minutes more, or until suited, then remove from the bath, and rinse in several messes of clean water, and dry in the shade. Use about 4 gals. water for dye-bath for 1 lb. of goods; less water for larger quantities.

LIQUID DYE COLORS.—1. *Blue.* Dilute Saxon blue or sulphate of indigo with water. If required for delicate work, neutralize with chalk. 2. *Purple.* Add a little alum to a strained decoction of logwood. 3. *Green.* Dissolve sap green in water and add a little alum. 4. *Yellow.* Dissolve annatto in a weak lye of subcarbonate of soda or potash. 5. *Golden color.* Steep French berries in hot water, strain, and add a little gum and alum. 6. *Red.* Dissolve carmine in ammonia, or in weak carbonate of potash water, or infuse powdered cochineal in water, strain, and add a little gum in water. The preceding colors, thickened with a little gum, may be used as inks in writing, or as colors to tint maps, foils, artificial flowers, &c., or to paint on velvet.

TO CLEANSE WOOL.—Make a hot bath composed of water 4 parts, urine 1 part, enter the wool, teasing and opening it out to admit the full action of the liquid ; after 20 minutes' immersion, remove from the liquid and allow it to drain, then rinse it in clean running water, and spread out to dry. The liquid is good for subsequent operations, only keep up the proportions, and use no soap.

STARCH LUSTRE.—A portion of stearine, the size of an old-fashioned cent, added to starch ½ half lb., and boiled with it for 2 or 3 minutes will add greatly to the beauty of linen, to which it may be applied. See also *Starch Polish* under the Grocers' Department.

TO DYE HATS.—The hats should be at first strongly galled by boiling them a long time in a decoction of galls with a little logwood, that the dye may penetrate the better into their substance ; after which a proper quantity of vitriol and decoction of logwood, with a little verdigris, are added, and the hats continued in this mixture for a considerable time. They are afterwards put into a fresh liquor of logwood, galls, vitriol, and verdigris, and, when the hats are of great price, or of a hair which with difficulty takes the dye, the same process is repeated a third time. For obtaining the most perfect color, the hair or wool is dyed blue previously to its being formed into hats.

CHESTNUT BROWN ON STRAW BONNETS.—For 25 hats, use ground sanders 1½ lbs., ground curcuma 2 lbs., powdered gall nuts, or sumac ¾ lb., rasped logwood $\frac{1}{10}$ lb. Boil all together with the hats in a large kettle (so as not to crowd), for 2 hours, then withdraw the hats, rinse, and let them remain over night in a bath of nitrate of 4° Baume, when they are washed. A darker brown may be obtained by increasing the quantity of sanders. To give the hats the desired lustre, they are brushed with a brush of dog's (couch) grass, when dry.

VIOLET DYE ON STRAW BONNETS.—Take alum 4 lbs., tartaric acid 1 lb., chloride of tin 1 lb. Dissolve and boil, allow the hats to remain in the boiling solution 2 hours, then add as much of a decoction of logwood and carmine of indigo as is requisite to induce the desired shade, and lastly, rinse finally in water in which some alum has been dissolved.

SILVER GREY DYE ON STRAW.—For 25 hats, select your *whitest* hats and soften them in a bath of crystallized soda to which some clean lime water has been added. See "*Lime water*" below. Boil for 2 hours in a large vessel, using for a bath a decoction of the following, viz.: alum 4 lbs., tartaric acid ⅜ lb., some ammoniacal cochineal, and carmine of indigo; a little sulphuric acid may be necessary in order to neutralize the alkali of the cochineal dye. If the last-mentioned ingredients are used, let the hats remain for an hour longer in the boiling bath, then rinse in slightly acidulated water.

LIME WATER FOR DYERS' USE.—Put stone lime 1 lb., and strong lime water 1½ lbs. into a pail of water; rummage well for 7 or 8 minutes, then let it rest until the lime is precipitated and the water clear; add this quantity to a tubful of clear water.

DARK STEEL COLOR.—Mix black and white wool together in the proportion of 50 lbs. of black wool to 7½ lbs. of white. For large or small quantities keep the same proportion, mixing carefully and thoroughly.

TO RENDER ANILINE COLORS SOLUBLE IN WATER.—A solution of gelatine in acetic acid of almost the consistence of syrups is first made, and the aniline in fine powder is gradually added, stirring all the time so as to make a homogeneous paste. The mixture is then to be heated over a water bath to the temperature of boiling water and kept at that heat for some time.

ANILINE GREEN ON SILK.—Iodine green or night green dissolves easily in warm water. For a liquid dye, 1 lb. may be dissolved in 1 gal. alcohol, and mixed with 2 gals. water, containing 1 oz. sulphuric acid.

TO DYE ANILINE SCARLET.—For every 40 lbs. of goods, dissolve 5 lbs. white vitriol (sulphate of zinc) at 180° Fah., place the goods into this bath for 10 minutes, then add the color, prepared by boiling for a few minutes, 1 lb. aniline scarlet in 3 gals. water, stirring the same continually. This solution has to be filtered before being added to the bath. The goods remain in the latter for 15 minutes, when they have become browned and must be boiled for another half hour in the same bath after the addition of sal-ammoniac. The more of this is added the deeper will be the shade.

BISMARCK BROWN FOR DYEING.—Mix together 1 lb. Bismarck, 5 gals. water, and ¾ lb. sulphuric acid. This paste dissolves easily in hot water and may be used directly for dyeing. A liquid dye may be prepared by making the bulk of the above mixture, to 2 gals. with alcohol. To dye with the above mixture, sour with sulphuric acid; add a quantity of sulphate of soda, immerse the wool, and add the color by small portions, keeping the temperature under 212° Fah. Very interesting shades may be developed by combining the color with indigo paste or picric acid.

TO DYE WOOL WITH ANILINE GREEN.—For wool, prepare two baths, one containing the dissolved dye and a quantity of carbonate of soda or borax. In this the wool is placed, and the temperature is raised to 212° Fah. A greyish green is produced, which must be brightened and fixed in a second bath of water 100° Fah., to which some acetic acid has been added. Cotton requires preparation by sumac.

ANILINE BLUE.—To 100 lbs. of fabric dissolve 1¼ lbs. aniline blue in 3 qts. hot alcohol; strain through a filter and add it to a bath of 130° Fah.; also 10 lbs. glauber salts, and 5 lbs. acetic acid. Enter the goods and handle them well for 20 minutes; next heat it slowly to 200° Fah.; then add 5 lbs. sulphuric acid diluted with water. Let the whole boil 20 minutes longer; then rinse and dry. If the aniline be added in two or three proportions during the process of coloring, it will facilitate the evenness of the color.

ANILINE RED.—Enclose the aniline in a small muslin bag; have a kettle (tin or brass) filled with moderately hot water and rub the substance out. Then immerse the goods to be colored, and in a short time they are done. It improves the color to wring the goods out of strong soap suds before putting them in the dye. This is a permanent color on wool or silk.

ANILINE VIOLET AND PURPLE.—Acidulate the bath by sulphuric acid, or use sulphate of soda; both these substances render the shade bluish. Dye at 212° Fah. To give a fair middle shade to 10 lbs. of wool, a quantity of solution equal to ½ to ¾ ozs. of the solid dye will be required. The color of the dyed fabric is improved by washing in soap and water, and then passing through a bath soured by sulphuric acid.

ANILINE BLACK FOR DYEING.—Water 20 to 30 parts, chlorate of potassa 1 part; sal-ammoniac 1 part; chloride of copper 1 part; aniline hydrochloric acid, of each 1 part, previously mixed together. It is essential that the preparation should be acid, and the more acid it is the more rapid will be the production of the blacks; if too much so, it may injure the fabric.

NEW MORDANT FOR ANILINE COLORS.—Immerse the goods for some hours in a bath of cold water in which chloride or acetate of zinc has been dissolved until the solution shows 2° Baumé; for the wool the mordanting bath should be at a boiling heat, and the goods should also be placed in a warm bath of tannin, 90° Fah., for half an hour. In dyeing, a hot solution of the color must be used to which should be added, in the case of the cotton, some chloride of zinc, and, in the case of the wool, a certain amount of tannin solution.

TO DYE ANILINE YELLOW.—This color is slightly soluble in water, and for dyers' use may be used directly for the preparation of the bath dye, but is best used by dissolving 1 lb. of dye in 2 gals. alcohol. Temperature of bath should be under 200° Fah. The color is much improved and brightened by a trace of sulphuric acid.

TO DYE WITH ALKALI BLUE AND NICHOLSON'S BLUE.—Dissolve 1 lb. of the dye in 10 gals. boiling water, add this by small portions to the dye bath, which should be rendered alkaline by borax. The fabric should be well worked about between each addition of the color. The temperature must be kept under 212° Fah. To develop the color, wash with water and pass through a bath containing sulphuric acid.

ANILINE BROWN DYE.—Dissolve 1 lb. of the brown in 2 gals. of spirit, specific gravity 8200, add a sufficient quantity to the dye bath, and immerse the fabric. Wool possesses a very strong affinity for this color and no mordant is required.

To Extract Oil Spots from Finished Goods.—Saturate the spot with benzine, then place two pieces of very soft blotting paper under and two upon it, press well with a hot iron, and the grease will be absorbed.

To Preserve Goods and Clothing from Mildew.—Alum, 2 lbs., dissolved in 60 lbs. water; blue vitriol, 2 lbs., dissolved in 8 lbs. of water; to which is added gelatine 1 lb., dissolved in 30 lbs. of water; acetate of lead, ½ lb. dissolved in 30 lbs. of water. The solutions are all hot, and separately mixed, with the exception of the vitriol, which is added.

To Bleach Feathers.—Place the feathers from 3 to 4 hours in a tepid dilute solution of bi-chromate of potassa, to which, cautiously, some nitric acid has been added (a small quantity only). To remove a greenish hue induced by this solution, place them in a dilute solution of sulphuric acid, in water, whereby the feathers become perfectly white and bleached.

To Clean Straw Bonnets.—First, brush them with soap and water, then with a solution of oxalic acid.

Crimson.—For 1 lb. of silk, alum, 3 oz.; dip at hand-heat, 1 hour; take out and drain, while making a new dye, by boiling, 10 minutes, cochineal, 3 oz.; brused nut-galls, 2 oz.; and cream of tartar, ½ oz., in one pail of water; when a little cool, begin to dip, raising the heat to a boil, continuing, to dip 1 hour; wash, and dry.

Cinnamon or Brown on Cotton and Silk.—Give the goods as much color, from a solution of blue vitriol, 2 oz., to water, one gal., as it will take up in dipping 15 minutes; then run it through lime-water; this will make a beautiful sky-blue of much durability; it has now to be run through a solution of prussiate of potash, 1 oz., to water, 1 gal.

Aniline Black on Silk or Cotton.—Water, 20 to 30 parts, chlorate of potassa, 1 part; sal-ammoniac, 1 part; chloride of copper, 1 part; aniline, 1 part; and hydrocloric, 1 part; previously mixed together. The fabric or yarn is dried in ageing rooms at a low temperature for 24 hours, and washed afterwards.

To Color Straw Hats or Bonnets a Beautiful Slate.—First, soak the bonnet in rather strong warm suds for 15 minutes to remove sizing or stiffening; then rinse in warm water, to get out the soap; now scald cudbear, 1 oz., in sufficient water to cover the hat or bonnet; work the bonnet in this dye, at 180° of heat, until you get a light-purple, now have a bucket of cold-water, blued with the extract of indigo, ½ oz., and work or stir the bonnet in this, until the tint pleases; dry, then rinse out with cold water, and dry again in the shade. If you get the purple too deep in shade the final slate will be too dark.

To Clean Ostrich Feathers.—Cut some white curd soap in small pieces, pour boiling water on them and add a little pearl ash. When the soap is quite dissolved, and the mixture cool enough for the hand to bear, plunge the feathers into it, and draw them through the hand till the dirt appears squeezed out of them, pass them through a clean lather with some blue in it, then rinse them in cold water with blue to give them a good color. Beat them against the hand to shake off the water, and dry by shaking them near a fire. When perfectly dry, coil each fibre separately with a blunt knife, or ivory folder.

TO CLEAN FURS.—For *dark* furs; warm a quantity of new bran in a pan, taking care that it does not burn, to prevent which it must be briskly stirred. When well warmed rub it thoroughly into the fur with the hand. Repeat this two or three times, then shake the fur, and give it another sharp brushing until free from dust. For *white* furs; lay them on a table, and rub well with bran made moist with warm water, rub until quite dry, and afterwards with dry bran. The wet bran should be put on with flannel, then dry with book muslin. Light furs, in addition to the above, should be well rubbed with magnesia or a piece of book muslin, after the bran process, against the way of the fur.

WASHING FLUID.—Take 1 lb. sal soda, ½ lb. good stone lime, and 5 qts. of water; boil a short time, let it settle, and pour off the clear fluid into a stone jug, and cork for use; soak your white clothes over night in simple water, wring out and soap wristbands, collars, and dirty or stained places; have your boiler half filled with water just beginning to boil, then put in one common teacupful of fluid, stir and put in your clothes, and boil for half an hour, then rub lightly through *one suds only*, and all is complete.

CHIP OR STRAW HATS OR BONNETS may be dyed black by boiling them three or four hours in a strong liquor of logwood, adding a little copperas occasionally. Let the bonnets remain in the liquor all night; then take out to dry in the air. If the black is not satisfactory, dye again after drying. Rub inside and out with a sponge moistened in fine oil; then block. *Red Dye.*—Boil ground Brazil-wood in a ley of potash, and boil your straw hats, &c., in it. *Blue Dye.*—Take a sufficient quantity of potash ley, 1 lb. of litmus or lacmus, ground; make a decoction and then put in the straw, and boil it.

DYES FOR HATS.—The ordinary bath for dyeing hats, employed by the London manufactures, consists, for twelve dozen, of 144 lbs. of logwood; 12 lbs. of green sulphate of iron or copperas; 7½ lbs. verdigris. The logwood having been introduced into the copper, and digested for some time, the copperas and verdigris are added in successive quantities, and in the above proportions, along with every successive two or three dozens of hats suspended upon the dripping machine. Each set of hats, after being exposed to the bath with occasional airings during forty minutes, is taken off the pegs, and laid out upon the ground to be more completely blackened by the peroxydizement of the iron with the atmospheric oxygen. In three or four hours, the dyeing is completed. When fully dyed, the hats are well washed in running water.

WATERPROOF STIFFENING FOR HATS.—Mix 18 lbs. of shellac with 1½ lb. of salt of tartar (carbonate of potash), and 5½ gals. water. These materials are to be put in a kettle, and made to boil gradually till the lac is dissolved, when the liquid will become as clear as water, without any scum upon the top, and if left to cool, will have a thin crust upon the surface, of whitish cast, mixed with the light impurities of the gum. When this skin is taken off, the hat body is to be dipped into the mixture in a cold state, so as to absorb as much as possible of it; or it may be applied with a brush or sponge. The hat body, being thus stiffened, may stand till it becomes dry, or nearly so; and after it has been brushed, it must be immersed in very dilute sulphuric or acetic acid, in order to neutralize the potash, and cause the shellac to set. If the hats are not to be napped immediately, they may be thrown into a cistern of pure water, and taken out as wanted.

METHOD OF BLEACHING STRAW.—Dip the straw in a solution of oxygenated muriatic acid, saturated with potash. (Oxygenated muriate of lime is much cheaper). The straw is thus rendered very white, and its flexibility is increased.

BLEACHING STRAW GOODS.—Straw is bleached by simply exposing it in a closed chamber to the fumes of burning sulphur, an old flour barrel is the apparatus most used for the purpose by milliners, a flat stone being laid on the ground, the sulphur ignited thereon, and the barrel containing the goods to be bleached turned over it. The goods should be previously washed in pure water.

VARNISH FOR FADED RUBBER GOODS.—Black Japan varnish diluted with a little linseed oil.

TO BLEACH LINEN.—Mix common bleaching-powder, in the proportion of 1 lb. to a gallon of water; stir it occasionally for three days, let it settle, and pour it off clear. Then make a ley of 1 lb. of soda to 1 gallon of boiling soft water, in which soak the linen for 12 hours, and boil it half an hour; next soak it in the bleaching liquor, made as above; and lastly, wash it in the usual manner. Discolored linen or muslin may be restored by putting a portion of bleaching liquor into the tub wherein the articles are soaking.

DYE FOR FEATHERS.—*Black:* Immerse for 2 or 3 days in a bath, at first hot, of logwood, 8 parts, and copperas or acetate of iron, 1 part. *Blue:* with the indigo vat. *Brown:* by using any of the brown dyes for silk or woollen. *Crimson:* a mordant of alum, followed by a hot bath of Brazil wood, afterwards by a weak dye of cudbear. *Pink or Rose:* with saf-flower or lemon juice. *Plum:* with the red dye, followed by an alkaline bath. *Red:* a mordant of alum, followed by a bath of Brazil-wood. *Yellow:* a mordant of alum, followed by a bath of turmeric or weld. *Green Dye.* Take of verdigris and verditer, of each 1 oz.; gum water, 1 pt.; mix them well and dip the feathers, they having been first soaked in hot water, into the said mixture. *For Purple,* use lake and indigo. *For Carnation,* vermilion and smalt. Thin gum or starch water should be used in dying feathers.

COLORS FOR ARTIFICIAL FLOWERS.—The French employ *velvet, fine cambric* and *kid* for the petals, and *taffeta* for the leaves. Very recently thin plates of *bleached* whalebone have been used for some portions of the artificial flowers. *Colors and Stains. Blue.*—Indigo dissolved in oil of vitriol, and the acid partly neutralized with salt of tartar or whiting. *Green.*—A solution of distilled verdigris. *Lilac.*—Liquid archil. *Red.*—Carmine dissolved in a solution of salt of tartar, or in spirits of hartshorn. *Violet.*—Liquid archil mixed with a little salt of tartar. *Yellow.*—Tincture of turmeric. The colors are generally applied with the fingers.

BLACK VARNISH FOR CHIP AND STRAW HATS.—Best alcohol, 4 oz.; pulverized black sealing-wax, 1 oz.; put them into a phial, and put the phial into a warm place, stirring or shaking occasionally until the wax is dissolved. Apply it when warm before the fire or in the sun. This makes a beautiful gloss.

EASY METHOD OF PREVENTING MOTHS IN FURS OR WOOLLENS.—Sprinkle the furs or woollen stuffs, as well as the drawers or boxes in which they are kept, with spirits of turpentine, the unpleasant scent of which will speedily evaporate on exposure of the stuffs to the air. Some persons place sheets of paper moistened with spirits of turpentine, over, under, or between pieces of cloth, &c., and find it a very effectual method. Many woollen drapers put bits of camphor, the size of a nutmeg, in papers, on different parts of the shelves in their shops, and as they brush their cloths every two, three or four months, this keeps them free from moths : and this should be done in boxes where the furs, &c., are put. A tallow candle is frequently put within each muff when laid by. Snuff or pepper is very good.

CLOTHING RENOVATOR.—Soft water, 1 gal. ; make a strong decoction of logwood by boiling the extract with the water. Strain, when cool, add 2 oz. gum arabic in powder ; bottle, cork well, and set aside for use ; clean the coat well from grease and dirt, and apply the above liquid with a sponge evenly. Dilute to suit the color, and hang in the shade to dry ; afterwards brush the nap smooth, and it will look like new.

WATERPROOF FOR POROUS CLOTH.—Dissolve $2\frac{1}{2}$ lbs. alum in 4 gals. water ; dissolve also in a separate vessel the same weight of acetate of lead in the same quantity of water. When both are well dissolved, mix the solutions together ; and, when the sulphate of lead resulting from this mixture has been precipitated to the bottom of the vessel in the form of a powder, pour off the solution, and plunge into it the fabric to be rendered waterproof. Wash and rub it well during a few minutes, and hang it in the air to dry.

TO REMOVE GREASE.—Aqua ammonia, 2 oz. ; soft water, 1 quart ; saltpetre, 1 teaspoonful ; shaving soap in shavings, 1 oz. ; mix altogether ; dissolve the soap well, and any grease or dirt that cannot be removed with this preparation, nothing else need be tried for it.

WATERPROOFING FOR CLOTHING.—Boiled oil, 15 lbs. ; bees-wax, 1 lb. ; ground litharge, 13 lbs. ; mix and apply with a brush to the article, previously stretched against a wall or a table, previously well washing and drying each article before applying the composition.

TO RENEW OLD SILKS.—Unravel and put them in a tub, cover them with cold water, let them remain one hour ; dip them up and down, but do not wring ; hang up to drain, and iron while very damp, and they will look beautiful.

DYES FOR FURS.—*For black*, use the hair dye described in these receipts. *Brown*, use tincture of logwood. *Red*, ground Brazil-wood, $\frac{1}{2}$ lb. ; water, $1\frac{1}{2}$ quarts ; cochineal, $\frac{1}{2}$ oz.; boil the Brazil-wood in the water one hour ; strain and add the cochineal ; boil fifteen minutes. *Scarlet color*, boil $\frac{1}{2}$ oz. saffron in $\frac{1}{2}$ pint of water, and pass over the work before applying the red. *Blue*, logwood, 7 oz. ; blue vitriol, 1 oz. ; water, 22 oz. ; boil. *Purple*, logwood, 11 oz. ; alum, 6 oz. ; water, 29 oz. *Green*, strong vinegar, $1\frac{1}{2}$ pints ; best verdigris, 2 oz. ; ground fine ; sap green, $\frac{1}{4}$ oz. ; mix all together and boil.

POTTER'S INVISIBLE WATERPROOFING.—Imbue the cloth on the wrong side with a solution of isinglass, alum, and soap dissolved in water, forming an emulsion of a milky thickness ; apply with a brush, rubbing in well. When dry, it is brushed on the wrong side against the grain, and then gone over with a brush dipped in water · afterwards brushed down smooth.

TO RAISE A NAP ON CLOTH.—Clean the article well ; soak it in cold water for half an hour ; put it on a board, and rub the thread-bare parts with a half-worn hatter's card filled with flocks, or with a teazle or a prickly thistle until a nap is raised ; then lay the nap the right way with a hatter's brush, and hang up to dry.

Black Reviver for Cloth.—Bruised galls, 1 lb. ; logwood, 2 lbs. ; green vitriol, ½ lb. ; water, 5 quarts ; boil two hours ; strain, and it is ready for use.

MEDICAL DEPARTMENT, &c.

Rules for Action, very Short but very Safe.—In health and disease endeavor always to live on the sunny side. Sir James Wylie, late physician to the Emperor of Russia, remarked during long observation in the hospitals of that country, that the cases of death occurring in rooms averted from the light of the sun, were four times more numerous than the fatal cases in the rooms exposed to the direct action of the solar rays. When poison is swallowed, a good off-hand remedy is to mix salt and mustard, 1 heaped teaspoonful of each, in a glass of water and drink immediately. It is quick in its operation. Then give the whites of 2 eggs in a cup of coffee, or the eggs alone if coffee cannot be had. For acid poisons give acids. In cases of opium poisoning, give strong coffee and keep moving. For light burns or scalds, dip the part in cold water or in flour, if the skin is destroyed, cover with varnish. If you fall into the water, float on the back, with the nose and mouth projecting. For apoplexy, raise the head and body ; for fainting, lay the person flat. Suck poisoned wounds, unless your mouth is sore, Enlarge the wound, or better cut out the part without delay, cauterize it with caustic, the end of a cigar or a hot coal. If an artery is cut, compress above the wound; if a vein is cut, compress below. If choked, get upon all-fours and cough. Before passing through smoke take a full breath, stoop low, then go ahead ; but if you fear carbonic acid gas, walk erect and be careful. Smother a fire with blankets or carpets; water tends to spread burning oil and increase the danger. Remove dust from the eyes by dashing water into them, and avoid rubbing. Remove cinders, &c., with a soft, smooth wooden point. Preserve health and avoid catching cold, by regular diet, healthy food and cleanliness. Sir Astley Cooper said: "The methods by which I have preserved my own health, are temperance, early rising, and sponging the body every morning with cold water, immediately after getting out of bed ; a practice which I have adopted for 30 years without ever catching cold." Water diluted with 2 per cent. of carbolic acid will disinfect any room or building, if liberally used as a sprinkle. Diphtheria can be cured by a gargle of lemon juice, swallowing a little so as to reach all the affected parts. To avert cold from the feet, wear two pairs of stockings made from different fabrics, one pair of cotton or silk, the other of wool, and the natural heat of the feet will be preserved if the feet are kept clean. In arranging sleeping rooms the soundest and most refreshing slumber will be enjoyed when the head is towards the north. Late hours and anxious pursuits exhaust vitality, producing disease and premature death, therefore the hours of labour and study should be short. Take abundant exercise and recreation. Be moderate in eating and drinking, using simple and plain diet avoiding strong drink, tobacco, snuff, opium and every excess. Keep the body warm, the temper calm, serene and placid; shun idleness; if your hands cannot be usefully employed, attend to the cultivation of your minds. For pure health giving fresh air, go to the country. Dr. Stockton Hough asserts that if all the inhabitants of the world were living in cities of the magnitude of London, the human race would become extinct in a century or two. The mean average of human life in the United States is 39½ years, while in New York and Philadelphia it is only 23 years; about 50 per cent. of the deaths in these cities being of children under five years of age. A great percentage of this excessive mortality is caused by bad air and bad food.

To Ascertain the State of the Lungs.—Draw in as much breath as you conveniently can, then count as long as possible in a slow and audible voice without drawing in more breath. The number of seconds must be carefully noted. In a consumptive the time does not exceed 10, and is frequently less than 6 seconds; in pleurisy and pneumonia it ranges from 9 to 4 seconds. When the lungs are sound the time will range as high as from 20 to 35 seconds. To expand the lungs, go into the air, stand erect, throw back the head and shoulders, and draw in the air through the nostrils as much as possible.

After having then filled the lungs, raise your arms, still extended, and suck in the air. When you have thus forced the arms backward, with the chest open, change the process by which you draw in your breath, till the lungs are emptied. Go through the process several times a day, and it will enlarge the chest, give the lungs better play, and serve very much to ward off consumption.

Remedy for Neuralgia.—Hypophosphite of soda taken in 1 dram doses 3 times per day in beef tea is a good remedy for this painful affection. So is the application of bruised horse-radish, or the application of oil of peppermint applied lightly with a camel hair pencil.

Remedy for Headache.—A Parisian physician has published a new remedy for headaches. He uses a mixture of ice and salt, in proportion of one to one-half, as a cold mixture, and this he applies by means of a little purse of silk gauze, with a rim of gutta percha, to limited spots on the head, when rheumatic headaches are felt. It gives instantaneous relief. The application is from ½ minute to 1½ minutes, and the skin is rendered white and hard by the applications.

To Cure a Cold.—Before retiring soak the feet in mustard water as hot as can be endured, the feet should at first be plunged in a pail half full of lukewarm water, adding by degrees very hot water until the desired heat is attained, protecting the body and knees with blankets so to direct the vapor from the water as to induce a good sweat. Next, to 2 table spoonfuls of boiling water, add 1 table spoonful of white sugar and 14 drops of strong spirits of camphor. Drink the whole and cuddle in bed under plenty of bedclothes and sleep it off.

Remedy for Consumption.—The following is said to be an effectual remedy, and will in time completely cure the disorder. Live temperately, avoid spirituous liquors, wear flannel next the skin, and take, every morning, half a pint of new milk, mixed with a wine glassful of the expressed juice of green horehound. One who has tried it says, "Four weeks' use of the horehound and milk relieved the pains of my breast, gave me ability to breathe deep, long and free, strengthened and harmonized my voice and restored me to a better state of health than I had enjoyed for years."

TRICHINA is the term applied to a minute, slender, and transparent worm, scarcely 1-20th of an inch in length, which has recently been discovered to exist naturally in the muscles of swine, and is frequently transferred to the human stomach when pork is used as food. Enough of these filthy parasites have been detected in half a pound of pork to engender 30,000,000 more, the females being very prolific, each giving birth to from 60 to 100 young, and dying soon after. The young thread-like worm at first ranges freely through the stomach and intestines, remaining for a short time within the lining membrane of the intestines, causing irritation, diarrhœa, and sometimes death, if present in sufficient numbers. As they become stronger, they begin to penetrate the walls of the intestines in order to effect a lodgment in the voluntary muscles, causing intense muscular pain and severe enduring cramps, and sometimes tetanic symptoms. After 4 weeks migration they encyst themselves permanently on the muscular fibre, and begin to secrete a delicate sac which gradually becomes calcareous. In this torpid state they remain during the person's lifetime.

REMEDY FOR DIPHTHERIA.—The treatment consists in thoroughly swabbing the back of the mouth and throat with a wash made thus: Table salt, 2 drams; black pepper, golden seal, nitrate of potash, alum, 1 dram each; mix and pulverize; put into a teacup half full of water; stir well, and then fill up with good vinegar. Use every half hour, one, two, and four hours, as recovery progresses. The patient may swallow a little each time. Apply 1 oz. each of spirits turpentine, sweet oil, and aqua-ammonia, mixed, every hour to the whole of the throat, and to the breast bone every four hours, keeping flannel to the part.

HOLLOWAY'S OINTMENT AND PILLS.—Butter, 22 oz.; beeswax, 3 oz.; yellow rosin, 3 oz.; melt; add vinegar of cantharides, 1 oz.; evaporate; and add Canada balsam, 1 oz.; oil of mace, ½ dram; balsam of Peru, 15 drops. *Pills:* Aloes, 4 parts; myrrh, jalap, and ginger, of each 2 parts; mucilage to mix.

ABERNETHY'S PILLS.—Each pill contains 2 grains of blue pill and 3 grains compound extract of colocynth.

WORM LOZENGES.—Powdered lump sugar, 10 oz.; starch 5 oz.; mix with mucilage; and to every ounce add 12 grains calomel; divide in 20 grain lozenges. Dose, two to six.

SOOTHING SYRUP.—Alcohol, oil of peppermint, castor oil, of each, 1 oz.; mix; add oil of anise, ½ dram; magnesia, 60 grains; pulverized ginger, 40 grains; water, 2 oz.; white sugar to form a syrup.

SOOTHING SYRUP.—Take 1 lb. of honey; add 2 tablespoonfuls of paregoric, and the same of oil of anise seed; add enough water to make a thick syrup, and bottle. For children teething, dose, teaspoonful occasionally.

INFANT'S SYRUP.—The syrup is made thus: 1 lb. best box raisins; ½ ounce of anise seed; two sticks licorice; split the raisins, pound the anise seed, and cut the licorice fine; add to it 3 quarts of rain water, and boil down to 2 quarts. Feed three or four times a day, as much as the child will willingly drink. The raisins strengthen, the anise expels the wind, and the licorice is a physic.

BRANDRETH'S PILLS.—Take 2 lbs. of aloes, 1 lb. of gamboge, 4 oz. of extract of colocynth, ½ lb. of Castile soap, 3 fluid drams of oil of peppermint, and 1 fluid dram of cinnamon. Mix, and form into pills.

DAVIS' PAIN KILLER IMPROVED.—Powdered guaiac 20 lbs.; camphor, 2 lbs.; powdered cayenne pepper, 6 lbs.; caustic liquor of ammonia, 1 lb.; powdered opium, ½ lb.; digest these ingredients in 32 gals. alcohol for two weeks, and filter.

COMPOUND SYRUP OF HYPOPHOSPHITES AND IRON.—Dissolve 256 grs. each of hypophosphites of soda, lime and potassa, and 126 grs. hypophosphite of iron, in 12 oz. water, by a water bath. Filter and add sufficient water to make up for the evaporation. Add 18 ozs. sugar by gentle heat, to make 21 fluid ozs. syrup. Each fluid oz. contains 12 grs. each of the hypophosphites of soda, lime and potassa, and six grs. hypophosphite of iron.

CURE FOR DRUNKENNESS.—*Warranted a certain Remedy.* Confine the patient to his room, furnish him with his favorite liquor of discretion, diluted with ⅔ of water, as much wine, beer, coffee and tea as he desires, but containing ⅓ of spirit; all the food—the bread, meat and vegetables steeped in spirit and water. On the fifth day of this treatment he has an extreme disgust for spirit, being continually drunk. Keep up this treatment till he no longer desires to eat or drink, and the cure is certain.

FAHNESTOCK'S VERMIFUGE.—Castor oil, oil of worm seed, each 1 oz.; oil anise, ½ oz.; tincture myrrh, ½ dram; oil turpentine, 10 minims. Mix.

SWAIM'S VERMIFUGE.—Wormseed, 2 oz.; valerian, rhubarb, pinkroot, white agaric, of each 1½ oz.; boil in sufficient water to yield 3 quarts of decoction; and add to it 10 drops of oil of tansy and 45 drops of oil of cloves, dissolved in a quart of rectified spirits. Dose, 1 tablespoonful at night.

AYER'S CHERRY PECTORAL.—Take 4 grains of acetate of morphia; 2 fluid drams of tincture of bloodroot; 3 fluid drams each of antimonial wine and wine of ipecacuanha, and 3 fluid oz. of syrup of wild cherry. Mix.

SPASMS.—Acetate of morphia, 1 gr. spirit of sal volatile, 1 oz. sulphuric ether, 1 oz. camphor julep, 4 ozs. Mix. Dose, 1 teaspoonful in a glass of cold water, or wine, as required. Keep closely corked, and shake well before using.

RADWAY'S READY RELIEF.—According to Peckolt, is an ethereal tincture of capsicum, with alcohol and camphor.

RADWAY'S RENOVATING RESOLVENT.—A vinous tincture of ginger and cardamon, sweetened with sugar.

AYER'S SARSAPARILLA.—Take 3 fluid ozs. each of alcohol, fluid extracts of sarsparilla and of stillingia; 2 fluid ozs. each, extract of yellow-dock and of podophyllin, 1 oz. sugar, 90 grs. iodide of potassium, and 10 grs. iodide of iron.

BROWN'S BRONCHIAL TROCHES.—Take 1 lb. of pulverized extract of licorice; 1½ lb. of pulverized sugar; 4 oz. of pulverized cubebs; 4 oz. pulverized gum arabic; 1 oz. of pulverized extract conium. Mix.

RUSSIA SALVE.—Take equal parts of yellow wax and sweet oil; melt slowly, carefully stirring; when cooling, stir in a small quantity of glycerine. Good for all kinds of wounds, &c.

DENTISTS' COMPOSITION FOR FILLING DECAYED TEETH.—Gold, 1 part; mercury, 8 parts; incorporated by heating together; when mixed pour them into cold water. Or, tinfoil and quicksilver; melt together in a convenient vessel, take a small quantity, knead it in the palm of the hand, and apply quick. Or, mix a little finely-powdered glass with some mineral succedaneum; apply as usual. Or, take some mineral succedaneum, and add some steel dust. Or, mineral succedaneum mixed with levigated porcelain or china. Or, gypsum, 1 part; levigated porcelain, 1 part; levigated iron filings, 1 part; make into a paste with equal parts of quick-drying copal and mastic varnish. Or, quicksilver, 40 grains; steel filings, 26 grains. Or, silver, 72 parts; tin, 20 parts; zinc, 6 parts. Better than any, pure gold, 1 part; silver, 3 parts; tin, 2 parts; melt the first two, add the tin, reduce all to a fine powder, use with an equal quantity of pure mercury.

Gutta-percha, softened by heat, is recommended. Dr. Rollfs advises melting a piece of caoutchouc at the end of a wire, and introducing it while warm.

Amalgams for the teeth are made with gold or silver, and quicksilver, the excess of the latter being squeezed out, and the stiff amalgam used warm. Inferior kinds are made with quicksilver and tin, or zinc. A popular nostrum of this kind consists of 40 grains of quicksilver and 20 of fine zinc filings, mixed at the time of using. The following is said to be the most lasting and least objectionable amalgam: Melt 2 parts of tin with 1 of cadmium, run it into an ingot, and reduce it to filings. Form these into a fluid amalgam with mercury, and squeeze out the excess of mercury through leather. Work up the solid residue in the hand, and press it into the tooth. Another cement consists of about 73 parts of silver, 21 of tin, and 6 of zinc, amalgamated with quicksilver. Beyond all doubt, gold foil is the best filling in use.

POUDRE METALLIQUE.—The article sold under this name in Paris appears to be an amalgam of silver, mercury, and ammonium, with an excess of mercury, which is pressed out before using it.

TO EXTRACT TEETH WITH LITTLE OR NO PAIN.—Tincture of aconite, chloroform, and alcohol, of each 1 oz.; mix; moisten two pledgets of cotton with the liquid, and apply to the gums on each side of the tooth to be extracted, holding them in their place with pliers or other instruments for from five to ten minutes, rubbing the gum freely inside and out.

TOOTH WASH—TO REMOVE BLACKNESS.—Pure muriatic acid, 1 oz.; water, 1 oz.; honey, 2 oz.; mix. Take a tooth-brush, and wet it freely with this preparation, and briskly rub the black teeth, and in a moment's time they will be perfectly white; then immediately wash out the mouth with water, that the acid may not act upon the *enamel* of the teeth.

DENTISTS' NERVE PASTE.—Arsenic, 1 part; rose pink, 2 parts. To destroy the nerve, apply this preparation on a pledget of cotton, previously moistened with creosote, to the cavity of the tooth, let it remain 4 hours, then wash out thoroughly with water. *Another.*—

Arsenous acid, 30 grs.; acetate of morphia, 20 grs.; creosote, q. s. for paste. Mix.

ALLOYS FOR DENTIST'S MOULDS AND DIES.—1. *Tin, very hard.*—Tin, 16 parts; antimony, 1 part; zinc, 1 part; 2. *Tin, softer than the last.* Tin, 8 parts; zinc, 1 part; antimony, 1 part; 3. *Copper Alloy, very hard.*—Tin, 12 parts; antimony, 2 parts; copper, 1 part; 4. *Cadmium Alloy, about the hardness of zinc.*—Tin, 10 parts; antimony, 1 part; cadmium, 1 part.

DENTISTS' EMERY WHEELS.—Emery, 4 lbs.; shellac, ½ lb.; melt the shellac over a slow fire; stir in the emery, and pour into a mould of plaster of Paris. When cold it is ready for use.

BASE FOR ARTIFICIAL TEETH.—PROPORTIONS.—India-rubber, 1 lb.; sulphur, ½ lb.; vermillion, 1 lb. 4 oz.

NITROUS OXIDE, OR LAUGHING GAS.—Take two or three ounces of nitrate of ammonia in crystals and put it into a retort, taking care that the heat does not exceed 500°; when the crystals begin to melt, the gas will be produced in considerable quantities. The gas may also be procured, though not so pure, by pouring nitric acid, diluted with five or six times its weight of water, on copper filings or small pieces of tin. The gas is given out till the acid begins to turn brown; the process must then be stopped

TO INHALE THE LAUGHING GAS.—Procure an oiled or varnished silk bag, or a bladder, furnished with a stop-cock, into the mouth, and at the same time hold the nostrils, and the sensation produced will be of a highly pleasing nature; a great propensity to laughter, a rapid flow of vivid ideas, and an unusual fitness for muscular exertion, are the ordinary feelings which it produces. The sensations, produced by breathing this gas, are not the same in all persons, but they are of an agreeable nature, and not followed by any depression of spirits like those occasioned by fermented liquors.

MAGNETIC PAIN KILLER, FOR TOOTHACHE AND ACUTE PAIN.—Laudnum 1 dr. gum camphor 4 drs. oil of cloves ½ dr. oil of lavender 1 dr. add then to 1 oz. alcohol, 6 drs. sulphuric ether, and 5 fluid drs. chloroform. Apply with lint, or for toothache rub on the gums, and upon the face against the teeth.

CURE FOR LOCK JAW, SAID TO BE POSITIVE.—Let any one who has an attack of lock jaw take a small quantity of spirits of turpentine, warm it, and pour it on the wound—no matter where the wound is, or what its nature is—and relief will follow in less than one minute. Turpentine is also a sovereign remedy for croup. Saturate a piece of flannel with it, and place the flannel on the throat and chest—and in very severe cases three to five drops on a lump of sugar may be taken internally.

NEW METHOD OF EMBALMING.—Mix together 5 pounds dry sulphate of alumine, 1 quart of warm water, and 100 grains of arsenious acid. Inject 3 or 4 quarts of this mixture into all the vessels of the human body. This applies as well to all animals, birds, fishes, &c. This process supersedes the old and revolting mode, and has been introduced into the great anatomical schools of Paris.

NITRATE OF SILVER.—Pure silver, 1½ oz.; nitric acid, 1 oz. diluted with water, 2 oz.; heat by a sand-bath until ebullition ceases, and the water is expelled then pour into moulds. This substance must be kept from the light.

CLIFFORD'S SHAMPOO COMPOUND.—Mix borax $\frac{3}{4}$ lb. with salts tartar $\frac{1}{4}$ lb. and dissolve 1 oz. of the mixture in 1 pt. water.

CLIFFORD'S HAIR DYE.—No 1. Pyrogallic acid 1 oz.; water 1 qt. No 2. Nitrate of silver 1 oz.; water 4 ozs.; ammonia 1 oz. Keep your materials free from grease, cool, and in the dark. Apply each No. alternately to the hair, first cleaning the hair well.

BAY RUM.—French proof spirit 1 gal. ext. Bay 6 ozs. Mix and color with caramel, needs no filtering.

HAIR INVIGORATOR.—Bay rum, 2 pints; alcohol, 1 pint; castor oil, 1 oz.; carb. ammonia, $\frac{1}{2}$ oz.; tincture of cantharides, 1 oz. Mix them well. This compound will promote the growth of the hair, and prevent it from falling out.

RAZOR-STROP PASTE.—Wet the strop with a little sweet oil, and apply a little flour of emery evenly over the surface.

OIL OF ROSES.—Olive oil, 1 lb.; otto of roses, 50 drops; oil of rosemary, 25 drops; mix. Another, roses (hardly opened) 12 oz.; olive oil, 10 oz., beat them together in a mortar; let them remain for a few days, then express the oil.

BALM OF BEAUTY.—Pure soft water, 1 qt.; pulverized Castile soap, 4 oz.; emulsion of bitter almonds, 6 oz.; rose and orange flower water, of each, 8 oz.; tincture of benzoin, 2 drs.; borax, 1 dr.; add 5 grs. bichloride of mercury to every 8 oz. of the mixture. To use, apply on a cotton or linen cloth to the face, &c.

ORIENTAL COLD CREAM.—Oil of almonds, 4 oz.; white wax and spermaceti, of each, 2 drs.; melt, and add rose water, 4 oz.; orange flower water, 1 oz.; used to soften the skin, apply as the last.

SHAVING CREAM.—White wax, spermaceti, almond and oil, of each $\frac{1}{4}$ oz.: melt, and while warm, beat in 2 squares of Windsor soap previously reduced to a paste with rose water.

CIRCASSIAN CREAM.—Take 2 ounces of perfectly fresh suet, either mutton or venison; 3 ounces of olive oil; 1 oz. gum benzoine in powder, and $\frac{1}{4}$ oz. of alkanet root. Put the whole into a jam jar, which, if without a lid, must be tied over with a bladder, and place the jar in a sauce pan containing boiling water, at the side of the fire. Digest for a whole day, then strain away all that is fluid through fine muslin, and stir till nearly cold. Add, say 1 dram of essence of almonds, roses, bergamot or any other perfume desired.

FRECKLE CURE.—Take 2 oz. lemon juice, or half a dram of powdered borax, and one dram of sugar; mix together, and let them stand in a glass bottle for a few days, then rub on the face occasionally.

YANKEE SHAVING SOAP.—Take 3 lbs. white bar soap; 1 lb. Castile soap; 1 quart rain water; $\frac{1}{2}$ pt. beef's gall; 1 gill spirits of turpentine. Cut the soap into thin slices, and boil five minutes after the soap is dissolved; stir while boiling; scent with oil of rose or almonds. If wished to color it, use $\frac{1}{2}$ oz vermilion.

BLOOM OF YOUTH.—Boil 1 ounce of Brazil wood in 3 pints of water for 15 minutes; strain. Add $\frac{3}{4}$ oz. isinglass, $\frac{1}{4}$ oz. cochineal, 1 oz. alum, $\frac{1}{2}$ oz. borax. Dissolve by heat, and strain.

COLOGNE WATER.—Oils of rosemary and lemon, of each $\frac{1}{4}$ oz.; oils of bergamot and lavender, each $\frac{1}{8}$ oz.; oil cinnamon, 8 drops; oils of cloves and rose, each 15 drops; best deodorized alcohol, 2 qts.; shake two or three times per day for a week.

We propose to give the formula for the following preparations, and shall commence with what is said to be

BOGLE'S HYPERION FLUID.—To 8 oz. of 90 or 95 per cent. alcohol, colored red with alkanet, add 1 oz. of castor oil; perfume with geranium and verbena.

LYON'S KATHAIRON.—To 8 oz. of 80 per cent. alcohol, colored yellow by a few drops extract of annatto, add 2 oz. castor oil, and perfume with a little bergamot.

PHALON'S HAIR RESTORATIVE.—To 8 oz. of 90 per cent. alcohol, colored by a few drops tincture of alkanet root, add 1 oz. of castor oil, and perfume with a compound of bergamot, neroli, verbena, and orange.

MRS. ALLEN'S.—To 16 oz. of rose water, diluted with an equal part of salt water, add ½ oz. of sulphur and ¼ oz. of sugar of lead; let the compound stand five days before using.

BATCHELOR'S HAIR-DYE.—No. 1. To 1 oz. of pyro-gallic acid, dissolved in 1 oz. alcohol, add 1 qt. of soft water. No. 2. To 1 oz. nitrate of silver, dissolved in 1 oz. of concentrated ammonia, add 4 oz. of soft water. Apply each No. alternately, with separate brushes, to the hair.

CHRISTADORO'S HAIR-DYE.—No. 1. To 1 oz. of pyro-gallic acid, dissolved in 1 oz. alcohol, add 1 qt. soft water. No. 2. To 1 oz. crystallized nitrate of silver, dissolved in 1 oz. concentrated aqua-ammonia and 1 oz. soft water, add ½ oz. gum arabic and 3 oz. soft water. Keep covered from the light.

PHALON'S INSTANTANEOUS HAIR-DYE.—No. 1. To 1. oz. pyro-gallic acid, and ¼ oz. of tannia, dissolved in 2 oz. of alcohol, add 1 qt. of soft water. No. 2. To 1 oz. crystallized nitrate of silver, dissolved in 1 oz. concentrated aqua-ammonia, add 1 oz. gum arabic, and 14 oz. soft water. Keep in the dark.

HARRISON'S.—No. 1. To 1 oz. pyro-gallic acid, 1 oz. of tannia dissolved in 2 oz. alcohol, add 1 qt. soft water. No. 2. To 1 oz. crystallized nitrate of silver, dissolved in 1 oz. of concentrated aqua-ammonia, add 5 oz. soft water and ½ oz. gum arabic. No. 3. 1 oz. hydro-sulphate of potassa, dissolved in 1 qt. of soft water. This last ingredient is intended to produce a deep black color if the others should fail. Keep away from the light.

PHALON'S (ONE PREPARATION.)—To 1 oz. crystallized nitrate of silver, dissolved in 2 oz. of aqua-ammonia, add 5 oz. soft water. This is not an instantaneous dye; but after exposure to the light and air, a dark color is produced upon the surface to which it is applied. Remember to remove all grease, &c., from the hair before applying these dyes.

PROFESSOR WOOD'S.—To 8 oz. vinegar, diluted with an equal part of soft water, add 2 drs. sulphur, and 2 drs. sugar of lead.

ALPINE HAIR-BALM.—To 16 oz. of soft water add 8 oz. of alcohol and ½ oz. spirits turpentine, ¼ oz. sulphur, and ¼ oz. sugar of lead.

GLYCERINE PREPARATION.—New rum, 1 qt.; concentrated spirits of ammonia, 15 drops; glycerine oil, 1 oz.; lac sulphur, 5½ drs.; sugar of lead, 5½ drs.; put the liquor into a bottle, add the ammonia, then the other components. Shake the compound occasionally for four or five days.

CRYSTALLINE CREAM.—Oil of almonds, 8 oz.; spermaceti, 1 oz.;

melt together. When a little cooled, add ½ oz. or less of essence of bergamot or other perfume; put into wide-mouthed bottles, and let it stand till cold. *Camphorated* crystalline cream may be made by using camphorated oil (*L. Camphoræ*) instead of oil of almonds.

Macassar Oil.—Olive oil, 1 qt.; alcohol, 2½ oz.; rose oil, 1½ oz.; then tie 1 oz. of chipped alkanet root in a muslin bag, and put it in the oil, let it alone for some days till it turns the color of a pretty red, then remove to other oils. Do not press it.

Ox Marrow.—Melt 4 oz. ox tallow; white wax, 1 oz.; fresh lard, 6 oz.; when cold, add 1½ oz. oil of bergamot.

Bears' Oil.—Use good sweet lard oil, 1 qt.; oil bergamot, 1½ oz.

Extract of Patchouli.—Mix 1¼ oz. ottar of Patchouli, and ¼ oz. otto of rose, with 1 gal. rectified spirits.

Sea Foam for Barbers.—Alcohol, 4 oz.; castor oil, 1 oz.; ammonia, ½ oz.; water, 1 pt. Dissolve the castor oil and ammonia in the alcohol, then add the alcohol mixture to the water.

Pyrogallic Hair Dye.—Pyrogallic acid, ¼ oz.; dissolve it in hot distilled water 1½ oz.; when the solution cools add gradually rectified spirit, ½ fluid oz.

Fine Shampoo Liquid.—Dissolve ½ oz. carb. of ammonia and 1 oz, of borax in 1 qt. water, then add 2 oz. glycerine, 3 qts. of New England rum, and 1 qt. of bay rum; moisten the hair with this liquor. shampoo with the hands until a slight lather is formed, then wash off with clean water.

Barber's Shampoo Mixture.—Soft water, 1 pt.; sal soda, 1 oz.; cream tartar, ¼ oz. Apply thoroughly to the hair.

Cheap Bay Rum.—Saturate a ¼ lb. block of carb. of magnesia with oil of Bay; pulverize the magnesia, place it in a filter, and pour water through it until the desired quantity is obtained, then add alcohol. The quantity of water and alcohol employed depends on the desired strength and quantity of the Bay rum. *Another*—Oil of Bay, 10 fluid drs.; oil of pimento, 1 fluid dr.; acetic ether, 2 fluid drs.; alcohol 3 gals.; water, 2½ gals. Mix, and after 2 weeks' repose, filter.

Liquid for Forcing the Beard.—Cologne, 2 oz.; liquid hartshorn, 1 dr.; tinct. cantharides, 2 drs.; oil rosemary, 12 drops; lavender, 12 drops. Apply to the face daily and await results. Said to be reliable.

Court Plaster.—Brush silk over with a solution of isinglass, in spirits or warm water, dry and repeat several times. For the last application apply several coats of balsam of Peru. Used to close cuts or wounds, by warming it and applying. It does not wash off until the skin partially heals.

Balm of a Thousand Flowers.—Deodorized alcohol, 1 pt.; nice white bar soap, 4 oz.; shave the soap when put in, stand in a warm place till dissolved; then add oil of citronella, 1 dr., and oils of neroli and rosemary, of each ½ dr.

New York Barbers' Star Hair Oil.—Caster oil 6½ pts.; alcohol, 1½ pts.; citronella and lavender oil, each ½ oz.

Frangipanni.—Spirits, 1 gal.; oil bergamot, 1 oz.: oil of lemon, 1 oz.; macerate for 4 days, frequently shaking; then add water, 1 gal.; orange-flower water, 1 pint, essence of vanilla, 2 oz. Mix.

Jockey Club.—Spirits of wine, 5 gal.; orange-flower water, 1 gal.; balsam of Peru, 4 oz.; essence of bergamot, 8 oz.; essence of musk, 8 oz.; essence of cloves, 4 oz.; essence of neroli, 2 oz.

LADIES' OWN.—Spirits of wine, 1 gal.; otto of roses, 20 drops; essence of thyme, ½ oz.; essence of neroli, ¼ oz.; essence of vanilla, ½ oz.; essence of bergamot, ¼ oz.; orange-flower water, 6 oz.

KISS ME QUICK.—Spirit, 1 gal.; essence of thyme, ¼ oz.; essence of orange-flowers, 2 oz.; essence neroli, ½ oz.; otto of roses, 30 drops; essence of jasmine, 1 oz.; essence of balm mint ½ oz.; petals of roses, 4 oz.; oil lemon, 20 drops; calorus aromaticus, ½ oz.; essence neroli, ¼ oz. Mix and strain.

UPPER TEN.—Spirits of wine, 4 qts.; essence of cedrat, 2 drs.; essence of violets, ¼ oz.; essence of neroli, ½ oz.; otto of roses, 20 drops; orange-flower essence, 1 oz.; oil of rosemary, 30 drops; oils bergamot and neroli, each ½ oz.

INDIA CHOLAGOGUE.—Quinine, 20 grs.; Peruvian bark, pulverized, 1 oz.; sulphuric acid, 15 drops, or 1 scruple of tartaric acid is best; brandy, 1 gill; water to make one pint; dose, 5 teaspoonfuls every 2 hours, in the absence of fever; an excellent remedy.

FEBRIFUGE WINE.—Quinine, 25 grs.; water, 1 pint; sulphuric acid, 15 drops; epsom salts, 2 oz.; color with tincture of red sanders. Dose, a wine glass 3 times per day. This is a world-renowned medicine.

BARRELL'S INDIAN LINIMENT.—Alcohol, 1 qt.; tincture of capsicum, 1 oz.; oil of origanum, sassafras, pennyroyal, and hemlock, of each ½ oz. Mix.

COD LIVER OIL, as usually prepared, is nothing more or less than cod oil clarified, by which process it is in fact deprived in a great measure of its virture. Cod oil can be purchased from any wholesale oil dealer for one thirtieth part of the price of cod liver oil as usually sold, and it is easy to clarify it. Dealers might turn this information to good account. To make it more palatable and digestible, put 1 oz. of fine table salt to each quart bottle.

COD LIVER OIL.—The first livers are placed in a jacketed pan heated by steam, and when the oil is separated from the scraps it is passed through felt bags until it is perfectly clear. To remove a portion of the stearine, it is subjected to refrigerating mixtures in the summer, and the incongealable portion is drawn off and placed in bottles.

PAREGORIC.—Best opium, ½ dr.; dissolve in about 2 tablespoonfuls of boiling water; then add benzoic acid ½ dr.; oil of anise, ½ a fluid dr.; clarified honey, 1 oz.; camphor gum, 1 scruple; alcohol, 76 per cent., 11 fluid oz.; distilled water, 4 fluid oz.; macerate (keep warm) for two weeks. Dose for children, 5 to 20 drops; adults; 1 to 2 teaspoonfuls.

COUGH SYRUP.—Put 1 qt. horehound tea, 1 qt. of water, and boil it down to 1 pt.; add 2 or 3 sticks licorice; 2 oz. syrup of squills, and a tablespoonful essence of lemon. Take a tablespoonful 3 times a day or as the cough requires.

COUGH SYRUP.—Syrup of squills, 2 oz.; tartarized antimony, 8 grs.; sulphate of morphine, 5 grs.; pulverized arabic, ¼ oz.; honey, 1 oz.; water, 1 oz.; mix. Dose for an adult, 1 small teaspoonful; repeat in half an hour if it does not relieve: child in proportion.

VEGETABLE SUBSTITUTE FOR CALOMEL.—Jalap, 1 oz. senna, 2 oz.;

peppermint, 1 oz. (a little cinnamon if desired), all pulverized and sifted through gauze. Dose, 1 teaspoonful put in a cup with 2 or 3 spoonfuls of hot water, and a good lump of white sugar; when cool, drink all; to be taken fasting in the morning; drink freely; if it does not operate in 3 hours, repeat ½ the quantity; use instead of calomel.

DYNAMIC POWER OF VARIOUS KINDS OF FOOD.—One lb., of oatmeal will furnish as much power as 2 lbs. of bread and more than 3 lbs of lean veal. One lb., butter gives a working force equal to that of 9 lbs. of potatoes, 12 lbs. of milk and more than 5 lbs. of lean beef. One lb. of lump sugar is equal in force to 2 lbs., of ham, or 8 lbs. of cabbage. The habitual use of spirituous liquors is inimical to health, and inevitably tends to shorten life. A mechanic or laboring man of average size, requires, according to Moleschott, 23 ozs., of dry solid matter, daily, one fifth nitrogenous. Food, as usually prepared, contains 50 per cent. of water, which would increase the quantity to 46 ozs., or 3 lbs. 14 ozs., with at least an equal weight of water in addition daily. The same authority indicates as healthy proportions, of albuminous matter 4.587 ozs., fatty matter 2.964, carbo-hydrate 14.250, salts 1.058, total 22.859 ozs., for daily use. This quantity of food will vary greatly in the requirements of individuals engaged in sedentary employments, or of persons with weak constitutions or impaired digestion, as also whether employed in the open air or within doors much also, depending on the temperature. Preference should be given to the food which most readily yields the materials required by nature in the formation of the human frame. Beef contains about 4 lbs. of such minerals in every 100 lbs. Dried extract of beef contains 21 lbs. in each 100 lbs. Bread made from unbolted wheat flour is also very rich in such elements, much more so than superfine flour; hence the common use of Graham bread for dyspepsia and other ailments. The analysis of Liebig, Johnston, and others give in 100 parts, the following proportions of nutritious elements, viz., Indian corn, 12.30 barley 14.00, wheat 14,06, oats 19.91. A fish diet is well adapted to sustain intellectual, or brain labor. What is required may be best known from the fact that a human body weighing 154 lbs., contains, on a rough estimate, of water 14 gals. (consisting of oxygen 111 lbs., of hydrogen 14 lbs.), carbon 21 lbs., nitrogen 3 lbs. 8 ozs., calcium 2 lbs., sodium 2¼ ozs., phosphorus 1¾ lbs., potassium ½ oz. sulphur 2 ozs. 219 grs., fluorine 2 ozs., chlorine 2 ozs. 47 grs., iron 100 grs., magnesium 12 grs., silicon 2 grs. After death, the human body is by gradual decay, slowly resolved into these its component parts, which elements are again used in the complex and wonderful laboratory of nature, to vivify the countless forms of vegetable life. These in their turn fulfil their appointed law by yielding up their substance for the formation of other bodies. What a suggestive comment on mortal ambition to witness the present inhabitants of Egypt engaged in what they consider the lucrative commerce of quarrying out the bones of the ancient inhabitants from the catacombs where they have been entombed for thousands of years and transporting them by the ship-load to England, in order to fertilize the crops which are destined to assist in forming the bone and sinew of the British nation!

CURE FOR SNAKE BITES.—The Inspector of Police in the Bengal Government reports that of 939 cases in which ammonia was freely administered 207 victims have recovered, and in the cured instances the remedy was not administered till about 3½ hours after the attack, on the average of the fatal cases the corresponding duration of time was 4½ hours.

REMEDY FOR SMALL POX.—Sulphate of zinc, 1 gr., foxglove [digitalis,] 1 gr., sugar ½ teaspoonful, mix with 2 teaspoonfuls of water, add 4 oz. of water, Dose 1 spoonful every hour, child in proportion. From experience it is known that nothing will break up this frightful disease sooner than continued and persevering bathing, with the water at a comfortable temperature.

RELIABLE SMALL POX REMEDY.—*Tested.*—A child 9 years old was effectually cured of small pox by administering 15 grs. sodæ sulphice dissolved in milk, sweetened, every 3 hours. The entire body was oiled with crude potroleum applied by hand. Next morning the eruption was killed and dry; and the disease broken up. To prevent pitting with small pox, as soon as the disease is distinguished, apply an ointment made of lard and charcoal to the face, neck, hands, &c., and continue until all signs of supperative fever has ceased. One case is worthy of notice, being that of a gentleman who suffered terribly for many days with this dreadful disease. Everything was done for him that medical skill could suggest, without giving the slightest relief. Finally, as a last resort, he was removed from the bed and placed in a warm bath; the transition was so soothing and delightful that he exclaimed, "Oh, my God, I thank Thee for this great relief!" In a short time he fell sound asleep in the bath, and continued in this position for many hours, the water being renewed from time to time to keep up the temperature. The cure proved to be immediate and permanent. Nothing is so conducive to health of body, and the eradication of disease therefrom, as the intelligent use of pure water. Sir Astley Cooper, being complimented on one occasion for his great skill, remarked, that he had "made mistakes enough to fill a graveyard," but it is scarcely possible to make a mistake with water, as no diseased person can fail to derive benefit from its use.

PORTABLE BATH.—Make a small circular boiler of copper or tin, and fit the same into an upright tin stand, in which, directly under the boiler, you must leave an aperture to contain a small spirit lamp. The boiler lid must fit tightly and be provided with three small tubes pointing upwards. The boiler being filled with water and the lamp lighted, as soon as the steam gets up, it rushes through these tubes, and the patient, seated on a cane chair, with his or her feet in a pan of warm water, with a suitable cloak tightly fastened around the neck, is speedily enveloped in a cloud of steam. Ten minutes is the time recommended for the duration of the first few baths. It may be afterwards increased, but not beyond half an hour. On getting out of the cloak, plunge into a cold bath for a few minutes, then rub the skin till it is quite dry and glowing with a coarse towel and a pair of good hair-gloves. Persons in health or disease will experience a wonderful recuperative power in the frequent use of this bath, and all will find it incomparably superior to the use of drugs in any form whatever. In this connection a new and very ingenious invention called SPONGIO PILINE, is deserving of favorable mention. It consists of wool and small particles of sponge felted together, and attached to a skin of India-rubber, the whole being about half an inch in thickness, and of inestimable value as a means of applying cold or tepid water, &c., to such exterior parts of the human frame as may be nearest to the seat of pain or disease. The water is sponged over the felted surface, the surplus, if any, wiped off; it is then placed on the skin, and covered over with several folds of bandages, which assist in retaining the heat and moisture, thus attracting healthy blood to the part, from which nature selects such food as is most conducive to expel disease and build up healthy tissue.

FLY PAPER.—Coat paper with turpentine varnish, and oil it to keep the varnish from drying.

SWEATING DROPS.—Ipecac., saffron, boneset, and camphor gum, of each, 3 oz.; opium, 1 oz.; alcohol, 2 qts. Let stand 2 weeks and filter. A teaspoonful in a cup of hot sage or catnip tea every hour until free perspiration is induced; good in colds, fevers, inflammations, &c. Bathe the feet in hot water at the same time.

SYRUP FOR CONSUMPTIVES.—Of tamarac bark, take from the tree, without rossing, 1 peck; spikenard root, ½ lb.; dandelion root, ¼ lb.; hops, 2 oz. Boil these sufficient to get the strength in 2 or 3 gals. water; strain, and boil down to 1 gal.; when blood warm, add 3 lbs. best honey, and 3 pints best brandy; bottle and keep in a cool place. Dose, drink freely of it 3 times per day before meals, at least a gill or more; cure very certain.

COMMON CASTOR OIL.—Pale vegetable oil, 1 gal.; castor oil, 3 gals.; mix.

PULMONIC WAFERS.—Lump sugar, licorice, and starch, of each 2 parts; gum, 10 parts; squills and ipecacuanha, of each 5 parts; lactucarium, 2 parts. Mix, and divide into 8 grain lozenges.

SIR JAMES CLARKE'S DIARRHŒA AND CHOLERA MIXTURE.—Tinct. of opium, tinct. of camphor, and spirits of turpentine, of each 3 drams; oil of peppermint, 30 drops; mix. Dose, 1 teaspoonful for cholera.

VEGETABLE OR COMPOSITION POWDER.—Fine bayberry bark, 1 lb; ginger 8 oz., common cayenne, 3 oz., mix. Dose, 1 teaspoonful in a cup of boiling water, sweeten and add milk.

TINCTURES are made with 1 oz. of gum, root, or bark, &c., dried, to each pint of proof spirits; let it stand one week, and filter.

ESSENCES are made with 1 oz. of any given oil, added to 1 pint alcohol. Peppermints are colored with tinct. turmeric; cinnamon with tinct. of red sanders; wintergreen with tinct. kino.

SUBSTITUTE FOR ARROWROOT.—Finest potato starch, 75 lbs.; lump sugar, 4 lbs.; finely-ground rice, 21 lbs. Mix, and sift through lawn; yields 100 lbs. excellent arrowroot.

CERTAIN CURE FOR CROUP.—Goose oil and urine equal parts. Dose, 1 teaspoonful. A certain cure if taken in time.

CORNS AND WARTS.—Take a small quantity of the potash paste recommended for Poll Evil, and apply to the corn or wart.

DRUGGIST'S COLORS.—*Yellow*, take iron filings, hydrochloric acid to dissolve, dilute with cold water. *Red*, solution of sal ammoniac, cochineal, to color. *Blue*, indigo, 1 part, oil of vitriol, 2 parts, dissolve, then dilute with water. *Green*, verdigris, 1 part, acetic acid, 3 parts, dilute with water. *Purple*, cochineal, 25 grs., sugar of lead 1 oz., dissolve.

Smelling Salts.—Sub-carbonate of ammonia, 8 parts ; put it in coarse powder in a bottle, and pour on it oil of lavendar, 1 part.

Tunbridge Wells Water.—Chloride of sodium, 5 grains ; tinct. steel, 20 drops ; distilled water, 1½ pints.

Mineral Water.—Epsom salts, 1 oz. ; cream tartar, ½ oz. ; tartaric acid, ¼ oz. ; loaf sugar, 1 lb. ; oil of birch, 20 drops ; put 1 qt. cold water on 2 tablespoonfuls yeast (winter green oil will do), let it work 2 hours and then bottle.

Congress Water for Fountains.—Common salt, 7¾ ozs. ; hydrate of soda, 20 grs. ; bicarbonate of soda, 20 grs. ; calcined magnesia, 1 oz. Add to 10 gal. of water, and then charge with gas.

Kissingen Water for Fountains.—Bicarbonate of soda, 1 dr. ; carbonate of lime, 2 drs., and 2 scr. ; precipitate carbonate of lime, 2 scr. ; common salt, 8 ozs. ; muriate of ammonia, 4 grs ; sulphate of soda, 2 drs. and 2 scr. ; sulphate of magnesia, 2 ozs. ; phosphate of soda, 13 grs. ; phosphate of lime 2 drs. and 2 scr. Mix. Add water ¾ of a gal. Let it stand for 6 hours, filter, add carbonate of magnesia, 3 drs. and 1 scr., and charge with 10 gals. of water.

Vichy Water for Fountains.—Sulphate of potass, 2 drs. ; sulphate of soda, 25 grs. ; common salt, 6 drs. ; bicarbonate of ammonia, 10 grs. Mix. Add water, 1 gal. Let it stand 1 day, filter and then charge with 10 gal. of water.

Genuine Seidlitz Powders.—Rochelle salts, 2 drs. ; bicarb. soda, 2 scr. ; put these into a blue paper, and 35 grains tartaric acid into a white paper. To use, put each into different tumblers, fill ⅓ with water, adding a little loaf sugar to the acid, then pour together and drink quick.

Bottled Seidlitz Water.—Fill soda-water bottles with clear water ; add to each as below ; cork and wire immediately : Rochelle salts, 3 drops ; bicarbonate of soda, 35 grs ; sulphuric acid, 11 drops.

Excellent Tooth Powder.—Suds of castile soap and spirits of camphor, of each an equal quantity ; thicken with equal quantities of pulverized chalk and charcoal to a thick paste. Apply with the finger or brush.

Rat Exterminator.—Warm water, 1 qt. ; lard, 2 lbs ; phosphorus, 1 oz. ; mix, and thicken with flour ; to be spread on bread and covered with sugar.

Bug Poison.—Alcohol, ½ pint; turpentine, ½ pint ; crude sal ammoniac, 1 oz. ; mix all together, and let it digest in a warm place for a few days, and it is ready for use.

Medicated Cough Candy.—To 5 lbs. candy just ready to pour on the slab, add the following mixture, and form it into sticks to correspond with the price asked for them : Tinct. squills, 2 oz. ; camphorated tinct. of opium and tinct. of tolu, of each ½ oz. ; wine of ipecac., ½ oz. ; oils of gaultheria, 4 drops ; sassafras, 3 drops ; and of anise seed oil, 2 drops, and use this freely in common coughs.

Ague Pill.—Quinine, 20 grs. ; Dover's powders, 10 grs. ; subcarbonate of iron, 10 grs. ; mix with mucilage of gum arabic and form into 20 pills. Dose, 2 each hour, commencing 5 hours before the chill should set in. Then take 1 night and morning until all are taken.

Age at which Menstruation Commences.—Dr. Walter Rigden gives the subjoined statistics obtained from females who were confined at University College Hospital. In 2,696 cases menstruation occured for the first time :

At the age of		At the age of	
9 in	3 cases.	18 in	150 cases.
10 "	14 "	19 "	76 "
11 "	60 "	20 "	29 "
12 "	170 "	21 "	7 "
13 "	353 "	22 "	3 "
14 "	560 "	23 "	2 "
15 "	540 "	24 "	0 "
16 "	455 "	25 "	0 "
17 "	272 "	26 "	2 "

It thus appears that it is most common at 14 years of age, and great care should be taken of the health on the occurrence of these important periods.

Atkinson's Infant's Preservative.—Carbonate of magnesia, 6 drs.; sugar, 2 oz. ; oil of anise seed, 20 drops ; sal-volatile, 2½ drs.; laudunum, 1 dr. ; syrup of saffron, 1 oz. Make up 1 pint with caraway water.

Pills to promote Menstrual Secretion.—Take pills of aloes and myrrh, 4 drs. ; compound iron pills, 280 grs. ; mix and form into 100 pills. Dose, 2 twice a day.

For Obstructed Menstruation.—Make a strong tea of smart weed, covering it to retain the strength, or use the extract of smart weed instead, taking 1 teaspoonful of the latter once every 3 hours, (or about 10 teaspoonfuls of the tea) in warm water, sweetened, making free use of hot baths for the feet and the lower parts of the body. It will give great relief.

Injection for Obstructed Menstruation.—Mix 1 to 2 fluid drs. liquor of ammonia with 1 pint milk. Use thrice daily.

For Obstructed Menstruation.—Sulphate of iron, 60 grs.; potassa (sub. carb.) 60 grs. ; myrrh, 2 drs. ; make them into 3½ gr. pills ; 2 to be taken three times a day, in the absence of fever. *For Painful Menstruation*, take pulv. rhei., 2 drs. ; pulv. jalap, 2 drs.; syrup of poppies to mix. Divide into 200 pills, and take night and morning. *To check Immoderate Flow*—Tinct. of ergot, 1 oz., liquor of ammonia, 3 drs.; mix. Dose, teaspoonful in water 3 times a day.

Stimulant.—In Low Fevers, and after Uterine Hemorrhages.—Best brandy and cinnamon water, of each, 4 fluid oz. ; the yolks of 2 eggs, well beaten ; loaf sugar ½oz. ; oil of cinnamon, 2 drops ; mix. Dose, from ½ to 1 (fluid) oz., as often as required. This makes both meat and drink. Of course, any other flavoring oils can be used, if preferred, in place of the cinnamon.

For Female Complaints.—One of the best laxative pills for female complaints is macrotin and rhubarb, each 10 grs.; extract of hyoscyamus 10 grs.; Castile soap, 40 grs.; scrape the soap, and mix well together, forming into common sized pills with gum solution. Dose, 1 pill at bed time, or sufficiently often to keep the bowels in a laxative state.

For Disease of the Kidneys.—Boil 1 oz. of pareira brava in 3 pints of water down to 1 pint. Dose, a wineglassful 3 times per day.

To cure vomiting in Pregnancy.—Mix 1 dr. carbonate of magnesia; $\frac{1}{2}$ oz. tinct. of colombo; $5\frac{1}{2}$ oz. peppermint water. Dose, 1 tablespoonful 3 times a day.

Harland's Venereal Cure.—Mix together powdered cubebs, $1\frac{1}{2}$ oz.; balsam capaiba, $\frac{1}{2}$ oz.; powdered gum arabic, $\frac{1}{2}$ oz.; cinnamon water, 3 ozs. A tablespoonful of the mixture to be taken at intervals 8 times a day.

Incontinence of Urine of Old People.—The continued use of 1 to 6 drops tinct. of iodine has proved a successful remedy. *For other persons*, put 4 drops tincture of aconite root in a tumbler of water, and use a teaspoonful every half hour until relieved.

Compound Extract Buchu.—Buchu, in coarse powder, 12 ozs.; alcohol, 3 pts.; water, 6 pts. are sufficient. Treat the leaves by maceration and displacement, first with a portion of the alcohol and then with the remainder mixed with the water, evaporate the resulting liquid with a gentle heat to three pints, and add $2\frac{1}{2}$ lbs. sugar, continue the heat till it is dissolved, and after removing from the fire, add oil of cubebs, oil of juniper; of each 1 fluid dr.; spirits of nitric ether, 12 fluid ozs., previously mixed, stir together.

Anodyne for Painful Menstruation.—Extract of stramonium and sulphate of quinine, each 16 grs.; macrotin, 8 grs.; morcrotin, 8 grs.; morphine, 1 gr.; make into 8 pills. Dose, 1 pill repeating once or twice only, 40 to 50 minutes apart, if the pain does not subside before this time. Pain *must* subside under the use of this pill, and costiveness is not increased.

Powder for Excessive Flooding.—Gums kino and catechu, each 1 gr.; sugar of lead and alum, each $\frac{1}{2}$ dr.; pulverize all and thoroughly mix, then divide into 7 to 10 grain powders. Dose, one every 2 or 3 hours until checked, then less often merely to control the flow.

Injection for Leucorrhœa.—When the glairy mucus discharge is present, prepare a tea of hemlock inner bark and witch hazel (often called spotted alder) leaves and bark, have a female syringe large enough to fill the vagina, and inject the tea, twice daily; and occasionally in bad cases, say twice a week, inject a syringe of the following composition: *For Chronic Female Complaints.* White vitriol and sugar of lead, each, $\frac{1}{2}$ oz.; common salt, pulverized alum, and loaf sugar, each, $\frac{1}{2}$ dr.; soft water, 1 pt. Inject as above.

For Prolapsus Uteri, or Falling of the Womb.—Not only the cheapest but the best support will be found to be a piece of fine firm sponge, cut to a proper size, to admit when damp of being pressed up the vagina to hold the womb in its place. The sponge should have a stout piece of small cord sewed 2 or 3 times through its centre, up and down, and left sufficiently long to allow its being taken hold of to remove the sponge, once a day, or every other day at the farthest, for the purpose of washing, cleaning, and using the necessary injections; and this must be done while the patient is lying down, to prevent the womb from again falling or prolapsing. After having injected some of the above tea, wet the sponge in the same, and introduce it sufficiently high to hold the womb in its place. If pain is felt about the head, back, or loins for a few days before the menses appear, prepare and use the following: *Emmenagogue Tincture.* Alcohol, 1 pt.; red oxide of iron, 1 oz.; oils of juniper and savin, each ¼ oz. ; oil of tansey, 1 dr. ; tincture of ergot, 3 drs.; tincture Spanish flies, ½ oz. : mix all, and shake when taken. Dose, 1 teaspoon 3 times daily, to be taken in mucilage of slippery elm or gum arabic, and drink freely of the mucilage also through the day, or use the following :

EMMENAGOGUE PILL.—Precipitated carbonate of iron and gum myrrh, of each 2 drs. ; aloes and tincture of Spanish flies, of each 1 dr.; and oil of savin, 1 dr.; all to be pulverized, and made into 100 pills by using thick gum solution. Dose, 1 pill, from 1 to 3 times daily, but not to move the bowels too much.

UTERINE HEMORRHAGE.—Unfailing cure. Sugar of lead, 10 grs.; ergot, 10 grs. ; opium, 3 grs.; ipecac., 1 gr.; all pulverized, and well mixed. Dose, 10 to 12 grs. ; given in a little honey or syrup.

In very bad cases after chilbbirth, it might be repeated in 30 minutes, or the dose increased to 15 or 18 grs. ; but in cases of rather profuse wasting, repeat it once at the end of 3 hours, or as the urgency of the case may require.

In every case of female debility make a liberal use of iron, as the want of iron in the system is often the cause of the trouble. Mix fine iron filings with as much ground ginger. Dose, half of a teaspoon 3 times daily in a little honey or molasses, increasing or lessening the dose to produce a blackness of the stools. Continue this course until well.

IMPERIAL DROPS FOR GRAVEL AND KIDNEY COMPLAINTS.—Oil of origanum, 1 oz., oil of hemlock, ¼ oz., oil of sassafras, ¼ oz., oil of anise, ½ oz., alcohol, 1 pint: mix. Dose, from ½ to 1 teaspoonful 3 times a day, in sweetened water, will soon give relief when constant weakness is felt across the small of the back, as well as gravelly affections causing pain about the kidneys.

POSITIVE CURE FOR GONORRHŒA.—Liquor of potass, ½ oz., bitter apple, ½ oz., spirits of sweet nitre, ½ oz., balsam of copaiba, ½ oz., best gum ¼ oz. To use, mix with peppermint water; take ½ teaspoonful 3 times per day: cure certain in 9 days.

CELEBRATED PILE OINTMENT.—Take carbonate of lead, ½ oz., sulphate of morphia, 15 grs.; stramonium ointment, 1 oz.; olive oil, 20 drops. Mix and apply 3 times per day, or as the pain may require.

Another—Powdered nut gall, 2 drs., camphor, 1 dr., melted wax, 10 oz., tincture of opium, 2 drs., mix.

STAMMERING.—Impediments in the speech may be cured, where there is no malformation of the organs of articulation, by preseverance, for three or four months, in the simple remedy of reading aloud, with the teeth closed, for at least 2 hours each day.

COLD IN THE HEAD.—Dr. Pollion, of France, says that cold in the head can be cured by inhaling hartshorn. The inhalation by the nose should be seven or eight times in five minutes.

CAMPHOR ICE.—Spermaceti, 1½ oz., gum camphor, ¾ oz., oil sweet almonds, 4 teaspoonfuls; set on the stove in an earthen dish till dissolved; heat just enough to dissolve it. While warm pour into small moulds, if desired to sell; then paper, and put into tinfoil; used for chaps on hands or lips.

SIMPLE REMEDIES FOR SCARLET FEVER.—Open the bowels regularly every day with some mild aperient medicine, such as castor oil, senna, etc. ; and keep the patient at rest, and comfortably warm ;

sponge the surface with tepid water, two or three times a day ; while it is hotter than natural, admit fresh air ; live on a bland diet, such as a cupful of arrowroot, several times a day ; toast-water for common drink. Gargle made of strong sage tea, honey and alum, or borax, may be used from the commencement, if the throat is affected.

NERVE AND BONE LINIMENT.—Beef's gall. 1 qt.; alcohol, 1 pt.; volatile liniment, 1 lb.; sirits of turpentine, 1 lb.; oil organum, 4 oz.; aqua ammonia, 4 oz.; tincture of cayenne, ½ pt. ; oil of amber, 3 oz.; tincture Spanish flies, 6 oz.; mix well.

CEPHALIC SNUFF.—Take asarbacca leaves, marjoram, light Scotch snuff, equal parts ; grind and sift, use like common snuff.

DOWNER'S SALVE.—Beeswax, 4 oz. ; opium, ¼ oz.; sugar of lead, 1 oz. ; melt the beeswax, and rub the lead up in the wax, then the opium, then 1 gill of sweet oil, incorporate all thoroughly together, spread lightly on cloth; good for burns, piles, &c.

ANOTHER SALVE.—Burgundy pitch, beeswax, white pine pitch, and resin, 1 oz. each, mutton tallow, 8 oz. ; goose oil, 1 gill ; tar, 1 gill ; melt and mix thoroughly. A first-rate salve.

WHOOPING COUGH SYRUP.—Best rum, 1 pt. ; anise oil, 2 ozs. ; honey, 1 pt. ; lemon juice, 4 oz. ; mix. Dose for adults, 1 tablespoonful, 3 or 4 times per day ; children 1 teaspoon, with sugar and water.

LIQUID OPODELDOC.—Warm brandy, 1 qt.; add to it gum camphor, 1 oz. ; sal ammoniac, ¼ oz. ; oils of origanum and rosemary, each ½ oz. ; oil wormwood, ¼ oz. ; when the oils are dissolved, add 6 oz. soft soap.

GREEN MOUNTAIN SALVE.—For rheumatism, burns, pains in the back or side, &c., take 2 lbs. resin, burgundy pitch, ¼ lb.; beeswax ¼ lb. ; mutton tallow, ¼ lb. ; melt slowly ; when not too warm, add oil hemlock, 1 oz. ; balsam fir, 1 oz. ; oil of origanum, 1 oz. oil of red cedar, 1 oz. ; Venice turpentine, 1 oz. ; oil of wormwood, 1 oz. ; verdigris, ½ oz. The verdigris must be finely pulverized and mixed with the oils ; then add as above, and work in cold water like wax till cold enough to roll ; rolls 5 inches long, 1 inch diameter, sell for 25 cents.

ENGLISH REMEDY FOR CANCER.—Take chloride of zinc, bloodroot pulverized, and flour, equal quantities of each, worked into a paste and applied. First spread a common sticking-plaster *much* larger than the cancer, cutting a circular piece from the centre of it a little larger than the cancer, applying it, which exposes a narrow rim of healthy skin ; then apply the cancer plaster, and keep it on 24 hours. On removing it, the cancer will be found to be burned into, and appears the color of an old shoe-sole, and the rim outside will appear white and parboiled, as if burned by steam. Dress with slippery elm poultice until suppuration takes place, then heal with any common salve.

CHRONIC GOUT—TO CURE.—Take hot vinegar, and put into it all the table salt which it will dissolve, and bathe the parts affected with a soft piece of flannel. Rub in with the hand and dry the foot, &c., by the fire. Repeat this operation four times in 24 hours, 15 minutes each time, for four days ; then twice a day for the same period ; then once, and follow this rule whenever the symptoms show themselves at any future time.

GOUT TINCTURE.—Veratrum viride (swamp hellebore), ½ oz. ; opium, ¼ oz. ; wine, ½ pt. ; let them stand for several days. Dose, 15 to 30 drops, according to the robustness of the patient, at intervals of 2 to 4 hours.

PARALYTIC LINIMENT.—Sulphuric ether, 6 oz.; alcohol, 2 oz.; laudanum, 1 oz.; oil of lavender, 1 oz.; mix, and cork tightly. In a recent case of paralysis let the whole extent of the numb surface be thoroughly bathed and rubbed with this preparation, for several minutes, using the hand, at least three times daily; at the same time take internally, 20 drops of the same, in a little sweetened water.

CHARCOAL A CURE FOR SICK HEADACHE.—It is stated that 2 teaspoons of finely powdered charcoal, drank in ½ a tumbler of water will, in less than fifteen minutes, give relief to the sick headache, when caused, as in most cases it is, by superabundance of acid on the stomach. We have frequently tried this remedy, and its efficacy in every instance has been signally satisfactory.

CATHARTIC SYRUP.—Best senna leaf, 1 oz.; butternut, the inner bark of the root, dried and bruised, 2 oz.; peppermint leaf, ½ oz.; fennel seed, ½ oz.; alcohol, ½ pt.; water, 1½ pts.; sugar, 2 lbs.; put all into the spirit and water, except the sugar, and let it stand two weeks, then strain, pressing out from the dregs, adding the sugar and simmering a few minutes only, to form the syrup. If it should cause griping in any case, increase the fennel seed and peppermint leaf. Dose, 1 tablespoon, once a day, or less often if the bowels become too loose, up to the next period when the headache might have been expected, and it will not be forthcoming.

CHILBLAINS.—TO CURE.—Mutton tallow and lard, of each ¾ lb.; melt in an iron vessel, and add hydrated oxyde of iron, 2 oz.; stirring continually with an iron spoon, until the mass is of a uniform black color; then let it cool, and add Venice turpentine, 2 oz.; Armenian bole, 1 oz.; oil of bergamot, 1 dr.; rub up the bole with a little olive oil before putting it in.

FELONS.—IF RECENT, TO CURE IN SIX HOURS.—Venice turpentine, 1 oz.; and put into it half a teaspoon of water, and stir with a rough stick until the mass looks like candied honey; then spread a good coat on a cloth, and wrap around the finger. If the case is only recent, it will remove the pain in six hours.

FELON SALVE.—A salve made by burning one tablespoon of copperas, then pulverizing it and mixing it with the yolk of an egg, is said to relieve the pain, and cure the felon in 24 hours; then heal with cream two parts, and soft soap one part. Apply the healing salve daily after soaking the part in warm water.

FELON OINTMENT.—Take sweet oil, ½ pt., and stew a 3-cent plug of tobacco in it until the tobacco is crisped; then squeeze it out, and add red lead, 1 oz., and boil until black; when a little cool, add pulverized camphor gum, 1 oz.

WARTS AND CORNS.—TO CURE IN TEN MINUTES.—Take a small piece of potash, and let it stand in the open air until it slacks, then thicken it to a paste with pulverized gum arabic, which prevents it from spreading where it is not wanted.

INFLAMMATORY RHEUMATISM.—Sulphur and saltpetre, of each 1 oz.; gum guaiac, ½ oz.; colchicum root, or seed, and nutmegs, of each ½ oz; all to be pulverized and mixed with simple syrup, or molasses, 2 oz. Dose, one teaspoon every 2 hours until it moves the bowels rather freely; then 3 or 4 times daily until cured.

THE CONSERVATION OF HEALTH.—This important object, so necessary to the enjoyment of life, can only be secured by conforming to an orderly state of existence. Every man is in duty bound to discharge with fidelity the debt which he owes to that frame, so "fearfully and wonderfully made," and so well adapted by the Divine contriver to fulfil the uses of life, by living with regularity and moderation, abstaining from every excess calculated to induce disease or inflict injury either on body or mind. Excessive intellectual labor is just as fatal in its degree as violent physical exertion. We have a lamentable proof of the truth of this remark in the sudden termination of a most useful life, that of the late Dr. Hall, Editor of *Hall's Journal of Health.* As is well known, the fatal stroke was induced by an overworked brain, it being his habit to apply himself ardently to study, writing, &c., from 5 in the morning to 10 in the evening, an imprudence all the more reprehensible as it was one which he was continually denouncing in others.

Business men are particularly liable to affections of the heart resulting from trade anxieties, &c., and in the male, the number of deaths from enlargement of the heart are as seven compared with five in the female. This phase of mortality is caused not only by intranquillity and worry of mind occasioned by lack of success in the grand struggles of life, but is too frequently brought on by conjugal infelicities and disturbances, which seldom fail to accelerate a crisis which terminates in death. Many a well meaning man lays plans which he fondly anticipates will result in securing to him and to those dependent on him, an honestly obtained competence, and confident of prosperity, does his best endeavors, and often risks a great deal, to ensure success, little dreaming of the poetic apothegm, that "the best laid schemes o' mice and men, gang aft aglee." The result too often is, as many know to their sorrow, entire failure, and subsequent reproaches, opprobrium, asperities, ascriptions of incapacity, &c., are showered on his head, and continued to the end of life, with more frequency and greater regularity than the dispensation of his daily bread, by the very one who should be all gentleness, all love, and her husband's chief comforter and consoler under misfortune. This is the most fatal kind of mental trouble, inasmuch as it involves a grinding grief of mind, which dissipates happiness, induces gloom, and tends to destroy life; whatever affects the love, which is the real man, or spirit, reacts upon, and affects in an equal degree the body which contains that spirit. That this is so, results from the correspondence existing between the soul and body, as may be palpably manifest to every one capable of interior reflection, and this to such a degree that to obtain convincing proof it is not necessary to extend his observations beyond his own experience.

Grief caused by financial loss and the reaction which sets in on retiring from business, after spending an active life in amassing a fortune, are also pregnant with evil results to health. No man has a right to retire from the duty of making himself useful to society, even if he has a fortune, and can afford to do so. If he does, this evil, like every other, is sure to work out its own retribution with a full harvest of unexpected misery.

Many of the influences which are patent for evil, and evil only, are self inflicted, such as the habitual indulgence in alcoholic drinks, wine, beer, &c., the use of tobacco, opium, and other narcotics. Eighty-seven per cent. of all kidney diseases are induced by alcohol. Its continued use curtails vitality, destroys the membranes, generates disease in the brain, heart, spinal cord, lungs, liver, muscles and blood vessels ; it wrecks the system, impedes the circulation, paralyzes manhood, and precipitates premature decay. Tobacco, also, in every form, exercises a most baneful effect on the health and mind.

A distinguished French savant, the Abbe Moigno, increased his daily allowance of snuff until in 1861 it was over 20 grammes, and he observed a rapid decay of the faculty of memory. He had learned some 1500 root words in each of several languages, but found them gradually dropping out of his mind, so as to necessitate frequent reference to dictionaries. At last he summoned resolution to abandon its use, and after 6 years of abstinence writes as follows:

"It was for us the commencement of a veritable resurrection of health, mind, and memory; our ideas have become more lucid, our imagination more vivid, our work easier, our pen quicker, and we have seen gradually return that army of words. Our memory, in a word, has recovered all its riches, all its sensibility. That tobacco, especially in the form of snuff, is a powerful enemy of memory, which it has destroyed little by little, and sometimes very promptly, cannot be doubted." With these known pernicious effects resulting from the use of alcholic drinks and tobacco, abstinence from both becomes an imperious necessity.

Other most important auxiliaries to the maintenance of health, are pure air, perfect ventilation in dwellings, and absolute cleanliness of person (See *Bathing*). Keill estimates the surface of the lungs at 150 cubic feet, or ten times that of the external body. During ordinary respiration, 16 or 17 cubic inches of atmospheric air pass into the lungs 20 times in a minute, or a cubic foot every 5.25 minutes ; 274 cubic feet in 24 hours, or a cube of 6½ feet each way. The lungs generate 10.7 cubic feet of deadly carbonic acid gas, and remove from the atmosphere the same amount of oxygen, every 24 hours. The cause of nearly all the headaches in crowded factories, schools and work shops, as well as all the sleeping and snoring in churches, is due more to vitiated air than to any other cause. To the same cause is owing the fearful mortality so prevalent in badly ventilated city tenements, boarding houses, cellars, &c., as well as in houses built on low levels, and boggy land near stagnant pools, inoperative sewers, imprisoned springs, &c. Bad air, imperfect ventilation, uncleanness and ill health must ever go hand in hand. It is worthy of note that while the death rate in the filthy eastern districts of London is nearly 60 per 1000 of the population, in White Chapel it is 41, in Limehouse it rises to 48, in part of the Aldgate district of the White Chapel union, it ranges between 58 and 59, or more than double what may be called the fair allowance of 25 per cent. Yet it appears from the recent statistics of the same city, that in the PEABODY MODEL BUILDINGS the mortality has fallen to 17 per 1000, very near the minimum of the most salubrious parts of England. Decaying vegetable and animal matter yields various noxious gases, also expired breath, all enter the lungs, poison the blood and permeate the system ; therefore all impurities should be kept away from our abodes, and every precaution taken to secure pure air. Temperature of rooms should be about 60° Fahr.

As the solar rays exercise a benignant influence on health and purify the air in dwellings, therefore admit the blessed sunlight without stint, for good health cannot exist without it.

As disinfectants, the following may be used with good effect. 1. Quicklime, to absorb moisture and putrid fluids. Use fresh lime, scattering it about, finely powdered, and whitewash with lime. 2. Charcoal powder, to absord putrid gases. The coal should be dry, and fresh, mixed with lime. 3. Chloride of lime, to give off chloride to absorb putrid effluvia and to stop putrefaction. 4. Sulphate of iron (copperas) 1 lb. dissolved in 1 qt. water and poured down a water closet, will destroy the foulest smells. A quantity in an open pan will purify the air in rooms. 5. Fluid carbolic acid dissolved at the rate of 1 part to 100 or 150 parts of water is also very good.

Among diseases liable to be spread by the distribution of organic, poisons, may be mentioned scarlet fever, typhus fever, typhoid fever, yellow fever, measles, small-pox, diphtheria, infectious ophthalmia, hydrophobia, erysipelas, cholera and glanders. The poisonous particles which effect contagion, are in every instance of organic origin, and are evolved from matter composing living bodies. They float in the atmosphere, are inhaled by the breath, and are absorbed by the walls of dwellings, hospitals, etc., and are liable at any time to enter on a career of baneful activity. The walls of hospitals should be glass lined, the better to prevent contamination, and means should be used to destroy the contagious matter by means of chemical agents, such as powerful heat, nitrous acid gas, bromine, chlorine, iodine, sulphurous acid, etc. Solar light is another powerful disinfectant, and as a means of health has been ranked by Lavoiser as superior to pure air.

Dust is highly inimical to health, and it is everywhere present in the air we breathe. Its presence is made manifest in a manner perfectly startling, by admitting a beam of sun-light through an orifice into a dark room. It has a most pernicious effect on the health in cities, and indeed everywhere, but the air may be filtered from the noxious particles previous to entering the lungs, by the use of a cotton-wool respirator. This contrivance possesses the further merit of being an effectual barrier to the admission to the lungs of those germs or poisonous particles whereby contagious disease is propagated.

Good health is impossible without pure water. The amount of organic and mineral impurities held in solution or suspension by water, is perfectly astonishing, and wherever suspicion of such impurities exists the water should be filtered. Good reliable filters may be purchased ready for immediate use, but wherever they cannot be obtained, an excellent substitute may be made from an oak tub made to hold from half to a barrel of water, according to the needs of the family. Let it stand on end, with a faucet near the bottom, or preferably, a hole through the bottom, near the front side, with a tube inserted to prevent the water from rotting the outside of the tub; then put clean pebbles 3 or 4 inches in thickness over the bottom of the tub. Spread a piece of clean white flannel over the pebbles; now have charcoal, pulverized to the size of small peas (that made from hard maple is best), and put in half a bushel or so at a time; pound it down quite firmly, then put in more and pound again until the tub is filled to within 8 inches of the top, and again put in 2 inches more of pebbles, then put a piece of clean white flannel over the whole top as a strainer. The flannel may be washed occasionally, to remove the impurities collected from the water, and it might be well to replenish the tub with fresh charcoal once a year at least. The result will be wholesome water.

Reckless exposure to cold, especially by aged and sensitive persons, should be carefully guarded against. From returns published by the Registrar General in England, it was found that during the winter months the body wastes, the loss of weight varying in an increasing ratio ; that during summer the body gains, the gain varying in an increasing ratio, and that the changes from gain to loss, and from loss to gain, are sudden, and take place, the first at the beginning of September, and the second at the beginning of April. Deaths from pneumonia and bronchitis attain their maximum in the months of January, February, and March; in the succeeding 3 months they decline, and in the next quarter reach their minimum, re-commencing to increase in October, November, and December. Air saturated with moisture tends to develop rheumatic disease, and organic diseases of the heart which spring from rheumatism.

During cold raw weather, aged persons should keep close to the house in apartments warmed by a cheerful, open, blazing fire, which is much preferable to the oppressive heat from a hot air register, steam pipes, or close stoves. If called out by business during a cold morning, do not go out too early, nor until after a good warm breakfast, and be sure to return before the chill of the evening. Add to the clothing early in the fall, diminish it very gradually in the spring, eat with great moderation and regularity of nourishing diet, and take a daily nap on a lounge, or in an armchair for 15 or 20 minutes after dinner, or during the forenoon. If rest is broken during the night, make it up with prolonged rest during the morning, for as a rule, those aged persons will live the longest who take the most rest and work the least, except in a very calm, placid, and unexcited way. During old age guard against haste, hurry, and excitement of body and mind, for nothing can be more dangerous to life.

Authors, clergymen and all others engaged in intense mental study, should, whenever they become exhausted by severe brain labor, at once cease from further effort, and recuperate their expended energies by taking as much sleep as nature requires. Nothing soothes, strengthens and invigorates the brain like refreshing sleep.

Clothing should not be worn in quantity to induce oppression or unnecessary smothering, but only enough to repel every feeling resembling chilliness. Keep a clean skin at all times, and as a safe precaution wear flannel next to it, as it possesses a powerful influence in modifying dangerous extremes of temperature. Dr. Pettenkofer states that equal surfaces of various materials are permeated by the air as follows, flannel being taken as 100: Linen of medium fineness, 58; silk, 40; buckskin, 58; chamois leather, 51; tanned leather, 1.

The dress should fit loosely, should be warm and light throughout, and frequently changed to remove the impurities exhaled through the skin. Clothing contaminated with excretory matter is highly inimical to health if worn too long. In cases of infectious disease, the sufferer should be isolated, and the infected clothing and bedding either destroyed or purified.

Sleeping apartments should be elevated, roomy, well ventilated, and kept at a temperature of about 60°. They should be free from direct draughts on the sleeper. The mattress, should be hard, but may be easy and springy if so desired. Feathers should not be used, the emanations from them are most unhealthy, and they generate an excess of heat which is very enfeebling and unwholesome. The sweetest repose is obtained with the head towards the north,—with the bed insulated by means of glass interposed between the feet and the floor, to bar the passage of the electric currents, which are liable to leave the body depleted of strength unless they are retained. Guard against sleeping in new dwellings before the plaster and paint have become fully dry. Thousands of deaths, seemingly very mysterious and principally of aged persons, have taken place from neglect of this precaution. The natural allowance for sleep is eight hours out of the twenty-four, and the most favorable time is from 10 o'clock until 6. Intellectual labor is more exhaustive than physical, consequently persons thus employed require more rest than working men. The most favorable position for sleep is on the right side; the worst is to lie on the back, as it generates a perilous heat over the region of the kidneys and spinal cord. Solitary repose is the most beneficial every way; when two parties sleep together, each one inhales a deleterious effluvia thrown off by his neighbor, and the weakest is always the greatest sufferer, more especially is this the case with children who sleep with aged persons. Add to this, electric changes are continually taking place, which frequently cause unrest, disquiet, and exhaustion, when two sleep together. Refreshing sleep gives rest to the brain and the nervous system. The retina is inert, the tympanum is placid, the nerves of taste, smell, and feeling, are dormant, and all the powers of the cerebrum and cerebellum are quiescent. Children require more sleep than adults, and they should get all they will take of it, with a benediction and kind words to begin with. It is atrocious to think of the hard language, maledictions, and downright lies addressed to tender hearted children by many parents on putting them to bed. They certainly are not aware of the grievous injury they inflict by such irrational conduct. Sleep is an absolute necessity to all animal existence, and when we think of its inestimable benefits, and wonderful surroundings, we can only stand mute, and with emotions inexpressible, refer their origin to that INFINITE LOVE which "neither slumbers nor sleeps."

In dressing children, use care to keep them warm, keeping flannel to their skin during the entire year, especially covering the extremities well. There is a peculiar fashion most deadly in its effects, which lets children run about with bare legs, arms, and necks, with the lower part of the dress expanded away from the person, thus admitting the chilling cold to do its worst. Such exposure would prove certain death to its parents in less than a month. Keep the extremities warm by keeping them well clothed, and thus keep up a free circulation, for cold feet and hands prevent health, and are the certain precursors of disease and death. Add to this plenty of good food, ripe fruit, and out-door exercise ad libitum, and you will have rosy, blooming children, as the result. In the matter of out-door exercise, it might not be amiss to use a little wholesome oversight and restraint, let them have their full swing in the enjoyment of exercise calculated to develop the frame, such as running, jumping, playing ball, driving hoops, &c., but when it comes to every day sport in the line of firing pistols, exploding fire crackers, cracking whips, and an everlasting battering of toy drums, &c., then I say, STOP IT AT ONCE, unless you wish to raise a dangerous boy and a dangerous man, for that is just the way to do it.

Children, or others who may be afflicted with impediments of speech, may be cured, if the remedy is not organic, by reading aloud for an hour or two every day, taking care to inhale air, and well fill the lungs, before reading each paragraph, as the cause of stammering in nine cases out of ten, is the endeavor to speak when the lungs are empty. Dr. Hunt, of Regent street, London, a celebrated and successful stammerers' doctor, charged fifty guineas for effecting cures by the method just noted.

It is only in civilized life that we find the most favorable conditions for health and longevity. The poets have expended much rapturous sentiment and romance about "the noble red man" in his native forest, but a personal investigation of the object of their effusions is very apt to cause a sudden revulsion of feeling. A filthy person, greasy blankets, rank skins, and other unsavory surroundings, are apt to make short work of high-strung ideas in the shape of poetry, romance, or sentiment. Of a verity, "cleanliness is next to godliness," and it is indeed a most auspicious token that the old mediæval ideas regarding the necessary connection between filth, poverty, and piety, are notions belonging to the past. Human life has been absolutely lengthened by the addition of several years to a generation, compared with what it was a hundred years ago, all owing to the observance of sanitary laws, and it will continue to lengthen, just in the proportion that these laws are respected.

Dr. Jarvis intimates that in ancient Rome, in the period of 200 to 500 years after the Christian era, the average duration of life in the most favored class was 30 years, while in the present century the average longevity of persons of the same class is 50 years. In the 16th century, the average longevity in Geneva was 21.21 years; between 1814 and 1833 it was 40.68, and as large a proportion now live to 70 as lived to 43 300 years ago. In 1000, only 228 medical men live from 63 to 72, and 328 theologians. In the last 50 years the mean term of life seems to have increased from 33 to 41. In professions, of those who attain the age of 66, there are found to be 43 Theologians, 40 Agriculturists, 35 Men in office. 32 Military, 32 Clerks, 29 Advocates, 28 Artists, 27 Professors, and 24 Medical practitioners.

When man, by an orderly life, passes through the various stages of a healthy existence, from childhood to youth, from youth to manhood, and from manhood to old age; during the decline of life he gradually approaches the verge of natural decay, and death takes place from the gradual effluxion of vitality. Few lives, comparatively speaking, terminate in this way, but when this consummation is attained, and death, purely natural, takes place, it must be regarded as much in the light of a blessing as is natural birth, for it is an orderly working out of a most wise and beneficent law, and the nearer advance we make to this natural limit of existence the better. Death is usually regarded as a curse, and as something very dreadful; there *is a death* which is indeed terrible beyond all powers of human conception, but natural death is not so, and is in no sense a calamity, but a wise provision of Infinite Mercy for man's highest good.

Harassing thoughts, mental anxiety, late hours, and worriment, are fruitful causes of disease in healthy persons, and of death in cases of illness. Use every possible means to get rid of such feelings, and do not scruple to make use of such diversions or amusements as will effectually divert an invalid's thoughts from being too much engrossed with self. When nature calls for rest and recreation, do not neglect the warning. Guard against extreme fatigue of either body or mind, especially a complication of both together. Keep the passions under thorough control; in doing this the good old Quaker's rule will be found of great assistance, viz., Never to allow himself to speak in a loud tone of voice. Nothing preserves health better than a placid temper. Exercise and physical training should not be neglected; persons engaged in sedentary employments should resort to exercise, or rest on finding their thoughts become confused, and laborers should not carry their efforts to the verge of exhaustion; the heart's action is greatly injured thereby, and the bad effects will become permanent.

Of all peoples, the Jews are notably the longest lived race; the reason is because they live orderly lives, they take care of themselves, so to speak, use proper food, and abstain from pork, which, from its liability to promote diseased conditions of the blood, and thence of the whole system, is decidedly injurious as an article of diet. The use of immoderate quantities of meat has an unhealthy influence on the body, and induces ferocity of the mind, as in Indians and others who subsist on it. Plutarch was astonished to think what appetite first induced man to taste of a dead carcase, and Pope said that the horrid and shocking sight of one of our modern kitchens gives one the image of a giant's den in romance, bestrewed with scattered heads and mangled limbs. Vegetable food is not liable to distend the vessels, load the system, or becloud the mind, but the heat, fulness, and weight of animal food is unfavorable to its efforts. *Cornaro*, the dietetic, allowanced himself to 12 ozs. of dry food and 14 ozs. of liquids per day, from the age of 40 to 100. See *Dynamic Power of Food*.

In eating, select good nourishing diet, so as to insure variety without excess, eat with regularity, without long intervals of abstinence, and eat leisurely. In drinking, avoid taking large draughts of cold water, drink with extreme moderation during meals, and avoid drinking water which has stood long in rooms or in lead pipes. Impure water is liable to produce malarial affections. Tea and coffee, if used strong, and in large quantities, are certain to produce nervous irritability and brain excitement, but if used in moderation and of mild strength, they are most refreshing and pleasant. Nervous persons will find coffee more soothing than tea, while persons of a different temperament will be better suited with the latter. Beyond all doubt, and for almost every purpose, in health and disease, pure water is the healthiest beverage, and it certainly is the natural drink of man. According to Hoffman, "If there be any universal medicine it is water; for, by its assistance, all distempers are alleviated or cured, and the body preserved sound and free from corruption, that enemy to life." As Dr. Gall said of another subject, so the writer would say here, that "This is TRUTH, though at enmity with the philosophy of ages."

ON BATHING.—Nothing is of more transcendant importance to the maintenance of health than cleanliness, and this can only be obtained by the free use of water, in washing, sponging, and bathing. The modes of bathing are various, and, when rightly used, are most powerful for good. The rule is, the more robust the constitution of the patient, and higher his exterior temperature, the colder should be the water. In bathing it is always well to avoid taking a full bath within two hours after a meal, or when exhausted by fatigue, or when cooling after perspiration, or when feeling chilly. Do not drink cold water before bathing, nor eat soon after it. Females, during the menstrual period, should never take cold baths. Never take a cold bath while the feet are cold. Never chill the body by standing or sitting on the banks during out-door bathing; enter the water while the body is warm, and avoid remaining too long in the water, leaving it on the first feeling of chilliness. Exercise before and after bathing is highly beneficial. Feeble and nervous persons should guard against powerful chilling shocks from cold water. The young and vigorous may bathe early in the morning on an empty stomach. Persons subjected to giddiness, faintness, palpitation, or other affections of the heart, should use a cold bath with extreme caution.

THE COLD BATH, usually taken in the sea or in a river, temperature from 35° to 65° Fahr., has a most powerful, exhilarating and tonic effect on the frame, and imparts a vigorous glow and stimulus to the system. It should not be continued longer than two or three minutes.

THE TEMPERATE BATH, ranging from 65° to 80° Fahr., is much preferable to the last for the use of invalids. Duration of bath should not be extended over three minutes, and the whole body should be thoroughly rubbed dry with a coarse towel, to induce a glow.

THE FULL WARM BATH, taken in the ordinary long bath tubs, as arranged by plumbers in dwellings, hotels, &c., are in the highest degree promotive of health and comfort. Fitted with hot and cold water connections, any desired temperature may be obtained, but for the best effect it should range from 90° to 98°; better under that than over it. The benefits will be increased by the use of carbonate of soda, 4 ozs. to 30 gals. water. This rids the system of much effete matter, promotes the cure of disease, and thoroughly cleanses the emunctories. After bathing, rub thoroughly dry.

THE HOT BATH, ranging from 98° to 112°, thoroughly stimulates the nervous system, but immersion cannot be prolonged over two or three minutes without permanent injury. Water scalds at 150°, but air heated to 260° is not painful. It is not safe to tamper much with such high temperatures, although Berger remained seven minutes in an oven, heated to 230°. Blagden exceeded this, remaining eight minutes in a temperature of from 240° to 260°. Delaroche could not remain more than 10 minutes in a vapor bath at 100°. Berger was obliged to get out of a vapor bath at a temperature of 122° in twelve and a half minutes. The sensation in hot vapor resembles that of contact with boiling water. Fish actually live in hot baths up to 150°. Trees also grow in a bath at 170°; flowers near a volcano, at 210°; and water-plants are found in boiling springs. The king's bath at Bath is 116°, the hot bath is 117°, at Vichy 120°, at Aix la Chapelle 140°. In the hot springs at Leuk, in Switzerland, the temperature of twenty springs varies from 95° to 125°; the baths are given at 98°, and, to make it as agreeable as possible, the patients bathe together, both men and women, dressed for the occasion. In the Hermbad, you may see the curious spectacle of people seated up to their necks in the bath, with coffee, books, cards, newspapers, work, &c., before them on little floating tables, or gossiping together or with their friends, who look on from the wooden gallery which runs around the wall. The waters are both drank and bathed in, being considered excellent for weak nerves, palsy, diseases of the skin, and many chronic complaints. Elevation, 4675 feet above the sea.

POOR MAN'S VAPOR BATH. Heat two or three bricks and place them under the patient's chair, sprinkle some water over the bricks, and cover the patient to keep in the steam, or, a large lump of quick lime placed in a pan or old iron pot and sprinkled with water, or wrapped up in a wet, coarse towel. Neither of these methods, however, are at all comparable to the efficiency of a properly administered vapor bath, either pure or medicated, in which the temperature of the steam, &c., can be regulated as follows: Temperature of tepid vapor bath, to be breathed, 90° to 100°, warm ditto 100° to 110°, hot ditto 110° to 130°; not to be breathed, tepid bath, 96° to 106°, warm 106° to 120°, hot 120° to 130°. These baths have performed wonders in cases of chronic rheumatism, stiffness of joints, indurations, diarrhœa, suppressions, &c.

THE SPONGE BATH is a means of health of such transcendant importance, that in the absence of other bathing facilities, it should never be neglected for a single day. It is a powerful conserver of health, and affords positive relief in almost every phase of disease. The water may be used of any desired temperature. Apply with a towel or sponge, and when through polish off with a regular hard finish with a coarse towel, or still better, two of them, well laid on, the last one dry, to induce a glow on the skin by friction.

Fig. 1.

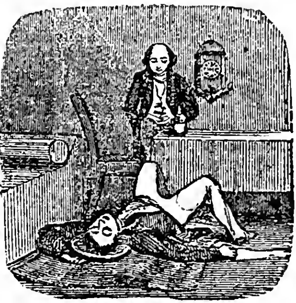


Fig. 2.

THE SITTING OR SITZ BATH, Fig. 1, should be arranged to admit of the complete immersion of the lower part of the back and abdominal regions, the thighs, &c., with ample room for laving the water and kneading the parts. The *cold* tonic bath given in this way is excellent for diseases of the kidneys, bladder, urino-genital organs, piles, constipation, &c. In cases of colic, spasm, griping pains, gravel, suppressed or painful menstruation, inflammation, &c., it should be given warm in order to prove effective. Cover the patient, if need be, to prevent catching cold. The cuts are borrowed from an excellent little work by Dr. Trall, entitled, "The Bath: its History and Uses in Health and Disease;" published by S. R. Wells, New York.

THE HEAD BATH, Fig. 2, is taken by placing the patient on his back, on a mattress, with his head in a shallow basin (made with a depression in the rim to accommodate the neck) with about 3 inches of water, warm or cold, as may be desired. A most excellent cooling application for affections of the head, brain, &c.

FIG. 3.

FIG. 4.

THE DOUCHE BATH, Fig. 3, consists of a jet of water used as a stimulant in lethargic states of the system; also as a remedy for swellings, sprains, stiff joints, rheumatic affections, &c., applied directly to the parts, as shown above. A jet from a hose may be used as a substitute for the douche bath in certain cases.

THE SHALLOW BATH, Fig. 4, may be used with immense advantage both by invalids and persons in health; the water may be used at any desired temperature, not more than 6 inches deep, contained in a spacious tub. The water should be thoroughly applied over the breast, abdomen, sides, thighs, and extremities; the head should be wet, and water, cold, or otherwise, as desired, poured over the neck and shoulders by an assistant. This bath is excellent for brain affections, headache, &c. The bath may be used for from 5 to 15 minutes; rub thoroughly to dry and induce a healthy glow on the skin.

THE WET SHEET PACK, Fig. 5. This is a most powerful remedial agent for invalids. Immerse a cotton or linen sheet in a pail of cold water, remove the bed clothes from the mattress, and on the mattress spread a coverlet; then two or three blankets, next, wring out the wet sheet in the bucket of water, and spread it over the blankets. The patient will now warm his feet, divest himself of clothing, and place himself at full length on the cold wet sheet, with his hands placed over his breast. The sheet, blankets and coverlets are now tucked in closely all around his body by an attendant, the head is elevated on pillows, and covered with a wet cloth. The first sensation is that of a chill, which gives place almost immediately to a comfortable glow, gradually increasing to a sweat. The patient should remain in the pack from 25 minutes to an hour or more. Some have been known to fall asleep in it. To receive the fullest benefit, it should be followed at once by a plunge bath (See Fig. 6), or thorough ablution in cold water previous to dressing. Then rub with friction by means of a coarse towel. In cases of severe disease, the benefit of this treatment is manifest from the very offensive odor imparted by the per-

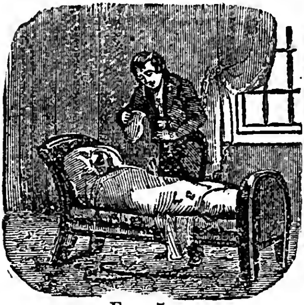


FIG. 5.

FIG. 6.

spirations to the sheet. Mercury, also, which had lodged in the system for years, having been taken under the guise of calomel, has been withdrawn through the pores by the wet sheet, and detected in its woven fabric. The wet sheet pack is of great value in fevers, colds chronic diseases, and general derangement of the system.

SPIRIT VAPOR BATH. The patient divested of all clothing except a night shirt, is seated on a wooden bottomed chair, and well covered before and behind with blankets or coverlets reaching from his shoulders to the floor. A saucer containing a few spoonfuls of alchohol, whiskey or any spirit that will burn, is now placed on the floor under the chair and ignited. The vapor ascends, and, confined by the blankets, it will soon induce a copious perspiration from every pore of the body subject to its action. The spirit may be replenished when it burns out, but not while burning or while under the patient, owing to the possible resulting danger. The operation is highly beneficial to the system, and may last from 10 to 15 minutes, or until a free perspiration is induced. Be careful that no damage results to the patient or his clothing from the burning spirit.

FOR SPONGIO PILINE, see Portable Bath.

SULPHUR AND MEDICATED BATHS.—The former is compounded by mixing sulphuret of potassium 4 ozs. and sulphuric acid 1 oz. in 30 gals. of water. The latter are decoctions of vegetable or other materials in water, in which the patient is immersed; or, it can be applied with a sponge if so desired, and may be tepid, warm, or hot, as preferred.

THE AIR BATH, taken by exposing the naked body to the air in a cool room, is very salutary and beneficial. When not carried too far, it is very soothing in its effects, and, in wakeful states, is promotive of sleep. The good effects are greatly enhanced by friction with a towel during exposure. The same remarks are eminently true when understood of *sun-bathing*, or exposure of the nude body to the sun, which, in certain diseased conditions, has a most vivifying and invigorating effect.

GALVANIC, ELECTRIC, AND MAGNETIC BATHS.—The first is taken by placing the patient in a wooden bath tub (or in a painted metallic tub), filled with water impregnated with any desired drug. The negative pole of the battery is suspended in the water, and a wire connected with the positive pole, with a sponge attached, communicates with the body. The electric current from the positive pole enters the body and escapes through the pores. The effect is beneficial in the highest degree. An electro-positive bath is given while the patient is seated on a chair, insulated by placing glass under the feet. While the glass plate of the electric machine is being revolved, the patient holds the prime conductor, and his body becomes charged with positive electricity. The effect is very stimulating to deficient vitality.

THE ACID BATH is highly beneficial in liver and other complaints, and may be compounded with water acidified with vinegar, or with water, 30 gals., muriatic acid, 14 ozs. Use the latter in a wooden tub or non-metallic vessel, as the acid is inimical to metals.

THE SHOWER BATH, with cold water, never fails to produce a shock which nervous and weak patients find it very hard to withstand; but, to persons of strong constitution, it cannot fail to prove beneficial, for the shock is usually succeeded by a most agreeable reaction. This bath may, however, be rendered agreeable, even to the feeble, by the use of tepid or warm water, applied in the form of a delicate spray, passed through minute perforations in a tin vessel placed overhead, and fitted with a proper apparatus for regulating the descent.

THE FOOT BATH is calculated to produce the most decided benefit in correcting cold feet, induced by liver complaint, etc.; also, to relieve heat in the head, caused by fullness of blood on the brain, with cold extremities. In such cases, use warm or hot water, with the addition of mustard or cayenne pepper. In cases of swelled limbs, ulcers, rheumatic pains, etc., great relief will be obtained by extending the treatment to the legs, knees, limbs, etc., thoroughly washing and laving the parts.

THE MUD BATH, equivocal as it may appear, is nevertheless one of the most powerful remedial agents. On the principle that charcoal purifies foul water, absorbing its impurities, so mud acts on the body, opening the pores, withdrawing effete matter, cooling the skin, and curing disease. If any diseased person doubts this, let him put it to the test.

THE IODINE BATH, for adults, is compounded of iodine, 1 dr.; iodide of potassium, 2 drs.; water, 20 gals. For children's use, it should be weaker. It is not adapted for indiscriminate use, but for diseases affecting the glands, tubercular troubles, scrofula, etc. The iodine vapor bath may be used as described under spirit vapor bath.

THE TURKISH BATH, by means of dry heated air, is one which may be, and often is, productive of much benefit in diseased conditions of the body, but is most inimical to health when used with regularity as a social enjoyment or luxury. Wherever it has become a national custom, this bath has always proved the principal agency in sealing the doom of that nation, as witness the collapsed Rome of the past, and the reeling Turkey of the present. In reference to this, one of the most prominent medical practitioners of the day, Dr. Richardson, of London, writes to the *British Medical Review*, as follows: "I predict it will be the same here, under the same principles. I predict that whenever Englishmen give up the active occupations I have named (he had been urging healthy men to spend the time required for the bath in digging, walking, rowing, rifle drill, cricketing, etc.), and, in slippered pantaloons, luxuriate daily in a bath, to rid themselves of the products of excretion, then this country will have passed its zenith. Then there will be no great hero to bid every man do his duty, no man to do the duty, and no England for which the duty should be done."

The foregoing, presenting a choice of between 20 and 30 different methods of bathing, is of great utility to all, but especially so in the prevention and cure of the complex and delicate affections to which females are liable, and which call for such careful treatment from medical practitioners. There is room for deep regret that this class of diseases has opened a wide field for the operations of numerous rapacious and incompetent men, who are a disgrace to the profession, and whose ravenous proclivities and infamous practices blind them to everything but the acquisition of plunder. The medical profession, as a class, have always been held in high estimation; so much so, that, during the reign of the Emperor Augustus, they were exempted from the payment of taxes; and that there should be so many cormorants in their ranks, is regretted by none more sincerely than by the respectable members of the profession. The real impostor is generally known by his resonant puffs, in the shape of advertisements, in which, while uttering the most savage maledictions against quacks and quackery, he almost lays personal claim to the powers of omnipotence in the cure of disease. These incorrigible rascals generally parade a dazzling list of fictitious certificates of cures performed by them where every other doctor had failed; but they will not hesitate to act the thief as nearly as the law allows, and strip their victim of his or her last dollar, exacted for services fifty times worse than useless.

Grateful, indeed, should he be who escapes with nothing worse than the loss of his money. The advertising quack is generally a dead shot, something of the Dr. Hornbook genus, as immortalized by Burns, very profuse in his promises to cure disease and conceal infirmities, but like his illustrious prototype, very uncanny, and altogether too ready to send his patients "aff to their lang hame, to hide them there."

In England, previous to the advent of the modern newspaper, the quack used to transform himself into a living advertisement, by itinerating through the provincial towns in a blazing uniform, dressed like a mountebank, with cocked hat and wig. Accompanied by an assistant, he would mount a platform, gather an immense crowd, and proceed to deliver an extravagant eulogium on his profound skill, prodigious wealth, and the wonderful virtues of his pills, panaceas and elixirs, as he offered them for sale. The assistant, who seemed to answer to the character of a modern clown in a circus, would aid with the sales, and keep up the farce by making witty remarks on the doctor's wild averments. For example, after listening to the doctor's statements regarding his boundless wealth, and great condescension in consenting to travel for the purpose of healing the sick, as he was not obliged to do so for want, the clown would announce to the audience that "The doctor tells the truth, we doant need to travel for want, for we have enoof of that at hoam." The result is a loud laugh, the crowd is in good humor, the pills, elixirs, etc., are sold, and the buyers are sold at the same time.

PRACTICAL DIETETIC ECONOMIES.—The following table, compiled from various authorities, is eminently and practically useful, presenting as it does at a glance the available percentage of nutritive elements contained in the leading staples used as human food.

Raw Cucumbers	2	Broiled Venison	22	Boiled Beans	87
" Melons	3	Potatoes	22½	Boiled Rice	88
Boiled Turnips	4½	Fried Veal	24	Barley Bread	83
Milk	7	Roast Pork	24	Wheat Bread	90
Cabbage	7½	Roast Poultry	26	Baked Corn Bread	91
Currants	10	Raw Beef	26	Boiled Barley	92
Whipped Eggs	13	" Grapes	27	Butter	92
Beets	14	" Plums	29	Boiled Peas	93
Apples	16	Broiled Mutton	30	Raw Oils	95
Peaches	20	Oatmeal Porridge	75		
Boiled Codfish	21	Rye Bread	79		

For further details on this subject see tables on pp. 623 and 765. The figures present a diversity, but the general results are fixed and invariable, presenting to the economist the relative amount of nutriment supplied by each kind of food. From the evidence presented it will be seen that the most wholesome and nutritious articles, as oatmeal, flour, peas, beans, rice, crushed wheat, corn bread, etc., are vastly superior to beef in supplying effective ability to labor, besides being, in the leading markets of the world, obtainable at about one-third the price of the latter. It will be seen that the nutriment supplied by beef is 26 per cent., while the cereals yield from 75 to 95 per cent.; while there is no room for dispute as to the comparative healthiness of the different kinds of diet. The bounding circulation, good digestion, and mental activity enjoyed by day, together with the sound sleep accorded by night, to the man who prefers plain to luxurious living, and vegetable to animal food, are certainly well worth striving for. If a fair percentage of wholesome ripe fruit be used with the above noted diet, its value and the enjoyment of using it will be greatly enhanced. After all that can be said, *pro* and *con*, touching a vegetable diet, certain are we that the average man who limits himself to a well-selected regimen of vegetable food will, accidents aside, go through life with a clear mind in a healthy body, will sleep sounder, and come nearer the alloted age of three-score and ten, have a better digestion, and have fewer headaches, than the man who indulges in roast beef with the usual variations *ad libitum*.

EFFECTS OF THE SOLAR LIGHT ON LUNATICS.—Dr. Ponza, director of the Lunatic Asylum at Alessandria, Piedmont, having conceived the idea that the solar rays might have some curative power in diseases of the brain, the experiment was tried in rooms lighted by stained glass, the walls being painted the same color as the windows. The patients passed the night in rooms oriented to the east and south, and painted and glazed as above. One of them, affected with morbid taciturnity, became gay and affable after 3 hours' stay in a red chamber; another, a maniac who refused all food, asked for some breakfast after having stayed 24 hours in the same red chamber. In a blue one, a highly excited madman with a straight waistcoat on, was kept all day, an hour after he appeared much calmer. The action of blue light is very intense on the optic nerve, and seems to cause a sort of oppression. A patient was made to pass the night in a violet chamber; on the following day he begged Dr. Ponza to send him home, because he felt himself cured, and indeed he has been well ever since. Dr. Ponza's conclusions from his experiments, are these: "The violet rays, are, of all others, those that possess the most intense electro-chemical power. The red light is also very rich in calorific rays: blue light, on the contrary, is quite devoid of them, as well as of chemical and electric ones. Its beneficent influence is hard to explain; as it is the absolute negation of all excitement, it succeeds admirably in calming the furious excitement of maniacs."

WEAK BACK.—Take a beef's gall, pour into it 1 pint alcohol, and bathe frequently. It acts like a charm.

SPRAINED ANKLE.—Wash the ankle frequently with cold salt and water, which is far better than warm vinegar or decoctions of herbs. Keep your foot as cold as possible to prevent inflammation, and sit with it elevated on a cushion.

SPITTING OF BLOOD.—Two spoonfuls of sage juice in a little honey, will speedily stop either spitting or vomiting blood, or, take 20 grains in water every two hours.

APOPLEXY.—Occurs only in the corpulent or among high livers. To treat—raise the head in a nearly upright position; unloose all tight clothes, strings, etc., and apply cold water to the head, and warm water and warm cloths to the feet. Have the apartment cool and well ventilated. Give nothing by the mouth until the breathing is relieved, and then only draughts of cold water.

BRIGHT'S DISEASE.—Dr. Arthur Scott Donkin, extols a skim milk diet in this disease. "The first appreciable action," he says, "of skim milk taken to the extent of 6 or 7 pts. daily, is that of a most energetic diuretic, a profuse flow of urine being rapidly produced. The effect of this in Bright's disease, is to flush the uriniferous tubules, and to dislodge and wash out the concrete casts of diseased epithelial cells by which they are blocked up and distended. The emptying of the tubules relieves their pressure on the surrounding secondary capillaries, the blood begins to flow more freely through them, the distension of the primary malpighian capillaries, is relieved; less and less albumen escapes through their walls, until the renal circulation is gradually restored, when it finally disappears from the urine. While this beneficial change is progressing, healthy epithelium is developed in the tubules, and the urinary excrement is withdrawn from the blood. In short, a healthy nutrition becomes re-established in the kidneys through the agency of milk, which, above all other substances, seems to exercise a controlling influence over this process.

REMEDY FOR GOUT AND RHEUMATISM.—Gum guaiacum, 1 oz.; rhubarb in powder, 2 drs.; flour of sulphur, 2 ozs.; cream of tartar, 1 oz., ginger powder 1 oz.; make into an electuary with molasses. Dose: 2 teaspoonfuls, night and morning. *Rheumatic Plaster*, resin ¼ lb., sulphur ¼ lb., melt them by a slow fire; then add cayenne pepper 1 oz., camphor gum ¼ oz. Stir well till mixed, and temper with neatsfoot oil. To guard against rheumatism, adhere to a regular diet, breath pure air, and avoid exposure.

INDUSTRY PROMOTES BODILY HEALTH AND MENTAL ACTIVITY.

Every true man will most willingly concur in the royal asseveration of old king Solomon, that the price of a wise, virtuous, and good woman, "is far above rubies." Poets of every age and race, have sung her praises, and many a man has had abundant reason to thank his Maker for an inestimable blessing in the companionship of a virtuous, loving, devoted and affectionate wife. What earthly prize can for a moment be compared with this. In her person we see the perfection of loveliness—modesty, grace, and beauty; in her voice we hear the sweetest music; in her mind we see a fragrant blending of the most attractive attributes, and the nearest created approximation to that Love which is Infinite. Sherlock avers that "The perception of woman is as quick as lightning. Her penetration is intuition: almost instinct. By a glance she will draw a deep and just conclusion. Ask her how she formed it, and she cannot answer the question. While she trusts her instinct she is scarcely ever deceived, but she is generally lost when she commences to reason."

Every one knows that this is true, but very few know the reason why it is so. This we find unfolded in the following quotation from the illumined Swedenborg: "The man is born to be intellectual, thus to think from the understanding, but the woman is born to be voluntary, thus to think from the will; which also is evident from the inclination or connate disposition of each, as also from their form. From the disposition, in that the man acts from reason, but the woman from affection. From the form, in that the man has a rougher and less beautiful face, a heavier speech, and a harder body, but the woman has a smoother and more beautiful face, a more tender speech, and a softer body. Similar is the distinction between the understanding and the will, or between thought and affection." Again, "The male is born into the affection of knowing, of understanding, and of being wise, and the female is born into the love of conjoining herself with that affection in the male." The special attributes of the will principle are perception, affection, and every resultant feminine grace, or in one word—LOVE.

The question which eclipses all others in importance is, How shall this most precious quality be trained and cultivated? Or, into what channels should its course be guided and directed? On this subject, hear Swedenborg once more: "Love truly conjugal, considered in its origin, and its correspondence, is heavenly, spiritual, pure, and clean, above every love which is with the angels of heaven and the men of the church." Again, "I know that few will acknowledge, that all joys and delights, from first to last, are gathered into conjugal love, because that love truly conjugal, is at this day so rare, that what it is is not known, and scarcely that it is." We may learn from this, that love is of heavenly origin, and was given that it might be used for heavenly ends and purposes. It follows from this therefore, that in order to attain to a full and healthy mental and physical development, it is imperiously necessary that immorality and unchastity in every form, should be discountenanced and shunned, for it is only in total abstinence from impurity and illicit pleasures, that we can find immunity from ruin, degradation, and death. This is true in the case of man, and it is still more so in the case of woman, for in almost every case after the first false step, she is led on to swift destruction by the ascendancy of her affections, without being arrested in her career by the wholesome restraint of the reflective or reasoning faculties which operate so powerfully in man. Every means should be employed that will operate to prevent such a baleful consummation. All obscene, immoral, and impure books, everything in the shape of literature which tends to inflame the passions, promote licentiousness, and corrode purity of mind, should be at once deposited in the only place where they will prove inocuous—in the fire. Labor to elevate and train the faculties of the soul in the love and practice of what is good and true; rule the propensities, and hold them in abeyance, remembering that no victory is at all comparable with that obtained over self.

Perhaps the intensest longing of which a good woman's heart is susceptible, is after union and intimate conjunction with a worthy husband. It may be no news to inform such women that nothing attracts the opposite sex to them compared with a tender and winning manner, blended with feminine sweetness of temper. The sweet temper is a crowning charm, together with the female grace which seems to solicit and invite, while at the same time it modestly repels. Men never respect boldness or audacity in women. What they most desire to see in them is something in which they are decidedly deficient themselves. Prof. Tyndall, the scientist, a man of great scientific attainments, is now fifty-six years of age, and but lately married. On being interrogated by a friend previous to his marriage, as to what attractions he saw in his intended which drew forth his preference for her more than for others, the characteristic reply was: "Less dynamic force." It has been so in all ages, and will so continue.

In every possible way try to act in a natural and becoming manner, without affectation. Dress according to your means and station, if you will, but always in a modest, unassuming style, and discard at once and forever all those wretched shams and miserable appliances in the shape of padding, painting, perfuming, curling, tight lacing, etc., which are calculated to ruin the health and deceive the observer. Cultivate kindness, cheerfulness, an even quiet temper, and repress asperities of every kind.

If the mother be endowed with physical vigor, a pure moral character, and is, in her domestic relations, a becoming model of all that is orderly, clean, prompt, dignified, kind and loving, she is certain in the very nature of things, to transmit these beneficient qualities to her offspring, and through them a blessing to society. Let all parents know that, by a law from which there is no appeal, those very qualities and endowments of mind which they cultivate in themselves, be they good or evil, they by that very act implant in their posterity.

The most powerful means for the repression of evil and the elimination of good, is constancy in some useful employment of body or mind. Useful industry promotes bodily health, enhances every female grace, sweetens the temper, and beautifies the countenance. It is the great safety-valve which, by Divine appointment, is designed to absorb and utilize the surplus energy dispensed to every healthy human being during the prime of life, and which, if spent in idleness, frivolity, dissipation, or senseless gossiping, is certain to produce the most malignant evils.

Ladies should never neglect pure air, and abundant out-door exercise, either in walking, carriage, or horseback riding. Confinement in close rooms, with stove or furnace heat, is most unfavorable to robust health. It is all important, in consideration of the performance of those high and holy functions entrusted to woman, that the beautiful, delicate, and exquisitely constructed body by which those functions are accomplished, should be kept attuned to the most perfect state of health. The mind should be kept free from moral contamination of every kind, and trained to habits of pure thought, sobriety and stability. Nothing can be of greater importance to humanity than the proper adjustment of the physical and mental equilibrium of woman. The weal or woe of the human race seem to turn on this primary essential as on a pivot. What our children are, is in a great measure what their mother's have made them, for in the turn on this primary essential as on a pivot. What our children are is in a great measure what their mothers have made them, for in the very nature of things, children are in the mother's hand, like plastic wax under the seal, and the impression is generally in harmony either with what she has taught them or neglected to teach.

Equally important is the duty incumbent on every female to vigilantly guard against forming matrimonial engagements with men of defective health or vitiated morals. The neglect of this wise precaution has caused an extent of misery and wretchedness beyond all human conception. On this subject, one of the ablest living medical men, Dr. B. W. Richardson, of London, England, remarks as follows: "The first step towards the reduction of diseases is, beginning at the beginning, to provide for the health of the unborn. If the intermarriage of disease were considered in the same light as the intermarriage of poverty, the hereditary transmission of disease would be at an end in three, or at most, four generations." He remarks in another place, "Greater care than is at present manifested, ought to be taken with women who are about to become mothers."

As many estimable ladies are pardonably anxious about their chances for marriage, the following curious statement, by Dr. Granville, is drawn up from the registered cases of 876 married women in France. It is the first table ever constructed to exhibit to ladies their chances of marriages at various ages. Of the 876 tabulated, there were married :—

Years of age.	Years of age.	Years of age.	Years of age.
3 at 13	118 at 20	28 at 27	5 at 34
11 at 14	86 at 21	22 at 28	3 at 35
16 at 15	85 at 22	17 at 29	0 at 36
43 at 16	59 at 23	9 at 30	2 at 37
45 at 17	53 at 24	7 at 31	0 at 38
77 at 18	36 at 25	5 at 32	1 at 39
115 at 19	24 at 26	7 at 33	0 at 40

It should not be forgotten that women, and men, too, in England, Canada, and the Northern States, are no nearer maturity at 20, than the French at 18. This is owing to the warm climate, which in France accelerates maturity with greater rapidity than in more northern climes. From salutary experience, it would be safe to say that the best results would follow, did our girls not marry until after 20, and our men till after 22, or even 24.

Women married at 25, live four years longer than unmarried ones; 72 married women live to 45, for 52 unmarried. Among married men, 41 attain 45, for 18 unmarried. At 60, there are 48 married men for 11 unmarried. At 80, the numbers are 9 married for 3 unmarried.

Cerebro-Spinal Meningitis, or Spotted Fever, is frequently caused by bad diet, malaria, cold, repression of the secretions, changeable weather, etc. It is a most malignant trouble, consisting of inflammation of the brain and spinal marrow. There is fever, pain in the head, rigidity of the muscles, intense thirst, terrible pain, and an abundance of purple spots. The head is forced backward with fearful agony, the intense suffering induces prostrations, stupidity, deafness,—in some cases blindness, and if the disease is not restrained by skilful treatment, insensibility and death. In treating this disease, keep the bowels open, and the body warm: immersion in a hot bath, made strong with salt and mustard, is good to bring the blood to the surface. Another way is to wrap the body in a woollen blanket wrung out of hot water, and place outside of the blanket bottles filled with hot water, and cover over close, as described under the wet sheet pack ; this will induce a copious perspiration and afford relief. Warm ginger tea is useful to generate internal heat, and tincture of pepper for outward application, with friction on the skin. If the pulse is high, give two to three drops extract of *Veratrum viride* (American Hellebore), every hour, diluted by adding 1 teaspoonful of water to each drop of the extract. Guard against constipation, retention of urine, convulsions, etc., and if the head is severely pained, relieve by dry cupping over the neck and spine.

CROUP SYRUP.—Crushed blood root, 2 teaspoonfuls ; vinegar, 2 gills ; white sugar, 8 tablespoonfuls ; boil all together and strain. Dose, from ¼ to 1 teaspoonful every hour or half hour, (warm) according to the severity of the case. Sponge the body with strong saleratus water, and if inflammation exists, give, for a child of 1 year, a teaspoonful (every hour) of a mixture of 5 drops of veratrum in 20 teaspoonfuls of water.

SULPHURIC ETHER.—Rectified spirit, 3 lbs.; sulphuric acid, 2 lbs. carbonate of potassa (previously ignited), 1 oz.; pour 2 lbs. of the spirit into a glass retort, add the acid, place the vessel on a sand bath, so that the liquor may boil as soon as possible, and the ether as it forms, pass over into a well cooled receiver; continue the distillation until a heavier fluid begins to pass over, then lower the heat, add the remainder of the spirit, and distil as before; pour off the supernatent portion, add the carbonate of potassa for one hour; finally, distil the ether from a large retort, and keep it in a well-stoppered bottle.

CHLOROFORM.—Take chloride of lime (in powder), 4 lbs.; water, 12 lbs.; mix in a capacious retort or still, add, of rectified spirit, 12 fluid ozs., and cautiously distil, as long as a dense liquid, which sinks in the water it passes over with, is produced ; separate this from the water, agitate it with a little sulphuric acid, and, lastly, rectify from carbonate of baryta. The only safe way known of purifying chloroform, consists in agitation with *pure* water and redistillation.

Prof. Nussbaum has succeeded in prolonging the anæsthesia induced by chloroform, by the sub-cutaneous injection of a solution containing 1 gr. of acetate of morphia. In one case the patient slept 12 hours and underwent a painful operation, without any sensation whatever. The injection performed without the previous inhalation of chloroform, produced no such effect.

CARBONIC OXIDE GAS, is inflammable, but arrests animal life. *Carbonic Acid Gas* may be *liquefied* as follows :—Get a strong iron bottle, strong enough to resist a pressure of 40 atmospheres, or 600 lbs. to the square inch ; put into it about 4 ozs. of sodic bicarbonate, and a small pot containing about the same quantity of oil of vitriol. Insert the latter carefully, so as not to spill any : close the bottle with an air tight cap, surround by a mixture of ice and salt, and upset the inner pot. The gas becomes condensed and liquified in the bottle, and on opening the bottle, by means of a stop-cock in the lid, will rush out, and part will fall down in a frozen state like snow. A jet of the liquid carbonic acid, directed on the bulb of a spirit thermometer, made it fall to 194° below zero. A jet passed into a phial is expanded 400 times, and the cold solidifies it as a white powder. Then, if the finger is placed on the powder, the expansion repels the finger, the cold being 231° below zero! It is too dangerously cold for medical applications, but a mixture of salt and finely broken ice, have been used to promote immunity from pain during amputation, and in cases of severe headache. Anæsthesia may also be produced by projecting a spray of sulphuric ether and rhigoline, which produces a temporary freezing, during which time an operation may be performed without pain to the patient, after which the parts thaw, and sensibility returns.

Rules to be Followed by the By-standers in case of injury by Machinery &c., where Surgical Assistance cannot be obtained,--In cases of severe shock, inducing paleness, chilliness, and prostration, place the sufferer on a bed with the head but slightly raised, keep up warmth by wrapping him in blankets and coverlets, assisted by bottles containing hot water, or by warm bricks, wrapped in cloths, and applied to the armpits, sides, feet, &c., stimulate with table spoonful doses of whiskey or brandy every 15 or 20 minutes, until partial recovery, and nourish by giving strong soup occasionally. If the patient is *not* bleeding, do not bind the limb tight, but cover the bruised part lightly with rags.

If bleeding results, do not try to stop it by binding up the wound, but find the artery by its beating, and place a firm and smooth wad made of cloth or rags rolled up, or any round smooth article of proper size, wrapped up and *place over the artery* as shown in the figures, tie a handkerchief around the limb and tighten up; put a stick through under the handkerchief as shown in Fig. B, giving it just enough of twist to stop the bleeding, then enter one end of the stick under the handkerchief as shown in Fig. C, to secure the bind. When the leg is bleeding below the knee, apply the pad over the artery at the back of the thigh, as shown at C, on Fig. A, and secure in front as above described.

The artery in the thigh runs along the inner side of the muscle in front near the bone. A little above the knee, it passes to the back of the bone. In injuries at or above the knee, apply the compress high up on the inner side of the thigh, at the point where two thumbs meet at C, on Fig. D, with the knot on the outer side of the thigh.

The artery in the arm runs down the inner side of the large muscle in front, quite close to the bone; low down it gets further forward towards the bend of the elbow. It is most easily found and compressed a little above the middle at C, as shown on Fig. E.

Examine the limb from time to time, and relax the compression if it becomes very cold or purple, but tighten the handkerchief again in case of bleeding.

To transport an injured person, make a soft bed for the injured part, of straw, folded coverlets, &c., laid on a board, with side-pieces of board nailed on, when this can be done. If possible let the patient be laid on a door, shutter, settee, or other firm support comfortably covered, and carry him steadily. *Send for a physician in all cases.* For BURNS and SCALDS, consult the Engineers' Department under that item.

For *Bruises*, use tepid applications at first. After inflammation subsides, use stimulating applications, as vinegar and water, or camphorated liniment.

For *Sprains*, elevate the limb; keep the joint easy; apply tepid lotions or fomentations. When inflammation subsides, apply stimulating liniments, and shower the part alternately with cold and tepid water.

FOR NUMBNESS FROM COLD.—Restore warmth *gradually*, in proportion as circulation in the parts or body increases.

FOR A FROZEN LIMB.—Rub with snow, and place in cold water for a short time. When sensation returns, place again in cold water; add heat *very gradually*, by adding warm water. *If apparently dead or insensible*, strip entirely of clothes, and cover body, with exception of mouth and nostrils, with *snow or ice-cold water*. When the body is thawed, dry it, place it in a cold bed; rub with warm hands under the cover; continue this for hours. If life appears, give small injections of camphor and water; put a drop of spts. camphor on the tongue; then rub body with spirits and water, finally with spirits; then give tea, coffee, or brandy and water.

IN APPARENT DEATH FROM BREATHING NOXIOUS VAPORS.—Expose the person to the air; sprinkle cold water on face and head; rub strong vinegar about nostrils; give drink of vinegar and water. *If suffocated by breathing charcoal fumes*, treat in the same manner, and excite breathing as directed in cases of drowning.

DR. M. HALL'S DIRECTIONS FOR RESTORING THE APPARENTLY DROWNED.—1. *Send for a physician in all cases.* 2. Treat the patient INSTANTLY ON THE SPOT, in the OPEN AIR, freely exposing the face, neck, and chest to the breeze, except in cold weather. 3. In order to CLEAR THE THROAT, place the patient gently on the face with one wrist under the forehead, that all fluid, and the tongue itself may fall forward, and leave the entrance into the windpipe free. 4. To EXCITE RESPIRATION, turn the patient slightly on his side, and apply some irritating or stimulating agent to the nostrils, as VERATRINE, DILUTE AMMONIA, &c., or snuff, or apply a feather to the throat. 5. Make the face warm by brisk friction; then dash cold water upon it. 6. If not successful, lose no time, but, TO IMITATE RESPIRATION, place the patient ON HIS SIDE, and a LITTLE BEYOND; then again on the face, and so on alternately. Repeat these movements deliberately and perseveringly 15 TIMES ONLY in a minute. (When the patient lies on the breast, this cavity is COMPRESSED by the weight of the body, and *ex*piration takes place. When he is turned on the side this pressure is removed, and *in*spiration occurs). 7. When the prone position is resumed, make a uniform and efficient pressure ALONG THE SPINE, removing the pressure immediately, before rotation on the side. (The pressure augments the *ex*piration; the rotation commences *in*spiration). Continue these measures. 8. Rub THE LIMBS UPWARD WITH FIRM PRESSURE, and with energy. (The object being to aid the return of venous blood to the heart). 9. Substitute for the patient's wet clothing, if possible, such other covering as can be instantly procured, each by-stander supplying a coat or vest, &c. Meantime, and from time to time, TO EXCITE INSPIRATION, let the surface of tne body be SLAPPED briskly with the hand. 10. Rub the body briskly till it is warm and dry, then dash COLD water upon it, and repeat the rubbing.

Avoid the immediate removal of the patient, as it involves a DANGEROUS LOSS OF TIME; also, the use of BELLOWS, or any forcing instrument, and ALL ROUGH TREATMENT.

RULES FOR ACCIDENTS ON WATER.—When upset in a boat or thrown into the water and unable to swim, draw the breath in well; keep the mouth tight shut; do not struggle and throw the arms up, but yield quietly to the water; hold the head well up, and stretch out the hands only *below* the water; to throw the hands or feet *up* will pitch the body *below* the water, hands or feet *up* will pitch the body head *down*, and cause the whole person to go immediately under water. Keep the head *above*, and every thing else under water.

Everyone should learn to swim; no animal, aquatic fowl, or reptile requires to be taught this, for they do it naturally. Few persons exist who have not some time or other, seen a bullfrog perform his masterly movements in the water, and it would detract from no one's dignity to take a few lessons from him. In learning, the beginner might sustain himself by a plank, a block of wood, an attachment composed of cork, an inflated bladder, a flying kite, or a stout cord attached to a long rod held by an assistant on the land. *Learn to swim cost what it will.*

An officer of the New York police force wears three medals, and receives $50 per month from the Life Saving Benevolent Association. He has saved 12 lives from death by drowning, but he says that when a boy he received a thrashing every night from his father for going in swimming.

OXYGEN GAS.—1. Use red oxide of mercury; heat over a spirit lamp, or ignited charcoal in a green glass retort, or in a short tube of Bohemian glass, closed with a perforated cork furnished with a piece of bent glass tube of small bore to convey the liberated gas to the vessel arranged to receive it. Pure. 1 oz. yields about 100 cubic inches. 2. Treat chlorate of potassa as above. Pure. *Product* 100 cubic inches of gas from 100 grains. 3. Bichromate of potassa, 3 parts; oil of vitriol, 4 parts; heat gently as before ; yields pure oxygen very freely and rapidly. 4. Binoxide of manganese and oil of vitriol, equal parts: treat as the last. Product, 256 cubic inches from 1 oz. binoxide. 5. *On the large scale ;* expose nitre to a dull red heat in an iron retort or gun barrel, *Product*, 1200 cubic inches of gas (from 1 lb. nitre), contaminated more or less with nitrogen. 6. Treat *good* commercial binoxide of manganese, as the last. *Product*, 1500 to 1600 cubic inches, or from 5 to 6 gals. from 1 lb. of binoxide. 7. Chlorate of potassa 1¼ lbs.; binoxide of manganese, ¾ lb.; treat as the last. Gas procured from manganese or nitre, may be purified by passing it through lime water. When required for nice experiments, the first gas should be allowed to pass away, or else be gathered separately, as it is apt to be impure. Oxygen gas is the supporter of vitality and fire, and is often used as a remedial agent in asphyxia, arising from the inhalation of carbonic acid or carbonic oxide. It was first discriminated as a distinct gas, by Priestly, in 1774.

GERMAN RHEUMATIC FLUID.—Oils of hemlock and cedar, of each ½ oz., oils of origanum and sassafras, each 1 oz.; aqua ammonia, 1 oz.; capsicum pulverized, 1 oz.; spirits of turpentine and gum camphor, each ½ oz.; put all into a quart bottle, and fill with 95 per cent. alcohol. Dose, for colic, for man, half a teaspoonful; for a horse, ½ to 1 oz., in a little warm water, every 15 minutes, till relieved.

LINIMENT FOR OLD SORES.—Alcohol, 1 qt.; aqua ammonia, 4 oz.; oil of origanum, 2 oz.; camphor gum, 2 oz.; opium, 2 oz.; gum myrrh, 2 oz.; common salt, two tablespoons. Mix, and shake occasionally for a week.

LINIMENT.—GOOD SAMARITAN.—Take 98 per cent. alcohol, 2 qts.; and add to it the following articles: Oils of sassafras, hemlock, spirits of turpentine, tincture of cayenne, catechu, guaiac (guac), and laudanum, of each, 1 oz.; tincture of myrrh, 4 oz.; oil of origanum, 2 oz.; oil of wintergreen, ½ oz.; gum camphor, 2 oz.; and chloroform, 1½ oz. This is one of the best applications for internal pains known: it is superior to any other enumerated in this work.

INHALATION OF TAR FOR CONSUMPTION.—Mix together 16 ozs. of liquid tar and one fluid oz. liquor of potassa, boil them for a few minutes in the open air, then let it simmer in an iron vessel over a spirit or other lamp in the chamber of the patient. This may at first excite a disposition to cough, but in a short time it allays it, and removes any tendency to it.

CANCER CURE.—Drink a tea made from the tops of red clover; about 1 qt. per day should be taken internally, and the tea should be used as a wash twice per day,; very strongly recommended.

TAYLOR'S REMEDY FOR DEAFNESS.—Digest 2 ozs. bruised garlic in 1 lb. oil of almonds for a week, and strain. A drop poured into the ear is effective in temporary deafness.

CURE FOR EARACHE.—Take equal parts of chloroform and laudanum, dip a piece of cotton into the mixture and introduce into the ear, and cover up and get to sleep as soon as possible.

OTTAWA ROOT BEER.—Take 1 oz. each of sassafras, allspice, yellow-dock, and winter green; ½ oz. each wild cherry bark and coriander; ¼ oz. hops and 3 qts. molasses. Pour sufficient boiling water on the ingredients and let them stand 24 hours, filter the liquor and add ½ pt. yeast, and it is ready for use in 24 hours.

TO EXTRACT ESSENTIAL OIL FROM WOOD, BARKS, ROOTS, HERBS, &c.—Take balm, mint, sage, or any other herb, &c., put it into a bottle, and pour upon it a spoonful of ether; keep in a cool place a few hours, and then fill the bottle with cold water; the essential oil will swim upon the surface and may be easily separated.

FUMIGATING PAPER.—Dip light paper in a solution of alum; strength of alum 1 oz., water 1 pt. Dry thoroughly, and on one side spread a mixture of equal parts of gum benzoin, galbanum, or Peruvian balsam; melt the gums in an earthenware dish and spread with a hot spatula; slips of the paper are held over a light, when the odorous matter will be evaporated, the alum preventing the paper from igniting.

TRANSPARENT CEMENT FOR GLASS.—Dissolve 1 part India-rubber in chloroform, and add 16 parts by measure of gum mastic in powder. Digest for 2 days, shaking the bottle frequently; apply with a fine camel's hair brush.

MOUTH WASH.—Proof spirits, 1 qt.; borax and honey, of each 1 oz.;

gum myrrh, 1 oz.; red sanders wood, 1 oz. Rub the honey and borax well together in a mortar, then gradually add the spirit, the myrrh and sanders wood, and macerate 14 days.

WASH FOR REMOVING PARTICLES OF ZINC OR IRON FROM THE EYE.—Muriatic acid, 20 drops; mucilage, 1 dr.; mix with 2 fluid ozs. rose water. Iron or steel particles may be extracted by holding near them a powerful magnet.

TO REMOVE TUMORS.—Dr. Simpson of Edinburgh introduces a hollow acupuncture needle, or very fine *trocar* (a surgical instrument in the form of a fine hollow needle) into their tissue, and injects a few drops of some irritant liquid, such as a solution of chloride of zinc, percholorde of iron, or creosote. The effect is to destroy the vitality of the tumors so treated, and admit of separating them.

COMPOUND SYRUP OF HYPOPHOSPHITES.—Take of hypophosphite of lime, 1½ oz.; hypophosphite of soda ½ oz; hypophosphite of potassa, ½ oz.; cane sugar, 1 lb. troy; hot water, 20 fluid ozs.; orange water, 1 fluid oz. Mix a solution of the mixed salts in the hot water, filter through paper, dissolve the sugar in the solution by heat, and strain, and add the orange flower water. Dose, a teaspoonful, containing nearly five grains of the mixed salts.

COOK'S ELECTRO-MAGNETIC LINIMENT.—Best alcohol, 1 gal.; oil of amber, 8 oz.; gum camphor, 8 oz.; Castile soap, shaved fine, 2 oz.; beef's gall, 4 oz.; ammonia, 3 F.'s strong, 12 oz.; mix, and shake occasionally for 12 hours, and it is fit for use. This will be found a strong and valuable liniment.

LONDON LINIMENT.—Take chloroform, olive oil, and aqua ammonia, of each 1 oz.; acetate of morphia, 10 grs. Mix and use as other liniments. Very valuable.

OINTMENTS.—FOR OLD SORES.—Red precipitate, ½ oz.; sugar of lead, ½ oz.; burnt alum, 1 oz.; white vitriol, ¼ oz., or a little less; all to be very finely pulverized; have mutton tallow made warm, ½ lb.; stir all in, and stir until cool.

JUDKIN'S OINTMENT.—Linseed oil, 1 pt.; sweet oil, 1 oz.; and boil them in a kettle on coals for nearly 4 hours, as warm as you can; then have pulverized and mixed borax, ½ oz.; red lead, 4 oz.; and sugar of lead, 1½ oz.; remove the kettle from the fire, and thicken in the powder; continue the stirring until cooled to blood heat, then stir in 1 oz. of spirits of turpentine; and now take out a little, letting it get cold, and if not then sufficiently thick to spread upon thin soft linen as a salve, you will boil again until this point is reached. It is good for all kinds of wounds, bruises, sores, burns, white swellings, rheumatisms, ulcers, sore breasts; and even where there are wounds on the inside, it has been used with advantage, by applying a plaster over the part.

MAGNETIC OINTMENT.—SAID TO BE TRASK'S.—Hard raisins cut in pieces, and fine-cut tobacco, equal weights; simmer well together, then strain, and press out all from the dregs.

MEAD'S SALT-RHEUM OINTMENT.—Aquafortis, 1 oz.; quicksilver, 1 oz.; good hard soap, dissolved so as to mix readily, 1 oz.; prepared chalk, 1 oz.; mixed with 1 lb. of lard; mix the above by putting the aquafortis and quicksilver into an earthen vessel, and when done effervescing, mix with the other ingredients, putting the chalk in last; add a little spirits of turpentine, say ½ tablespoon.

GREEN OINTMENT.—Honey and beeswax, each ½ lb.; spirits of turpentine, 1 oz.; wintergreen oil and laudanum, each 2 oz.; verdigris, finely pulverized, ¼ oz.; lard, 1½ lb.; mix by a stove fire, in a copper kettle, heating slowly.

ITCH OINTMENT.—Unsalted butter, 1 lb.; burgundy pitch, 2 oz., spirits of turpentine, 2 oz.; red precipitate, pulverized, 1¼ oz.; melt the pitch and add the butter, stirring well together; then remove from the fire, and when a little cool add the spirits of turpentine, and lastly the precipitate, and stir until cold.

JAUNDICE.—IN ITS WORST FORMS.—Red iodide of mercury, 7 grs.; iodide of potassium, 9 grs.; aqua dis. (distilled water), 1 oz.; mix. Commence by giving 6 drops 3 or 4 times a day, increasing 1 drop a day until 12 or 15 drops are given at a dose. Give in a little water, immediately after meals. If it causes a griping sensation in the bowels, and fulness in the head, when you get up to 12 or 15 drops, go back to 6 drops, and up again as before.

REMEDY FOR RHEUMATISM AND STIFF JOINTS.—Strong camphor spirits, 1 pt.; neat's-foot, coon, bear's, or skunk's oil, 1 pt.; spirits of turpentine, ½ pt. Shake the bottle when used, and apply 3 times daily, by pouring on a little at a time, and rubbing in all you can for 20 or 30 minutes.

ASTHMA REMEDIES.—Elecampane, angelica, comfrey, and spikenard roots with hoarhound tops, of each 1 oz.; bruise and steep in honey, 1 pt. Dose, a tablespoon, taken hot every few minutes, until relief is obtained, then several times daily until a cure is effected.

ANOTHER.—Oil of tar, 1 dr.; tincture of veratrum viride, 2 drs.; simple syrup, 2 drs.; mix. Dose, for adults, 15 drops 3 or 4 times daily. Iodide of potassium has cured a bad case of asthma, by taking 5 gr. doses 3 times daily. Take ½ oz. and put it in a phial, and add 32 teaspoons of water; then 1 teaspoon of it will contain the 5 grs., which put into ½ gill more water, and drink before meals.

COMPOSITION POWDER.—THOMPSON'S.—Bayberry bark, 2 lbs.; hemlock bark, 1 lb.; ginger root, 1 lb.; cayenne pepper, 2 oz.; cloves, 2 oz.; all finely pulverized and well mixed. Dose, ½ a teaspoon of it, and a spoon of sugar; put them into a tea-cup, and pour it half full of boiling water; let it stand a few minutes, and fill the cup with milk, and drink freely. If no milk is to be obtained, fill up the cup with hot water.

FRENCH REMEDY FOR CHRONIC RHEUMATISM.—Dr. Bonnet, of Graulbet, France, states, in a letter to the "Abeille Medicale," that he has been long in the habit of prescribing "the essential oil of turpentine by friction for rheumatism; and that he has used it himself with perfect success, having almost instantaneously got rid of rheumatic pains in both knees and in the left shoulder."

DIURETICS—PILLS, DROPS, DECOCTION, &c.—Solidified copaiba, 2 parts; alcoholic extract of cubebs, 1 part; formed into pills with a little oil of juniper. Dose, 1 or 2 pills 3 or 4 times daily. This pill has been found very valuable in affections of the kidneys, bladder, and urethra, as inflammation from gravel, gonorrhœa, gleet, whites, leucorrhœa, common inflammations, &c. For giving them a sugar coat, see that heading, if desired.

DIURETIC DROPS.—Oil of cubebs, ¼ oz.; sweet spirits of nitre, ½ oz.; balsam of copaiba, 1 oz.; Harlem oil, 1 bottle; oil of lavender, 20 drops; spirits of turpentine, 20 drops; mix. Dose, 10 to 25 drops, as the stomach will bear, three times daily. It may be used in any of the above diseases with great satisfaction.

DIURETIC TINCTURE.—Green or growing spearmint mashed, put into a bottle, and covered with gin, is an excellent diuretic.

DIURETIC FOR CHILDREN.—Spirits of nitre—a few drops in a little spearmint tea—is all sufficient. For very young children, pumpkin-seed, or water-melon-seed tea is perhaps the best.

DROPSY.—SYRUP AND PILLS.—Queen-of-the-meadow root, dwarf-elder flowers, berries, or inner bark, juniper berries, horse-radish root, pod milkweed, or silkweed, often called, root of each, 4 oz.; prickly-ash bark of berries, mandrake root, bittersweet bark, of the root of each, 2 oz.; white-mustard-seed, 1 oz.; Holland gin, 1 pt. Pour boiling water on all except the gin, and keep hot for 12 hours; then boil and pour off twice, and boil down to 3 qts., and strain, adding 3 lbs. of sugar, and lastly the gin. Dose, take all the stomach will bear, say a wine glass a day, or more.

DROPSY PILLS.—Jalap, 50 grs.; gamboge, 30 grs.; podophyllin, 20 grs.; elatarium, 12 grs.; aloes, 30 grs.; cayenne, 35 grs.; Castile soap, shaved and pulverized, 20 grs.; croton oil, 90 drops; powder all finely, and mix thoroughly; then form into pill mass, by using a thick mucilage made of equal parts of gum arabic and gum tragacanth, and divide in three-grain pills. Dose, 1 pill every 2 days for the first week; then every 3 or 4 days, until the water is evacuated by the combined aid of the pill with the alum syrup. This is a powerful medicine, and will well accomplish its work.

LIVER PILL.—Leptandrin, 40 grs.; podophyllin and cayenne, 30 grs. each; sanguinarin, iridin, and ipecac, 15 grs. each; see that all are pulverized and well mixed; then form into pill mass by using ½ dr. of the soft extract of mandrake and a few drops of anise oil; then roll out into three-grain pills. Dose, 2 pills taken at bed-time will generally operate by morning; but some persons require 3.

IRRITATING PLASTER.—EXTENSIVELY USED BY ECLECTICS.—Tar, 1 lb.; burgundy pitch, ½ oz.; white-pine turpentine, 1 oz.; resin, 2 oz. Boil the tar, resin, and gum together a short time, remove from the fire, and stir in finely pulverized mandrake root, blood root, poke root, and Indian turnip, of each, 1 oz.

PILLS.—TO SUGAR COAT.—Pills to be sugar coated must be very dry, otherwise they will shrink away from the coating, and leave it a shell easily crushed off. When they are dry, you will take starch, gum arabic, and white sugar, equal parts, rubbing them very fine in a marble mortar, and if damp, they must be dried before rubbing together; then put the powder into a suitable pan, or box, for shaking; now put a few pills into a small tin box having a cover, and pour on to them just a little simple syrup, shaking well to moisten the surface only; then throw into the box of powder, and keep in motion until completely coated, dry, and smooth. If you are not very careful, you will get too much syrup upon the pills; if you do, put in more, and be quick about it to prevent moistening the pill too much, getting them into the powder as soon as possible.

POSITIVE CURE FOR HYDROPHOBIA.—The dried root of elecampane, pulverize it, and measure out 9 heaping tablespoonfuls, and mix it with 2 or 3 teaspoonfuls of pulverized gum arabic; then divide into

9 equal portions. When a person is bitten by a rabid animal, take one of these portions and steep it in 1 pt. of new milk, until nearly half the quantity of milk is evaporated ; then strain, and drink it in the morning, fasting for 4 or 5 hours after. The same dose is to be repeated 3 mornings in succession, then skip 3, and so on, until the 9 doses are taken.

The patient must avoid getting wet, or the heat of the sun, and abstain from high-seasoned diet, or hard exercise, and, if costive, take a dose of salts. The above quantity is for an adult; children will take less according to age.

Eye Preparations.—Eye Water.—Table salt and white vitriol, of each 1 tablespoon ; heat them upon copper plates or in earthenware until dry ; the heating drives off the acrid water, called the water of crystallization, making them much milder in their action ; now add to them soft water ½ pt. ; putting in white sugar, 1 tablespoon ; blue vitriol, a piece the size of a common pea. If it should prove too strong in any case, add a little more soft water to a phial of it. Apply it to the eyes 3 or 4 times daily.

India Prescription for Sore Eyes.—Sulphate of zinc, 3 grs. ; tincture of opium (laudanum), 1 dr. ; rose water, 2 oz. ; mix. Put a drop or two in the eye, 2 or 3 times daily.

Another.—Sulphate of zinc, acetate of lead, and rock salt, of each ½ oz. ; loaf sugar, 1 oz. ; soft water, 12 oz. ; mix without heat, and use as other eye waters. If sore eyes shed much water, put a little of the oxide of zinc into a phial of water, and use it rather freely. This will soon effect a cure. Copperas and water has cured sore eyes of long standing ; and used quite strong, it makes an excellent application in erysipelas. Allum and the white of an egg is good.

Indian Eye Water.—Soft water, 1 pt. ; gum arabic, 1 oz. ; white vitriol, 1 oz. ; fine salt, ½ teaspoon ; put all into a bottle, and shake until dissolved. Put into the eye just as you retire to bed.

Black Oil.—Best alcohol, tincture of arnica, British oil, and oil of tar, of each 2 oz. ; and *slowly* add sulphuric acid, ½ oz. These black oils are getting into extensive use as a liniment, and are indeed valuable, especially in cases attended with much inflammation.

Vermifuge Lozenges.—Santonin, 60 grs. ; pulverized sugar, 5 oz. ; mucilage of gum tragacanth, sufficient to make into a thick paste, worked carefully together, that the santonin shall be evenly mixed throughout the whole mass ; then if not in too great a hurry, cover up the mortar in which you have rubbed them, and let stand from 12 to 24 hours to temper ; at which time they will roll out better than if done immediately ; divide into 120 lozenges. Dose, for a child 1 year old, 1 lozenge, night and morning ; of 2 years, 2 lozenges ; of 4 years, 3 ; of 8 years, 4 ; of 10 years or more, 5 to 7 lozenges ; in all cases to be taken twice daily, and continuing until the worms start on a voyage of discovery.

Harlem Oil or Welsh Medicamentum.—Sublimed or flowers of sulphur and oil of amber, of each 2 oz. ; linseed oil, 1 lb. ; spirits of turpentine sufficient to reduce all to the consistence of thin molasses. Boil the sulphur in the linseed oil until it is dissolved, then add the oil of amber and turpentine. Dose, from 15 to 25 drops, morning and evening. Amongst the Welsh and Germans it is extensively used for strengthening the stomach, kidneys, liver, and lungs ; for asthma, shortness of breath, cough, inward or outward sores, dropsy, worms, gravel, fevers, palpitation of the heart, giddiness, headache, &c., by taking it internally ; and for ulcers, malignant sores, cankers, &c., anointing externally, and wetting linen with it, and applying to burns.

EGYPTIAN CURE FOR CHOLERA.—Best Jamaica ginger root, bruised, 1 oz. ; cayenne, 2 teaspoons ; boil all in 1 qt. of water to ½ pt., and add loaf sugar to form a thick syrup. Dose, 1 tablespoon every 15 minutes, until vomiting and purging ceases ; them follow up with a blackberry tea.

INDIAN PRESCRIPTION FOR CHOLERA.—First dissolve gum camphor, ¼ oz., in 1½ oz. of alcohol ; second, give a teaspoon of spirits of hartshorn in a wine glass of water, and follow it every 5 minutes with 15 drops of the camphor in a teaspoon of water, for 3 doses ; then wait 15 minutes, and commence again as before ; and continue the camphor for 30 minutes, unless there is returning heat. Should this be the case, give one more dose, and the cure is effected ; let them perspire freely (which the medicine is designed to cause), as upon this the life depends, but add no additional clothing.

ISTHMUS CHOLERA TINCTURE.—Tincture of rhubarb, cayenne, opium, and spirits of camphor, with essence of peppermint, equal parts of each, and each as strong as can be made. Dose, from 5 to 30 drops, or even to 60, and repeat, until relief is obtained, every 5 to 30 minutes.

KING OF OILS, FOR NEURALGIA AND RHEUMATISM.—Burning fluid, 1 pt. ; oils of cedar, hemlock, sassafras, and origanum, of each 2 oz. ; carbonate of ammonia, pulverized, 1 oz. ; mix. DIRECTIONS.—Apply freely to the nerve and gums around the tooth ; and to the face, in neuralgic pains, by wetting brown paper and laying on the parts, not too long, for fear of blistering,—to the nerves of teeth by lint.

NEURALGIA.—INTERNAL REMEDY.—Sal-ammoniac, ½ dr., dissolve in water 1 oz. Dose, one tablespoon every 3 minutes, for 20 minutes, at the end of which time, if not before, the pain will have disappeared.

ARTIFICIAL SKIN.—FOR BURNS, BRUISES, ABRASIONS, &C.—PROOF AGAINST WATER.—Take gun cotton and Venice turpentine, equal parts of each, and dissolve them in 20 times as much sulphuric ether, dissolving the cotton first, then adding the turpentine ; keep it corked tightly. Water does not affect it, hence its value for cracked nipples, chapped hands, surface bruises, &c., &c.

INDIAN BALSAM.—Clear, pale resin, 3 lbs., and melt it, adding spirits of turpentine, 1 qt. ; balsam of tolu, 1 oz. ; balsam of fir, 4 oz. ; oil of hemlock, origanum, with Venice turpentine, of each, 1 oz. ; strained honey, 4 oz. ; mix well, and bottle. Dose, 6 to 12 drops ; for a child of six, 3 to 5 drops, on a little sugar. The dose can be varied according to the ability of the stomach to bear it, and the necessity of the case. It is a valuable preparation for coughs, internal pains, or strains, and works benignly upon the kidneys.

WENS—TO CURE.—Dissolve copperas in water to make it very strong ; now take a pin, needle, or sharp knife, and prick or cut the wen in about a dozen places, just sufficient to cause it to bleed ; then wet it well with the copperas water, once daily.

BRONCHOCELE.—ENLARGED NECK.—TO CURE.—Iodide of potassium (often called hydriodate of potash), 2 drs. ; iodine, 1 dr. ; water

$2\frac{1}{2}$ oz. ; mix and shake a few minutes, and pour a little into a phial for internal use. Dose, 5 to 10 drops before each meal, to be taken in a little water. EXTERNAL APPLICATION.—With a feather, wet the enlarged neck, from the other bottle, night and morning, until well. It will cause the scarf skin to peel off several times before the cure is perfect, leaving it tender; but do not omit the application more than one day at most, and you may rest assured of a cure, if a cure can be performed by any means whatever.

DALBY'S CARMINATIVE.—Magnesia, 2 drs. ; oil peppermint, 3 drops; oil nutmeg, 7 drops ; oil anise, 9 drops ; tinct. of castor, $1\frac{1}{2}$ drs.; tinct. of assafœtida, 45 drops ; tinct. of opium, 18 drops ; essence pennyroyal, 50 drops ; tinct. of cardamons, 95 drops ; peppermint water, 7 oz. ; mix.

POSITIVE CURE FOR DIARRHŒA.—Take 2 wine glasses of vinegar, and one tablespoonful of salt. Mix the whole thoroughly to dissolve the salt; add 7 to 10 drops of laudanum. according, to the age or strength of the patient, and give the whole at one dose.

CURE FOR AGUE.—Cut three lemons into thin slices and pound them with a mallet, then take enough coffee to make a quart, boil it down to a pint and pour it while quite hot over the lemons. Let it stand till cold, then strain through a cloth, and take the whole at one dose, *immediately after* the chill is over, and *before* the fever comes on.

TO IMPROVE THE VOICE.—Beeswax, 2 drs.; copaiba balsam, 3 drs. ; powder of liquorice root, 4 drs. ; melt the copaiba balsam with the wax in a new earthen pipkin ; when melted, remove them from the fire, and mix in the powder ; make the pills of 3 grs. each. Two of these pills to be taken occasionally, 3 or 4 times a day. Very best known.

CURE FOR TAPE WORM.—Take at one dose, ether $\frac{3}{8}$ oz. 2 hours after this take castor oil, 1 oz. The worm is discharged entire or almost so, and always with the head intact.

NECESSARY RULES FOR SLEEP.—There is no fact more clearly established in the physiology of man than this, that the brain expends its energies and itself during the hours of wakefulness and that these are recuperated during sleep. If the recuperation does not equal the expenditure, the brain withers ; this is insanity. Thus it is in early English history, persons who were condemned to death by being prevented from sleeping always died raving maniacs, and those who are starved to death become insane ; the brain is not nourished and they can not sleep. The practical inferences are three; 1st. Those who think most, who do the most brain work, require the most sleep. 2d. The time "saved" from necessary sleep is infallibly destructive to mind, body and estate. 3d. Give yourself, your children, your servants, give all that are under you, the fullest amount of sleep they will take, by compelling them to go to bed at some regular early hour, and to *rise in the morning at the moment they awake*; and, within a fortnight, Nature, with almost the regularity of the rising sun, will unloose the bonds of sleep the moment enough repose has been secured for the wants of the system. This is the only safe and efficient rule.

SIGNS OF DISEASE IN CHILDREN.—In the case of a baby not yet able to talk, it must *cry* when it is ill. The *colic* makes a baby cry loud, long, and passionately, and shed tears—stopping for a moment and beginning again.

If the chest is affected, it gives *one* sharp cry, breaking off immediately, as if crying hurt it.

If the head is affected, it cries, in *sharp, piercing shrieks*, with *low moans and wails between.* Or there may be quiet dozing, and startings between.

It is easy enough to perceive, where a child is attacked by disease that there is some change taking place; for either its skin will be dry and hot, its appetite gone; it is stupidly sleepy, or fretful and crying; it is thirsty, or pale and languid, or in some way betrays that something is wrong. When a child vomits, or has a diarrhœa, or is costive and feverish, it is owing to some derangement, and needs attention. But these various symptoms may continue for a day or two before the nature of the disease can be determined. A warm bath, warm drinks, etc., can do no harm, and may help to determine the case. On coming out of the bath, and being well rubbed with the hand, the skin will show symptoms of rash, if it is a skin disease which has commenced. By the appearance of the rash, the nature of the disease can be learned. Measles are in patches, dark red, and come out first about the face. If scarlet fever is impending, the skin will look a deep pink all over the body, though mostly so about the neck and face. Chicken-pox shows fever, but not so much running at the nose, and appearance of cold, as in measles, nor is there as much of a cough. Besides, the spots are smaller, and do not run much together, and are more diffused over the whole surface of the skin, and enlarge into little blisters in a day or two.

Let the room where the child is sick be shady, quiet, and cool. Be careful not to speak so suddenly as to startle the half-sleeping patient and handle it with the greatest tenderness when it is necessary to move it. If it is the lungs that suffer, have the little patient somewhat elevated upon the pillows for easier breathing, and do everthing to sooth and make it comfortable, so as not to have it cry, and to thus distress its inflamed lungs. If the child is very weak, do not move it too suddenly, as it may be startled into convulsions. In administering a bath, the greatest pains must be taken not to frighten the child. It should be put in so gradually, and so amused by something placed in the water on purpose as to forget its fear; keep up a good supply of fresh air, at a temperature of about 60° Fah. If a hired nurse *must* be had, select if possible a woman of intelligence, gentle and loving disposition, kind and amiable manners, and of a most pacific unruffled, and even temper. If a being can be got possessed of these angelic qualities, and we believe there are many such, you will be quite safe in intrusting to her care the management of your sick child or yourself either, in case of sickness. She should not be under twenty-five or over fifty-five, as between these two ages she will, if healthy, be in her full strength and capacity.

Whooping Cough.—To empty the child's stomach by a lobelia emetic, is the first step. After this make a syrup of sugar, ginger-root, a little water, and enough lobelia tincture to produce a slight nausea. This, given two or three times a day, will loosen the cough very much. See "Whooping Cough Syrup."

Diarrhœa.—Nothing is better for looseness of the bowels than tea made of ground bayberry. Sweeten it well, and give a half-teacupful once in two hours, until the child is better. Bathing must not be neglected. For Croup Remedy see "Cure for Lockjaw."

Colic.—This can be cured with warm injections of simple soap-suds, or warm water with a warming tincture in it. A little warm tea may be given at the same time, and the bowels rubbed. Every family should have a small and large syringe. Nothing is oftener needed, particularly in the care of children.

FEVER.—Where a child has a simple fever from teething or any other cause not connected with acute disease, give a teaspoonful of syrup of rhubarb, a warm injection, and sponge-baths. These will generally be all that is needed.

RICKETS AND SCROFULA.—If children have either of these, or both these diseases, a good, nutritive diet is a great essential. Then the alkaline-bath, a little lime-water, say a teaspoonful three times a day, and out-door exercise, are the chief remedies.

FITS—SPASMS—When these are brought on by indigestion, place the child in a warm bath immediately, give warm water, or a lobelia emetic, rub the skin briskly, etc., to get up an action. In brain disease the warm water is equally useful. In fact, unless the fit is constitutional, the warm bath will relieve the patient by drawing the blood to the surface.

ENLARGEMENT OF THE BRAIN.—This chiefly effects children, and consists in an unnatural growth of the brain. The skull may grow with it, and there be no symtoms of disease, though children with this large brain are apt to die of some brain disease. The *symptoms* of enlargement of the brain are, dullness of intellect, indifference to external objects, irritable temper, inordinate appetite, giddiness, and habitual headache. Sometimes there are convulsions, epileptic fits, and idiocy. There is also a pecular projection of the parietal bones in this disease.

Treatment.—As much as possible, repress all exercise of the mind. Do not suffer the child to go to school; but put it to the most active and muscular exercise in the open air. The moment there is any heat in the top of the head, apply cold water, ice, or cold evaporating lotions. The diet should be very simple, bread and milk only, if, as the child grows up, the signs of the disease increase.

WATER IN THE HEAD.—Another disease of children, and especially of scrofulous children. It is inflammatory, and should be early noticed.

Symptoms.—Capricious appetite, a foul tongue, offensive breath enlarged, and some times tender belly, torpid bowels, stools light-colored from having no bile, or dark from vitiated bile, fetid, sour-smelling, slimy and lumpy. The child grows pale and thin; and is heavy, languid, dejected; it is fretful, irritable, uneasy, and apt to be tottering in its gait.

The disease may begin, after these symptoms, by pains in the head, becoming more severe and frequent, sharp and shooting, causing the child to waken and shriek out. As the drowsy state advances, the shrieking gives place to moaning. There is great stiffness in the back of the neck, pain in the limbs, tenderness in the scalp, vomiting, sighing, intolerance of light, knitting of the brows, and increased disturbance of the stomach and bowels. This may last from ten to fourteen days, the patient growing more weak and peevish. Another form of attack is marked by acute pain in the head, high fever, convulsions, flushed face, brilliant eyes, intolerance of light and sound, pain, tenderness in the belly, stupor, great irritability of stomach, causing retching and vomiting on every attempt to sit up. The third mode of attack is very insidious—the early symptoms being so mild as hardly to be noticed. In this case, the convulsions or palsy come suddenly, without notice, bringing swift and unexpected destruction. In the first stage of the disease there is increased sensibility; in the second decreased sensibility; in the third, palsy, convulsions, squinting of the eyes, rolling of the head, stupor, and a rapid, thread-like pulse.

Treatment.—In the first stage, purging is very important, and must be continued for three or four days. An excellent purgative is this: pulverized scammony, six grains; croton oil, four drops; pulverized loaf sugar, sixteen teaspoonfuls. Rub well together in a mortar. Give one teaspoonful every hour or two, till it operates. Apply cold water or ice to the head. In the second stage put blisters upon the back of the neck, and one on the bowels, if very tender. In the third stage use the warm bath, also alteratives and diuretics. For an alterative, use iodide of potassium, one dram; water, half an ounce; mix. Thirty drops to a child seven years old every hour. For a diuretic, use tincture of digitalis, one ounce; syrup of squills, one ounce; mix. Ten drops for a child seven years old every four hours. The patient should be kept in a dark room, away from all noise and excitement, and should lie upon a hair mattress, with his head somewhat elevated. The diet in the first stage snould be nothing more than gruel; after that, more nourishing, but easy of digestion, such as beef-tea, plain chicken-broth, animal-jellies, etc. At the same time the patient should be supported by the cautious use of wine-whey, valerian, or ten drops of aromatic spirits of ammonia every four hours.

MUMPS.—This disease, most common among cnildren, begins witn soreness and stiffness in the side of the neck. Soon a swelling of the paratoid gland takes place, which is painful and continues to increase for four or five days, sometimes making it difficult to swallow, or open the mouth. The swelling sometimes comes on one side at a time, but commonly upon both. There is often heat and sometimes fever, with a dry skin, quick pulse, furred tongue, constipated bowels, and scanty and high-colored urine. The disease is contagious.

Treatment.—Keep the face and neck warm, and avoid taking cold, Drink warm herb teas, and if the symptoms are severe, 4 to 6 grs. of Dover's powder; or if there is costiveness, a slight physic, and observe a very simple diet. If the disease is aggravated by taking cold, and is very severe, or is translated to other glands, physic must be used freely, leeches applied to the swelling, or cooling poultices. Sweating must be resorted to in this case.

SCARLET FEVER is an acute inflammation of the skin, both external and internal, and connected with an infectious fever.

Sumptoms.—The fever shows itself between two and ten days after exposure. On the second day of the fever the eruption comes out in minute pimples, which are either clustered together, or spread over the surface in a general *bright scarlet color.* The disease begins with languor, pains in the head, back, and limbs, drowsiness, nausea and chills, followed by heat and thirst. When the redness appears the pulse is quick, and the patient is restless, anxious and often delirious. The eyes are red, the face swollen, and the tongue covered in the middle with white mucus, through which are seen elevated points of extreme redness. The tonsils are swollen, and the throat is red. By the evening of the third or fourth day the redness has reached its height, and the skin becomes moist, when the scarf-skin begins to come off in scales.

In this fever the flesh puffs up so as to distend the fingers, and disfigure the face. As it progresses the coating suddenly comes off the tongue, leaving it and the whole mouth raw and tender. The throat is very much swollen and inflamed, and ulcers form on the tonsils. The eustachian tube which extends up to the ear, the glands under the ear and jaw, sometimes inflame and break ; and the abscesses formed in the ear frequently occasion deafness, more or less difficult to cure. The symptoms of this disease may be known from that of measles by the absence of cough ; by the finer rash ; by its scarlet color ; by the rash appearing on the second instead of the fourth day ; and by the ulceration of the throat.

Treatment.—In ordinary cases the treatment required is very simple. The room where the patient lies should be kept cool, and the bed-covering light. The whole body should be sponged with cool water as often as it becomes hot and dry, and cooling drinks should be administered. A few drops of belladonna, night and morning, is all that is needed.

If there is much fever and soreness of throat, give the following tincture of hellebore often enough to keep down the pulse :—

Tincture of American hellebore, 1 dr. ; tincture of black cohosh, 2 oz. ; mix. Take 1 teaspoonful 3 to 6 times a day.

It would also be useful to commence treatment with an emetic · and to soak the feet and hands in hot water containing a little mustard or cayenne pepper ; continuing this bath 20 minutes, twice a day, for 2 or 3 days. The cold stage being passed, and the fever having set in, warm water may be used without the mustard or pepper. If the head is affected, put drafts upon the feet ; and if the bowels be costive, give a mild physic. Solid food should not be allowed; but when the fever sets in, cooling drinks, such as lemonade, tamarind-water, rice-water, flaxseed tea, then gruel, or cold water may be given in reasonable quantities. To stimulate the skin, muriatic acid, 45 drops in a tumbler filled with water and sweetened, and given in doses of a teaspoonful, is a good remedy.

Where the disease is very violent, and the patient inclines to sink immediately ; where typhoid symptoms appear and there is great prostration ; the eruption strikes in ; the skin changes to a mahogany color ; the tongue is a deep red, or has on it a dark brown fur, and the ulcers in the throat become putrid, the treatment must be different from the above. In this case it must be *tonic.* Quinia must be given freely ; and wine whey, mixed with toast-water, will be useful. Quinia is made as follows :—Sulphate of quinine, 1 scruple ; alcohol, 4 ozs. ; sulphuric acid, 5 drops ; Madeira wine, 1 quart ; mix. Two wine-glassfuls a day. Tincture of cayenne, in sweetened water, may be given in small doses. Gargles are also necessary. A good one is made of pulverized cayenne, 1 dram ; salt, one dram ; boiling water, 1 gill. Mix, and let them stand 15 minutes. Then add 1 gill vinegar. Let it stand an hour and strain. Put a teaspoonful in the child's mouth once in an hour. A warm bath should be used daily as soon as the skin begins to peel off, to prevent dropsy. If dropsy sets in, the bath once in 3 days is sufficient, and sweating should be promoted by giving the tincture of Virginia snake-root and similar articles; a generous diet should be allowed at the same time, to bring up the child's strength

MEASLES is an acute inflammation of the skin, internal and external, combined with an infectious fever.

Symptoms.—Chills succeeded by great heat, languor, and drowsiness, pains in the head, back, and limbs, quick pulse, soreness of throat, thirst, nausea and vomiting, a dry cough, and high-colored urine. These symptoms increase in violence for four days. The eyes are inflamed and weak, and the nose pours forth a watery secretion, with frequent sneezing. There is considerable inflammation in the larynx, windpipe, and bronchial tubes, with soreness of the breast and hoarseness. About the fourth day the skin is covered with a breaking out which produces heat and itching, and is red in spots, upon the face first, gradually spreading over the whole body. It goes off in the same way, from the face first and then from the body, and the hoarseness and other symptoms decline with it; at last the outside skin peels off in scales.

Treatment.—In a mild form, nothing is required but a light diet, slightly acid drinks, and flax seed or slippery elm tea. Warm herb teas, and frequent sponge baths with tepid water, serve to allay the fever; care should be taken not to let the patient take cold. If the fever is very high, and prevents the rash coming out, a slight dose of salts, or a nauseating dose of ipecac., lobelia, or hive-syrup should be given, and followed by teasponful doses of compound tincture of Virginia snake-root until the fever is allayed. If the patient from any derangement takes on a low typhoid type of fever, and the rash does not come out until the seventh day, and is then of a dark and livid color, tonics and stimulants must be given, and expectoration promoted by some suitable remedy. There is always danger of the lungs being left in an inflamed state after the measles, unless the greatest care is taken not to suffer the patient to take cold. Should there be much pain, and a severe cough, this must be treated as a separate disease, with other remedies.

TYPHOID FEVER.—*Symptoms.*—Is generally preceded by several days of languor, low spirits, and indisposition to exertion. There is also, usually, some pain in the back and head, loss of appetite, and drowsiness, though not rest. The disease shows itself by a chill. During the first week there is increased heat of the surface, frequent pulse, furred tongue, restlessness, sleeplessness, headache, and pain in the back; sometimes diarrhœa and swelling of the belly, and sometimes nausea and vomiting.

The second week is often distinguished by small, rose-colored spots on the belly, and a crop of little watery pimples on the neck and chest, having the appearance of minute drops of sweat; the tongue is dry and black, or red and sore; the teeth are foul; there may be delirium and dullness of hearing; and the symptoms every way are more serious than during the first week. Occasionally, the bowels are at this period perforated or ate through by ulceration, and the patient suddenly sinks. If the disease proceeds unfavorably into the third week, there is low, muttering delirium; great exhaustion; sliding down of the patient toward the foot of the bed; twitching of the muscles, bleeding from the bowels; and red or purple spots upon the skin. If, on the other hand, the patient improves, the countenance brightens up, the pulse moderates, the tongue cleans, and the discharges look healthy.

Treatment.—Give the patient good air, and frequent spongings with water, cold or tepid, as most agreeable. Keep the bowels in order and be more afraid of diarrhœa than costiveness. Diarrhœa should be restrained by a little brandy, or by repeated doses of Dover's powder. For costiveness, give mild injections, made slightly loosening by castor oil, or common molasses. To keep down the fever, and produce perspiration, give tincture of veratrum viride, 10 drops every hour. If the bowels are swelled, relieve them by hot fomentations of hops and vinegar. If the pain in the head is very severe and constant, let the hair be cut short, and the head bathed frequently with cold water. Give light nourishment, and if the debility is great, broth and wine will be needed. Cleanse the mouth with very weak tea—old hyson. If the fever runs a low course, and the patient is very weak, quinine may be given from the beginning. Constant care and good nursing are very important.

Typhus fever is distinguished from typhoid by there being no marked disease of the bowels in typhus.

GROCERS AND CONFECTIONERS' RECEIPTS.

Cheap Vinegar.—Mix 25 gals. of warm rain water, with 4 gals. molasses and 1 gal. yeast, and let it ferment; you will soon have the best of vinegar; keep adding these articles in these proportions as the stock is sold.

For Grocers' Sales—Take three barrels; let one of them be your vinegar barrel; fill this last up before it is quite empty, with molasses, 2 gals.; soft water, 11 gals; yeast. 1 qt.; keeping these proportions in filling up the whole three barrels; sell the vinegar out of your old vinegar barrel as soon as it is ready, which will be in a short time; when nearly empty, fill it up with the fluid as before, and pass on to sell out of the next barrel; by the time it is disposed of go on to the last; then go back to the first, filling up your barrels in every case when nearly empty, and you will always keep a stock of good vinegar on hand unless your sales are very large; in which case, follow the next process. Have the bung-holes open in the barrels to admit air. The free admission of warm air hastens the process.

Vinegar in Three Days.—Get a quantity of maple, beech, or basswood chips or shavings, and soak these in good vinegar, for two or three days. With these chips you will fill a barrel, which has been pierced with a large number of inch holes all around the sides for the free admission of air among the chips (the more holes in the barrel the better, for the more air the sooner the vinegar will be made) cut another barrel in two halves, place one half below the barrel with the chips and the other half above it. The top tub must have its bottom pierced with a number of gimlet holes, in which are placed several threads of twine, to conduct the vinegar evenly over the chips. The liquid drains down slowly through the chips and out of a faucet near the bottom of the barrel into the lower tub. It should run through every four hours, and then be baled or pumped back. Directions to make vinegar from sugar: Use 1½ lb. to each gal. of water; of the dregs of molasses barrels, use 2 lb. to each gal. of water; small beer, lager beer, ale, &c., which have become sour, make good vinegar by being reduced with water; small beer needs but little water, lager beer as much water as beer; to 2 gals. cider, add ½ gal. of water; you can also make excellent vinegar out of the artificial cider mentioned below. Use, in every case, soft water to make vinegar, and use 2 qts, yeast to every barrel. It makes much quicker if the fluid is slightly lukewarm. Leach either of these preparations through the shavings.

This process should be attended to during warm weather, or in a room where a pretty high temperature is kept up, as it will not work otherwise.

EXCELLENT VINEGAR, CHEAP.—Acetic acid, 5 lbs.; molasses, 2 gal.; yeast, 2 qts,; put them into a forty-gal. cask, and fill it up with rain water; stir it up, and let it stand one to three weeks, letting it have all the air possible, and you will have good vinegar. If wanted stronger, add more molasses. Should you at any time have weak vinegar on hand, put molasses into it to set it working. This will soon correct it. Make in a warm place.

WHITE WINE VINEGAR.—Mash up 20 lbs. raisins, and add 10 gals. water; let it stand in a warm place for one month, and you will have pure white wine vinegar. The raisins may be used a second time the same way.

TO PRESERVE EGGS.—To each patent pailful of water, add 2 pts. of fresh slacked lime, and 1 pt. of common salt; mix well. Fill your barrel half full with this fluid, put your eggs down in it any time after June, and they will keep two years if desired.

LIQUID MUCILAGE.—Fine clear glue 1 lb.; gum arabic, 10 oz.; water, 1 qt.; melt by heat in a glue kettle or water bath; when entirely melted, add slowly 10 ozs. strong nitric acid, set off to cool. Then bottle, adding in a couple of cloves to each bottle.

CANDIED LEMON PEEL.—Take lemon peels and boil them in syrup; then take them out, and dry.

BAKING POWDER.—Tartaric acid, 5 lbs.; pure sesquicarbonate of soda, 8 lbs.; potato farina, or other flour or starch, 16 lbs. Dry separately by gentle heat. Mix this perfectly in a dry room, pass the mixture through a sieve and put up at once into damp proof hard pressed packages. To use, 1 or 2 teaspoonfuls are mixed with dry flour, which is then mixed with cold water, and baked immediately. *Another.*—Tartaric acid, 1 lb.; pure bicarbonate of soda ¾ lbs.; potato farina, ¾ lb. Treat the same as the last.

TO MAKE AN ICE CHEST.—Take 2 drygoods boxes, one of which is enough smaller than the other to leave a space of about 3 inches all around when it is placed inside. Fill the space between the two with sawdust packed closely, and cover with a heavy lid made to fit neatly inside the larger box. Insert a small pipe in the bottom of the chest to carry off the water from the melting ice. For family use or grocers, use this will prove as serviceable as refrigerators that cost twenty times as much.

SOAP MANUFACTURE.—When wood ashes cannot conveniently be had it is usual for soap manufacturers to use equal quantities of recently slacked lime, and sal soda, soda ash or caustic soda, using water enough to give the ley sufficient strength to support a fresh egg. It must be very strong. The solution can be effected by heat, or stirring, or by both methods, finally drawing off, or bailing out the liquid clear of sediment, previously throwing in salt and giving time for the sediment to settle; 1 ton of yellow soap will require about 1000 lbs. tallow and 350 lbs. resin, with ley sufficient. The same quantity of white soap will require nearly 1300 lbs. tallow, boiling in every case with the proper quantity of ley, until it forms a perfectly homogeneous mass by a perfect blending of the component parts all together, when it is poured out into suitable frames to harden and cool. It is afterwards cut up into proper sized bars by means of wires to which handles are attached and then piled up to dry.

TRANSPARENT SOAP.—Slice 6 lbs. nice yellow bar-soap into shavings; put into a brass, tin or copper kettle, with alcohol, ½ gal., heating gradually over a slow fire, stirring till all is dissolved; then add 1 oz. sassafras essence, and stir until all is mixed; now pour into pans about 1½ inches deep, and when cold cut into square bars the length or width of the pan, as desired.

ENGLISH BAR-SOAP.—Six gals. soft water; 6 lbs. good stone lime; 20 lbs. sal-soda; 4 oz. borax; 15 lbs. fat (tallow is best); 10 lbs. pulverized resin, and 4 oz. beeswax; put the water in a kettle on the fire, and when nearly boiling add the lime and soda; when these are dissolved, add the borax; boil gently, and stir until all is dissolved; then add the fat, resin, and bees-wax: boil all gently until it shows flaky on the stick, then pour into moulds.

BEST SOFT SOAP.—Mix 10 lbs. potash in 10 gals. warm soft water over night; in the morning boil it, adding 6 lbs. grease; then put all in a barrel, adding 15 gals. soft water.

SOAP WITHOUT LYE OR GREASE. In a clean pot put ½ lb. home-made hard or mush soap, and ½ lb. sal-soda, and 5 pts. of soft water. Boil the mixture 15 minutes, and you will have 5 lbs. good soap for 7½ cents. *Hard Soap.*—Take 5 lbs. hard soap, or 7 lbs. soft soap, and 4 lbs. sal-soda, and 2 oz. borax, and 1 oz. hartshorn; boil one quarter hour with 22 qts. water; add, to harden, ½ lb. resin.

GERMAN YELLOW SOAP.—Tallow and sal-soda, of each 112 lbs., resin, 56 lbs.; stone lime, 28 lbs.; palm oil, 8 oz.; soft water, 28 gals. Put soda, lime, and water into a kettle and boil, stirring well; then let it settle, and pour off the lye. In another kettle, melt the tallow, resin, and palm oil; having it hot, the lye being also boiling hot, mix all together, stirring well and the work is done. *For small quantities.*—Tallow and sal-soda each, 1 lb.; resin, 7 oz.; stone lime, 4 oz.; palm oil, 1 oz.; soft water, 1 qt.

HARD SOAP WITH LARD.—Sal-soda and lard, each 6 lbs.; stone lime, 3 lbs.; soft water, 4 gals.; dissolve the lime and soda in the water by boiling, stirring, settling, and pouring off; then return to the kettle (brass or copper), and add the lard, and boil it till it becomes soap; then pour into a dish or moulds; and, when cold, cut into bars, and dry it.

WHITE HARD SOAP WITH TALLOW.—Fresh slacked lime, sal-soda, and tallow, of each, 2 lbs.; dissolve the soda in 1 gal. boiling soft water; now mix in the lime, stirring occasionally for a few hours; after which, let it settle, pouring off the clear liquor, and boiling the tallow therein until it is all dissolved; cool it in a flat box or pan, cut into bars or cakes as desired. It may be perfumed with sassafras oil or any other perfume desired, stirring it in when cool. *One hundred pounds soap, very cheap.*—Potash, 6 lbs.; lard, 4 lbs.; resin, ¼ lb. Beat up the resin, mix all together, and set aside for five days; then put the whole into a 10-gal. cask of water, and stir twice a day for ten days, when it is ready for use.

VARIEGATED SOAPS.—Soft water 3 qts., nice white bar soap 3 lbs., sal-soda 2 ozs.; Chinese vermilion and Chinese blue, of each about 7 grs., oil sassafras ½ oz.; shave the soap into thin slices and add it to the water as it begins to boil, when dissolved set it off the fire, take out a cup of soap and stir in the vermillion, take out another cup of soap and stir in the blue; then pour in the contents of the first cup, giving two or three turns only with a stirring stick, then add the other cupful in the same way, then pour into moulds, or into a proper box, and when cold it can be cut into bars; it will present a beautiful streaked appearance.

CAMPHOR SOAP.—Curd soap 28 lbs., otto of rosemary 1¼ lbs. Reduce the camphor to powder, add one ounce almond oil, then sift it, when the soap is melted and ready to turn out, add the camphor and rosemary. *White Windsor Soap.*—Curd soap 1 cwt., marine soap 21 lbs. oil soap 14 lbs., oil caraway, 1½ lbs., oil thyme and rosemary of each ½ lb. oils of cassia and cloves of each ¼ lb. *Brown Windsor Soap.* Curd soap ¾ cwt., marine soap ¼ cwt., yellow soap ¼ cwt., oil soap ¼ cwt. Brown coloring (caramel) ½ pt. oils caraway, cloves, thyme, cassia. petit grain and French lavender of each 2 oz. *Sand Soap.*—Curd soap 7 lbs. marine soap 7 lbs., sifted silver sand 28 lbs., oils thyme, cassia, caraway, and French lavender of each 2 oz.

SOLID CANDLES FROM LARD.—Dissolve ¼ lb. alum and ¼ lb. saltpetre in ½ pt. water on a slow fire; then take 3 lbs. of lard cut into small pieces, and put into the pot with this solution, stirring it constantly over a very moderate fire until the lard is all dissolved; then let it simmer until all steam ceases to rise and remove it at once from the fire. If you leave it too long it will get discolored. These candles are harder and better than tallow.

TALLOW—TO CLEANSE AND BLEACH.—Dissolve alum, 5 lbs., in water, 10 gals., by boiling; and when it is all dissolved, add tallow, 20 lbs.; continue the boiling for an hour, constantly stirring and skimming; when sufficiently cool to allow it, strain through thick muslin; then set aside to harden; when taken from the water, lay it by for a short time to drip.

IMITATION WAX CANDLES.—Purify melted tallow by throwing in powdered quick lime, then add two parts wax to one of tallow, and a most beautiful article of candle, resembling wax, will be the result. Dip the wicks in lime water and saltpetre on making. To a gallon of water add 2 oz. saltpetre and ½ lb. of lime; it improves the light, and prevents the tallow from running.

ADAMANTINE CANDLES FROM TALLOW.—Melt together 10 oz. mutton tallow; camphor, ¼ oz.; bees-wax, 4 oz.: alum, 2 oz.

Table of Miscellaneous Weights and Measures.

Apples, dried, bush. about 25 lbs.
Almonds, seron of, 1 to 2 cwt.
Beef, firkin, 100 lbs.
" or Pork, barrel, 200 lbs.
Buckwheat, bush. usually 50 lbs.
Beans, white, bushel, 60 lbs.
Butter, barrel, 224 lbs.
" firkin, 56 lbs.
" tub, 84 lbs.
Coffee, tierce of, 5 to 7 cwt.
" bags of Rio, about 162 lbs.
" " St. Domingo, about 130 lbs.
" pocket of Java, about 50 lbs.
" bale of Mocha, 2 to 2½ cwt.
Clover seed, cask, 7 to 9 cwt.
" " bushel, usually 60 lbs.
Corn, per bushel, in most places, 56 lbs.
Cement, barrel, 300 lbs.
Cotton, bale, N. Orleans and Alabama, 400 to 300 lbs.
" " East Indies, 320 to 380 lbs.
" " Carolina, Georgia & West Indies, 300 to 312 lbs.
" " Brazilian 160 to 200 lbs.
Dried Peaches, bush, usually 33 lbs.
Flax, bale, Russian, 5 to 6 cwt.
Fish, quintal, 112 lbs.
" barrel, pickled, 200 lbs.
Flaxseed, bush. in most places, 55 lbs.
Flour, bbl. net, 196 lbs.
" including bbl., 216 lbs.
" sack, 5 bushels, 280 lbs.
Figs, drum, 24 lbs.
Ginger, ground, box, 24 lbs.
Honey, gal., 12 lbs.
Hops, bag of, about 2½ cwt.
Hempseed, bush. in most places 44 lbs.
Indian Meal, hogshead, 800 lbs.
Lime, bbl., 225 lbs.
Lemons, box, Sicily, about 350 lbs.
Mace, case, about 1½ cwt.
Molasses, hhd. from 130 to 150 gals.
Oats, per bush., 32 lbs.
Oranges, box, double O, 300 to 350 lbs.
" " single O, 175 to 350 lbs.
Rye, bush. in most places, 56 lbs.
Salmon, box, 120 to 130 lbs.
Salt, hhd., 3 bush. *
" bbl., 3½ bush.
" bushel of, fine ground, 70 lbs.
Sugar, bbl., 200 to 250 lbs.
" box, 400 to 500 lbs.
Soap, bbl. 256 lbs.
" box, 75 lbs.
Tea, chest, Congou, 75 lbs.
" " Hyson, 60 to 84 lbs.
" ½, about 40 lbs. net.
Timothy Seed, bushel, 45 lbs.
Wheat, bushel, 60 lbs.

Beer, hhd., 54 gals.
Butt of Sherry, 108 gals.
Brandy, puncheon of, 110 to 120 gals.
" hhd., 55 to 60 gals.
Claret, hhd., 46 gals.
Puncheon of Scotch Whiskey, 110 to 130 gals.
" Rum, 100 to 110 gals.
Pipe of Port, 115 gals.
" Maderia, 92 gals.
" Teneriffe, 100 gals.
A hogshead is one-half, a quarter cask is one-fourth, and an octave is one-eighth of a pipe, butt, or puncheon.

British Measures of Volume.

The *Imperial gallon* measures 277-274 cubic inches, and contains 10 lbs avoirdupois of distilled water at 32° Fahr.

The *Ale gallon* is 282 cubic inches, and contains 10.2 lbs. avoirdupois of distilled water.

The wine gallon of 231 cubic ins. containing 8.355 lbs. avoirdupois of distilled water, is the government or customs gallon of the United States, and the legal gallon of each State in which no law exists fixing a State or statute gallon, and the *Standard* U.S. bushel is the *Winchester*, containing 2150.42 cubic inches, or 77.627413 lbs. avoirdupois of distilled water.

The *Imperial bushel*=2218.192 cubic ins. The *heaped* bushel=19.5 ins. diameter, cone 6 ins. high=2815.4872 cubic ins. *For Grain*—8 bushels=1 quarter. 1 quarter=10.2694 cubic feet. *Coal or Heaped measure*—3 bushels=1 sack, 12 sacks=1 chaldron; 1 chaldron=58.656 cubic feet and weighs 3136 lbs. 1 stone=14 lbs. 1 Quarter is equal to 8¼ U. S. bushels 1 sack flour=5 bushs.=280 lbs. Anthracite coal per cubic ft. weighs 90 to 102 lbs. Bituminous coal, per cubic ft. 79 to 82 lbs. Coal as conventional ly purchased=43.56 cubic ft. to a ton (or about 28 bushels and 5 pecks), in the U. S., and is bought wholesale by the dealer at 2240 lbs. per ton, and retailed at 2000 lbs. In commerce, 1 ton of flour is 8 sacks, and 1 ton of potatoes 10 bushels. The weight and measures in the Dominion of Canada are the same as those of Great Britain, but the United States bushel and gallon are most in use. The dimensions of a barrel should be, diam. of head, 17 ins., do. at bung, 19 ins.; length, 28 ins.; volume 7689 cub. ins. A tun is 2 pipes, 4 hogsheads, 3 puncheons, 8 barrels, or 252 gals.

QUANTITY OF GOODS ESTIMATED TO COMPOSE A TON IN CALCULATING FREIGHTS BY WATER.—Lemons, 20 boxes; Raisins, 20 casks; do., 80 boxes; do., 160 half boxes; do., 320 quarter boxes; Almonds, 16 frails; Grapes, 40 kegs; Wine, Malaga, 8 quarter casks; ditto, 14 Indian barrels; Cassia, 25 piculs; Jute, 4 bales; Linseed, 1600 lbs., or 8½ bags per ton; Ginger, 110 lbs.; Twine, 890 lbs.; Matting, 4-4, 8¾ rolls of 40 yds.; do., 5-4, 7 rolls of 40 yds.; do., 6-4, 5¾ rolls of 40 yards; Gunny bags, large, 425; medium do., 500; small do., 625; Saltpetre, 11 to 12 bags per ton of 2240 lbs.

NEW YORK FREIGHTS.—QUANTITY OF GOODS WHICH COMPOSE A TON.—*Extract from the Bye-Laws of the New York Chamber of Commerce.* In freighting vessels by the ton, in the absence of a definite agreement between the owner of the vessel and freighter of the goods, the following regulations shall be the standard of computation: That the articles the *bulk of which shall compose a Ton, to equal a Ton of heavy materials*, shall be in weight as follows. Coffee in casks, 1568 lbs.; Coffee in bags, 1830 lbs.; Cocoa in casks, 1120 lbs.; Cocoa in bags, 1307 lbs.; Pimento in casks, 952 lbs.; Pimento in bags, 1110 lbs.; Dry hides, 10 cwt.; Chinese raw silk, 8 cwt.; Bohea tea, net, 10 cwt.; Green teas, 8 cwt.; Ship-bread, bulk, 8 cwt.; Ship-bread, bags, 7 cwt.; Ship-bread, casks, 6 cwt.; Grain, Peas, or Beans in casks, 22 bushels; Grain, in bulk, 36 bushels; European salt, 31 bushels; West India salt, 31 bushels; Sea coal, 29 bushels; Tobacco, 6 hhds.; Pig and Bar iron, Potashes, Sugar, Logwood, Fustic, Nicaragua wood and Heavy Dye-woods, Rice, Honey, Copper ore, and all other heavy goods, 20 cwt.=1 ton; Coffee, cocoa, and dried codfish in bulk, 16 cwt.=1 ton; Dried Codfish, in casks of any size, 12 cwt.=1 ton; Oil, Wine, Brandy, or any kind of liquor, reckoning the full contents of the cask, wine measures 200 gals.=1 ton. Mahogany, Square timber, Oak Plank, Pine and other boards, Beavers, Furs, Peltry, Beeswax, Cotton, Wool, and ale of all kinds, 40 cubic ft.=1 ton. Flour, in bbls. of 196 lbs. each 8 bbls.= 1 ton; Beef, Tallow, Pickled fish, Pitch, Tar, and Turpentine, 6 bbls.=1 ton.

A CAR-LOAD.—As a general rule the following quantities constitute a car-load throughout Canada and the United States, viz.: 20,000 lbs. or 70 bbls. of salt, 70 of lime, 70 of flour, 60 of whiskey, 200 sacks of flour, 6 cords of hard wood, 7 of soft wood, 16 head of horses, 18 to 20 head of cattle, 50 to 60 head of hogs, 80 to 100 head of sheep, 9,000 feet of solid boards, 17,000 feet of siding, 13,000 feet of flooring, 40,000 shingles, one-half less of hard lumber, one-fourth less of green lumber, one-tenth less of joists, scantling and all other large timber, 340 bushels of wheat, 360 of corn, 680 of oats, 400 of barley, 360 of flax-seed, 360 of apples 430 of Irish potatoes, 356 of sweet potatoes, 1,000 bushels of bran.

EXCHANGE ON ENGLAND.

Exchange is the method of adjusting accounts or paying debts, when the debtor and creditor are distant from each other, by means of an order or draft called a *bill of exchange*, so as to avoid the transmission of either money or goods; for example, A of New York wishing to pay a debt to B, of London, pays an equivalent amount to C, of New York, who has a debtor, D, in London; and A receives from C an order, addressed to D, requesting him to pay the amount to B. This is sent in a letter to B, who presents it to D for acceptance or payment. Thus the debtor in one place is substituted for the debtor in another, and two accounts may be adjusted at the same time by the simple transmission of a letter. *Par of ex-*

change, is the equivalency of a certain amount of the currency of one country to the currency of another, the currencies of both being of the precise weight and purity fixed by their respective mints. Thus according to the mint regulations of England and France, £1 sterling is equal to 25 francs, 20 centimes, which is consequently said to be the *par* between London and Paris. Exchange is made to diverge from par, either by depreciation of the currency in either country below the mint standard, or by the difference in the amounts of indebtedness between one country and another, called the *balance of trade*, which effects the relative demand for bills of exchange. Thus in the following table, the present standard value of £1 stg. in the United States, being $4.84.4, when exchange is at 9 per cent., it is then at par; if higher than 9, it is above par, if less than 9, it is below, as shown by the table.

EXCHANGE TABLE.

5 per cent.	$4.66.7	7¾ per cent.	$4.78.9	10 per cent.	$4.88.9
5½ "	4.68.0	8 "	4.80.0	10¼ "	4.90.0
5¾ "	4.70.0	8¼ "	4.81.1	10½ "	4.91.1
6 "	4.71.1	8½ "	4.82.2	10¾ "	4.92.2
6¼ "	4.72.2	8¾ "	4.83.3	11 "	4.93.3
6½ "	4.73.3	9 "	4.84.4	11¼ "	4.94.4
6¾ "	4.74.4	9¼ "	4.85.6	11½ "	4.95.6
7 "	4.75.6	9½ "	4.86.7	11¾ "	4.96.7
7¼ "	4.76.7	9¾ "	4.87.8	12 "	4.97.8
7½ "	4.77.8				

THE FOLLOWING TABLE EXHIBITS THE LEGAL EQUIVALENTS OF BRITISH MONEY IN AMERICAN DOLLARS AND CENTS.

S.	$ c. m.	S.	$ c. m.	£	$ c.	£	$ c.	£	$ c.	£	$ c.	£	$ c.
1	24.2	11	2.66.2	1	4 84	11	53 24	21	101 64	31	150 04	41	198 44
2	48.4	12	2.90.4	2	9 68	12	58 08	22	106 48	32	154 88	42	203 28
3	72.6	13	3.14.6	3	14 52	13	62 92	23	111 32	33	159 72	43	208 12
4	96.8	14	3.38.8	4	19 36	14	67 76	24	116 16	34	164 56	44	212 96
5	1.21.0	15	3.63.0	5	24 20	15	72 60	25	121 00	35	169 40	45	217 80
6	1.45.2	16	3.87.2	6	29 04	16	77 44	26	125 84	36	174 24	50	242 00
7	1.69.4	17	4.11.4	7	33 88	17	82 28	27	130 68	37	179 08	60	290 40
8	1.93.6	18	4.35.6	8	38 72	18	87 12	28	135 52	38	183 92	70	338 80
9	2.17.8	19	4.59.8	9	43 56	19	91 96	29	140 36	39	188 76	80	387 20
10	2.42.0	20	4.84.0	10	48 40	20	96 80	30	145 20	40	193 60	90	436 00

FLAVORING EXTRACTS, VANILLA, GINGER, &C.—Vanilla beans, 4 ozs.; sugar, 2 ozs.; alcohol, 4 fluid ozs.; simple syrup, 4 ozs.; brandy, 1 pt. Cut the beans finely, and rub thoroughly with the sugar, put all into a strong stone bottle, secure the cork with twine, and boil in a water bath for ½ hour, then transfer to a filter and allow it to percolate through, then add brandy sufficient to make 4 pts. Other extracts, as ginger, &c., can be made in a similar manner, by using the respective ingredients.

Essential oils of aniseed, lavender, peppermint, cloves, cinnamon, &c., are obtained by submitting parts of the plants, previously ground to a coarse powder, to distillation with water, when the oils are carried over in a minute state of division with the aqueous vapor. The essential oils enclosed in the skins of lemons, oranges, bergamots, &c., are obtained by pressing the rinds of these fruits.

TO PRESERVE APPLES.—Pack in boxes or barrels elevated from the cellar floor, with a layer of dry sawdust at the bottom of each box or barrel, then a layer of apples placed out of contact with each other, then a layer of sawdust, and so on till all are full. Sound apples packed in this way will keep fresh a long time.

WEIGHTS, IN POUNDS, OF VARIOUS ARTICLES, AS RATED BY RAILWAY COMPANIES, WHEN THEIR WEIGHTS CANNOT OTHERWISE BE ASCERTAINED.

		POUNDS.
Ashes, pot or pearl	Barrel	450
Apples, and barrelled fruits	Barrel	200
Apples	Bushel	50
Barley	Bushel	45
Beef, pork, bacon	Per hhd	1,000
Butter, tallow, lard	Per bbl	333
Salt fish and meat	Per firkin	100
Bran, feed, shipstuffs, oats	Bushel	35
Buckwheat	Bushel	48
Bricks, common	Each	5
Bark	Cord	2,000
Charcoal	Bushel	22
Coke, and cake meal	Bushel	40
Clover seed	Bushel	62
Eggs	Barrel	200
Fish and salt meat	Per firkin	100
Flour and meal	Per bushel, 56 lbs, Barrel	216
Grain and seeds, not stated	Bushel	60
Hides (green)	Each	85
Hides (dry), salted or Spanish	Each	33
Ice, coal, lime	Bushel	80
Liquors, malt and distilled	Barrel	350
Liquors	Per gallon	10
Lumber—pine, poplar, hemlock	Ft. b. m	4
Lumber—oak, walnut, cherry, ash	Ft. b. m	5
Nails and spikes	Keg	106
Onions, wheat, potatoes	Bushel	60
Oysters	Per bushel, 100 lbs., per 1,000	350
Plastering lath	Per 1,000	600
Resin, tar, turpentine	Barrel	300
Sand, gravel, etc	Per cubic ft	150
Shingles	Per M., short, 900 lbs., Long	1,400
Salt	Per bushel	70
Stone, undressed	Perch	4,000
Stone, dressed	Cubic ft	180
Timothy and light grass seed	Bushel	40
Wood—hickory	Cord	4,500
Wood—oak	Cord	3,500

1 ton (2240 lbs.) cured hay is 425 cubic ft.; 1 ton of hay in mow, 414.37 lbs., or a cube of 7½ ft. Hay, as usually delivered, weighs 5 lbs. per cubic ft.; do., well pressed, 8 lbs. Straw, loose, weighs 3½ lbs. per cubic ft.; do., well pressed, 5¾ lbs. U. S. gallon of water weighs 8.33 lbs.; do., of molasses, 11⅔; do., of turpentine, 7.31; do., of alcohol, 6.96.

BELFAST GINGER ALE.—Double refined sugar, powdered, 1 lb.; bicarbonate of soda, 3½ ozs.; citric acid, 4½ ozs.; concentrated ess. of ginger, 1½ ozs.; ess. of cayenne, 2 drs.; ess. of lemon, 40 drops. The soda, acid and sugar must be carefully dried separately at a temperature not exceeding 120°; and the sugar before drying must be thoroughly incorporated with the essences, to which a small quantity of caramel, as color, may be added. The whole forms a powder, a dessertspoonful of which will make a tumblerful of the drink.

UNFERMENTED WINE.—To make this, boil grapes of any kind over a slow fire till the pulp has thoroughly separated from the skin, adding just enough water to prevent burning at the bottom of the vessel, then press the juice through a fine cloth and add ¼ its weight of sugar, mix well, bring the juice to the boiling point once more, and can it in air-tight jars. This wine will keep sweet for years, and has the color of port.

To IMPROVE SPOILED BUTTER.—The cut represents an excellent arrangement for the restoration of bad butter by means of the well-known absorbent and deodorizing qualities of charcoal. The tainted butter is removed from the firkin or other vessel by removing the staves and hoops surrounding it. It is then placed in a clean bag and buried in granulated charcoal in a suitable barrel or box. In a short time, the offensive odor and bad smell will disappear, and a fine, fresh, marketable appearance will be imparted to the butter by the conserving operation of the charcoal.

Another way, melt the butter in twice its weight of boiling water, shake well and pour the melted butter into cold water to regain a proper consistence. Or, wash in good new milk, in which the butyric acid, which causes the rancidity, is freely soluble. Wash afterwards in cold spring water. Another good way is to wash the butter in strong lime water, previously permitting the lime ample time to settle, and using the clear portion.

To CAN FRUIT.—The following instructions for boiling and canning fruit will prove useful to many. The first number after the name of the fruit has reference to the number of minutes required for boiling, and the second to the ounces of sugar required to each quart. Currants, 6, 8; cherries, 5, 6; crab-apples, 25, 8; blackberries, 6, 6; gooseberries, 8, 8; grapes, 10, 8; plums, 10, 8; peaches (whole), 15, 4; peaches (halves), 8, 4; pears (whole), 30, 8; quinces (sliced), 15, 10; tomatoes, 30, (no sugar); beans and peas, 3 to 4 hours, no sugar.

To Can Green Corn.—Dissolve 2½ ozs. tartaric acid in 1 pt. water, and use 1 teaspoonful to every pint of corn while the corn is at boiling heat. When opened for use, add one teaspoonful of soda to every 3 cans of corn.

PERCENTAGE OF ALCOHOL IN 100 PARTS OF THE FOLLOWING LIQUORS.—*Prof. Brande.*

Scotch Whiskey	54.53	Currant Wine	20.50
Irish do	53.9	Port	22.90
Rum	53.68	Maderia	22.27
Gin	51.6	Teneriffe	19.79
Brandy	53.39	Sherry	19.17
Burgundy	14.57	Claret	15.1
Cape Muscat	18.25	Elder	8.79
Champagne (still)	13.80	Ale	6.87
Do. (sparkling)	12.61	Porter	4.2
Cider	5.2 to 9.8	Malaga	17.26
Constantia	19.75	Rhenish	12.8
Gooseberry Wine	11.48	Small Beer	1.28

RAPID PROCESS OF MARKING GOODS AT ANY DESIRED PER CENT. PROFIT.—Retail merchants, in buying goods by wholesale, buy a great many articles by the dozen, such as boots and shoes, hats and caps, and notions of various kinds ; now, the merchant, in buying, for instance, a dozen hats, knows exactly what one of these hats will retail for in the market where he deals ; and, unless he is a good accountant, it will often take him some time to determine whether he can afford to purchase the dozen hats and make a living profit by selling them by the single hat ; and in buying his goods by auction, as the merchant often does, he has not time to make the calculation before the goods are bid off. He therefore loses the chance of making good bargains by being afraid to bid at random, or if he bids, and the goods are cried off, he may have made a poor bargain, by bidding thus at a venture. It then becomes a useful and practical problem to determine *instantly* what per cent. he would gain if he retailed the hat at a certain price, to tell what an article should retail for to make a profit of 20 per cent.

RULE.—*Divide what the articles cost per dozen by* 10, *which is done by removing the decimal point one place to the left.*

For instance, if hats cost $17.50 per dozen, remove the decimal point one place to the left, making $1.75, what they should be sold for apiece to gain 20 per cent on the cost. If they cost $31.00 per dozen, they should be sold at $3.10 apiece, etc. We take 20 per cent. as the basis for the following reasons, viz : because we can determine instantly, by simply removing the decimal point, without changing a figure, and, if the goods would not bring at least 20 per cent. profit in the home market, the merchant could not afford to purchase, and would look for cheaper goods.

The reason for the above rule is obvious, for if we divide the cost of a dozen by 12, we have the cost of a single article ; then if we wish to make 20 per cent. on the cost (cost being 1-1 or 5-5), we add the per cent., which is 1-5, to the 5-5, making 6-5 or 12-10 ; then as we multiply the cost, divided by 12, by the 12-10 to find at what price one must be sold to gain 20 per cent., it is evident that the 12s will cancel and leave the cost of a dozen to be divided by 10, to do this remove the decimal point one place to the left.

EXAMPLE 1.—If I buy 2 dozen caps at $7.50 per dozen, what shall I retail them at to make 20 per cent. ? Ans. 75 cents.

EXAMPLE 2.—When a merchant retails a vest at $4.50 and makes 20 per cent. what did he pay per doz. ? Ans. $45.

EXAMPLE 3.—At what price should I retail a pair of boots that cost $85.00 per doz. to make 20 per cent ? Ans. $8.50.

Now, as removing the decimal point one place to the left, on the cost of a dozen articles, gives the selling price of a single one with 20 per cent. added to the cost, and, as the cost of any article is 100 per cent., it is obvious that the selling price would be 20 per cent. more, or 120 per cent. ; hence, to find 50 per. cent. profit which would make the selling price 150 per cent., we would first find 120 per cent. then add 30 per cent. by increasing it one-fourth itself ; for 35 per cent., increase it one-eight itself, etc. Hence to mark an article at any per cent. profit we find the following:

—GENERAL RULE.—*First find 20 per cent. profit by removing the decimal point one place to the left on the price the articles cost per doz.; then, as 20 per cent profit is 120 per cent. add to or subtract from this* *amount the fractional part that the required per cent. added to* 100 *is more or less than* 120.

Merchants, in marking goods, generally take a per cent. that is an aliquot part of 100, as 25, 33 1-3, 50, &c. The reason they do this is because it makes it much easier to add such a per cent. to the cost; for instance, a merchant could mark almost a dozen articles at 50 per cent. profit in the time it would take him to mark one at 49 per cent. The following is arranged for the convenience of business men in marking the prices of all articles bought by the dozen.

To make	20	per cent.	remove	the	point one place to the left.			
"	80	"	"	"	"	and add	½	itself.
"	60	"	"	"	"	"	1-3	"
"	50	"	"	"	"	"	1-4	"
"	44	"	"	"	"	"	1-5	"
"	40	"	"	"	"	"	1-6	"
"	37	"	"	"	"	"	1-7	"
"	35	"	"	"	"	"	1-8	"
"	33 1-3	"	"	"	"	"	1-9	"
"	32	"	"	"	"	"	1-10	"
"	30	"	"	"	"	"	1-12	"
"	28	"	"	"	"	"	1-15	"
"	26	"	"	"	"	"	1-20	"
"	25	"	"	"	"	"	1-24	"
"	12½	"	"	"	"	subtract	1-16	"
"	16 2-3	"	"	"	"	"	1-36	"
"	18¾	"	"	"	"	"	1-96	"

If I buy a doz. shirts for $28.00, what shall I retail them for to make 50 per cent.? Ans. $3.50

EXPLANATION.—Remove the point one place to the left, and add ¼ itself.

ALIQUOT PARTS OF 100 AND 1000.—Merchants in selling goods generally make the price of an article some aliquot part of 100, as in selling sugar at 12½ cents per lb., or 8 lbs. for $1.00, or in selling calico for 16 2-3 cents per yard, or 6 yds. for $1.00, etc. The following table will be found valuble for all such calculations.

12½ is 1-8 part of 100.	8⅓ is 1-12 part of 100.
25 is 1-4 part of 100.	16 2-3 is 2-12 or 1-6 of 100
37½ is 3-8 part of 100.	33 1-3 is 4-12 or 1-3 of 100.
50 is 4-8 or ½ of 100.	66 2-3 is 8-12 or 2-3 of 100
62½ 5-8 part of 100.	83 1-3 is 10-12 or 5-6 of 100
75 is 6-8 or 3-4 part of 100.	125 is 1-8 part of 1000.
87½ is 7-8 part of 100.	250 is 2-8 or ¼ of 1000.
6¼ is 1-16 part of 100.	375 is 3-8 part of 1000.
18¾ is 3-16 part of 100.	625 is 5-8 part of 1000.
31¼ is 5-16 part of 100.	875 is 7-8 part of 1000.

To multiply by an aliquot part of 100.

RULE.—Add two cyphers to the multiplicand, then take such part of it as the multiplier is part of 100.

N. B. If the multiplicand is a mixed number reduce the fraction to a decimal of two places before dividing.

N. B. For the sake of uniformity, it has been thought best to classify the Coal, Interest and Ready Reckoner Tables at the end of the *Engineers' Department.*

TEAS.—The names of the different kinds of tea relate to the time of their being gathered, or to some peculiarity in their manufacture. It is a general rule, that all tea is fine in proportion to the tenderness and immaturity of the leaves. The quality and value of the different kinds diminish as they are gathered later in the season.

BLACK TEAS.—As soon as the leaf-bud begins to expand, it is gathered to make *Pekoe.* A few days' later growth produces black-leaved Pekoe. The next picking is called *Souchong* ; as the leaves grow larger and more mature, they form *Congou* ; and the last picking is *Bohea. Bohea* is called by the Chinese, *Ta-cha* (large tea), on account of the maturity and size of the leaves ; it contains a larger proportion of woody fibre than other teas, and its infusion is of a darker color and coarser flavor. *Congou*, the next higher kind, is named from a corruption of the Chinese *Koong-foa* (great care, or assiduity). This forms the bulk of the black tea imported, and is mostly valued for its strength.

Souchong—Seaoa-choong (small scarce sort), is the finest of the strongest black tea, with a leaf that is generally entire and curly. It is much esteemed for its fragrance and fine flavor. *Pekoe* is a corruption of the Canton name, *Pak-ho* (white down), being the first sprouts of the leaf-buds ; they are covered with a white silky down. It is a delicate tea, rather deficient in strength, and is principally used for flavoring other teas.

GREEN TEAS.—The following are the principal kinds. *Twankay, Hyson-Skin, Hyson, Gunpowder,* and *Young Hyson.*

Young Hyson is a delicate young leaf, called in the original language *Yu-tsien* (before the rains), because gathered in the early spring. *Hyson*, from the Chinese word *He-tchune*, which means, flourishing spring. This fine tea is gathered early in the season, and prepared with great care and labor. Each leaf is picked separately, and nipped off above the footstalks ; and every separate leaf is rolled in the hand. It is much esteemed for its flavor. *Gunpowder Tea* is only Hyson rolled and rounded to give it the *granular* appearance whence it derives its name. The Chinese call it *Choo-cha* (peal tea). *Hyson-Skin* is so named from the Chinese term, in which connection *skin* means the refuse, or inferior portion. In preparing Hyson, all leaves that are of a coarse yellow, or imperfectly twisted appearance, are separated, and sold as *skin-tea*, at an inferior price.

Twankay is the last picking of green tea, and the leaf is not rolled or twisted as much as the dearer descriptions. There is altogether less trouble bestowed on the preparation.

COFFEES.—JAVA COFFEE.—Use of the imported article, 20 lbs. ; dried dandelion root, 7 lbs. ; chiccory, 13 lbs. Roast and grind well together.

FOR WEST INDIA, use rye roasted with a little butter, and ground very fine.

FOR TURKEY COFFEE, use rice or wheat roasted with a little butter, 7 lbs. ; chiccory, 3 lbs. ; grind.

ESSENCE OF COFFEE is made by boiling down molasses till hard ; grind to a powder ; add ½ lb. of good Java coffee to every 4 lbs. of the mixture. Put up for sale in round tin cans or air-tight paper packages.

COFFEE FOR POUND PACKAGES.—Best Java coffee, 1 lb. ; rye, 3 lbs.; carefully clean the rye from all bad grains, wash to remove dust, drain off the water, and put the grain into your roaster, carefully stirring to brown it evenly. Brown the rye and coffee separately, grind and put up in tight packages to preserve the aroma.

To Flavor Tobacco.—This is done by means of a mixture of 1 part each of lemon peel, orange peel, figs, coriander seed and sassafras; ½ part each of elderflowers, elderberries, and cinnamon; 2 parts of saltpetre, 3 of salt, and 4 of sugar. This mixture must be digested in 50 parts of water, and, before applying it flavored with an alcoholic solution of gum benzion, mastic, and myrrh. It is said that this decoction gives a flavor to common leaves resembling Porto Rico, but to this end the leaves must be well dried, about a year old, well permeated with the preparation, kept in a pile for 8 days, turned daily, and finally dried.

Flavor for Cigar Makers.—Take 2 ozs. tonqua beans and 1 oz. cinnamon; bruise and pulverize them to a powder, and put them into 1 pint of Santa Cruz rum; let it stand for a few days to macerate; stir all together, and with this liquid sprinkle your common or inferior tobacco. Dry out of the sun, and the flavor will be unequalled.

Tabac Perfumee aux Fleurs is made by putting orange flowers, jasmines, tube roses, musk roses, or common roses, to snuff in a close chest or jar, sifting them out after 24 hours, and repeating if necessary.

Maccaboy Snuff is imitated by moistening the tobacco with a mixture of treacle and water, and allowing it to ferment.

Spanish Snuff is made, from unsifted Havana snuff, reduced by adding ground *Spanish nutshells*, sprinkling the mixture with treacle water, and allowing it to sweat for some days before packing.

Yellow Snuff is prepared from ordinary *pale snuff*, moistened with a mixture of *yellow ochre* diffused in *water*, to which a few spoonfuls of thin mucilage has been added.

Perfumes for Snuff.—Tonqua beans, essence of ditto, ambergris musk civet, leaves of orchis fusca, and essence of orris root, essence or oils of bergamot, cedar, cloves, lavender, petit grain, neroli and roses, as well as several others, either alone or compounded.

Unerring Tests for good Flour.—Good flour is white, with a yellowish or straw-colored tint. Squeeze some of the flour in your hand; if good, it will retain the shape given by pressure. Knead a little between your fingers; if it works soft and sticky, it is poor. Throw a little against a dry perpendicular surface; if it fall like powder, it is bad.

To Correct Musty Flour.—Carbonate of magnesia, 3 lbs.; flour, 765 lbs.; mix. This improves bad flour, causing it to become more wholesome, producing lighter and better bread than when alum is used, and absorbs and dissipates the musty smell.

Ærated Bread.—1 lb. flour, 100 grs. carb. of soda; 60 grs. common salt; 1 teaspoon powdered sugar; 120 grs. muriatic acid, more or less, according to its strength; 1 wine pt. of water, inferior flour will require less. Well mix the flour, soda, salt, and sugar in an earthen vessel, then add the acid mixed with the water, stir with a wooden spoon. Bake in one loaf about 1 hour. Bake in tin or iron pans, but avoid the use of metallic vessels or spoons while mixing.

PATENT SELF-RAISING FLOUR.—Kiln-dried flour, 1 cwt.; tartaric acid, 10½ oz.; mix thoroughly. After 2 or 3 days, add, of bicarb. soda, 12 oz.; lump sugar ½ lb.; common salt, 1½ lb. Mix, and pass through the "dressing machine." Have all the articles perfectly dry, and separately reduced to fine powder before adding to the flour. Mix with cold water, and bake at once. It produces light and porous bread.

TO CURE BUTTER.—Take 2 parts of fine salt; 1 part loaf sugar; 1 part saltpetre; mix completely. Use 1 oz. of this mixture to each pound of butter; work well. Bury your butter firkins in the earth in your cellar bottom, tops nearly level with the ground, or store away in a very cool place, covering the butter with a clean cloth and a strong brine on the top, and it will keep two years if desired.

TO KEEP BUTTER DURING HOT WEATHER.—A simple mode of keeping butter in warm weather is to invert a large crock of earthen, or a flower pot if need be, (varying with the size of the vessel containing the butter,) over the dish or firkin in which the butter is held. The porousness of the earthenware will keep the butter cool, and all the more so if the pot be wrapped in a wet cloth, with a little water in the dish with the butter. Not the porosity of the earthenware, but the rapid absorption of heat by external evaporation causes the butter to become hard.

TO RESTORE RANCID BUTTER.—Use 1 pt. water to each lb. of butter, previously adding 20 grs. chloride of lime to each pt. of water; wash well the butter in this mixture, afterward re-wash in cold water and salt; or melt the butter in a water bath with animal charcoal, coarsely powdered and previously well sifted to free it from dust; skim, remove, and strain through flannel; then salt.

TOMATO CATSUP.—Boil 1 bushel of tomatoes till they are soft; squeeze them through a fine wire sieve; add 1½ pts. salt, 2 oz. cayenne pepper, and 5 heads of onions, skinned and separated; mix together, and boil till reduced one half; then bottle.

THE NORTHERN-LIGHT BURNING FLUID.—Get good deodorized benzine, 60 to 65 gravity, and to each brl. of 42 gals. add 2 lbs. pulverized alum, 3½ oz. gum camphor, and 3½ oz. oil of sassafras, or 2 oz. oil bergamot; stir up and mix thoroughly together, and it will soon be ready for use. N. B.—As this fluid creates a much larger volume of light and flame than carbon oil, it is necessary to use either a high burner, such as the sun burner, to elevate the flame away from the lamp, in order to keep it cool, or instead thereof, to use a burner provided with a tube for the escape of the gas generated from the fluid, such, for instance, as the Meriden burner.

TEST FOR BURNING OIL.—Heat water in a pot on the fire to 120° Fahr. Take a tin and put in it a tablespoonful of the oil you wish to test, place the tin containing the oil in the hot water, let it cool down to 112° Fahr.; when at this point, approach a light very cautiously towards the oil, and if it takes fire before the light touches it you will be safe in rejecting it.

PRESERVED OR SOLIDIFIED MILK.—1. Fresh-skimmed milk, 1 gal.; sesquicarbonate of soda (in powder), 1½ dr. Mix; evaporate to ⅓ part by heat of steam or waterbath, with constant agitation; then add of powdered sugar 6½ lbs. and complete the evaporation at a reduced temperature. Reduce the dry mass to powder, add the *cream* well drained, which was taken from the milk. After thorough admixture, put the whole into well stopped bottles or tins, and hermetically seal. 2. Carbonate of soda, ½ dr.; water, 1 fluid oz.; dissolve; add of fresh milk, one qt.; sugar, 1 lb.; reduce by heat to the consistency of a syrup, and finish the evaporation on plates by exposure, in an oven. *Observe*—About 1 oz. of the powder agitated with 1 pt. of water forms a good substitute for milk.

SEALING-WAX, Red.—Shellac (very pale), 4 oz.; cautiously melt in a bright copper pan over a clear charcoal fire; when fused, add Venice turpentine, 1¼ oz. Mix, and further add vermilion, 3 oz.; remove the pan from the fire, and pour into a mould. For a *black* color, use ivory black, or lampblack, instead of the vermilion; for a *blue* color, use Prussian blue, instead of the vermilion, same quantity. Each color must be well mixed with the composition; of the lampblack, use only sufficient to color.

HORTICULTURAL INK.—Copper, 1 part; dissolve in nitric acid, 10 parts, and add water, 10 parts; used to write on zinc, or tin labels.

BOTTLE WAX—BLACK.—Black resin, 6½ lbs.; beeswax, ½ lb.; finely powdered ivory black, 1½ lbs. Melt together. RED, as the last, but substitute Venetian red, or red lead, for the ivory black.

GOLD-COLORED SEALING-WAX.—Bleached shellac, 3 lbs.; Venice turpentine 1 lb.; Dutch leaf ground fine, 1 lb., or less. The leaf should be ground, or powdered sufficiently fine, without being reduced to dust. Mix with a gentle heat, and pour into moulds.

LITHOGRAPHIC INK.—Venice turpentine 1 part, lampblack 2 parts, hard tallow soap 6 parts, mastic in tears, 8 parts, shellac 12 parts, wax 16 parts; melt, stir, and pour it out on a slab.

INKS.—1. *Fine Black writing Ink.*—To 2 gals. of a strong decoction of logwood, well strained, add 1½ lbs. blue galls in coarse powder, 6 ozs. sulphate of iron, 1 oz. acetate of copper, 6 ozs. of well ground sugar, and 8 oz. gum arabic. Set the above on the fire until it begins to boil; strain, and then set it away until it has acquired the desired black. 2. *Green Ink.* Cream of tartar 1 part, verdigris 2 parts, water 8 parts. Boil till reduced to the proper color. 3. *Blue Ink.* Take sulphate of indigo, dilute it with water till it produces the required color. 4. *Violet Ink.* Is made by dissolving some violet aniline in water to which some alcohol has been added: it takes very little aniline to make a large quantity of the ink. 5. *Gold Ink.* Mosaic gold, two parts, gum arabic, one part, rubbed up to a proper condition. 6. *Silver Ink.* Triturate in a mortar equal parts of silver foil and sulphate of potassa, until reduced to a fine powder, then wash the salt out, and mix the residue with a mucilage of equal parts of gum arabic water. 7. *Fullam's Recipe for Indelible Stencil-plate Ink.* 1 lb. precipitate carbonate of iron; 1 lb. sulphate of iron; 1¼ lbs. acetic acid. Stir over a fire until they combine; then add 3 lbs. printer's varnish and 2 lbs. fine book ink, and stir until well mixed. Add 1 lb. of Ethiop's mineral. 8 *Exchequer Ink.* Bruised galls, 40 lbs.; gum, 10 lbs.; green sulphate of iron, 9 lbs.; soft water, 45 gals. Macerate for 3 weeks with frequent agitation and strain. This ink will endure for ages. 9. *Asiatic Ink.* Bruised galls, 14 lbs.; gum, 5 lbs. Put them in a small cask, and add of boiling soft water, 15 gals. Allow the whole to macerate, with frequent agitation, for two weeks, then further add green copperas, 5 lbs., dissolved in 7 pts. water. Again mix well, and agitate the whole daily for two or three weeks 10. *Extra good Black Ink.* Bruised galls, 2 lbs., logwood chips, green copperas and gum, of each, 1 lb.; water, 7 gals. Boil 2 hours and strain. Product. 5 gals. 11. *Brown Ink.* A strong decoction of catechu. The shade may be varied by the cautious addition of a little weak solution of bichromate of potash. 12. *Indelible Ink.* Nitrate of silver, ¼ oz.; water, ¾ oz. Dissolve, add as much of the strongest liquor of *ammonia* as will dissolve the precipitate formed on its first addition; then add of mucilage 1½ dr., and a little sap green, syrup of buckthorn, or finely powdered indigo, to color. Turns black on being held near the fire, or touched with a hot iron. 13. *Indelible Ink for Glass or Metal.* Borax, 1 oz; shellac, 2 oz.; water, 18 *fluid* oz.; boil in a covered vessel, add of thick mucilage, 1 oz.; triturate it with levigated indigo and lampblack q. s., to give it a good color. After 2 hours' repose, decant from the dregs and bottle for use. It may be bronzed after being applied. Resists moisture, chlorine, and acids. 14. *Common Ink.* To 1 gal. boiling soft water, add ¾ oz. extract logwood; boil two minutes; remove from the fire, and stir in 48 grains bichromate of potash, and 8 grains prussiate of potash; for 10 gals. use 6½ oz. logwood extract; 1 oz. bichromate of potash, and 80 grains prussiate of potash; strain. 15. *Black Copying Ink, or Writing fluid* Take 2 gals. rain water and put into it gum arabic, ¼ lb.; brown sugar, ¼ lb.; clean copperas, ¼ lb.; powdered nutgalls, ¾ lb.; mix, and shake occasionally for ten days and strain; if needed sooner, let it stand in an iron kettle until the strength is obtained. This ink will stand the action of the atmosphere for centuries, if required. 16. *Red Ink.* In an ounce phial put 1 teaspoonful of aqua-ammonia; gum arabic size of two or three peas; and 6 grains of No. 40 carmine; fill up with soft water, and it is soon ready for use.

LIQUID BLACKING.—Ivory black, 2 lbs.; molasses, 2 lbs.; sweet oil, 1 lb.; rub together till well mixed; then add oil vitrol, ¾ lb.; add coarse sugar, ½ lb.; and dilute with beer bottoms; this cannot be excelled.

TICKETING INK FOR GROCERS, &c.—Dissolve 1 oz. of gum arabic in 6 oz. water, and strain; this is the mucilage; for *black color*, use drop black, powdered, and ground with the mucilage to extreme fineness; for *blue*, ultra-marine is used in the same manner; for *green*, emerald green; for *white*, flake white; for *red*, vermilion, lake, or carmine; for *yellow*, chrome yellow. When ground too thick they are thinned with a little water. Apply to the cards with a small brush. The cards may be sized with a thin glue, and afterwards varnished, if it is desired to preserve them.

BLUING FOR CLOTHES.—Take 1 oz. of soft Prussian blue, powder it, and put in a bottle with 1 quart of clear rain water, and add ½ oz. of pulverized oxalic acid. A tablespoonful is sufficient for a large washing

PREMIUM METHOD OF KEEPING HAMS, &c.—To 4 gals. water, add 8 lbs. coarse salt; ¼ oz. potash; 2 oz. saltpetre; 2 lbs. brown sugar. Boil together, skim when cold, put on the above quantity to 100 lbs. meat; hams to remain in eight weeks, beef, three weeks. Let the hams dry several days before smoking. Meat of all kinds, salmon and other fish, lobsters, &c., may be preserved for years by a light application of pyroligneous acid applied with a brush, sealing up in cans as usual. It imparts a splendid flavor to the meat, is very cheap, and an effectual preservative against loss.

To preserve Meats, Salmon, Lobsters, &c., hermetically sealed.--The meat to be preserved is first parboiled or somewhat more and freed from bones. It is then put into tin cases or canisters, which are quite filled up with a rich gravy. A tin cover, with a small aperture, is then carefully fixed on by solder; and, while the vessel is perfectly full, it is placed in boiling water, and undergoes the remainder of the cooking. The small hole in the cover is completely closed up by soldering while the whole is yet hot. The canister, with its ingredients, is now allowed to cool, in consequence of which these contract, and the sides of the vessel are slightly forced inward by atmospheric pressure, and become a little concave. The vessel being thus hermetically sealed, and all access of the air prevented, it may be sent into any climate without fear of putrefaction; and the most delicate food of one country may be used in another in all its original perfection, months and years after its preparation. Lobsters should be boiled longer than meats, and the scales removed previous to putting into the canisters. Salmon put up by this process is most delicious. By the French process the meat is boiled till it is three-quarters done, when two-thirds of it are taken out, the remaining one-third is boiled into a concentrated soup, and the meat previously taken out is put into the canisters, which are then filled up with the soup; the tin cover with aperture is soldered on, and the canister with its contents submitted to farther boiling in hot water, when the aperture is closed, as above stated, and the canisters laid away in store.

To preserve Fruits without Sugar.—Fill some stone wide-mouthed bottles with the fruit carefully picked, and set them in a copper or large kettle; then fill the kettle with cold water nearly up to the mouths of the bottles. Corks should be prepared to fit the bottles, and a cloth should be put under the bottoms of the bottles to prevent their cracking with the heat. Light the fire under the kettle, and heat the water to 160° or 170°. This heat should be continued for half an hour, when the fruit will be sufficiently scalded; after that, fill up the bottles with boiling water to within an inch of the cork, and cork them tightly. Lay the bottles on their sides; change the position of the bottles once or twice a week during the first two months, turning them round to prevent any fermentation that might take place. Fruits could also be kept by the process mentioned above for meats, remembering that they are to be scalded only, not boiled, as in the case with meats.

Another Method.—After paring and coring, put among them sufficient sugar to make them palatable for present eating, about 3 or 4 lbs. only to each bushel; let them stand awhile to dissolve the sugar, not using any water; then heat to a boil, and continue the boiling with care for 20 to 30 minutes, or sufficiently long to heat them through, which expels the air. Have ready a kettle of hot water, into which dip the can or bottle long enough to heat it; then fill in the fruit while hot, corking it immediately, dipping the end of the cork into the bottle-wax preparation described elsewhere.

Worcestershire Sauce.—White vinegar 15 gals.; walnut catsup

10 gals.; Maderia wine 5 gals.; mushroom catsup 10 gals.; table salt 25 lbs.; Canton soy, 4 gals.; powdered capsicum 2 lbs.; powdered allspice 1 lb.; powdered coriander, seeds 1 lb.; cloves, mace, and cinnamon, of each, ½ lb.; asafœtida ¼ lb.; dissolved in brandy 1 gal. Boil 20 lbs. hogs livers in 10 gals. of water for 12 hours, renewing the water from time to time. Take out the liver, chop it, mix with water, work through a sieve, and mix with the sauce.

GHERKINS.—Take small cucumbers (not young), steep for a week in *very strong* brine; it is then poured off, heated to the boiling point, and again poured on the fruit. The next day the gherkins are drained on a sieve, wiped dry, put into bottles or jars, with some spice, ginger, pepper, or cayenne, and at once covered with strong pickling vinegar.

MIXED PICKLES from cauliflowers, white cabbage, French beans, onions, cucumbers, &c., are treated as *gherkins*, with raw ginger, capsicum, mustard-seed and long pepper, added to each bottle. A little bruised turmeric improves both the color and flavor.

INDIAN PICKLE.—*Piccalilli.*—Take one hard white cabbage (sliced), 2 cauliflowers, pulled to pieces, 20 French beans, 1 stick of horse-radish, sliced fine, 2 doz. small white onions, and 1 doz. gherkins. Cover these with boiling brine; next day, drain the whole on a sieve, put it into a jar, add of curry powder, or turmeric, 2 oz.; garlic, ginger, and mustard-seed, of each 1 oz.; capsicum ½ oz. Fill up the vessel with hot pickling vinegar; bung it up close, and let it stand for a month, with occasional agitation.

TO PRESERVE FRUIT JUICE WITHOUT HEAT.—Ingredients: 10 lbs. of fresh-gathered, picked, red-ripe currants, or other fruit, 2 qts. cold water, 5 oz. tartaric acid, 6 lbs. of coarse sifted sugar. Put the fruit into a large earthen pan, pour the water with the tartaric acid dissolved in it over the fruit, cover the pan with some kind of lid, and allow the whole to steep for 24 hours in a *cold* place, and it would be all the better if the pan containing the fruit could be immersed in rough ice. Next, pour the steeped fruit into a suspended stout flannel bag, and when all the juice has run through, tie up the open end of the bag, and place it on a large earthen dish, with another dish upon it; place a half-hundred weight upon this, to press out all the remaining juice, and then mix it with the other juice. You now put the sifted sugar into the juice, and stir both together occasionally, until the sugar is dissolved, and then bottle up the syrup, cork, and tie down the bottles with wire, and keep them in the ice well or in a cold cellar, in a reclining position.

TO RESTORE INJURED MEAT.—When the brine sours and taints the meat, pour it off; boil it, skim it well, then pour it back again on the meat boiling hot; this will restore it, even when much injured. If tainted meat is injured, dip it in the solution of chloride of lime prescribed for rancid butter; it will restore it. Fly-blown meat can be completely restored by immersing it for a few hours in a vessel containing a small quantity of beer; but it will taint and impart a putrid smell to the liquor. Fresh meat, hams, fish, &c., can be preserved for an indefinite length of time without salt, by a light application of pyroligneous acid applied with a brush; it imparts a fine smoky flavor to the meat, and is an effectual preservative. But pure acetic acid may be used instead.

FRESH MEAT—TO KEEP A WEEK OR TWO IN SUMMER.—Farmers or others living at a distance from butchers can keep fresh meat very nicely for a week or two, by putting it into sour milk, or butter milk, placing it in a cool cellar. The bone or fat need not be removed. Rinse well when used.

MILKMAN'S PROCESS.—To give a body to diluted milk use the following nutritive and healthy compound at the rate of 8 oz. to every 5 gals., stirring it up in the milk, till all is dissolved: arrowroot, 6 oz.; magnesia, 6 oz.; starch, 1 lb.; flour, ½ lb.; white sugar in powder, 1 lb.; mix all intimately together, and keep in a dry place for use.

CUSTARD POWDERS.—Sago meal and flour, 1 lb. each; color with turmeric to a cream color. Flavor with essential oil of almonds, 1 dr.; ess. of lemon, 2 drs. Use with sweetened milk to form extemporaneous custards.

CURRY POWDER.—Turmeric, and coriander seeds, of each, 4 oz.; black pepper, 2½ oz.; ginger 14 drs.; cinnamon, mace, and cloves, each, ½ oz.; cardamon seeds, 1 oz.; cummin seeds, 2 drs.; cayenne pepper, 1 oz.; powder and mix.

NAPOLEON'S CAMP SAUCE.—Old strong beer, 2 qts., white wine, 1 qt., anchovies, 4 ounces; mix; boil for ten minutes; remove it from the fire, and add peeled shallots, 3 ounces; macerate for 14 days, and bottle.

PICKLED ONIONS.—Choose small round onions, remove the skins, steep them in strong brine for a week in a stone vessel, pour it off, and heat till it boils; then pour on the onions, boiling hot; after 24 hours, drain on a seive, then put them in bottles, fill up over them with strong spiced vinegar, boiling hot, cork down immediately, and wax over the cork. In a similar manner are pickled mushrooms, cauliflowers, samphires, peas, beans, green gooseberries, walnuts, red cabbages (without salt, with cold vinegar). Observe that the soft and more delicate do not require so much soaking in brine as the harder and coarser kinds, and may be often kept by simply pouring very strong pickling vinegar on them without the application of heat. *For peaches*, select ripe but not soft ones; rub with a dry cloth; put four cloves, free from their heads, in each large peach, and two in small ones; to 1 gallon vinegar, put 6 lbs. brown sugar; put the peaches in a jar and put the vinegar (diluted with water, if too strong), and sugar in a preserving kettle over the fire; boil and skim it; pour it boiling hot over the peaches, covering them closely; repeat the operation three times; then seal them tightly in cans or bottles.

FRENCH PATENT MUSTARD.—Flour of mustard, 8 lbs.; wheat flour, 8 lbs.; bay salt, 2 lbs.; cayenne pepper, 4 oz.; vinegar to mix.

COMMON MUSTARD.—Flour of mustard 28 lbs.; wheat flour, 28 lbs., cayenne pepper, 12 oz., or as required; common salt 10 lbs.; rape oil 3 lbs.; turmeric to color; mix well, and pass through a fine seive.

STARCH POLISH.—White wax, 1 oz.; spermaceti, 2 oz.; melt them together with a gentle heat. When you have prepared a sufficient amount of starch, in the usual way, for a dozen pieces, put into it a piece of the polish about the size of a large pea; more or less, according to large or small washings. Or thick gum solution (made by pouring boiling water upon gum arabic), one tablespoon to a pint of starch, gives clothes a beautiful gloss.

FIRE KINDLERS.—To make very nice fire kindlers, take resin, any quantity, and melt it, putting in for each pound being used, from 2 to 3 oz. of tallow, and when all is hot, stir in pine sawdust to make very thick; and, while yet hot, spread it out about 1 inch thick, upon boards which have fine sawdust sprinkled upon them, to prevent it from sticking. When cold, break up into lumps about 1 inch square. But if for sale, take a thin board and press upon it, while yet warm, to lay it off into inch squares; this makes it break regularly, if you press the crease sufficiently deep, greasing the marked board to prevent it from sticking.

TO KEEP CIDER SWEET, AND SWEETEN SOUR CIDER.—To keep cider perfect, take a keg and bore holes in the bottom of it; spread a piece of woollen cloth at the bottom; then fill with clean sand closely packed; draw your cider from a barrel just as fast as it will run through the sand; after this, put in clean barrels which have had a piece of cotton or linen cloth 2 by 7 inches dipped in melted sulphur and burned inside of them, thereby absorbing the sulphur fumes (this process will also sweeten sour cider); then keep it in a cellar or room where there is no fire, and add ½ lb. white mustard seed to each barrel. If cider is long made, or souring when you get it, about 1 qt. of hickory ashes (or a little more of other hard wood ashes) stirred into each barrel will sweeten and clarify it nearly equal to rectifying it as above; but if it is not rectified, it must be racked off to get clear of the pomace, as with this in it, it will sour. Oil or whisky barrels are best to put cider in, or ½ pint sweet oil to a barrel, or a gallon of whisky to a barrel, or both, may be added with decidedly good effects; isinglass, 4 oz. to each barrel, helps to clarify and settle cider that is not to be rectified.

GINGER WINE.—Water, 10 gals., lump sugar, 20 lbs., bruised ginger, 8 oz.; 3 or 4 eggs. Boil well and skim; then pour hot on six or seven lemons cut in slices, macerate for 2 hours; then rack and ferment; next add spirit 2 qts., and afterwards finings, 1 pint; rummage well. To make the color, boil ½ oz. saleratus and ½ oz. alum in 1 pint of water till you get a bright red color.

ICE CREAM.—Have rich, sweet cream, and a half-pound of loaf sugar to each quart of cream or milk. If you cannot get cream, the best imitation is to boil a soft custard, 6 eggs to each quart of milk (eggs well beat). Or another is made as follows: boil 1 quart of milk, and stir into it, while boiling, 1 tablespoonful of arrowroot wet with cold milk; when cool stir into it the yolk of 1 egg to give it a rich color. Five minutes' boiling is enough for either plan. Put the sugar in after they cool; keep the same proportions for any amount desired. Or thus: to 6 quarts of milk add ½ lb. Oswego starch, first dissolved; put the starch in 1 quart of the milk; then mix altogether, and simmer a little (not boil); sweeten and flavor to your taste; excellent. The juice of strawberries or raspberries gives a beautiful color and flavor to ice creams, or about ½ oz. essence or extract to 1 gallon, or to suit the taste. Have your ice well broken, 1 qt. salt to a bucket of ice. About one hour's constant stirring, with occasional scraping down and beating together, will freeze it.

CHICAGO ICE CREAM.—Irish moss soaked in warm water one hour, and rinsed well to cleanse it of sand and a certain foreign taste; then steep it in milk, keeping it just at the point of boiling or simmering for one hour, or until a rich yellow color is given to the milk ; without cream or eggs, from 1 to 1½ oz. to a gal. only is necessary, and this will do to steep twice. Sweeten and flavor like other creams.

SUBSTITUTE FOR CREAM.—Take 2 or 3 whole eggs, beat them well up in a basin ; then pour boiling hot tea over them ; pour gradually to prevent curdling. It is difficult for the taste to distinguish it from rich cream.

GINGER BEER.—Take 5½ gals. water, ¾ lb. ginger root bruised, tartaric acid, ½ oz., white sugar, 2½ lbs., whites of 3 eggs well beaten, 10 small teaspoonfuls of lemon ess. ; yeast, 1 gill ; boil the root for 30 minutes in 1 gal. of the water; strain off, and put the ess. in while hot; mix, make over night; in the morning, skim and bottle, keeping out the sediments.

PHILADELPHIA BEER.—Take 30 gals. water, brown sugar, 20 lbs ginger root bruised, ¼ lb., cream of tartar, 1¼ lbs., carbonate of soda, 3 oz., oil of lemon, cut in a little alcohol, 1 teaspoonful, the white of 10 eggs well beaten, hops, 2 oz., yeast, 1 qt. The ginger root and hops should be boiled for twenty or thirty minutes in enough of the water to make all milk-warm; then strained into the rest and the yeast added and allowed to work itself clear; then bottle.

CIDER WITHOUT APPLES.—Water, 1 gallon; common sugar, 1 lb.; tartaric acid, ½ oz.; yeast, 1 tablespoonful; shake well, make in the evening, and it will be fit to use next day.

FOR BOTTLING.—Put in a barrel, 5 gals. hot water; 30 lbs. common sugar; ¾ lb. tartaric acid; 25 gallons cold water; 3 pints of hop or brewers' yeast, worked into paste with 1 pint of water and 1 lb. flour. Let it work in the barrel forty-eight hours, the yeast running out of the bunghole all the time, putting in a little sweetened water occasionally to keep it full; then bottle, putting in two or three broken raisins to each bottle; and it will nearly equal champagne.

CHEAP CIDER.—Put in a cask 5 gals. hot water; 15 lbs. brown sugar; 1 gal. molasses; ½ gal. hop or brewers' yeast; good vinegar, 6 qts.; stir well, add 25 gals. cold water, ferment as the last.

ANOTHER CIDER.—Cold water, 20 gals., brown sugar, 15 lbs., tartaric acid, ½ lb.; rummage well together, and add, if you have them, 3 or 4 lbs. of dried sour apples, or boil them and pour in the expressed juice. This cider will keep longer than the others.

SPRUCE AND GINGER BEER.—Cold water, 10 gals.; boiling water, 11 gals.; mix in a barrel; add molasses, 30 lbs., or brown sugar, 24 lbs.; oil of spruce or any oil of which you wish the flavor, 1 oz.; add 1 pint yeast, ferment, bottle in two or three days. If you wish white spruce beer, use lump sugar; for ginger flavor, use 17 oz. ginger root bruised, and a few hops; boil for thirty minutes in three gals. of the water, strain and mix well; let it stand two hours and bottle, using yeast, of course, as before.

HOP BEER, VERY FINE.—Mix 14 lbs.of molasses and 11 gals. water well together, and boil them for 2 hours with 6 oz. hops. When quite cool, add a cupful of yeast, and stir it well by a gallon or two at a time. Let it ferment for 16 hours, in a tub covered with a sack, then put it in a 9-gallon cask, and keep it filled up; bung it down in 2 days, and in 7 days it will be fit to drink, and will be stronger than London porter

EDINBURGH ALE.—Employ the best pale malt—1st, mash 2 barrels pr. quarter, at 183°, mash three-quarters of an hour, let it stand 1 hour, and allow half an hour to run off the wort; 2d, mash 1 barrel per quarter. 180°, mash three-fourths of an hour, let it stand about three-fourths, and tap as before; 3d, mash 1 barrel per quarter, at 170°, mash half an hour, let it stand half an hour, and tap as before. The first and second wort may be mixed together, boiling them about an hour or an hour. and a quarter, with a quantity of hops proportioned to the time the ale is required to be kept. The first two may be mixed at the heat of 60°, in the glyetun, and the second should be fermented separately for small beer. The best hops should be used in the proportion of about 4 lbs. for every quarter of malt employed.

BOTTLING PORTER.—BROWN STOUT. Pale malt, 2 quarters; amber and brown malt, of each 1½ do.; mash at 3 times, with 12, 7, and 6 barrels of water; boil with hops, 50 lbs; set with yeast, 29 lbs. Product, 17 barrels, or 1½ times the malt.

LEMON BEER.—To make 20 gals, boil 6 oz. of ginger root bruised, ¼ lb. cream of tartar, for 20 or 30 minutes, in 2 or 3 gals. water; this will be strained in 13 lbs. coffee sugar, on which you have put ½ oz. oil of lemon, and six good lemons squeezed up together, having warm water enough to make the whole 20 gals. just so hot that you can hold your hand in it without burning, or about 70 degrees of heat; put in 1½ pints of hop or brewers' yeast, worked into paste with 5 or 6 oz. flour. Let it work over night, then strain and bottle for use.

TABLE BEER.—Malt, 8 bushels; hops, 7 lbs; molasses, 25 lbs.; brew for 10 barrels; smaller quantity in proportion.

HOP BEER.—Hops, 6 ounces; molasses, 5 quarts; boil the hops till the strength is out, strain them into a 30-gallon barrel; add the molasses and one teacupful of yeast, and fill up with water; shake it well, and leave the bung out till fermented, which will be in about 24 hours. Bung up, and it will be fit for use in about three days.

MOLASSES BEER.—Hops, 1 oz.; water, 1 gal.; boil for ten minutes, strain, add molasses, 1 lb.; and when luke-warm, yeast, 1 spoonful. Ferment.

ROOT BEER.—Water 10 gals, heat to 60° Fah. then add 3 gals. molasses; let it stand 2 hours, pour it into a bowl and add powdered or bruised sassafras and wintergreen bark of each ½ lb.; yeast 1 pt.; bruised sarsaparilla root, ½ lb.; add water enough to make 25 gals. in all. Ferment for 12 hours, then bottle.

OTTAWA BEER AND GINGER ALE.—Ottawa beer is made by using 8 ozs. of a fluid extract which contains the concentrated strength of 4 lbs. of 13 different roots and barks, added to 1 gal. syrup which is mixed with 14 gals. water, into which carbonic acid gas is forced at a pressure of 80 lbs. to the square inch. *Ginger Ale* is made in the same way except that 4 ozs. of extract is sufficient. When the ginger is really used, an extract deprived of resinous impurities is made use of, which gives a clear amber colored drink.

CHEAP BEER.—Water, 15 gals.; boil half the water with ¾ lb. hops; then add to the other half in the tun, and mix well with 1 gal. molasses and a little yeast.

TO RESTORE SOUR BEER.—Good hops, ¼ lb., powdered chalk, 2 lbs. Put in the hole of the cask, and bung close for a few days; for frosted beer, add some finings, a few handfuls of flour, and some scalded hops; for ropy beer, use a handful or two of flour, the same of hops, with a little powdered alum to each barrel. Rummage well.

To Improve the Flavor of Beer.—Bruised ginger, 1 oz.; bruised cloves, ½ oz.; a few scalded hops and a doz. broken coarse biscuits to every two barrels. Rummage well.

Lemonade.—White sugar, 1 lb., tartaric acid, ¼ ounce, essence of lemon, 30 drops, water 3 qts. Mix.

Cream Soda.—Loaf sugar, ten lbs., water, 3 gals.; warm gradually so as not to burn; good rich cream, 2 quarts; extract vanilla, 1½ ounces; extract nutmeg, ½ ounce; tartaric acid, 4 ounces. Just bring to a boiling heat; for if you cook it any length of time, it will crystallize; use 4 or 5 spoonfuls of this syrup instead of three, as in other syrups; put ½ teaspoonful of soda to a glass, if used without a fountain. For charged fountains no acid is used.

Freezing Preparation.—Common sal-ammoniac, well pulverized, 1 part; saltpetre, 2 parts; mix well together. Then take common soda, well pulverized. To use take equal quantities of these preparations (which must be kept separate and well covered previous to using) and put them in the freezing pot; add of water a proper quantity, and put in the article to be frozen in a proper vessel; cover up, and your wants will soon be supplied. For freezing cream or wines this cannot be beat.

Sarsaparilla Mead.—1 lb. of Spanish Sarsaparilla, boil 5 hours and strain off 2 gals: add sugar 16 lbs. and tartaric acid 10 ozs., half a wine glass of syrup to half pint tumbler of water, and half teaspoonful of soda is a fair proportion for a drink.

Portable Lemonade.—Tartaric acid, 1 ounce, white sugar, 2 lbs., essence of lemon, quarter ounce; powder and keep dry for use. One dessert spoonful will make a glass of lemonade.

Imperial Cream Nectar.—Part 1st, take 1 gallon water, loaf sugar, 6 lbs., tartaric acid, 6 ounces, gum arabic, 1 ounce. Part 2d, flour, 4 teaspoonfuls, the whites of 5 eggs; beat finely together; then add ½ pint water; when the first part is blood warm, put in the second; boil 3 minutes, and it is done. Directions: 3 tablespoonfuls of syrup to two-thirds of a glass of water; add one-third teaspoonful of carbonate of soda, made fine; stir well, and drink at your leisure.

Peppermint Cordial.—Good whisky, 10 gals., water 10 gals., white sugar, 10 lbs., oil peppermint, 1 ounce, in 1 pint alcohol, 1 lb. flour well worked in the fluid, ½ lb. burned sugar to color. Mix, and let it stand one week before using. Other oil in place of peppermint, and you have any flavor desired.

Silver-top Drink.—Water, 3 qts., white sugar, 4 lbs., ess. of lemon, 4 teaspoonfuls, white of 5 eggs, beat with 1 tablespoonful of flour; boil to a syrup; then divide into equal parts, and to one add 3 ounces tartaric acid, to the other 4 ounces of carbonate of soda; put in a teaspoonful of each of the syrups, more or less (according to the size of the glass), to two-thirds of a glass of water; drink quick.

Sangaree.—Wine, ale, or porter, or two-thirds water, hot or cold, according to the season of the year, loaf sugar to taste, with nutmeg.

Soda Syrups.—Loaf or crushed sugar, 8 lbs., pure water, 1 gallon, gum arabic, 2 oz.; mix in a brass or copper kettle. Boil until the gum is dissolved, then skim and strain through white flannel, after which add tartaric acid, 5½ oz. ; dissolve in hot water ; to flavor, use extract of lemon, orange, vanilla, rose, sarsaparilla, strawberry, &c., &c., ½ oz. or to your taste. If you use juice of lemon, add 2½ lbs. of sugar to a pint, you do not need any tartaric acid with it ; now use two tablespoonfuls of syrup to ¾ of a tumbler of water, and ⅛ teaspoonful of super-carbonate of soda, made fine ; drink quick. For soda fountains, 1 oz. of super-carbonate of soda is used to 1 gallon of water. For charged fountains no acids are needed in the syrups.

STOUGHTON BITTERS.—Gentian, 4 ounces, orange peel, 4 ounces, Columbo, 4 ounces, camomile flowers, 4 ounces, quassia, 4 ounces, burned sugar, 1 lb., whiskey, 2½ galls. Mix and let it stand 1 week. Bottle the clear liquor.

COMMON SMALL BEER.—A handful of hops to a pail of water, a pint of bran, add half a pint of molasses. a cup of yeast, and a spoonful of ginger.

ROYAL POP.—Cream tartar, 1 lb., ginger, 1½ oz., white sugar, 7 lbs., essence of lemon, 1 drachm, water, 6 galls., yeast 1 pint. Tie the corks down.

RASPBERRY SYRUP WITHOUT RASPBERRIES.—First make a syrup with 36 lbs. of white sugar, and 10 gallons of water, and put it into a clean mixing barrel. Then dissolve ¼ lb. of tartaric acid in 1 qt. of *cold* water, and add to the syrup. Next take ½ lb. orris root and pour over it half a gallon of *boiling* water ; let it infuse until cold, then filter, and put it into the mixing barrel, stirring it well.

TO COLOR.—Boil ½ oz. of cochineal ; ¾ oz. cream tartar; ½ oz. saleratus ; and ½ oz. alum in 1 qt. of water until you get a bright red color, and add this to the syrup till the color suits. The above is a very valuable receipt, and will make 16 gals. syrup at a very low cost per gallon. If it is desirable to produce a richer syrup, add more sugar. Colors should be made in a brass or copper kettle.

BOTTLED SODA WATER WITHOUT A MACHINE.—In each gallon of water to be used, carefully dissolve ¾ lb. crushed sugar, and one ounce of super-carbonate of soda ; then fill pint bottles with this water, have your corks ready ; now drop into each bottle ½ dram of pulverized citric acid, and immediately cork, and tie down. Handle the bottles carefully, and keep cool until needed. More sugar may be added if desired.

OYSTER SOUP.—To each dozen or dish of oysters, put ½ pint of water ; milk, 1 gill ; butter ½ oz. ; powdered crackers to thicken ; bring the oysters and water to a boil, then add the other ingredients previously mixed together, and boil from three to five minutes only Season with pepper and salt to taste.

MOCK TERRAPIN.—*A supper dish.* Half a calf's liver ; seasoned, fry brown. Hash it, not very fine, dust thickly with flour, a teaspoonful mixed mustard, as much cayenne pepper as will lie on a half dime ; 2 hard eggs, chopped fine, a lump of butter as large as an egg, a teacup of water. Let it boil a minute or two ; cold veal will do, if liver is not liked.

BLACKBERRY WINE.—Wash the berries, and pour 1 qt. of boiling water to each gal. Let the mixture stand 24 hours, stirring occasionally ; then strain and measure into a keg, adding 2 lbs. sugar, and good rye whiskey 1 pint, or best alcohol, ½ pint to each gal. Cork tight, and put away for use. The best wine that can be made

MUTTON HARRICOT.—Take a loin of mutton, cut it into small chops, season it with ground pepper, allspice, and salt, let it stand a night, and then fry it. Have good gravy well seasoned with flour, butter, catsup and pepper, if necessary. Boil turnips and carrots, cut them small, and add to the mutton stewed in the gravy, with the yolks of hard boiled eggs, and forced meat balls.

IMITATION APPLE BUTTER.—Vinegar, 1 qt.; cheap molasses 1 qt.; mix together, set over the fire till it commences to cook; take it off, add 10 tablespoonfuls of wheat flour, and cold water to make a batter, then add 1 qt. scalding water, stir and cook for fifteen minutes.

LEMON SYRUP.—Havana sugar, 1 lb., boil in water down to a quart, drop in the white of 1 egg, and strain it. Add ¼ oz. tartaric acid; let it stand 2 days; shake often; 12 drops essence of lemon will much improve it.

SUPERIOR RAISIN WINE.—Take 30 lbs. of chopped raisins free from stems and dust; put them in a large keg, add to them 10 gals. soft water; let them stand two weeks unbunged, shaking occasionally (warm place in winter), then strain through woollen, or filter; color with burnt sugar; bottle and cork well for use. The more raisins the better the wine, not exceeding 5 lbs. to each gallon.

RAISIN WINE EQUAL TO SHERRY.—Boil the proper quantity of water and let it stand till cold. To each gal. of this add 4 lbs. of chopped raisins, previously well washed, and freed from stalks; let the whole stand for 1 month, stirring frequently; then remove the raisins, and bung up closely for 1 month more; then rack into another vessel, leaving all sediment behind, and repeat till it becomes fine: then to every 10 gals. add 6 lbs. of fine sugar, and 1 doz. of good oranges, the rinds being pared very thin, and infused in 2 qts. of brandy, which should be added to the liquor at its last racking. Let the whole stand three months in the cask, then bottle. It should remain bottled twelve months. To give it the flavor of Madeira, when it is in the cask, put in a couple of green citrons. and let them remain till the wine is bottled.

PORT WINE.—Worked cider, 42 gals.; good port wine, 12 gals; good brandy, 3 gals.; pure spirits, 6 gals; mix. Elderberries and aloes, and the fruit of the black haws. make a fine purple color for wines, or use burnt sugar.

AMERICAN CHAMPAGNE.—Good cider (crab-apple cider is the best), 7 gals.; best fourth-proof brandy, 1 qt.; genuine champagne wine, 5 pts.; milk, 1 gal.; bitartrate of potassa, 2 oz. Mix, let stand a short time; bottle while fermenting. An excellent imitation.

BRITISH CHAMPAGNE.—Loaf sugar, 56 lbs.; brown sugar (pale), 48 lbs.; water (warm), 45 gals.; white tartar, 4 oz.; mix, and at a proper temperature add yeast, 1 qt.; and afterwards sweet cider, 5 gals.; bruised wild cherries, 14 or 15 oz.; pale spirits 1 gal.; orris-powder, ½ oz. Bottle while fermenting.

BRITISH MADEIRA.—Pale malt, 1 bushel; boiling water, 12 gals.; mash and strain; then add white sugar, 4 lbs.; yeast 1 lb. Ferment, next add raisin or Cape wine, 3 qts.; brandy, 3 qts.; sherry, 2 qts.; port, 2 qts.; bung down. The malt may be mashed again for bottle beer

CURRANT AND OTHER FRUIT WINES.—To every gallon of expressed juice, add 2 gals. soft water, 6 lbs. brown sugar, cream tartar, 1½ oz.;

and qt. brandy to every 6 gals.; some prefer it without brandy. After fermentation, take 4 oz. isinglass dissolved in 1 pt. of the wine, and put to each barrel, which will fine and clear it: when it must be drawn into clean casks, or bottled, which is preferable.

BLACKBERRY AND STRAWBERRY WINES are made by taking the above wine when made with port wine, and for every 10 gals. from 4 to 6 qts. of the fresh fruit, bruised and strained, are added, and let stand four days till the flavor is extracted; when bottling, add 3 or four broken raisins to each bottle.

MORELLA WINE.—To each quart of the expressed juice of the morella, or tame cherries, add 3 qts. water and 4 lbs. of coarse brown sugar; let them ferment, and skim till worked clear; then draw off, avoiding the sediment at the bottom. Bung up, or bottle, which is best for all wines, letting the bottles lie always on the side, either for wines or beers.

LONDON SHERRY.—Chopped raisins, 400 lbs.; soft water, 100 gals.; sugar, 45 lbs.; white tartar, 1 lb.; cider, 16 gals. Let them stand together in a close vessel one month; stir frequently. Then add of spirits, 8 gals.; wild cherries bruised, 8 lbs. Let them stand one month longer, and fine with isinglass.

ENGLISH PATENT WINE FROM RHUBARB.—To each gal. of juice, add 1 gal. soft water, in which 7 lbs. brown sugar have been dissolved; fill a keg or barrel with this proportion, leaving the bung out, and keep it filled with sweetened water as it works off, until clear. Any other vegetable extract may be used if this is not liked; then bung down or bottle as you please. The stalks will yield ¾ their weight in juice; fine and settle with isinglass as above. This wine will not lead to intemperance.

VARIOUS WINES.—To 28 gals. clarified cider add good brandy 1 gal.; crude tartar (this is what is deposited by grape wines), milk to settle it, 1 pt.; draw off 36 hours after thoroughly mixing.

GINGER WINE.—Put one oz. of good ginger-root bruised in 1 qt. 95 per. cent. alcohol; let it stand nine days, and strain; add 4 qts. water, and 1 lb. white sugar dissolved in hot water, color with tincture of sanders to suit.

ANOTHER.—To 1 qt. 95 per cent. alcohol add 1 oz. best ginger-root (bruised but not ground), 5 grs. capsicum and 1 dr. tartaric-acid. Let it stand one week and filter; now add 1 gal. water in which 1 lb. of crushed sugar has been boiled. Mix when cold. To make the color, boil ½ oz. cochineal, ¾ oz. cream tartar, ½ oz. saleratus, and ½ oz. alum, in 1 pt. of water till you get a bright-red color.

TO RESTORE FLAT WINE.—Add 4 or 5 gals. of sugar, honey, or bruised raisins to every 100 gals., and bung close; a little spirits may be added, to roughen; take bruised aloes, or powdered catechu, and add to the wine in suitable proportions, or add a small quantity of bruised berries of the mountain ash, to allay inordinate flatness. Let it stand 2 hours and bottle, using yeast, of course, as before.

WHITE WINES are generally fined by isinglass in the proportion of 1½ oz. (dissolved in 1½ pts. of water, and thinned with some of the wine) to the hogshead. *Red Wines* are generally fined with the whites of eggs, in the proportion of 12 to 18 to each pipe; they must be well beaten, to a froth with about 1 pt. of water, and afterwards mixed with a little of the wine before adding them to the liquor. Rummage well

CHAMPAGNE CIDER.—Good pale cider, 1 hhd.; spirits, 3 gals.; sugar, 20 lbs.; mix, and let it stand one fortnight; then fine with skimmed milk, ½ gal.; this will be very pale, and a similar article, when properly bottled and labelled, opens so brisk, that even good judges have mistaken it for genuine champagne.

BERLIN CARRAWAY CORDIAL.—Take 8 gals. spirit, 50 per cent.; 1 oz. oil of carraway, which you dissolve in spirit 95 per cent.; 8 lbs. sugar; 8 lbs. water. Dissolve your sugar in the water; mix, stir and filter.

STOMACH BITTERS EQUAL TO HOSTETTERS'.—European gentian root, 1½ oz.; orange peel, 2½ oz.; cinnamon, ¼ oz.; anise seed, ½ oz.; coriander seed, ½ oz.; cardamon seed, ⅛ oz.; unground Peruvian bark, ½ oz.; gum kino, ¼ oz.; bruise all these articles, and put them into the best alcohol, 1 pt.; let it stand a week, and pour off the clear tincture; then boil the dregs a few minutes in 1 qt. of water, strain, and press out all the strength; now dissolve loaf sugar, 1 lb. in the hot liquid, adding 3 qts. cold water, and mix with the spirit tincture first poured off, or you can add these, and let it stand on the dregs if preferred.

BOKER'S BITTERS.—Rasped quassia, 1½ oz.; calamus, 1½ oz.; powdered catechu, 1½ oz.; cardamon, 1 oz.; dried orange peel, 2 oz.; macerate the above ten days in ½ gal. strong whiskey, and then filter, and add 2 gals. water; color with mallow or malva flowers.

CURACOA CORDIAL, 40 GALS.—Essence of bitter oranges, 2 oz.; ess. of neroli, 2 oz.; ess. of cinnamon, ¼ oz.; 3 drs. mace, infused in alcohol. Dissolve the above essence in 1 gal. alcohol, 95 per cent.; then put in a clean barrel 13 gals. alcohol, 85 per cent.; 26 gals. sugar syrup, 30 degrees Baumé; and add 1 gal. perfumed spirit as above. Color with saffron or turmeric.

CURACOA D'HOLLANDE, 20 Gals.—Curacoa orange-peel, 2 lbs; ½ lb. Ceylon cinnamon. Let them soak in water; boil them for five minutes with the juice of 32 oranges and 14 gals. of plain white syrup; then add 6 gals. alcohol, 95 per cent.; strain, filter; color dark yellow with sugar coloring.

ANISETTE CORDIAL, 40 GALS.—Put in a barrel 13 gals. alcohol, 75 per cent. Dissolve 3½ oz. essence of green anise-seed in 1 gal. 95 per cent. alcohol, and add ½ gal. orange-flower water; 8 or ten drops infusion of mace, and 5 drops essence of cinnamon. Then put in the barrel 26 gals. sugar syrup, 25 degrees Baumé; stir fifteen minutes, and let it rest four or five days; then filter. Add 2 or 3 sheets of filtering paper.

RATAFIA.—Ratafia may be made with the juice of any fruit. Take 3 gals. cherry juice, and 4 lbs. sugar, which you dissolve in the juice; steep in 2½ gals. brandy ten days; 2 drs. cinnamon, 24 cloves; 16 oz. peach-leaves; 8 oz. bruised cherry kernels. Filter, mix both liquids, and filter again.

ARRACK PUNCH SYRUP.—53½ lbs. sugar; 3½ gals. water. Boil up well; then add 1⅜ gals. lemon-juice to the boiling sugar, and stir till the liquid is clear; pour it in a clean tub, and when nearly cool, add 5 gals. Batavia arrack, then filter.

SYRUPS FOR SODA FOUNTAINS, &c.—1. *Simple syrup.* White sugar, 10 lbs; water, 1 gal; best isinglass, ¼ oz. Dissolve the isinglass in hot water, and add it to the hot syrup. The syrup is to be made with gentle heat and then strained. 2. *Lemon—a*—Grate off the yellow rind of lemons and beat it up with a sufficient quantity of granulated sugar. Express the lemon juice, add to each pt. of juice 1 pt. of water, and 3 lbs. of granulated sugar, including that rubbed with the rind; warm until the sugar is dissolved and strain. 3. *Lemon—b—* Simple syrup 1 gal., oil of lemon 25 drops, citric acid 10 drams. Rub the oil of lemon with the acid, add a small portion of syrup, and mix. 4. *Strawberry—a—*Strawberry juice 1 pt., simple syrup 3 pints, solution of citric acid 2 drams. 5. *Strawberry—b—*Fresh strawberries 5 qts. white sugar 12 lbs., water, 1 pt. Sprinkle some of the sugar over the fruit in layers, and allow the whole to stand for several hours; express the juice and strain, washing out the pulp with water; add the remainder of the sugar and water, bring the fluid to the point of boiling, and then strain. This will keep for a long time. 6. *Raspberry.* Raspberry juice 1 pt., simple syrup 3 pts., citric acid 2 drams. Raspberry syrup may also be made in a way similar to No. 5 for strawberry. 7. *Vanilla.*—Fluid extract of vanilla 1 oz., citric acid, ¾ oz., simple syrup 1 gal. Rub the acid with some of the syrup, add the extract of vanilla, and mix. 8. *Vanilla Cream.*—Fluid extract of vanilla 1 oz., simple syrup 3 pts., cream or condensed milk 1 pt.; may be colored with carmine. 9. *Cream.*—Fresh cream 1 pt., fresh milk 1 pt., powdered sugar 1 lb.; mix by shaking, and keep in a cool place. The addition of a few grains of bicarbonate of soda will for some time retard souring. 10. *Ginger.*—Tincture of ginger 2 fluid ozs. simple syrup 4 pts. 11. *Orange.*—Oil of orange 30 drops, tartaric acid 4 drams, simple syrup 1 gal. Rub the oil with the acid, and mix. 12. *Pineapple.*—Oil of pineapple 1 dram, tartaric acid 1 dram, simple syrup 6 pts. 13. *Orgeat.*—Cream syrup 1 pt., vanilla syrup 1 pt., oil of bitter almonds 4 drops. 14. *Nectar.*—Vanilla syrup 5 pts., pineapple syrup 1 pt., strawberry, raspberry or lemon 2 pts. 15. *Sherbet.*—Vanilla syrup 3 pts., pineapple 1 pt., lemon syrup 1 pt. 16. *Grape.*—Brandy ¾ of a pt., spirits of lemon ¾ oz., tincture of red sanders 2 ozs., simple syrup 1 gal. 17. *Banana.*—Oil of banana 2 drams, tartaric acid 1 dram, simple syrup 6 pts. 18. *Coffee.*—Coffee roasted ¾ lbs., boiling water 1 gal. Enough is filtered to make about ½ gal. of the infusion, to which add granulated sugar 7 lbs. 19. *Wild Cherry.*—Wild cherry bark coarse powder, 5 ozs. Moisten the bark with water, and let it stand for 24 hours in a close vessel. Then pack it firmly in a percolator, and pour water upon it until 1 pt. of fluid is obtained. To this add 28 ozs. of sugar. 20. *Wintergreen.*—Oil of wintergreen 25 drops, simple syrup 5 pts., and a sufficient quantity of burnt sugar to color. 21. *Sarsaparilla—a—*Oil wintergreen 10 drops, oil of anise 10 drops, oil of sassafras 10 drops, fluid extract of sarsaparilla 2 ozs. simple syrup 5 pts., powdered extract of licorice 1 oz. 22. *Sarsaparilla —b—*Simple syrup 4 pts., compound syrup of sarsaparilla 4 fluid ozs., caramel 1½ ozs., oil of wintergreen 6 drops, oil of sassafras 6 drops. 23. *Maple.*—Maple sugar 4 lbs., water 2 pts. 24. *Chocolate.*—Best chocolate 8 ozs., water 2 pts., white sugar 4 lbs. Mix the chocolate in water, and stir thoroughly over a slow fire. Strain, and add the sugar. 25. *Coffee Cream.*—Coffee syrup 2 pts., cream 1 pt. 26. *Ambrosia.*—Raspberry syrup 2 pts., vanilla 2 pts., hock wine 4 ozs. 27. *Hock and Claret.*—Hock or claret wine 1 pt., simple syrup 2 pts. 28. *Solferino.*—Brandy 1 pt., simple syrup 2 pts. 29. *Fruit Acid.*—(Used in some of the syrups). Citric acid 4 ozs., water, 8 ozs. Most of the syrups not made from fruits may have a little gum arabic added in order to produce a rich froth.

Butyric Ether is much used to impart a pine apple flavor to rum. Dissolved in 8 or 10 parts of alcohol, it forms the pine apple essence. From 20 to 25 drops of this essence, added to 1 lb. sugar, containing a little citric acid, imparts to the mixture a strong taste of pine apple.

Amylo-Acetic Ether is a preparation of fruit-oil and other ingredients, and when diluted with alcohol, it is sold as *essence of Jargonelle pear*, and is used for flavoring different liquors. Fifteen parts amylo-acetic ether, with half a part of acetic ether, dissolved in 100 parts of alcohol, form what may be called the *Bergamot-pear essence*, which, when employed to flavor sugar, acidulated with a little citric acid, imparts the odor of the Bergamot pear, and a fruity, refreshing taste.

Pelargonate or Ethylic Ether (pelargonic ether), has the agreeable odor of the quince, and, when dissolved in alcohol in due proportion, forms the *quince essence*.

Acetate of Amylic Ether (same as amylo ether), mixed with *butyric ether*, forms in alcoholic solution the *banana essence*.

Valerianate of Amylic Ether.—An alcoholic solution of this ether in the proportion of 1 part to 6 or 8 of alcohol, forms a flavoring liquid under the name of *apple essence*.

Milk Punch.—One tablespoonful of fine white sugar, 2 ditto of water, 1 wine glass of Cognac brandy, ½ ditto Santa Cruz rum, ⅛ tumblerful of shaved ice; fill with milk. Shake the ingredients well together, and grate a little nutmeg on top. To make it hot, use *hot* milk and no ice.

Glasgow Punch.—Melt lump-sugar in cold water, with the juice of a couple of lemons, passed through a fine wire strainer; this is sherbet, and most be well mingled. Then add old Jamaica rum, one part of rum to five of sherbet. Cut a couple of lemons in two, and run each section rapidly around the edge of the jug or bowl, gently squeezing in some of the delicate acid, when all is ready.

Mint Julep.—One tablespoonful of white pulverized sugar, 2½ ditto water; mix well with a spoon. Take 3 or 4 sprigs of fresh mint, press them well in the sugar and water, add 1½ wine glasses of Cognac brandy, and fill the glass with shaved ice, then draw out the sprigs of mint, and insert them in the ice with the stems downwards, so that the leaves will be above in the shape of a bouquet; arrange berries and small pieces of sliced orange on top in a tasty manner, dash with Jamaica rum, and sprinkle sugar on top. Sip with a glass tube or straw.

Cider Nectar.—One qt. cider, 1 bottle soda water, 1 glass sherry, 1 small glass brandy, juice of half a lemon, peel of ¼ of a lemon, sugar and nutmeg to taste. Flavor it with extract of pine apple, strain, and ice it all well.

Half and Half.—In London, this drink is made by mixing half porter and half ale; in America, it is made by mixing half new and half old ale.

Apple Toddy.—One tablespoonful of fine white sugar, 1 wine-glass of cider brandy, ½ of a baked apple. Fill the glass two-thirds full of boiling water, and grate a little nutmeg on top.

Apple Punch.—Lay in a china bowl slices of apples and lemons alternately, each layer being thickly strewed with powdered sugar. Pour over the fruit, when the bowl is half filled, a bottle of claret; cover, and let it stand for 6 hours. Then pour it through a muslin bag, and it is all ready.

OLD MAN'S MILK.—One wine-glass of port wine, 1 teaspoonful of sugar. Fill the tumbler one third full of hot milk.

PERFECT LOVE.—One tablespoonful sugar, 1 piece each of orange and lemon peel. Fill the tumbler one-third full of shaved ice, and fill balance with wine; ornament in a tasty manner with berries in season; sip through a straw.

MOLASSES CANDY.—West-Indian molasses, 1 gallon; brown sugar, 2 lbs.; boil the molasses and sugar in a preserving kettle over a slow fire; when done enough it will cease boiling; stir frequently, and when nearly done, stir in the juice of four lemons or two teaspoonfuls of essence of lemon · afterwards butter a pan, and pour out.

CONFECTIONERS' COLORS.—*Red*, cochineal, 1 oz.; boil 5 minutes in half pint water; then add cream tartar, 1 oz.; pounded alum, ½ oz.; boil 10 minutes longer, add sugar, 2 oz.; and bottle for use. *Blue*, put a little warm water on a plate, and rub in indigo till the required color is got. *Yellow*, rub with some water a little yellow gamboge on a plate, or infuse the heart of a yellow-lily flower with milk-warm water. *Green*, boil the leaves of spinach about 1 minute in a little water, and. when strained, bottle for use.

TO CANDY SUGAR.—Dissolve 2 parts of double refined sugar in 1 of water. Great care must be taken that the syrup does not boil over, and that the sugar is not burnt. The first degree is called the thread, which is subdivided into the little and great thread; if you dip your finger in the syrup, and apply it to the thumb, the tenacity of the syrup will, on separating the finger and thumb, afford a thread which shortly breaks, this is the little thread; if the thread admits of a greater extension of finger and thumb, it is called the great thread; by longer boiling you obtain the pearl, which admits of being drawn without breaking by the utmost extension of finger and thumb; this makes candied sugar: by further boiling you obtain the *blow*, which is known by dipping a skimmer with holes in the syrup, and blowing through them; if bubbles are perceived, you have got the blow. The *feather* implies more numerous bubbles, and then the sugar will fly off like flakes while the skimmer is being tossed. By boiling longer, you obtain the *crack;* it will crack when broken, and does not stick to the teeth; dip a teaspoon into the sugar, and let it drop to the bottom of a pan of cold water. If the sugar remains hard, it has attained the degree termed *crack*.

FIG CANDY,—Take 1 lb. of sugar and 1 pint of water; set over a slow fire. When done add a few drops of vinegar and a lump of butter, and pour into pans in which split figs are laid.

RAISIN CANDY can be made in the same manner, substituting stoned raisins for the figs. Common molasses candy is very nice with all kinds of nuts added.

SCOTCH BUTTER CANDY.—Take 1 lb. of sugar and 1 pint of water; dissolve and boil. When done, add one tablespoonful of butter, and enough lemon juice and oil of lemon to flavor.

COMMON LEMON CANDY.—Take 3 lbs. coarse brown sugar: add to it three teacupfuls of water, and set over a slow fire for half an hour; put to it a little gum arabic dissolved in hot water; this is to clear it. Continue to take off the scum as long as any rises. When perfectly clear, try it by dipping a pipe-stem first into it and then into cold water, or by taking a spoonful of it into a saucer; if done, it will snap like glass. Flavor with essence of lemon and cut it into sticks.

PEPPERMINT, ROSE, OR HOREHOUND CANDY.—They may be made as lemon candy. Flavor with essence of rose or peppermint or finely powdered horehound. Pour it out in a buttered paper, placed in a square tin pan.

POPPED CORN, dipped in boiling molasses, and stuck together, forms an excellent candy.

ROCK CANDY.—To make fine rock candy, clarify double refined white sugar, filter it, and boil it till it is ready to crystallize, or boiled to a blister. The boiling sugar must measure 35° on the syrup weight, a degree more or less prevents its crystallization. Then take a brass kettle, of about 16 or 18 inches diameter and from 6 to 8 inches deep, smooth and polished on the inside. Make 8 or 10 small holes at equal distances from each other in a circle around the sides of the kettle, about 2 inches from the bottom; pass threads through these from one side to the other, and stop the holes on the outside with paste or paper to prevent the syrup from running out. Having thus prepared the kettle, pour in the syrup, till it rises about an inch above the threads; then place it in a stove moderately heated, and leave it to crystallize, agitating it from time to time. The crystallization will take place in six or seven days. As soon as the crystals are formed, pour off the remaining syrup, and throw in a little water to wash the crystals that are left at the bottom of the vessel. So soon as the mass is thoroughly draiend set it in a very hot stove, leave it for two days, when it is fit for use. *Straw-colored* rock candy is made by substituting brown for loaf sugar. The syrup must be boiled over a very hot fire in order to render the candy perfectly white. The sides of the kettle should be sponged repeatedly during the boiling process, to prevent the sugar from adhering and burning.

ORANGE ROCK CANDY is made by flavoring the syrup with a couple of teaspoonfuls of orange flower water, and coloring with saffron, just as the syrup is about to be taken from the fire. *Rose Rock Candy* is flavored with rose water, and colored with clarified carmine lake. *Vanilla Rock Candy* is perfumed with vanilla, and colored with liquid violet. The degree of coloring may be tested by dropping a little of the colored syrup on a sheet of white paper.

GINGER CANDY.—Dissolve 1 lb. double-refined sugar in ½ pint of spring water; set it over a clear fire, and let it boil to a thin syrup. Have ready a teaspoonful of powdered ginger, mix it smoothly with 2 or 3 spoonfuls of the syrup, then stir it gradually into the whole. Boil the mixture into a *flake*, watching it carefully, that it may not exceed this point; then add the freshly grated rind of a large lemon, and stir the sugar constantly and rapidly until it fall in a mass from the spoon, without sinking when dropped upon a plate. If boiled for a moment beyond the point, it will fall into a powder. Should this happen by mistake, add a little water, and boil to the proper consistency. Dip the candy from the kettle, and drop it in small cakes upon buttered pans, then set it away to cool.

CREAM CANDY.—To 3 lbs. of loaf sugar add $\frac{1}{2}$ pt. water, and set it over a slow fire for half an hour; then add a teaspoonful of gum arabic dissolved, and a tablespoonful of vinegar. Boil it till it is brittle, then take it off, and flavor with vanilla, rose, or orange. Rub the hands with sweet butter, and pull the candy till it is white; then twist or break it, or stretch it out into thin white strips, and cut it off.

RED VERDUN SUGARED ALMONDS.—Dry the almonds in a stove by a slow fire. When dry enough to snap between the teeth, put them into a swinging basin and gum them by throwing over them a little gum arabic solution, cold; swing them constantly till dry; then give them another coating of gum arabic mixed with 4 oz. sugar, and swing them again till dry, using no fire. When they are thoroughly dry, set them over a moderate fire. Dissolve some sugar in orange or rose water, not too thin, set it over the fire 2 or 3 minutes, strain it through a sieve, and pour it over the almonds in the basin. Swing them till they are thoroughly coated and dried; then add another coating, composed of 2 parts of carmine, one part of gum, and one part of sugar, and proceed as before. If the almonds are not perfectly covered, give them a coating in which there is considerable gum; and when thoroughly moistened, throw on them some sifted sugar, stir till the mixture is all absorbed, then add successive coatings of sugar till they are large enough, and put them into the stove to remain till the next day, when in order to *whiten* them, you will proceed to boil 6 or 7 lbs. of fine clarified sugar to a blister, add 1 lb. of starch after taking it from the fire, stiring it constantly till a paste is formed a little thicker than that used for pastilles; a few drops of blue lake may be added to produce a pearl white. Put the almonds, warm, into the swinging basin, add enough of the prepared sugar to coat them, swing the basin till they are nearly dry, then set on the fire to finish the drying, then take the basin off the fire, heap them up in the middle, so as to allow the bottom of the vessel to cool; then add the coating of sugar, swing and dry them as before, and continue the process until 4 successive coatings of equal thickness have been given; then heat them well in the basin, put them into pans, and set them in the stove to remain over night. You will then proceed to *polish* them by giving them a coat of the prepared sugar and starch, and shake them violently until they are quite dry; give them another coating and proceed as before, and continue the process until they have received 4 successive coatings, when they will generally be found sufficiently polished. When the polishing is finished, put the almonds over a fire and stir gently till all are thoroughly heated, then place in a stove till the next day in a wicker basket lined with paper.

SPANISH SUGARED ALMONDS.—Make verdun sugared almonds about the size of pigeon's eggs, whiten and polish them by the previous directions, and paint different designs on them when completed.

SUPERFINE VANILLA SUGARED ALMONDS.—Proceed in the same manner as in the manufacture of verdun sugared almonds, make the solution of sugar in pure water; crush the essence of vanilla with a little sugar, and put in the solution.

COMMON SUGARED ALMONDS.—Common almonds, 20 lbs., sugar 8 lbs., farina, 20 lbs., starch, 2 lbs. Heat the almonds in the swinging basin, when they boil, make them into a pulp with diluted starch; give first a warm then a cold coating, cover them with farina, shaking the basin violently ; then, when the almonds have been coated to the requisite size, spread them out on sieves ; after a fortnight put them in a stove to finish drying : whiten them, and finish by the process described for the fine sugared almonds.

SUPERFINE CHOCOLATE SUGARED ALMONDS.—Caraccasa cacao nuts, shelled and roasted, 20 lbs., Martinique sugar, 16 lbs., vanilla 4 drs., starch 10 oz. The same method is required as for the superfine vanilla sugar plums, but care must be taken in adding the coatings of gum, to touch the cacao nuts lightly, as they are very easily broken.

SUPERFINE SUGARED FILBERTS.—Filberts, 50 lbs., sugar, 4 lbs., starch, 4 oz. Employ the same process as for sugared almonds and flavor to taste. Rose water is generally preferred on account of its color and fragrance.

CORIANDER SUGAR PLUMS.—Coriander, 2 lbs., farina, 30 lbs., sugar, 14 lbs. The washings of the basin are added to the coriander and farina without making a paste, and the method is followed that has been prescribed for the common sugared almonds ; 8 lbs. of sugar are used to whiten them, and 6 to polish them ; color after being polished with carmine, Prussian blue, and saffron.

CORIANDER IN BOTTLES.—Coriander, 10 lbs., farina, 10 lbs., sugar for the whitening, 3 lbs., starch, 1 lb. These are simply colored, and do not require brilliancy. They are made of the size of small peas, and are put into little bottles. In making these follow the receipt for common sugared almonds.

ANISE-SEED SUGAR PLUMS.—Dry 2 lbs. of green anise-seed in the stove ; rub it in the hands to break off the stems, winnow to rid of dust, then put it in a swinging basin, and coat it with sugar boiled to a thread, so as to render the candies hard and brittle. When coated sufficiently, whiten and polish them, like the verdun sugared almonds. They vary in size, being generally as large as a pea.

MINT SUGAR PLUMS.—Dry some peppermint seed in a stove and coat it in the same manner as anise seed (it must not, however, be whiter than rape seed), whiten and finish like anise seed. The first coating is sometimes composed of equal parts of peppermint and sugar.

COMMON TWIST CANDY.—Clarify 3 lbs. of common brown sugar, and boil it till it is brittle, take it from the fire, pour it in buttered pans ; rub the hands with a little butter, and as soon as it is cooled, pull it as you would molasses candy until it is perfectly white ; then twist and braid it, and cut it into sticks.

CARAMEL is made by boiling clarified sugar till it is very brittle, then pouring it on an oiled slab or sheet of tin, and, as soon as it is cool enough to receive an impression with the finger, stamping it in small squares, about an inch in size, with a caramel mould ; then turning over the mass, wiping the bottom to remove any oil that may have adhered from the slab, and putting it in a dry place to harden. If you have no caramel mould, you may score it on the slab with a common case knife, after which they are glazed with another coating with sugar. Keep them tightly closed from the air after they are made.

LEMON CARAMEL is made by grating the yellow rind of a lemon with a lump of sugar ; add to this a few drops of lemon juice with water enough to dissolve the sugar completely and stir the whole into the boiled syrup a few minutes before it is taken from the fire. *Orange* and *Lime* caramels are prepared in the same manner from these respective fruits. *Coffee caramel*, coffee, 2 oz., sugar 1 lb. Make an infusion of the coffee, using as little water as possible; strain it through a cloth, and stir it gradually into the boiled syrup a few minutes before taking it from the fire. *Chocolate caramel*, chocolate, 4 oz., sugar 1 lb. Dissolve the chocolate in as little water as possible, and add it to the boiled sugar, as in the coffee caramels. *Vanilla* and *Orange cream caramels* are made by using the respective essences of these fruits.

COCOA NUT CANDY.—Pare and cut cocoa-nut into slips, or grate on a coarse grater the white meat of cocoa-nuts until you have ½ a pound; dissolve ½ lb. of loaf sugar in 2 tablespoonfuls of water; put it over the fire, and, as soon as it boils, stir in the cocoa-nut. Continue to stir it until it is boiled to a flake, then pour it on a buttered pan or marble slab, and cut in whatever forms you wish, when it is nearly cold. Lemon or other flavors may be added.

CANDY DROPS OR PASTILLES.—Pound and sift double-refined sugar, first through a coarse, and then through a fine sieve. Put the sugar into an earthen vessel, and dilute it with the flavoring extract, mixed with a little water. If too liquid, the syrup will be too thin, and the drops will run together; while, if too thick, the syrup will be too compact, and cannot be poured out easily. When the sugar is mixed in a rather stiff paste, put it in a small saucepan with a spout and set it over the fire. As soon as it begins to bubble up the sides of the saucepan, stir it once in the middle, take it from the fire, and drop it in small lumps, of the size and shape required, upon sheets of tin, to stand for 2 hours, then put them in the stove to finish drying. As soon as they are perfectly hard and brilliant, take them from the fire, otherwise they will lose their aroma. Color the syrup just before taking it from the fire.

ORANGE, JASMINE, AND CLOVES DROPS are made by mixing the above paste with these respective extracts:

FOR SALAD DROPS.—Water distilled from lettuce is used.

SAFFRON DROPS.—Make an infusion of saffron, strain it, let it cool, use it to mix the paste, and proceed as before.

HELIOTROPE DROPS.—Proceed in the same manner, flavoring the paste with a few drops of oil of neroli, or oil of orange, jasmine and tube-rose, and color violet.

PINK DROPS.—Flavor the taste with tincture of red pinks, and color with carmine lake.

CINNAMON DROPS.—Mix 5 drs. powdered cinnamon and 8 oz. of sugar with mucilage enough to make it into a paste, and proceed as above.

CHEWING GUM.—Take of prepared balsam of tulu. 2 oz.; white sugar 1 oz., oatmeal 3 oz., soften the gum in water bath and mix in the ingredients; then roll in finely powdered sugar or flour to form sticks to suit.

MARSHMALLOW AND LICORICE drops are made the same way.

ROSE DROPS.—Mix the paste with rose water, and color with carmine lake. Proceed as above.

LEMON AND ORANGE DROPS.—Rasp off the yellow rind of an orange or lemon; mix the raspings with double-refined sugar; add 5 grs. of tartaric acid to every pound of sugar, color with yellow lake or saffron, and proceed as before. If too much tartaric acid is used, the candies will adhere to the sheets of tin.

VIOLET DROPS.—Flavor the paste with tincture of Florence iris, and color with blue and carmine lakes. A few drops of tartaric acid may be added to sustain the blue.

COFFEE DROPS.—Substitute a strong, filtered infusion of coffee for water, in mixing the paste.

CHOCOLATE DROPS.—For every pound of sugar, take 5 pts. good chocolate, pulverize it, and mix it into a paste, as already directed, taking care not to boil the paste too long, lest it granulate, and become unfit for use.

VANILLA DROPS.—Mix the paste with extract of vanilla, or finely-ground vanilla bean; to which add 2 oz. 3 grs. of tartaric acid, dissolved in water, to sustain the blue, without which it would disappear.

IMITATION CURRANT DROPS.—Mix the paste with water, adding a little essence of raspberry and of violet, or Florence iris, with a little tartaric acid dissolved in water; color with carmine, and proceed as above.

PEPPERMINT DROPS—Dissolve finely-powdered sugar with a little strong peppermint-water in a saucepan with a spout. As soon as it is thoroughly dissolved, add an equal quantity of coarse-grained sugar with a few drops more of the peppermint, stir the whole for a few moments, then drop the mixture on paper, and dry it in the open air. In the same way are made lemon, rose, vanilla, and other drops. Citric and tartaric acid may be used to increase the acidity of lemon drops.

EXTEMPORANEOUS PASTILLES.—Make the paste as usual, without flavoring the water, drop the pastilles upon paper, leave them for two hours, then take them off and put them into the stove to dry. When wanted for use, put the quantity required into a large-mouthed jar, and flavor as desired. For instance, to make 2 lbs. of peppermint drops, take 5 pts. of sulphuric ether in which are diluted a few drops of essence of peppermint, and pour it over the candies, then cover the jar, and shake it until they are thoroughly moistened ; then place them on a sieve, and set them in the stove for 5 minutes, evaporate the ether. In this manner rose, orange, lemon, jonquil, tube-rose, mignonette, clove, cinnamon, or any other drops may be made, dissolving their essential oils in sulphuric ether.

GINGER CANDY TABLETS.—Take 1 lb. loaf sugar, a few drops of acetic acid or the juice of half a lemon, a dessert-spoonful of essence of Jamaica ginger. Boil the sugar with just water enough to dissolve it to the ball degree, then add the acid and the essence, and rub the sugar with the back part of the bowl of a silver spoon up against the sides of the sugar-boiler to whiten or grain it sufficiently to give to the whole an opalized appearance; then pour it into very small-sized moulds, measuring half an inch or an inch oblong square, or else into a tin pan, the bottom part of which is marked out in small tablets, so that the candy may be easily broken into squares when dry. Smear the moulds slightly with oil of almonds. When the sugar is poured into the moulds, place in the screen for half an hour or more, to dry them hard.

ORANGE FLOWER CANDY TABLETS.—Ingredients : 1 lb. loaf sugar, a tablespoonful of orange-flower water, and a few drops of acetic acid. Proceed as directed in the preceding. No color.

VANILLA CANDY TABLETS.—Ingredients; 1 lb. loaf sugar, a few drops of essence of vanilla, sugar, and a few drops of acetic acid. Proceed as for ornaments in grained sugar.

PEPPERMINT CANDY TABLETS.—Ingredients: 1 lb. of loaf sugar, a few drops of essence of peppermint, and a few drops of acetic acid. Proceed as above. No color.

LIQUOR CANDY TABLETS.—Ingredients: 1 lb. of loaf sugar, and a gill of any kind of liquor. Boil the sugar to the crack, then incorporate the liquor, and finish as in the preceding. No color.

CINNAMON CANDY DROPS.—Use 1 lb. loaf sugar, and a few drops essence of cinnamon. Proceed as in the last. This may be colored rose pink, the color is to be added while the sugar is boiling.

CLOVE CANDY TABLETS are prepared in the same way as the foregoing, essence of cloves being used instead of cinnamon.

ROSE CANDY TABLETS.—Use 1 lb. loaf sugar, a few drops of essence of roses, a few drops of acetic acid, and a few drops of prepared cochineal. Proceed as in the preceding.

FRUIT CANDY TABLETS.—Use 1 lb. of loaf sugar, ½ pint of the juice of any kind of fruit, either currants, cherries, strawberries, raspberries &c., extracted by pressing with a spoon through a clean hair sieve. Boil the sugar to the crack, then incorporate the fruit juice by rubbing it with the sugar, as directed in the preceding, and finish the candies as therein indicated.

TO FREE MOLASSES FROM ITS SHARP TASTE, AND TO RENDER IT FIT TO BE USED INSTEAD OF SUGAR.—Take 24 lbs. molasses, 24 lbs. water, and 6 lbs. of charcoal, coarsely pulverized; mix them in a kettle, and boil the whole over a slow wood fire. When the mixture has boiled half an hour, pour it into a flat vessel, in order that the charcoal may subside to the bottom; then pour off the liquid, and place it over the fire once more, that the superfluous water may evaporate and the molasses be brought to its former consistence. 24 lbs. of molasses will produce 24 lbs. of syrup.

PEPPERMINT LOZENGES.—Ingredients: 1 oz. of picked gum tragacanth soaked with 5 oz. of tepid water in a gallipot (this takes some 6 hours), and afterwards squeezed and wrung through a cloth, about 1½ lbs. of fine icing sugar, and a teaspoonful of essence of peppermint. Work the prepared gum with the flattened fist on a very clean slab until it becomes perfectly white and elastic, then gradually work in the sugar, adding the peppermint when the paste has become a compact, smooth, elastic substance; a few drops of thick, wet, cobalt blue should also be added while working the paste, to give a brilliant whiteness. The paste thus prepared is to be rolled out with fine sugar dredged over the slab to the thickness of two penny pieces, then if you possess a ribbed rolling-pin, use to roll the paste again in cross directions, so as to imprint on its whole surface a small lozenge or diamond pattern. You now use your tin cutter to stamp out the lozenges; as you do so place them on sugar powdered baking sheets to dry in the screen.

GINGER LOZENGES.—Proceed as in the last; use a tablespoonful of essence of ginger, or 1 oz. of ground ginger to flavor, and a few drops of thick wet gamboge to color the paste. *Horehound Lozenges.* Ingredients: 1 oz. of gum dragon soaked in a gill of very strong extract of horehound, 1½ lbs of fine icing sugar. Proceed as for the peppermint lozenges. *Cinnamon Lozenges* are prepared in the same manner as ginger or peppermint, with this difference only; a dessert-spoonful of essence of cinnamon is to be used in the flavoring of them, a few drops of thick, ground, wet-burnt umber should be used with a pinch of carmine to give the paste the tinge of cinnamon color *Clove Lozenges.* The same as peppermint lozenges, using essence of cloves for flavoring, and burnt umber to color the paste. *Orange Lozenges.* Ingredients: 1 oz. prepared gum, 1½ lbs. sugar, 2 oz. of orange-sugar, the gum to be soaked in 2 oz. of orange flower water. Proceed as for peppermint lozenges. *Lemon Lozenges.* Ingredients: 1 oz. prepared gum, 1½ lbs. of icing sugar, 2 oz. of lemon sugar, and a few drops of acetic acid. *Colt's foot Lozenges.* Ingredients: 1 oz. of gum dragon soaked in 2 oz. of orange flower water, 1½ lb. of fine icing sugar, and ½ oz. of essence of colt's foot. Proceed as for peppermint lozenges. *Cayenne and Catechu Lozenges.* Ingredients: 1 oz. of gum dragon soaked in 2 oz. of water, 2 lbs. fine icing sugar, ½ oz. essence of cayenne, and ½ oz. of prepared catechu. Proceed as for peppermint lozenges.

GUM PASTILLES, OR JUJUBES.—Ingredients: 1 lb. of picked gum arabic, 14 oz. of the finest sugar pounded and sifted, ½ gill of double orange flower water, and 1 pt. tepid water to soak the gum in, which is afterwards to be strained off clean. Put the soaked and strained gum into a sugar boiler with the sugar, and use a clean spoon to stir it over a very moderate fire, while it boils and reduces to the small pearl degree; then add the orange flower water, stir all together on the fire, remove the preparation from the stove, skim off the froth, and use the mixture to cast the jujubes in levelled layers of starch powder contained in a flat box.

SPANISH LICORICE JUJUBES.—Ingredients: 1 lb. picked gum arabic, 14 oz. of sugar, and 2 oz. of Spanish licorice dissolved in a gill of hot water, and afterwards strained clean. First prepare the gum and boil it with sugar as directed in the preceding article, and when reduced by boiling to the small pearl degree, incorporate the prepared Spanish licorice with it, remove the scum from the surface, and finish the jujubes in the manner indicated above. *Raspberry Jujubes.* Ingredients: 1 lb. picked gum arabic soaked in 1 pint of hot water and afterwards strained, 14 oz. of sugar, 1 gill of filtered raspberry juice, and a few drops of cochineal. Proceed as directed in the foregoing case, adding the raspberry and coloring last. *Black Currant Jujubes.* Proceed in all respects as indicated for raspberry jujubes, omitting the cochineal, black currant juice being used. *Red Currant Jujubes.*—The same as black currant jujubes, red currant juice being used and a few drops of cochineal. *Ordinary Jujubes.* Ingredients : 1 lb. gum arabic soaked in 1 pt. of hot water and afterwards strained, 14 oz. sugar, ½ oz. essence of roses, and a few drops of prepared cochineal. Let the mixture be prepared as for other jujubes, but instead of casting them in impressions made in starch-powder, when the preparation is ready, pour it into a very clean smooth tinned baking sheet to the depth of a quarter of an inch, and set it to dry in the screen, or hot closet (moderate heat) ; when sufficiently dried, so that on pressing the surface it proves somewhat elastic to the touch, remove it from the heat, and allow it to become cold; the sheet of jujube may then be easily detached, and is to be cut up with scissors in the shape of diamonds.

STICK APPLE SUGAR. —Boil the sugar to caramel, flavor with apple juice together with tartaric or other acid, pour it on a marble slab, draw it into sticks, cut them of equal length, then roll them on a slab till they are perfectly cold; when finished, wrap them in tissue-paper and put them in fancy envelopes.

CURRANT AND RASPBERRY PASTE DROPS,—Ingredients: 1 lb. of pulp (the currants and raspberries in equal proportions boiled, and afterwards rubbed through a sieve), 1 lb. of sifted sugar. Stir both together in a copper sugar-boiler or preserving pan over a brisk fire, until the paste becomes sufficiently reduced to show the bottom of the preserving pan as you draw the spoon across it; then proceed to lay out the drops about the size of a florin, using a spouted sugar boiler for the purpose. The drops should then be placed in the screen to dry, at a low heat for an hour or so. When the drops are dry, use a thin knife to remove them from the tin sheet on which you laid them out, and put them away between sheets of paper in closed boxes, in a dry place. *Damson Paste Drops.*—Ingredients: 1 lb. of damson thick pulp, 1 lb. bruised sugar. Stir the pulp and sugar on the fire until reduced to a thick paste, then proceed to lay out the drops on square sheets of polished tin; dry them in the screen (moderate heat), and remove them in the manner aforesaid. These drops may be prepared with all kinds of plums and also with gooseberries. *Pear Paste Drops.*—Use 1 lb. pear pulp (made by peeling the pears, and boiling them to a pulp with ½ pt. of cider or perry, and rubbing this through a coarse sieve), 1 lb. of bruised sugar. Proceed as for damson paste. *Apple Paste Drops.*—Use 1 lb. of apple pulp (made by peeling, slicing and boiling the apples with ½ pt. cider), 1 lb. of bruised sugar. Proceed as in the foregoing cases, adding a few drops of cochineal to half of the paste for the sake of variety. *Pine Apple Paste Drops.*—Use 1 lb. of pine-apple pulp (made by first peeling, and then grating the pine-apple on a dish, using a clean coarse tin grater for the purpose), 1 lb. of bruised sugar. Proceed as in the former cases.

VASES, BASKETS, FIGURES, ANIMALS, &c., IN GRAINED SUGAR.—The sugar being boiled to the ball degree, add a few drops of acetic acid, and work the sugar with the back part of the bowl of a silver tablespoon up against the side of the sugar boiler, fetching up the whole in turns, so that every portion may acquire an opalized or whitish color. As soon as the sugar has been worked up to this state, which constitutes "graining," pour it immediately into the ready prepared mould; and when it has become perfectly set firm in the centre, you may turn the vase, basket, animal, or whatever the object may be, out of its mould, and place it in the screen or hot closet to dry, at a *very* moderate heat. Afterwards they may be painted in colors to imitate nature.

EVERTON TAFFY.—To make this favorite and wholesome candy, take 1½ pounds of moist sugar, 3 ounces, of butter, a teacup and a half of water, and one lemon. Boil the sugar, butter, water, and half the rind of the lemon together; and, when done,—which will be known by dropping into cold water, when it should be quite crisp,—let it stand aside till the boiling has ceased, and then stir in the juice of the lemon. Butter a dish, and pour it in about a quarter of an inch in thickness. The fire must be quick, and the taffy stirred all the time.

CANDY FRUIT.—Take one pound of the best loaf sugar; dip each lump into a bowl of water, and put the sugar into your preserving kettle. Boil it down, and skim it until perfectly clear, and in a candying state. When sufficiently boiled, have ready the fruits you wish to preserve. Large white grapes, oranges separated into small pieces, or preserved fruits, taken out of their syrup and dried, are very nice. Dip the fruits into the prepared sugar while it is hot; put them in a cold place; they will soon become hard.

JELLIES WITHOUT FRUIT.—To 1 pint of water put ¼ oz. alum; boil a minute or two; then add 4 lbs. white sugar; continue the boiling a little; strain while hot; and, when cold, put in half a twenty-five cent bottle of extract of vanilla, strawberry, lemon, or any other flavor you desire for jelly.

PRIZE HONEY.—Good common sugar, 5 lbs.; water, 2 lbs. bring gradually to a boil, skimming when cool; add 1 lb. bees' honey and 4 drops essence of peppermint. If you desire a better article, use white sugar, and ½ lb. less water, ½ lb more honey.

ANOTHER.—Coffee sugar, 10 lbs.; water 3 lbs.; cream tartar, 2ozs.; strong vinegar, 2 tablespoons; white of an egg well beaten; bees' honey, ½ lb; Lubin's extract of honeysuckle, 10 drops. Put on the sugar and water in a suitable kettle on the fire; when lukewarm stir in the cream tartar and vinegar; add the egg; when the sugar is nearly melted put in the honey. and stir till it comes to a boil; take it off, let it stand a few minutes; strain, then add the extract of honeysuckle last; stand over night, and it is ready for use. *Another.*—Common sugar, 4 lbs.; water, 1 pt.; let them come to a boil, and skim. Then add pulverized alum, ¼ oz. remove from the fire, and stir in cream of tartar, ½ oz. and water, or extract of rose, 1 tablespoonful, and it is fit for use.

TO KEEP FRUITS FRESH.—Rosin 2 lbs.; tallow, 2 oz.; bees'-wax, 2 oz. Melt slowly over the fire in an iron pot, but don't boil. Take the fruit separately, and rub it over with pulverized chalk or whiting (to prevent the coating from adhering to the fruit), then dip it into the solution once, and hold it up a moment to set the coating, then pack away carefully in barrels, boxes, or on shelves, in a cool place. Unequalled for preserving apples, pears, lemons, &c.

ACID DROPS.—Pound and sift into a clean pan 8 ozs. of double refined sugar, add slowly as much water as will render the sugar sufficiently moist not to stick to the stirring spoon, place the pan on a small stove or slow fire, and stir till it nearly boils, remove from the fire and stir in ¼ oz. tartaric acid. Place it on the fire for half a minute, then dip out small quantities from the pan, and let it fall in small drops on a clean tin plate; remove the drops in 2 hours with a knife. Ready for sale in 24 hours.

CHOCOLATE CREAM CANDY.—Chocolate scraped fine, ¼ oz., thick cream, 1 pt., best sugar, 3 ozs., heat it nearly boiling, then remove it from the fire and mill it well; when cold, add the whites of 4 or 5 eggs; whisk rapidly and take up the froth on a sieve. Serve the cream in glasses and pile up the froth on top of them.

TANNERS, CURRIERS, BOOT, SHOE AND RUBBER M'FRS, MARBLE WORKERS, BOOKBINDERS, &c.

Best Color for Shoe and Harness Edge.—Alcohol, 1 pint; tincture of iron, 1½ ozs.; extract logwood, 1 oz.; pulverized nutgalls, 1 oz.; soft water, ½ pint; sweet oil, ½ oz.; put this last into the alcohol before adding the water. Nothing can exceed the beautiful finish imparted to the leather by this preparation.

Cheap Color for the Edge.—Soft water, 1 gallon; extract logwood, 1 oz.; boil till the extract is dissolved; remove from the fire, add copperas, 2 oz., bichromate of potash, and gum arabic, of each ½ oz., all to be pulverized.

Beautiful Bronze for Leather.—Dissolve a little of the so-called insoluble aniline violet in a little water, and brush the solution over the leather: after it dries repeat the process.

Superior Edge Blacking.—Soft water 5 gallons; bring to a boil, and add 8 oz. logwood extract, pulverized; boil 3 minutes, remove from the fire, and stir in 2½ oz. gum arabic, 1 oz. bichromate of potash, and 80 grains prussiate of potash.

For a small quantity of this, use water, 2 quarts; extract of logwood, ¾ oz.; gum arabic, 96 grains; bichromate of potash, 48 grains; prussiate of potash; 8 grains. Boil the extract in the water 2 minutes; remove from the fire and stir in the others, and it is ready for use.

For tanners' surface blacking, which is not required to take on a high polish, the gum arabic may be omitted.

Sizing for Boots and Shoes in Treeing Out.—Water, 1 quart; dissolve in it, by heat, isinglass, 1 oz.; adding more water to replace loss by evaporation; when dissolved, add starch, 6 oz.; extract of logwood, beeswax, and tallow, of each, 2 oz. Rub the starch up first by pouring on sufficient boiling water for that purpose. It makes boots and shoes soft and pliable, and gives a splendid appearance to old stock on the shelves.

Black Varnish for the Edge.—Take 98 per. cent alcohol, 1 pint; shellac, 3 oz.; rosin, 2 oz.; pine turpentine, 1 oz.; lampblack, ¼ oz.; mix: and when the gums are all cut, it is ready for use. This preparation makes a most splendid appearance when applied to boot, shoe, or harness edge, and is equally applicable to cloth or wood, where a gloss is required after being painted.

Waterproof Varnish for Harness.—India-rubber, ½ lb.; spts. turpentine 1 gal.; dissolve to a jelly, then take hot linseed oil equal parts with the mass, and incorporate them well over a slow fire.

Blacking for Harness.—Beeswax. ½ lb.; ivory black, 2 ozs.; spts. of turpentine, 1 oz. Prussian blue, ground in oil 1 oz.; copal varnish, ½ oz.; melt the wax and stir into it the other ingredients, before the mixture is quite cold; make it into balls, rub a little upon a brush, apply it upon the harness, and polish lightly with silk.

Best Harness Varnish Extant.—Alcohol, 1 gallon; white turpentine, 1½ lbs.; gum shellac, 1½ lbs.; Venice turpentine, 1 gill. Let them stand by the stove till the gums are dissolved, then add sweet oil, 1 gill; and color it if you wish with lampblack, 2 oz. This will not crack like the old varnish.

HARNESS OIL.—Neat's-foot oil, 1 gal.; lampblack, 4 oz. Mix well.

BRILLIANT FRENCH VARNISH FOR LEATHER.—Spirit of wine, ⅜ pint; vinegar, 5 pints; gum senegal in powder, ½ lb.; loaf sugar, 6 oz.; powdered galls, 2 oz.; green copperas, 4 oz. Dissolve the gum and sugar in the water; strain, and put on a slow fire, but don't boil; now put in the galls, copperas, and the alcohol; stir well for five minutes; set off; and when nearly cool, strain through flannel, and bottle for use. It is applied with a pencil brush. Most superior.

LIQUID JAPAN FOR LEATHER.—Molasses, 8 lbs.; lampblack, 1 lb.; sweet oil, 1 lb.; gum arabic, 1 lb.; isinglass, 1 lb. Mix well in 32 lbs. water; apply heat; when cool, add 1 quart alcohol; an ox's gall will improve it.

WATERPROOF OIL-BLACKING. Camphene, 1 pint; add all the India-rubber it will dissolve; curriers' oil, 1 pint; tallow, 7 lbs.; lampblack, 2 oz. Mix thoroughly by heat.

SHOEMAKERS' HEEL BALLS.—Beeswax, 8 oz.; tallow, 1 oz.; melt, and add powdered gum arabic, 1 oz., and lampblack to color.

BEST HEEL BALL.—Melt together beeswax, 2 lbs.; suet, 3 ozs.; stir in ivory black, 4 ozs., lampblack, 3 oz., powdered gum arabic, 2 oz., powdered rock candy, 2 oz., mix and when partly cold pour into tin or leaden moulds.

CHANNELLERS AND SHOEMAKERS' CEMENT.—India-rubber dissolved to a proper consistence in sulphuric ether.

CEMENT FOR LEATHER OR RUBBER SOLES AND LEATHER BELTING.—Gutta percha, 1 lb.; India-rubber, 4 oz.; pitch, 2 oz.; shellac, 1 oz.; oil, 2 oz.; melt, and use hot.

GERMAN BLACKING.—Ivory-black, 1 part; molasses, ½ part; sweet oil, ⅛ part; mix, as before; then stir in a mixture of hydrochloric acid, ⅛ part; oil of vitriol, ¼ part; each separately diluted with twice its weight of water before mixing them. This forms the ordinary paste blacking of Germany, according to Liebig.

OIL PASTE BLACKING. Ivory-black, 4 lbs.; molasses, 2 lbs.; sweet oil, 1 lb.; oil of vitrol 3 lbs.; mix and put in tins.

GOLD VARNISH.—Turmeric, 1 dram; gamboge, 1 dram; turpentine, 2 pints; shellac, 5 oz.; sandarach, 5 oz.; dragon's blood, 8 drams; thin mastic varnish, 8 oz.; digest with occasional agitation for fourteen days; then set aside to fine; and pour off the clear.

GRAIN BLACK FOR HARNESS LEATHER.—First stain in tallow; then take spirits turpentine, 1 pint; cream of tartar, 1 oz.; soda 1 oz.; gum shellac, ½ oz.; thick paste, reduced thin, 2 quarts. Mix well. This will finish 12 sides.

BEAUTIFUL STAINS FOR BOOTS, SHOES AND LEATHER GOODS.—Soft water 1 pt.; oxalic acid, 2 tablespoonfuls or more; if required stronger, dissolve, and for a red color, add finely pulverized rose-pink, vermilion or drop lake. *Blue*, add finely pulverized Prussian blue, or indigo. *Yellow*, king's yellow, yellow ochre, &c. *White*, flake white. *Green*, blue and yellow mixed. *Orange*, red and yellow mixed. Purple, red and blue mixed. Pulverize the ingredients well before mixing with the water and acid. Any other shade desired can be selected from the "*Compound colors*" in the next department.

BRIDLE STAIN.—Skimmed milk, 1 pt.; spirits of salts, ½ oz.; spts.

of red lavender, ½ oz.; gum arabic, 1 oz.; and the juice of 2 lemons; mix well together, and cork for use; apply with a sponge; when dry, polish with a brush or a piece of flannel. If wished paler, put in less red lavender.

ON RUBBER GOODS.—As many parties require to use rubber goods who are entirely ignorant of the cheap mixtures which are vended in large quantities, at enormous profits by manufacturers, I have thought proper in this place to irradiate the subject with a little "light" for the benefit of those whom "it may concern," and accordingly present the formulæ for compounding the different mixtures which enter into the composition of many articles sold quite extensively as *pure rubber* goods, but which, owing to large adulterations, in many cases cost 75 per cent. less than the prices charged for them. The first I shall present is for

LIGHT BUFFER SPRINGS.—Grind together clear Java rubber, 25 lbs.; Para rubber, 5 lbs.; common magnesia, 10 lbs.; pure sulphur, 25 ozs. This is brown at first, but in a few days turns grey or white, and just sinks in water. Springs made from this compound, 4½ x 2½ x 1, pressed to half an inch, showed 3½ tons on the dial.

GREY PACKING FOR MARINE ENGINES, &C.—Grind together cleaned Java rubber, 5 lbs.; Para rubber, 25 lbs.; oxide of zinc, 16 lbs.; carbonate of magnesia, 6 lbs.; Porcelain or Cornwall clay, 3 lbs.; red lead, 2 lbs.; pure sulphur, 30 ozs. It may be proper to state that good purified Java rubber might be substituted by engineers with good effect for Para rubber in the above and some other compositions.

RAG PACKING FOR VALVES, BEARING SPRINGS, &C.—This is made principally from the useless cuttings in the manufacture of India-rubber coats, when the gum is run or spread on calico foundations. Proportions as follows: grind together useless scraps, 35 lbs.; black-lead 18 lbs.; Java gum, 16 lbs.; yellow sulphur, 1 lb.

COMPOSITION FOR SUCTION HOSE FOR FIRE ENGINES, &C.—Grind together Java rubber, 20 lbs.; Para do. 10 lbs.; white lead, 14 lbs.; red lead, 14 lbs.; yellow sulphur, 1½ lbs. This is spread upon flax cloth, which weighs 10, 16, and 32 ozs. to the square yard.

COMMON BLACK PACKING.—Grind together, Java rubber, 15 lbs.; Para do., 15 lbs.; oxide of zinc, 15 lbs.; China or Cornwall clay, 15 lbs.; yellow sulphur, 28 ozs.

COMMON WHITE BUFFER RINGS, &C.—Grind together Java rubber, 30 lbs.; oxide of zinc, 18 lbs. carbonate of magnesia, 6 lbs.; clean chalk or whiting, 6 lbs.; flour of sulphur, 2 lbs.

VULCANITE, OR EBONITE.—If the amount of sulphur added to the prepared rubber amounts to 10 per cent. and the operations of vulcanizing is performed in close vessels, at a temperature exceeding 300, or the heat required for VULCANIZING INDIA-RUBBER as decribed under that head, which see, an article will be produced known as *vulcanite, or ebonite.* It is a black, hard, elastic substance, resembling horn in its texture and appearance, and capable of taking a very high polish. It is of great use in the arts, and is largely manufactured for making combs, door handles, and hundreds of articles hitherto made in ivory or bone. Its electrical properties also are very great.

BEST PURE SPRING, OR WASHERS.—Grind together Para gum, 30 lbs.; oxide of zinc, 5 lbs.; carb. magnesia, 2 lbs.; common chalk, 3 lbs.; Porcelain or Cornwall clay, 2 lbs.; pure sulphur, 30 oz.

COMPANION QUALITY TO ABOVE.—Para rubber, 30 lbs.; oxide of zinc, 5 lbs.; Porcelain or Cornwall clay, 5 lbs.; pure sulphur, 32 oz.

"HYPO" CLOTH FOR WATERPROOF COATS.—Grind together clean Java gum, 30 lbs.; lampblack, 5 lbs.; dry chalk or whiting, 11 lbs.; sulphuret of lead, 5 lbs. This composition is applied to waterproof garments.

TO VULCANIZE INDIA RUBBER.—The vulcanizing process patented by the late Charles Goodyear consists in incorporating with the rubber from 3 to 10 per cent. of sulphur, together with various metallic oxides, chiefly lead and zinc, the quantity of the latter articles being regulated by the degree of elasticity &c., required in the desired article. The goods of one large establishment are vulcanized in cylindrical wrought iron steam heaters, over 50 feet long and from 5 to 6 feet in diameter. These heaters have doors opening on hinges at one end, and through these doors the goods to be vulcanized are introduced on a sort of railway carriage, then, after the door is shut, steam is let on, and a temperature of from 250° to 300° of heat is kept up for several hours, the degree of heat being ascertained by means of thermometers attached to the heaters. The value, solidity, and quality of the goods is much increased by keeping the articles under the pressure of metalic moulds or sheets while undergoing this process. The whole process requires careful manipulation and great experience to conduct it properly.

TO DEODORIZE RUBBER.—Cover the articles of rubber with charcoal dust, place them in an enclosed vessel, and raise the temperature to 94° Fahr., and let it remain thus for several hours. Remove and clean the articles from the charcoal dust, and they will be found free from all odor.

GUTTA-PERCHA AND RUBBER WASTE.—The waste is cut into small pieces, and 100 lbs. of the same are placed in a well-closed boiler with 10 lbs. of bisulphide of carbon and 4 ozs. absolute alcohol, well stirred; then the boiler is closed, and left a few hours to soak. After this time it is found to be changed into a soft dough mass, which, after being ground or kneaded, is fit to be formed into any shape, when the solvent will evaporate. If too much of the latter has been used, a thick unmanageable liquid is obtained.

TO UTILIZE LEATHER SCRAPS.—First clean the scraps, then soak them in water containing 1 per cent. of sulphuric acid until the material becomes soft and plastic, then compress into blocks and dry by steam. In order to soften the blocks, 1 lb. of glycerine is added to 100 lbs. of the material; they are then passed through rollers, and brought to the proper thickness to be used as inner soles of boots and shoes.

DEER SKINS.—TANNING AND BUFFING FOR GLOVES.—For each skin, take a bucket of water, and put it into 1 qt. of lime ; let the skin or skins lie in from 3 to 4 days ; then rinse in clean water hair, and grain ; then soak them in cold water to get out the glue ; now scour or pound in good soap-suds for half an hour ; after which take white vitriol, alum, and salt, 1 tablespoonful of each to a skin ; these will be dissolved in sufficient water to cover the skin, and remain in it for 24 hours ; wring out as dry as convenient, and spread on with a brush ½ pint of curriers' oil, and hang in the sun about 2 days; after which you will scour out the oil with soap-suds, and hang out again until perfectly dry; then pull and work them until they are soft; and if a reasonable time does not make them soft, scour out in suds again as before, until complete. The oil may be saved by pouring or taking it from the top of the suds, if left standing a short time. The buff color is given by spreading yellow ochre evenly over the surface of the skin when finished, rubbing it well with a brush.

TANNING WITH ACID.—After having removed the hair, scouring, soaking and pounding in the suds, &c., as in the last recipe, in place of the white vitriol, alum, and salt as there mentioned, take oil of vitriol (sulphuric acid), and water, equal parts of each, and thoroughly wet the flesh-side of the skin with it, by means of a sponge or cloth upon a stick; then folding up the skin, letting it stand for 20 minutes only, having ready a solution of sal-soda and water, say 1 lb. to a bucket of water, and soak the skin or skins in that for two hours, when you will wash in clean water, and apply a little dry salt, letting lie in the salt over night, or that length of time; then remove the flesh with a blunt knife, or, if doing business on a large scale, by means of the regular beam and flesh-knife; when dry, or nearly so, soften by pulling and rubbing with the hands, and also with a piece, of pumice-stone. This of course is the quickest way of tanning, and by only wetting the skins with the acid, and soaking out in 20 minutes, they are not rotted.

ANOTHER METHOD.—Oil of vitriol, ½ oz.; salt, 1 teacup; milk sufficient to handsomely cover the skin, not exceeding 3 qts.; warm the milk, then add the salt and vitriol; stir the skin in the liquid 40 minutes, keeping it warm; then dry, and work it as directed in the above.

CANADIAN PROCESS.—The Canadians make four liquors in using the japonica. The FIRST liquor is made by dissolving, for 20 sides of upper, 15 lbs. of terra japonica in sufficient water to cover the upper being tanned. The SECOND liquor contains the same amount of japonica, and 8 lbs. of saltpetre also. The THIRD contains 20 lbs. of japonica and 4½ lbs. of alum. The FOURTH liquor contains only 15 lbs. of japonica, and 1½ lbs. of sulphuric acid; and the leather remains 4 days in each liquor for upper; and for sole the quantities and time are both doubled. They count 50 calf-skins in place of 20 sides of upper, but let them lie in each liquor only 3 days.

TO TAN FUR SKINS, &C.—To remove the legs and useless parts, soak the skin soft, and then remove the fleshy substances, and soak it in warm water 1 hour. Now take for each skin, borax, saltpetre, and Glauber-salt, of each ½ oz., and dissolve or wet with soft water sufficient to allow it to be spread on the flesh-side of the skin. Put it on with a brush thickest in the centre or thickest part of the skin, and double the skin together, flesh side in; keeping it in a cool place for 24 hours, not allowing it to freeze. Then wash the skin clean, and take sal-soda 1 oz.; borax ½ oz,; refined soap 2 oz.; melt them slowly together, being careful not to allow them to boil, and apply the mixture to the flesh side at first. Boil up again and keep in a warm place for 24 hours; then wash the skin clean again, as above, and have saleratus 2 oz., dissolved in hot rain water sufficient to well saturate the skin; take alum 4 oz.; salt 8 oz.; and dissolve also in hot rain water; when sufficiently cool to allow the handling of it without scalding, put in the skin for 12 hours; then wring out the water and hang up for 12 hours more to dry. Repeat this last soaking and drying 2 or 3 times, according to the desired softness of the skin when finished. Lastly finish, by pulling and working, and finally by rubbing with a piece of pumice-stone and fine sand-paper. This works like a charm on sheep-skins, fur skins, dog, wolf, bear-skins, &c.

PROCESS OF TANNING CALF, KIP, AND HARNESS LEATHER IN FROM 6 TO 30 DAYS.—For a 12-lb calf-skin, take 3 lbs. of terra japonica, common salt, 2 lbs.; alum, 1 lb.; put them in a copper kettle with sufficient water to dissolve the whole without boiling. The skin will be limed, haired, and treated every way as for the old process, when it will be put into a vessel with water to cover it, at which time you will put in 1 pint of the composition, stirring it well, adding the same night and morning for three days, when you will add the whole, handling 2 or 3 times daily all the time tanning; you can continue to use the tanning liquid by adding half the quantity each time, by keeping these proportions for any amount. If you desire to give a dark color to the leather, you will put in 1 lb. of Sicily sumac; kip skins will require about 20 days, light horse hides for harness 30 days, calf-skins from 6 to 10 days at most.

TO TAN RAW HIDE.—When taken from the animal, spread it flesh side up; then put 2 parts of salt, 2 parts of saltpetre and alum combined, make it fine, sprinkle it evenly over the surface, roll it up, let it alone a few days till dissolved; then take off what flesh remains, and nail the skin to the side of a barn in the sun, stretch tight, to make it soft like harness leather, put neat's-foot oil on it, fasten it up in the sun again; then rub out all the oil you can with a wedge-shaped stick, and it is tanned with the hair on.

TO TAN MUSKRAT SKINS WITH THE FUR ON.—First, for soaking, to 10 gals. cold soft water, add 8 parts of wheat bran, old soap, ½ pt.; pulverized borax, 1 oz.; sulphuric acid, 2 ozs. If the skins have not been salted, add salt, 1 pt. Green skins should not be soaked more than 8 to 10 hours. Dry ones should soak till very soft. The sulphuric acid hastens the soaking process. For tan liquor, to 10 gals. warm soft water, add bran, ½ bushel; stir well, and let it ferment in a warm room. Then add slowly, sulphuric acid, 2½ lbs.; stir all the time. Musk rat skins should remain in about 4 hours; then take out and rub with a fleshing knife; an old chopping knife with the edge taken off will do. Then work it over a beam until entirely dry.

TO DYE FURS.—Any dye that will color wool will also color furs, and an immense number of such dyes can be found under the dyers department. In buying furs, examine the density and length of the down next the skin, this can easily be done by blowing briskly against the set of the fur, if it is very close and dense it is all right, but if it opens easily and exposes much of the skin, reject it.

FRENCH FINISH FOR LEATHER.—Take a common wooden pailful of scraps (the legs and pates of calf-skins are best), and put a handful each of salt and alum upon them, and let stand three days; then boil until they get a thick paste; in using, you will warm it, and in the first application put a little tallow with it, and for a second time a little soft soap, and use it in the regular way of finishing, and your leather will be soft and pliable, like French leather.

French Patent Leather.—Work into the skin with appropriate tools 3 or 4 successive coatings of drying varnish, made by boiling linseed oil with white lead and litharge, in the proportion of one pound of each of the latter to one gallon of the former, and adding a portion of chalk or ochre, each coating being thoroughly dried before the application of the next. Ivory black is then substituted for the chalk or ochre, the varnish thinned with spirits of turpentine, and five additional applications made in the same manner as before, except that it is put on thin and not worked in. The leather is rubbed down with pumice-stone, in powder, and then placed in a room at 90 degrees, out of the way of dust. The last varnish is prepared by boiling ½ lb. asphaltum with 10 lbs. of the drying oil used in the first stage of the process, and then stirring in 5 lbs. copal varnish and 10 lbs. of turpentine. It must have 1 month's age before using it.

Cheap Tanning without Bark or Mineral Astringents.—The astringent liquor is composed of water, 17 gals.; Aleppo galls. ½ lb.; Bengal catechu, 1½ oz. and 5 lbs. of tormentil, or septfoil root. Powder the ingredients, and boil in the water 1 hour; when cool, put in the skins (which must be prepared by being plunged into a preparation of bran and water for 2 days previously); handle them frequently during the first 3 days, let them alone the next 3 days, then handle three or four times in one day; let them lie undisturbed for 25 days more, when the process will be complete.

New Tanning Composition.—*For harness leather*, 4 lbs. catechu, 3 pts. common ley, 3 oz. of alum. *For wax leather* (split leather), 3 lbs. catechu, 3 pts. common ley, 3 oz. alum. *For calf-skins* 2 lbs. catechu, 1 pt. ley. *For sheep-skins*, 1 lb. catechu, 1 pt. ley, 1 oz. alum. The catechu by itself will make the leather hard and brittle, the ley will soften it; the alum being only used for coloring, can be dispensed with, or other matter used in its place. The mixture is in every case boiled, and the leather is then immersed in it long enough to be thoroughly tanned, for which purpose the harness leather should be steeped from 18 to 20 days, wax leather from 12 to 14 days, calf-skins from 7 to 9 days, and sheep-skins from 2 to 4 days.

French Polish or Dressing for Leather.—Mix 2 pts. best vinegar, with 1 pt. soft water; stir into it ¼ lb. glue, broken up, ½ lb. logwood-chips, ¼ oz. of finely powdered indigo, ¼ oz. of the best soft soap, ¼ oz. of isinglass; put the mixture over the fire, and let it boil ten minutes or more; then strain, bottle, and cork. When cold, it is fit for use. Apply with a sponge.

Tanning.—The first operation is to soak the hide, as no hide can be properly tanned unless it has been soaked and broken on a fleshing beam. If the hide has not been salted add a little salt and soak it in soft water. In order to be thoroughly soaked, green hides should remain in the liquor from 9 to 12 days; of course the time varies with the thickness of the hide. The following liquor is used to remove hair, or wool, viz.: 10 gals. cold water (soft); 8 qts. slacked lime, and the same quantity of wood ashes. Soak until the hair or wool will pull off easily. As it frequently happens it is desirable to cure the hide and keep the hair clean, the following paste should be made, viz: equal parts of lime and hard wood ashes (lime should be slaked) and made into a paste with soft water. This should be spread on the flesh side of the hide and the skin rolled up flesh side in and placed in a tub just covering it with water. It should remain 10 days or until the hair will pull out easily, then scrape with a knife. The skins of animals are composed mainly of glue or gluten. This is soluble, and the principle derived from the bark, tannin or tannic acid is also to a considerable extent soluble; when the latter is allowed to act upon the former, chemical combination takes place, and leather is produced, which is insoluble.

CURRIERS' SIZE.—Take of sizing, 1 qt.; soft soap, 1 gill; stuffing, 1 gill; sweet milk, ½ pt.; boil the sizing in water to a proper consistence, strain, and add the other ingredients; and when thoroughly mixed, it is ready for use.

CURRIERS' PASTE.—*First Coat.*—Take of water, 2 qts.; flour, ½ pint; Castile soap, 1 oz.; make into paste. *Second Coat.*—Take of first paste, ½ pt.; gum tragacanth, 1 gill; water, 1 pt.; mix all together. This will finish 18 sides of upper.

CURRIERS' SKIRTING.—This is for finishing skirting and the flesh of harness leather, in imitation of oak tanning. Take of chrome yellow, ½ lb.; yellow ochre, 1 lb.; cream of tartar, 1 oz.; soda, ½ oz.; paste 5 qts.; mix well. This will finish twelve sides.

SKIRTING.—For the grain to imitate oak tan. Take of chrome yellow, ½ lb.; yellow ochre, ½ lb.; cream of tartar 1 oz.; soda, 1 oz.; paste 2 qts.; spirits of turpentine, 1 pt.; mix well. This will finish twelve sides.

DYES FOR MOROCCO AND SHEEP LEATHER.—(*Blue.*)—Blue is given by steeping the subject a day in urine and indigo, then boiling it with alum; or, it may be given by tempering the indigo, with red wine, and washing the skin therewith.—*Another.*—Boil elderberries or dwarf-elder, then smear and wash the skins therewith and wring them out; then boil the elderberries as before in a solution of alum water, and wet the skins in the same manner once or twice, dry them, and they will be very blue.—(*Red.*)—Red is given by washing the skin and laying them 2 hours in gall, then wringing them out, dipping them in a liquor made with ligustrum, alum, and verdigris, in water, and lastly in the dye made of Brazilwood boiled with ley. (*Purple.*)—Purple is given by wetting the skins with a solution of roche alum in warm water, and when dry, again rubbing them with the hand with a decoction of logwood in cold water. (*Green.*)—Green is given by smearing the skin with sap-green and alum boiled. (*Dark Green.*)—Dark green is given with steel-filings and sal-ammoniac, steeped in wine till soft, then smeared over the skin, which is to be dried in the shade. (*Yellow.*)—Yellow is given by smearing the skin over with aloes and linseed-oil dissolved and strained, or by infusing in weld. (*Light Orange.*)—Orange color is given by smearing it with fustic berries boiled in alum water, or for deep orange, with turmeric. (*Sky-color.*) Sky-color is given with indigo steeped in boiling water, and the next morning warmed and smeared over the skin. *See Dyers' Department.*

TO MARBLE BOOKS OR PAPER.—Provide a wooden trough 2 inches deep and the length and width of any desired sheet; boil in a brass or copper pan any quantity of linseed and water until a thick mucilage is formed; strain it into the trough, and let cool; then grind on a marble slab any of the following colors in small beer. For *Blue.*—Prussian blue or indigo. *Red.*—Rose-pink, vermilion, or drop lake. *Yellow.*—King's yellow, yellow ochre, &c. *White.*—Flake white.

Black.—burnt ivory or lamb black. *Brown.*—Umber, burnt do.; terra di sienna, burnt do. *Black*, mixed with yellow or red, also makes brown. *Green.*—Blue and yellow mixed. *Orange.*—Red and yellow mixed. *Purple.*—Red and blue mixed. For each color you must have two cups, one for the color after grinding, the other to mix it with ox-gall, which must be used to thin the colors at discretion. If too much gall is used, the colors will spread; when they keep their place on the surface of the trough, when moved with a quill, they are fit for use. All things in readiness, the colors are successively sprinkled on the surface of the mucilage in the trough with a brush, and are waved or drawn about with a quill or a stick, according to taste. When the design is just formed, the book, tied tightly between cutting boards of the same size is lightly pressed with its edge on the surface of the liquid pattern, and then withdrawn and dried. The covers may be marbled in the same way only letting the liquid colors run over them. In marbling paper the sides of the paper is gently applied to the colors in the trough. The flim of color in the trough may be as thin as possible, and if any remains after the marbling it may be taken off by applying paper to it before you prepare for marbling again. To diversify the effects, colors are often mixed with a little sweet oil before sprinkling them on, by which means a light halo or circle appears around each spot.

BOOKBINDERS' VARNISH.—Shellac, 8 parts; gum benzoin, 3 parts; gum mastic, 2 parts; bruise, and digest in alcohol, 48 parts; oil of lavender, ½ part. Or, digest shellac, 4 parts; gum mastic, 2 parts; gum dammer and white turpentine, of each, 1 part; with alcohol (95 per cent.), 28 parts.

RED SPRINKLE FOR BOOKBINDERS' USE.—Brazilwood (ground), 4 parts; alum, 1 part; vinegar, 4 parts; water, 4 parts. Boil until reduced to 7 parts, then add a quantity of loaf sugar and gum; bottle for use. *Blue.*—Strong sulphuric acid, 8 oz.; Spanish indigo, powdered, 2 oz.; mix in a bottle that will hold a quart, and place it in a warm bath to promote solution. For use, dilute a little to the required color in a tea-cup. *Black.*—No better black can be procured than that made by the receipt for edge blacking, in this work, *which see.* *Orange color.*—Ground Brazilwood, 16 parts; annatto, 4 parts, alum, sugar, and gum arabic, each 1 part; water, 70 parts, boil, strain, and bottle. *Purple.*—Logwood chips; 4 parts, powdered alum, 1 part; soft water, 24 parts; boil until reduced to 16 parts, and bottle for use. *Green.*—French berries, 1 part; soft water, 8 parts. Boil, and add a little powdered alum, then bring it to the required shade of green, by adding liquid blue. *Brown.*—Logwood chips, 1 part; annatto, 1 part. boil in water, 6 parts; if too light add a piece of copperas the size of a pea.

TREE-MARBLE.—A marble in the form of trees may be done by bending the boards a little on the centre, using the same method as the common marble, having the covers previously prepared. The end of a candle may be rubbed on different parts of the board to form knots. *Rice-Marble.*—Color the cover with spirits of wine and turmeric, then place on rice in a regular manner, throw on a very fine sprinkle of copperas water till the cover is nearly black, and let it remain till dry. The cover may be spotted with the red liquid or potash-water, very freely, before the rice is thrown off the boards.

Spotted Marble for Books, etc.—After the fore-edge of the book is cut, let it remain in the press, and throw on linseeds in a regular manner, sprinkle the edge with any dark color till the paper is covered, then shake off the seeds. Various colors may be used; the edge may be colored with yellow or red before throwing on the seeds, and sprinkling with blue. The seeds will make a fine fancy edge when placed very thick on different parts, with a few slightly thrown on the spaces between. *Japan Coloring for Leather Book-covers, etc.* — After the book is covered and dry, color the cover with potash-water mixed with a little paste: give 2 good coats of Brazil wash, and glaze it; put the book between the hands, allowing the boards to slope a little; dash on copperas-water, then with a sponge full of red liquid press out on the back and on different parts large drops, which will run down each board and make a fine shaded red; when the cover is dry, wash it over 2 or 3 times with Brazil wash to give it a brighter color. (*See the various dyes for leather.*)

GOLD SPRINKLE FOR BOOKS.—Put in a marble mortar ½ oz. pure honey and one book of gold leaf, rub them well together until they are very fine, add ½ pint clear water, and mix well together; when the water clears, pour it off, and put in more till the honey is all extracted, and nothing remains but the gold; mix one grain of corrosive sublimate in a teaspoonful of spirits of wine, and when dissolved, put the same, together with a little gum water, to the gold, and bottle for use. The edges of the book may be sprinkled or colored very dark, with green, blue, or purple, and lastly with the gold liquid in small or large spots, very regular, shaking the bottle before using. Burnish the edges when dry, and cover them with paper to prevent the dust falling thereon. This sprinkle will have a most beautiful appearance on extra work.

TO GILD THE EDGES OF BOOKS.—Armenian bole, 4 parts; sugar candy, 1 part; white of egg to mix. Apply this composition to the edge of the leaves, previously firmly screwed in the cutting-press; when nearly dry, smooth the surface with the burnisher; then take a damp sponge and pass over it, and with a piece of cotton wool, take the leaf from the cushion and apply it to the work; when quite dry, burnish, observing to place a piece of silver or India paper between the gold and the agate.

CHINESE EDGE FOR BOOKS.—Color the edge with light liquid blue and dry; then take a sponge charged with vermilion and dab on spots according to fancy; next throw on rice, and finish the edge with dark liquid blue.

TO MAKE PAPER INTO PARCHMENT.—To produce this transformation, take unsized paper and plunge it into a solution of two parts of concentrated sulphuric acid combined with 1 part water; withdraw it immediately, and wash it in clean water, and the change is complete. It is now fit for writing; for the acid supplies the want of size, and it becomes so strong that a strip 2 or 3 inches wide will bear from 60 to 80 lbs. weight, while a like strap of parchment will bear only about 25 lbs.

TO MANUFACTURE GLUE.—This article is usually made from the parings and waste pieces of hides and skins, the refuse of tanneries, the tendons and other offal of slaughter houses. They ought to be obtained and kept in the dry state, to prevent decomposition. For use, they are first steeped for 14 or 15 days in milk of lime, and then drained and dried ; this constitutes the cleaning or the preparation. Before conversion into glue they are usually steeped in weak milk of lime, well worked in water, and exposed to the air for 24 hours. They are then placed in a copper boiler ⅔ filled with water and furnished with a perforated false bottom, to prevent them from burning, and as much is piled on as will fill the vessel and rest on the top of it. Heat is next applied, and gentle boiling continued until the liquor on cooling becomes a gelatinous mass. The clear portion is then run off into another vessel, where it is kept hot by a water bath, and all around to repose for some hours to deposit, when it is run into the congealing boxes and placed in a cool situation. The next morning the cold gelatinous mass is turned out upon boards wetted with water, and are cut horizontally in thin cakes with a stretched piece of brass wire, and into smaller cakes with a moistened flat knife. These cakes are placed upon nettings to dry, after which they are dipped one by one in hot water and slightly rubbed with a brush wetted with boiling water, to give them a gloss ; they are lastly stove dried for sale. During this time the undissolved skins, &c., left in the copper is treated with water and the whole operation is repeated again and again, as any gelatinous matter is extracted. The first runnings produce the finest and best glue. The refuse matter from the tanners and leather dressers yields on the average, when dried, 50 per cent of its weight in glue.

To Dye Leather Yellow.—Picric acid gives a good yellow without any mordant ; it must be used in very dilute solution, and not warmer than 70° Fahr., so as not to penetrate the leathe

Green Dye for Leather.—Aniline blue modifies picric acid to a fine green. In dyeing the leather, the temperature of 85° Fahr., must never be exceeded. *See Aniline Dyes in Dyers' Dep't.*

Dyes for Ivory, Horn, and Bone.—*Black.*—1. Lay the articles for several hours in a strong solution of nitrate of silver, and expose to the light. 2. Boil the article for some time in a strained decoction of logwood, and then steep in a solution of per-sulphate or acetate of iron. 3. Immerse frequently in ink until of sufficient depth of color. *Blue.*—1. Immerse for some dilute solution of sulphate of indigo, partly saturated with potash, and it will be fully stained. 2. Steep in a strong solution of sulphate of copper. *Green.*—1. Dip blue-stained articles for a short time in a nitro-hydrochlorate of tin, and then in a hot decoction of fustic. 2. Boil in a solution of verdigris in vinegar until the desired color is obtained. *Red.*—1. Dip the article first in a tin mordant used in dyeing, and then plunge in a hot decoction of Brazil wood—½ lb. to a gallon of water or—cochineal. 2. Steep in red ink till sufficiently stained. *Scarlet.*—Use lack dye instead of the preceding. *Violet.*—Dip in the tin mordant, and then immerse in a decoction of logwood. *Yellow.*—Boil the articles in a solution of alum, 1 lb. to ½ a gallon, then immerse for half an hour in the following mixure: Take ½ lb. of turmeric, and ¼ lb. pearlash; boil in 1 gal. water: when taken from this, the bone must be again dipped in the alum solution.

Mother of Pearl Work.—This delicate substance requires great care in its workmanship, but it may be cut with the aid of saws, files and drills, with the aid of muriatic or sulphuric acid, and it is polished by colcothar, or the brown red oxide of iron left after the distillation of the acid from sulphate of iron. In all ornamental work, where pearl is said to be used, for flat surfaces, such as inlaying, mosaic work, &c., it is not real pearl, but mother of pearl that is used.

To Polish Pearl.—Take finely pulverized rotten stone and make into a thick paste by adding olive oil; then add sulphuric acid a sufficient quantity to make into a thin paste, apply on a velvet cork; rub quickly and, as soon as the pearl takes the polish, wash it.

To Polish Ivory.—Remove any scratches or file marks that may be present with finely pulverized pumice-stone, moistened with water.—Then wash the ivory and polish with prepared chalk, applied moist upon a piece of chamois leather, rubbing quickly.

Etching Fluid for Ivory,—Take dilute sulphuric acid, dilute muriatic acid, equal parts: mix. For etching varnish take white wax, 2 parts; tears of mastic, 2 parts: mix.

To gild Ivory.—Immerse it in a solution of nitro-muriate of gold, and then expose it to hydrogen gas while damp. Wash it afterwards in clean water.

To Silver Ivory.—Pound a small piece of nitrate of silver in a mortar, add soft water to it, mix them well together, and keep in vial for use. When you wish to silver any article, immerse it in this solution, let it remain till it turns of a deep yellow; then place it in clear water, and expose it to the rays of the sun. If you wish to depicture a figure, name, or cipher, on your ivory, dip a camel's-hair pencil in the solution, and draw the subject on the ivory. After it has turned a deep yellow, wash it well with water, and place it in the sunshine, occasionally wetting it with pure water. In a short time it will turn of a deep black color, which, if well rubbed, will change to a brilliant silver.

To Soften Ivory.—In 3 oz. spirits of nitre and 15 oz. of spring-water, mixed together, put your ivory to soak; and in three or four days it will obey your fingers.

To Whiten Ivory.—Slake some lime in water; put your ivory in the water, after being decanted from the grounds, and boil it till it looks quite white. To polish it afterwards, set it in the turner's wheel; and, after having worked, take rushes and pumice-stones, subtile powder, with water, rub it till it looks perfectly smooth. Next to that, heat it by turning it against a piece of linen or sheep-skin leather: and when hot, rub it over with a little dry whiting diluted in oil of olive; then with a little dry whiting alone: finally with a piece of soft white rag. When all this is performed as directed, the ivory will look very white.

Another way to Bleach Ivory.—Take 2 handfuls of lime, slake it by sprinkling it with water: then add 3 pts. of water, and stir the whole together; let it settle ten minutes, and pour the water into a pan for your purpose. Then take your ivory and steep it in the lime-water for 24 hours, after which, boil it in a strong alum-water 1 hour, and dry it in the air.

Horn in Imitation of Tortoise-Shell.—First steam and then press the horn into proper shapes, and afterwards lay the following mixture on with a small brush, in imitation of the mottle of tortoise-shell; Take equal parts of quick lime and litharge, and mix with strong soap-lees; let this remain until it is thoroughly dry; brush off, and repeat two or three times if necessary. Such parts as are required to be of a reddish brown should be covered with a mixture of whiting and the stain.

TO CUT AND POLISH MARBLE.—The marble saw is a thin plate of soft iron, continually supplied, during its sawing motion, with water and the sharpest sand. The sawing of moderate pieces is performed by hand: that of large slabs is most economically done by a proper mill. The first substance used in the polishing process is the sharpest sand, which must be worked with till the surface becomes perfectly flat. Then a second and even a third sand, of increasing fineness, is to be applied. The next substance is emery, of progressive degrees of fineness; after which, tripoli is employed; and the last polish is given with tin putty. The body with which the sand is rubbed upon the marble is usually a plate of iron; but, for the subsequent process, a plate of lead is used, with fine sand and emery. The polishing-rubbers are coarse linen cloths, or bagging, wedged tight into an iron planing tool. In every step of the operation, a constant trickling supply of water is required.

POWERFUL CEMENT FOR BROKEN MARBLE.—Take gum arabic, 1 lb.; make into a thick mucilage: add to it powdered plaster of Paris, 1½ lb.; sifted quick lime, 5 oz.; mix well; heat the marble, and apply the mixture.

SEVEN COLORS FOR STAINING MARBLE.—It is necessary to heat the marble hot, but not so hot as to injure it, the proper heat being that at which the colors nearly boil. *Blue;* alkaline indigo dye, or turnsole with alkali. *Red;* Dragon's blood in spirits of wine. *Yellow;* gamboge in spirits of wine. *Gold Color;* sal-ammoniac, sulphate of zinc, and verdigris equal parts. *Green;* sap green in spirits of potash. *Brown;* tincture of logwood. *Crimson;* alkanet root in turpentine. Marble may be veined according to taste. To stain marble *well* is a difficult operation.

PERPETUAL INK FOR TOMSTONES, ETC.—Pitch, 11 lbs.; lampblack, 1 lb.; turpentine sufficient; mix with heat.

TO CLEAN OLD MARBLE.—Take a bullock's gall, 1 gill soap lees, half a gill of turpentine; make into a paste with pipeclay, apply it to the marble; let it dry a day or two, and then rub it off, and it will appear equal to new; if very dirty, repeat the application.

TO EXTRACT OIL FROM MARBLE OR STONE.—Soft soap, 1 part; fuller's earth, 2 parts; potash, 1 part; boiling water to mix. Lay it on the spots of grease, and let it remain for a few hours.

TO GILD LETTERS ON MARBLE.—Apply first a coating of size and then several successive coats of size thickened with finely powdered whiting until a good face is produced. Let each coat become dry and rub it down with fine glass paper before applying the next. Then go over it thinly and evenly with gold size and apply the gold leaf, burnishing with an agate; several coats of leaf will be required to give a good effect.

TO CLEAN MARBLE.—Take two parts of common soda, 1 part pumice-stone, and 1 part of finely powdered chalk; sift it through a fine sieve, and mix it with water; then rub it well all over the marble, and the stains will be removed; then wash the marble over with soap and water, and it will be as clean as it was at first.

TO MAKE A CHEMICAL BAROMETER.—Take a long narrow bottle, and put into it 2½ drs. of camphor; spirits of wine 11 drs. When the camphor is dissolved, add to it the following mixture: water 9 drs., saltpetre, 38 grs.; sal-ammoniac, 38 grs. Dissolve these salts in the water prior to mixing with the camphorated spirit; then shake all well together, cork the bottle well, wax the top, but afterwards make a very small aperture in the cork with a red-hot needle. By observing the different appearances which the materials assume as the weather changes, it becomes an excellent prognosticator of a coming storm or of a sunny sky.

TRAPPERS' AND ANGLERS' SECRET FOR GAME AND FISH.—A few drops of oil of anise, or oil rhodium, on any trapper's bait, will entice any wild animal into the snare trap. India cockle mixed with flour dough, and sprinkled on the surface of still water, will intoxicate fish, rendering them insensible; when coming up to the surface they can be lifted in a tub of fresh water to revive them, when they may be used without fear. Fish may also be caught in large numbers during the winter season by watching them through the ice and striking it with a mallet directly over where they happen to be. The shock stuns them, and they will rise, belly upwards towards the surface, when they are easily secured by breaking a hole in the ice.

PAINTERS, CABINETMAKERS, GILDERS, BRONZERS, GLASS STAINERS, &c.

COMPOUND COLORS—32 TINTS—*Blue.*—Grind Prussian blue in turps, other blue, very fine in linseed oil; mix with white paint to the color required. *Straw.*—A mixture of chrome yellow and white lead, oil and turps. *Steel.*—Mix ceruse, Prussian blue, fine lac, and vermilion, with oil and turps. *Purple.*—White lead, Prussian blue and vermilion, with oil and turps. *French Gray.*—White lead and Prussian blue tinged with vermilion, and for the last coat substitute carmine or lake for vermilion. *Drab.*—White lead with a little Prussian blue and French yellow, linseed oil and turps. *Another Drab.*—White lead with a little Prussian blue and lampblack, linseed oil and turps. *Dark Red, for common purposes.*—Mix English Venetian red, in boiled oil, with a little red lead and litharge, to give a drying quality. *Lighter Red.*—Mix together equal parts of Venetian red and red lead in boiled oil and turps. *Imitation of Vermilion.*—Grind together, in oil, red lead and rose pink. *Deep Red.*—Mix in oil, vermilion with a dust of Venetian red, or red lead. *Unfading Orange*—This is a mixture of orange lead (orpiment) and French or stone yellow, oil and turps. *Bright Yellow, for floors.*—White lead and linseed oil, mixed with some French yellow, and a little chrome yellow to heighten it, some red lead, burnt white vitriol and litharge, added to give it a drying quality. This color mixed with equal parts of boiled oil and turpentine, and used very thin. *Dark Yellow.*—Mix French yellow in boiled oil, adding to it a little red lead or litharge to give the paint a drying quality. *Light Yellow.*—This is a mixture of French yellow and white lead, with oil and turpentine. *Another.*—French yellow, white lead and red lead. *Another.*—This is a mixture of Prussian blue, French yellow, a small portion of Turkey umber, and a littlle burnt vitriol. Ground the same way. *Another, in oil.*—Mix Prussian blue and chrome yellow. Ground the same. *Another Shade.*—A mixture of Prussian blue and French yellow, with a small quantity of white lead and Turkey umber; add burnt vitriol, ground the same. *Another, light.*—White mixed with verdigris. A variety of shades may be obtained by using blue and yellow with white lead. *Another. Olive.*—Black and blue mixed with yellow, in such quantities as to obtain the colors or shades required. For *distemper*, use indigo and yellow pink mixed with whiting or white lead powder. *Freestone color.*—A mixture of red lead, Venetian red, French yellow and lampblack, (varying the shade according to taste,) with linseed oil and turpentine. *Olive Green.*—Grind separately, Prussian blue and French yellow, in boiled oil, then mix to the tints required with a little burnt white vitriol to act as a dryer. A cheap and handsome color for outside work, such as doors, carts, wagons, railings, &c. *Light Gray* is made by mixing white lead with lampblack, using more or less of each material, as you wish to obtain a lighter or a darker shade. *Buff* is made from yellow ochre and white lead. *Silver or Pearl Gray.*—Mix white lead, Prussian blue, and a very slight portion of black, regulating the quantities you wish to obtain. *Flaxen Gray* is obtained by a mixture of white lead and Prussian blue, with a small quantity of lake. *Brick Color.*—Yellow ochre and red lead, with a little white. *Oak Wood Color.*—¾ white lead and ¼ part umber and yellow ochre, proportions of the last two ingredients being determined by the desired tints. *Walnut-tree Color.*—⅔ white lead, and ⅓ red ochre, yellow ochre, and umber, mixed according to the shade sought. If veining is required, use different shades of the same mixture, and for the deepest places, black. *Jonquil.*—Yellow, pink, and white lead. This color is only proper for distemper. *Lemon Yellow.*—Realgar and orpiment. The same color can be obtained by mixing yellow pink with Naples yellow; but it is then only fit for distemper. *Orange Color.*—Red lead and yellow ochre. *Violet Color.*—Vermilion, or red lead, mixed with black or blue, and a small portion of white. Vermilion is preferable to red lead in mixing this color. *Purple.*—Dark red mixed with violet color. *Carnation.*—Lake and white. *Gold color.*—Massicot, or Naples yellow, with a small quantity of realgar, and a very little Spanish white. *Olive Color* may be obtained by black and a little blue, mixed with yellow. Yellow-pink, with a little verdigris and lampblack; also ochre and a small quantity of white will produce an olive color. For *distemper*, indigo and yellow-pink, mixed with white lead or Spanish white, must be used. If veined, it must be done with umber. *Lead Color.*—Prussian blue and white. *Chestnut Color.*—Red ochre and black, for a dark chestnut. To make it lighter, employ a mixture of yellow ochre. *Light timber Color.*—Spruce ochre, white, and a little umber. *Flesh Color.*—Lake, white lead, and a little vermilion. *Light Willow Green.*—White, mixed with verdigris. *Grass Green.*—Yellow-pink mixed with virdigris. *Stone Color.*—White, with a little spruce ochre. *Dark Lead Color.*—Black and white, with a little Prussian blue. *Fawn Color.*—White lead, stone ocnre, with a little vermilion. *Chocolate Color.*—Lampblack and Spanish brown. On account of the fatness of lampblack, mix some litharge and red lead. *Portland Stone Color.*—Umber, yellow ochre, and white lead. *Rose Color.*—White lead and carmine or lake. *Salmon Color.*—White lead and blue, yellow, and red. *Pearl Color.*—White lead, Prussian blue, and red. *Slate Color.*—White lead, black, red, and blue. *Pea Green.*—White lead and Chrome, or Paris green. *Cream Color.*—White lead, yellow and red. *Straw Color.*—White lead and yellow. *Peach Blossom Color.*—White lead and vermilion. *Brown.*—Venetian red and lampblack. *Dark Green.*—Lampblack and chrome green. *Olive Color.*—Red, green, or black, yellow and red. *Snuff Color.*—Yellow, sienna, and red.

FRESCO PAINTING.—Steep good glue over night in water to soften, then melt in a suitable pot or kettle, applying the heat cautiously, so as not to boil, as boiling will render it unfit for use. Then take as much Paris whiting as you think you will use for your first coat, beat it up thick with water to a perfect pulp to get rid of lumps, &c. Now put in a pail as much of this whiting mixture as will be required for your work and proceed to mix in the colors required to produce the desired shade. The colors, previously ground in water, should be cautiously mixed with the hand, and the shade tested by drying a little on a shingle or white paper; if too dark, add more whiting, if too light, more color. Now add enough of your melted glue to bind or fix the color very hard so as not to rise or wash up with your second coat, and test this on paper or wood also, otherwise you may ruin your work. For *Yellow*, chrome yellow of different tints may be used. *Buff* or *Drab* can be got by a mixture of yellow ochre, red, blue, or black, and sometimes umber is intermixed with good effect. Buff or drab colors may be produced by yellow ochre, chrome yellow, or raw sienna, intermixed with Turkey umber. For *Green*, mineral or Paris greens are first class. Any good chrome green will suit very well. For *Blue*, use cobalt ultramarine blue, Prussian blue and verditer. For *Gray*, use composition of white, blue, red, and black. For *Red*, use vermilion, Indian red, Venetian red, lake, and carmine. For *Pink* or *Rose* tints, use a mixture of red with white, if not wanted bright, use Indian red, if a strong rich color is desired, use carmine, lake, Venetian red, or vermilion. For *Black*, use blue black and the Frankfort, or pure ivory black. For *Browns for shading, &c.*, use burnt sienna, burnt ochre, purple brown, colcothar, burnt umber, Vandyke brown. For other tints, see COMPOUND COLORS. *French Size for Gilding Ornaments, Ceilings, &c.* Mix thick glue to the proper consistence, with a little pure honey, this imparts a beautiful color to the gold, and gives a splendid effect to the work. Previous to using the distemper colors, give the walls and ceilings, if new and clean, a good coat of paint, which should be mixed about ⅔ turpentine and ⅓ linseed oil, using as much Japan dryer as will dry it hard; be careful of adding too much oil, as it will spoil the subsequent work.

In preparing vestibules, halls, &c., to stand washing, go over the walls with oil paint for the first coat, but for the last coat no oil should be used, only spirits of turpentine. A harder surface will be given to the wall by adding 1 tablespoonful of good pale copal varnish to each 25 lbs. of paint used for the last coat. Previous to the wall receiving the last two coats, let the design or panelling be all correctly laid out.

To prepare old walls or ceilings; if there are any stains or cracks in the plaster, repair with size putty, if small, or use plaster of Paris and a little putty lime if the cracks are large, damping the places with a brush and water, then applying the plaster with a small trowel, afterwards smoothing off neatly. When all is dry and hard prepare the walls or ceilings with a coat of paint prepared as before directed, or with a preparation coat in size made of whiting with an extra quantity of melted glue containing a small quantity of alum. Give the walls a good coat of this, let it harden well, then apply another; this ought to be sufficient if good flowing coats are applied.

Now mix the colors to the proper tints (in oil), lay in the panels first; then the stiles, and when dry, put on the flat or last coat (spirit color). When the work is dry for panelling, use the following for mixing the finishing colors: Turpentine, a little mastic varnish, a little white wax, and a little pale damar. Varnish, use but little varnish, else too much gloss will be produced, the only use being to cause the color to set quickly to permit rapid work.

The fresco painter will find continued use for a book of designs to illustrate the different orders of architecture, pillars, columns, scrolls, borders, &c. and should make a particular study in the line of sketching any thing and every thing calculated to assist him in the business.

House Painting.—*Priming*, apply as thick as the paint will spread easily, rubbing out well with the brush. Use litharge as a dryer. After sandpapering and dusting, putty up all the nail heads and cracks with a putty-knife. *Outside second Coat.* Mix your paint with raw oil, using it as thick as possible consistent with easy spreading. After it is applied, cross-smooth the work until it is level and even, then finish lengthwise with long light sweeps of the brush. *Outside third Coat.* Make a little thinner than the last, rub out well, cross-smooth and finish very lightly with the tip of the brush. *Inside second Coat.* Mix your paint as thick as you can work it, using equal parts of raw oil and turpentine, rub this out well and carefully with the brush, cross-smooth and finish even and nice. *Inside third Coat.* Mix with 3 parts turpentine and 1 part of raw oil, rub out well and smooth off with great care. *Fourth Coat, Flatting.* Mix with turpentine alone thin enough to admit of spreading before it sets. Apply quickly without cross-smoothing, and finish lengthwise with light touches of the tip of the brush, losing no time, as it sets rapidly. *Drawn Flatting.* Ground white lead is mixed with turpentine almost as thin as the last-named mixture. The lead will soon settle and the oil and turpentine rise to the top, pour it off, and repeat the mixture until what rises to the top is clear turpentine. The oil being all withdrawn by this process, the lead is mixed with turpentine, and applied thickly and evenly with great care. This is used as a fourth coat, and the room must be kept shut and free from draught, as the color sets as fast as it is put on. See Porcelain Finish for Parlors. *Plastered Walls.* Give them a coat of glue size before painting in oil. *Killing Smoky Walls or Ceilings.* Wash over the smoky or greasy walls with nitre, soda, or thin lime whitewash, the last is the best.

Useful Hints to Painters.—*Painters' Colic.* To 2½ gals. spruce or table beer add 1 dram of sulphuric acid, mix well and let it stand 3 hours. A tumbler full 2 or 3 times per day is said to be very beneficial in cases of lead colic. Sweet oil and milk are also good, but acid, fruits, spirituous liquors, and vinegar should be avoided in every illness caused by paint. Avoid inhaling the dust when handleing dry colors, or drinking water which has stood long in a painted room or paint shop. Never eat or sleep without washing the hands and face, and rinsing the mouth, cleaning well out under the nails. Bathe the whole body every few days, avoid spattering your clothes, and either wear overalls or change your garments every week, well airing those you put off. Keep your paint shop clean, well ventilated, and avoid sleeping in it at any time. *To Remove Paint from Clothing.* Saturate the spots with equal parts turpentine and spirits of ammonia until they become soft, then wash out with soapsuds. *To dissolve Paint Skins, Cleanings of Pots, Brushes, &c.* Save them carefully, and dissolve them by boiling them in oil. *To Clean Brushes.* Use turpentine first, then wash in warm soapsuds. *To Clean Paint Pails, &c.* Use strong ley, hot. *Sanding.* The perforated sprinkler of a watering pot attached to the nozzle of a pair of bellows, is a first-rate contrivance for applying sand to painted work. Apply on the fourth or fifth coat, with another coat on the sand. To remove old putty, apply nitric or muriatic acid.

PRUSSIAN BLUE.—Take nitric acid, any quantity, and as much iron shavings from the lathe as the acid will dissolve; heat the iron as hot as can be handled with the hand; then add it to the acid in small quantities as long as the acid will dissolve it; then slowly add double the quantity of soft water that there was of acid, and put in iron again as long as the acid will dissolve it. 2d. Take prussiate of potash, dissolve it in the hot water to make a strong solution, and make sufficient of it with the first to give the depth of tint desired, and the blue is made. *Another Method.*—A very passable Prussian blue is made by taking sulprate of iron (copperas) and prussiate of potash, equal parts of each; and dissolving each separately in water, then mixing the two waters.

CHROME YELLOW.—1st. Take sugar of lead and Paris white, of each 5 lbs.; dissolve them in hot water. 2d. Take bichromate of potash, 6½ oz.: and dissolve it in hot water also; each article to be dissolved separately; then mix all together, putting in the bichromate last. Let stand twenty-four hours.

CHROME GREEN.—Take Paris white, 6¼ lbs.; sugar of lead, and blue vitriol, of each 3½ lbs.; alum, 10½ oz.; best soft Prussian blue, and chrome yellow, of each 3⅓ lbs. Mix thoroughly while in fine powder, and add water, 1 gal., stirring well, and let stand three or four hours, *Another Green, durable and cheap.*—Take spruce yellow, and color it with a solution of chrome yellow and Prussian blue, until you give it the shade you wish. *Another Method.*—Blue vitriol, 5 lbs.; sugar of lead, 6¼ lbs.; arsenic, 2½ lbs.; bichromate of potash, 1½ oz.; mix them thoroughly in fine powder, and add water 3 parts, mixing well again and let stand three or four hours.

PEA BROWN.—1st. Take sulphate of copper any quantity, and dissolve it in hot water. 2d. Take prussiate of potash, dissolve it in hot water to make a strong solution; mix of the two solutions, as in the blue, and the color is made.

ROSE PINK.—Brazil wood 1 lb., and boil it for two hours, having 1 gal. of water at the end; then strain it, and boil alum, 1 lb., in the water until dissolved; when sufficiently cool to admit the hand, add muriate of tin, $\frac{3}{4}$ oz. Now have Paris white, $12\frac{1}{2}$ lb.; moisten up to a salvy consistence, and when the first is cool, stir them thoroughly together. Let stand twenty-four hours.

PATENT YELLOW.—Common salt, 100 lbs., and litharge, 400 lbs., are ground together with water, and for some time in a gentle heat, water being added to supply the loss by evaporation; the carbonate of soda is then washed out with more water, and the white residuum heated till it acquires a fine yellow color.

NAPLES YELLOW.—No 1. Metallic antimony, 12 lbs.; red lead, 8 lbs.; oxide of zinc, 4 lbs. Mix, calcine, triturate well together, and fuse in a crucible: the fused mass must be ground and elutriated to a fine powder.

CHEAP YELLOW PAINT.—Whiting, 3 cwt.; ochre, 2 cwt.; ground white lead, 25 lbs. Factitions linseed oil to grind.

STONE COLOR PAINT.—Road-dust sifted, 2 cwt.; ground white lead, $\frac{1}{2}$ cwt.; whiting, 1 cwt.; ground umber, 14 lbs.; lime water, 6 gals. Factitious linseed oil to grind.

GLAZIER'S PUTTY.—Whiting, 70 lbs.; boiled oil, 20 lbs. Mix; if too thin, add more whiting; if too thick, add more oil.

TO IMITATE BROWN FREESTONE.—First make a pretty thick oil paint of the same color as the stone to be imitated, which may be done in different ways, the basis is white lead or zinc white, colored with umber and mars red, or any other pigments which suit you; put it on as usual, and while yet sticky throw common white sand against it; this will not affect the color and will make a rough, sandy coat imitating the surface of the stone.

GERMAN CARMINE.—Cochineal, 1 lb.; water, 7 gals.; boil for 5 minutes, then add alum, 1 oz. Boil for 5 minutes more, filter and set aside the decoction in glass or porcelain vessels for 3 days, then decant the liquor and dry the carmine in the shade. The remaining liquor will still deposit of an inferior quality, by standing.

STAIN FOR FLOORS.—To strong ley of wood-ashes add enough copperas for the required oak shade. Put this on with a mop and and varnish afterwards.

LEAD COLOR FOR IRON.—Take litharge and place it over a fire in a ladle; sprinkle over it flour of brimstone to turn it dark; grind it in oil. It dries quick and stands well in any weather.

A GOOD IMITATION OF GOLD.—Mix white lead, chrome yellow and burnt sienna until the proper shade is obtained.

BEAUTIFUL WHITE PAINT.—For inside work, which ceases to smell, and dries in a few hours. Add 1 lb. of frankincense to 2 qts. turpentine; dissolve it over a clear fire, strain it, and bottle it for use; then add 1 pt. of this mixture to 4 pts. bleached linseed oil, shake them well together, grind white lead in spirits of turpentine, and strain it; then add sufficient of the lead to make it proper for painting; if too thick in using, thin with turpentine, it being suitable for the best internal work on account of its superiority and expense.

FOR A PURE WHITE PAINT.—Nut-oil is the best: if linseed oil is used, add one-third of turpentine.

TO MIX COMMON WHITE PAINT.—Mix or grind white lead in linseed oil to the consistency of paste; add turpentine in the proportion of one quart to the gallon of oil; but these proportions must be varied according to circumstances. Remember to strain your color for the better sorts of work. If the work is exposed to the sun, use more turpentine for the ground-color, to prevent its blistering.

INVISIBLE GREEN FOR OUTSIDE WORK.—Mix lampblack and French yellow with burnt white vitriol. These colors mix in boiled oil. Burnt vitriol is the best drier for greens, as it is powerful and colorless, and, consequently, will not injure the color.

BRIGHT VARNISH GREEN, FOR INSIDE BLINDS, FENDERS, &c.—The work must first be painted over with a light lead color, and, when dry, grind some white lead in spirits of turpentine ; afterwards take about ⅓ in bulk of verdigris, which has been ground stiff in linseed oil ; then mix them both together, and put into a little resin varnish, sufficient only to bind the color. When this is hard, which will be the case in 15 minutes, pour into the color some resin to give it a good gloss. Then go over the work a second time and, if required, a third time. Thus you will have a cheap and beautiful green, with a high polish. It possesses a very drying quality, as the work may be completed in a few hours. The tint may be varied according to taste, by substituting mineral green for verdigris ; and if a bright grass-green is required, add a little Dutch pink to the mixture. N.B.—This color must be used when quite warm, to give the varnish a uniform extension.

COMPOUND GREENS.—This is a mixture of whiting, indigo and Dutch pink, the intensity of which may be increased or diminished by the addition of blue or yellow. These mixtures will not admit of any fixed rules in regard to the quantities of the matters used in their composition. They must depend on the taste of the artist and the tone he is desirous of giving to the color.

PEA GREEN.—Take one pound of genuine mineral green, one pound of the precipitate of copper, one pound and a half of blue verditer, three pounds of white lead, three ounces of sugar of lead, and three ounces of burnt white vitriol. Mix the whole of these ingredients in linseed oil, and grind them quite fine. It will produce a bright mineral pea-green paint, preserve a blue tint and keep any length of time in any climate, without injury, by putting water over it. To use this color for house or ship painting, take one pound of the green paint with some pale boiled oil, mix them well together, and this will produce a strong pea-green paint. The tint may be altered at pleasure, by adding a proportionate quantity of white lead to the green, which may be ground in linseed oil, and thinned with spirits of turpentine for use. It may also be used for painting Venetian window blinds, by adding white lead and mixing the color with boiled oil. For all the aforesaid preparations it will retain a blue tint, which is very desirable.

FOR KNOTTING.—One pint of vegetable naphtha, 1 tablespoonful of red lead, ¼ pint of japanners' gold size, 7 ozs. of orange shellac, mix all together, set in a warm place to dissolve, and frequently shake. *Another.*—Mix white lead, or red lead powder, in strong glue size, and apply it warm.

WHITE LEAD.—The most usual method of manufacturing white lead is that known as the Dutch method. It consists in exposing lead, cast in thin gratings, to the combined action of acetic acid, moist air and carbonic acid gas. The gratings are supported a little above the bottom of earthen pots, similar to flower pots, in each of which a small quantity of weak acetic acid is placed. The pots are built up in alternate layers with spent tanners' bark, until a stack is formed, each layer of pots being covered with a board. Fermentation soon takes place in the tan, and serves the double place of generating heat and supplying carbonic acid. After the lapse of six or eight weeks, the metallic lead is found converted into white masses of carbonic mixed with hydrated oxide. It is then levigated, washed, dried, and ground with oil.

To Cure Damp Walls.—Boil 2 ozs. of grease with 2 quarts of tar, for nearly twenty minutes, in an iron vessel, and have ready pounded glass, 1 lb. ; slaked lime, 2 lbs. ; well dried in an iron pot and sifted through a flour sieve ; add some of the lime to the tar and glass, to make it the thickness of thin paste, sufficient to cover a square foot at a time, as it hardens so quick. Apply it about an eighth of an inch thick.

To Protect Wood and Brick work from Damp Weather.—Take 3 pecks of lime, slaked in the air, 2 pecks of wood-ashes, and 1 peck of white sand. Sift them fine, and add linseed oil sufficient to use with a paint brush : thin the first coat ; use it as thick as it will work for the second coat, grind it fine, or beat it in a trough, and it is a good composition.

Putty for Repairing Broken Walls.—The best putty for walls is composed of equal parts of whiting and plaster of Paris, as it quickly hardens. The walls may be immediately colored upon it. Some painters use whiting with size ; but this is not good, as it rises above the surface of the walls, and shows the patches when the work is finished. Lime must not be used as putty to repair walls, as it will destroy almost every color it comes in contact with.

Instructions for Sign Writing, with the Colors to be used for the Ground and Letters.—On an oak ground, ornamental letters, in ultramarine blue, filled in with gold and silver leaf, blocked up and shaded with burnt sienna. *Another.*—Gold letters on a white marble ground, blocked up and shaded with a transparent brown or burnt sienna. *On glass.*—Gold letters, shaded with burnt sienna. *Another.*—Gold letters, shaded with black, on a scarlet or chocolate ground. On a rich blue ground, gold letters, double shaded, black and white. White letters on a blue ground, shaded with black, look very well. On a purple ground, pink letters shaded with white. Mix ultramarine and vermilion for a ground color, white letters shaded with a light grey. Vermilion ground, chrome yellow, stained with vermilion and lake, for the letters, shaded black. A substitute for the above colors: Rose pink and red lead; and for the letters, stone yellow, white lead and Venetian red. A good substitute for gold is obtained by grinding white lead, chrome yellow, and a dust of vermilion together. Mix your colors for writing in boiled oil, and use for drier gold size. Other good grounds for gold letters are: blues, vermilion, lake, and Saxon. When your sign is ready for gilding, follow the directions given under the head of *"To Gild Letters on Wood."*

To Give Lustre to a Light Blue Ground.—After the letters are written and dry, paint the ground over again, between the letters, with the same color, and while wet take pulverized Prussian blue and sift over the surface; glass, frost, or smalts may be used instead of or with the blue. When dry, brush off the loose particles.

Gilders' Gold Size.—Drying or boiled linseed oil, thickened with yellow ochre, or calcined red ochre, and carefully reduced to the utmost smoothness by grinding. Thin with oil of turpentine.

To Gild Letters on Wood, &c.—When your sign is prepared as smooth as possible, go over it with a sizing made by white of an egg dissolved in about four times its weight of cold water; adding a small quantity of fuller's earth, this to prevent the gold sticking to any part but the letters. When dry, set out the letters and commence writing, laying on the size as thinly as possible, with a sable pencil. Let it stand until you can barely feel a slight stickiness, then go to work with your gold leaf, knife, and cushion, and gild the letters Take a leaf up on the point of your knife, after giving it a slight puff into the back part of your cushion, and spread it on the front part of the cushion as straight as possible, giving it another slight puff with your mouth to flatten it out. Now cut it into the proper size, cutting with the heel of your knife forwards. Now rub the tip lightly on your hair; take up the gold on the point, and place it neatly on the letters; when they are all covered get some very fine cotton wool, and gently rub the gold until it is smooth and bright. Then wash the sign with clean water to take off the egg size. *See Gilding on Wood.*

To Use Smalts.—For a gold lettered sign, lay out on a lead color or white surface the line of letters, and roughly size the shape of each letter with *fat oil size.* This must be allowed at least 12 hours to get tacky and ready for gilding. After the gold leaf is laid and perfectly dry, mix up (for blue smalts) Prussian blue and keg lead with oil, adding a little dryer. Outline carefully around the letters, and fill up all the outside with blue paint; then with a small sieve sift on the smalts, allowing the sign to lay horizontally. Cover every part with plenty of smalts, and allow it to remain unmolested until the paint is dry. Then carefully shake off the surplus smalts, and the work is done.

Superfine Size for Gilding.—Good drying oil, 1 lb.; pure gum animi, powdered, 4 ozs.; bring the oil almost to the boiling point in a covered metal pot, add your gum gradually and cautiously to the oil, stirring all the time to dissolve completely. Boil to a tarry consistency and strain while warm through silk into a warm bottle with a wide mouth; keep it well corked; use as required, thinning with turpentine. This is the celebrated Birmingham "secret size," and is unequalled for tenacity and durability. *Size to fix the Pearl on Glass Signs.* 1. Copal varnish 1 part, Canada balsam 2 parts. 2. Pure mastic varnish. 3. Pale, quick drying copal varnish.

To Paint Banners, &c., on Cloth or Silk.—Stretch the fabric upon a frame, and finish your design and lettering. Use a size made of bleached shellac dissolved in alcohol, thinned to the proper consistence, go over such parts as are to be gilded or painted, overrunning the outlines slightly, to prevent the color from spreading. For inside work the white of an egg makes a good size; lay the gold while the size is still wet, when dry, dust off the surplus gold, and proceed with the shading, painting, &c. A little honey, combined with thick glue, is another good size.

JAPANNED TIN SIGNS.—Draw your letters on paper to suit your piece of tin, having first cleaned it with diluted alcohol and a piece of cotton. This will remove any grease or other matter that might hold the gold. Then take some whiting and rub it over the back of the paper upon which your design is made and lay it upon the Japanned tin. Next place a weight upon the four corners of the paper, or otherwise fix it securely to the tin; then, with a fine pointed piece of hard wood, trace the design carefully, bearing upon the paper with the point just hard enough to cause the whiting on the under side of the paper to adhere to the tin, and after going carefully over the whole, you will have transferred the entire design in fine white outline to the tin you are to finish it upon. Now size with oil size, and when dry enough for gilding, lay on the gold leaf and dab it down thoroughly, afterwards brushing off the loose gold with your flat camel-hair brush or cotton.

CHANGEABLE SIGNS.—Make a wooden sign in the usual manner, and have a projecting moulding around it. Now cut thin grooves into the moulding, an inch apart, allowing each cut to reach to the surface of the sign. In each of these grooves insert strips of tin one inch wide; and long enough to reach quite across the sign board. When all are fitted, take out the tin strips, and placing them edge to edge on a level table, paint any desired words on their united surface; when dry, reverse them and paint other words on the opposite side. Now finish your lettering as usual on the wooden sign board, and when dry, insert the painted tin strips in correct order in the grooves. This will present the curious novelty of three signs in one, as viewed from different positions.

TRANSPARENT CLOTH.—Dissolve together white rosin, pulverized, 8 ozs., bleached linseed oil 6 ozs., white beeswax 1½ ozs., add the turpentine while hot. Apply to both sides of the cloth while it is stretched tight. A good vehicle for mixing colors for painting on cloth or paper is gum shellac dissolved in alcohol.

TINSELLED LETTER GLASS SIGNS.—Paint the ground-work of your sign, on glass, any desired color, but be careful to leave the lettering or design naked, after it is dry, take any of the fancy colored copper or tin foils, crumple them in your hand and apply them over the black lettering, &c., after partially straightening them out.

TO INCRUST WINDOW GLASS WITH JEWELS.—Dissolve dextrine in a concentrated solution of sulphate of magnesia, sulphate of zinc, sulphate of copper or other metallic salts, strain the liquid and brush a thin coat of it over the glass and dry slowly at the ordinary temperature, keeping the glass level. For protection it may be varnished. The effect produced is that of an incrustation of diamonds, sapphires, &c., according to the color of the salt used.

TO PAINT IN IMITATION OF GROUND GLASS.—Grind and mix white lead in three-fourths of boiled oil and one-fourth spirits of turpentine, and to give the mixture a very drying quality, add sufficient quantities of burnt white vitriol and sugar of lead. The color must be exceedingly thin, and put on the panes of glass with a large sized paint brush in as even a manner as possible. When a number of the panes are thus painted, take a dry duster quite new, dab the ends of the bristles on the glass in quick succession, till you give it a uniform appearance. Repeat this operation till the work appears very soft.

and it will then appear like ground glass. When the glass requires fresh painting, get the old coat off first by using strong pearl-ash water. *Another Method.*—Spirits of salts, 2 ozs.; oil of vitriol, 2 ozs.; sulphate of copper, 1 oz.; gum arabic, 1 oz.; mix all well together, and dab on the glass with a brush. *Another.*—Dab your squares regularly over with putty; when dry, go over them again; the imitation will be complete.

PAINTING ON GLASS.—Take clear rosin, 1 oz., melt in an iron vessel. When all is melted, let it cool a little, but not harden; then add oil of turpentine sufficient to keep it in a liquid state. When cold, use it with colors ground in oil.

HARD DRYING PAINT.—Grind Venetian red, or any other color you wish, in boiled oil; then thin it with black japan. It will dry very hard for counter tops, &c.

PASTE FOR PAPER HANGINGS, BOOKS, PAPER BOXES, &c.—Good wheat flour, sifted, 4 lbs., make it into a stiff batter with cold water in a pail, beat it well to break the lumps, then add pulverized alum, 2 ozs. Into this pour boiling water, hissing hot from the fire, stirring the batter thoroughly all the time. As it cooks it swells and loses its white color, and when cold, will make about ¾ of a pail of thick paste. Thin with cold water to adapt it for easy use with the brush. For painted or varnished walls, add ½ oz., pulverized rosin to each 2 qts. paste, and reduce the mass with thin gum arabic or glue water. A little pulverized corrosive sublimate will enhance the keeping qualities of paste, but alum used as above will do very well.

TO REMOVE OLD PAINT.—Sal sóda, 2 lbs.; lime, ¼ lb.; *hot* water, 1 gal.; rummage all together and apply to the old paint while warm. It will soon loosen the paint so that you can easily remove it. Another simpie method is to sponge over your old paint with benzine, set it on the fire, and you can then flake off the paint as quick as you like. Do not attempt to go over too much surface at a time, otherwise you might get more to do than you can attend to.

REFUSE PAINT AND PAINT SKINS.—Dissolve sal soda, ½ lb., in rain water, 1 gal.; cover the refuse paint for 2 days, then heat it, adding oil to reduce it to a proper consistence for painting and straining.

SPIRIT GRAINING FOR OAK.—Two pounds of whiting, quarter of a pound of gold size, thinned down with spirits of turpentine; then tinge your whiting with Vandyke brown and raw sienna, ground fine. Strike out your lights with a fitch dipped in turpentine, tinged with a little color to show the lights. If your lights do not appear clear, add a little more turpentine. Turpentine varnish is a good substitute for the above mentioned. This kind of graining must be brushed over with beer, with a clean brush, before varnishing. Strong beer must be used for glazing up top-graining and shading.

OIL FOR GRAINING OAK.—Grind Vandyke brown in turpentine, add as much gold size as will set, and as much soft soap as will make it stand the comb. Should it set too quickly, add a little boiled oil. Put a teaspoonful of gold size to half a pint of turpentine, and as much soap as will lie on a twenty-five cent piece, then take a little soda mixed with water and take out the veins.

TO PREPARE THE GROUND FOR OAK ROLLERS.—Stain your white lead with raw sienna and red lead, or with chromo yellow and Venetian red; thin it with oil and turps, and strain for use. When the ground work is dry, grind in beer, Vandyke brown, whiting and a little burnt sienna, for the graining color; or you may use raw sienna with a little whiting, umbers, &c.

To Imitate Old Oak.—To make an exceedingly rich color for the imitation of old oak, the ground is a composition of stone ochre or orange chrome and burnt sienna; the graining color is burnt umber or Vandyke brown, to darken it a little. Observe that the above colors must be used whether the imitation is in oil or distemper. When dry, varnish.

To Imitate Old Oak, in Oil.—Grind Vandyke and whiting in turpentine, add a bit of common soap to make it stand the comb, and thin it with boiled oil.

To Imitate Pollard Oak.—The ground color is prepared with a mixture of chrome yellow, vermilion, and white lead, to a rich light buff. The graining colors are Vandyke brown and small portions of raw and burnt sienna and lake ground in ale or beer. Fill a large tool with color, spread over the surface to be grained, and soften with the badger hair brush. Take a moistened sponge between the thumb and finger, and dapple round and round in kind of knobs, then soften very lightly; then draw a softener from one set of knobs to the other while wet, to form a multiplicity of grains, and finish the knots with a hair pencil, in some places in thicker clusters than others. When dry put the top grain on in a variety of directions, and varnish with turps and gold size; then glaze up with Vandyke and strong ale. To finish, varnish with copal.

To Imitate Mottled Mahogany.—The ground is prepared with the best English Venetian red, red lead, and a small portion of white lead. The graining colors are burnt sienna, ground in ale, with a small portion of Vandyke brown, sufficient to take away the fiery appearance of the sienna. Cover the surface to be grained, soften with the badger hair brush, and while wet take a mottling-roller and go over the lights a second time, in order to give a variety of shade, then blend the whole of the work with the badger softener. Put the top grain on with the same color. When dry, varnish.

To Imitate Rosewood.—Mix vermilion and a small quantity of white lead for the ground. Take rose pink, tinged with a little lampblack, or Vandyke brown, and grind very fine in oil, then take a flat graining brush, with the hairs cut away at unequal distances, and cut down the grain as if wending round a knot. When nearly dry, take a graining comb that is used for oak, and draw down the grain. This will give it the appearance of nature. When dry, varnish. *Another.*—The ground color is prepared with vermilion and small quantities of white lead and crimson lake. When the ground is dry and made very smooth, take Vandyke brown, ground in oil, and with a small tool spread the color over the surface in different directions forming kind of knots. Before the work is dry, take a piece of leather, and with great freedom strike out the light veins; having previously prepared the darkest tint of Vandyke brown, or gum asphaltum, immediately take the flat graining brush with few hairs in it, draw the grain over the work and soften. When varnished, the imitation will be excellent.

Another Rosewood Imitation in Size.—Mix Venetian red, white lead powder, vermilion and common size, the consistency of which, when cold, must be that of a weak trembling jelly. With this composition paint the work twice over. When the ground is dry, take some lampblack, finely ground in beer, and beat the white of an egg into it; take the flat graining brush, dipped in the black, and put on the grain. When dry, stain the first coat of varnish with rose pink, finely ground in turpentine, and finish the work by giving it a coat of clear varnish

To Imitate Bird's-eye Maple.—The ground is a light buff, prepared with white lead, chrome yellow, and a little vermilion or English Venetian red, to take off the rawness of the yellow. The graining color is equal parts of raw umber and sienna ground in oil to the proper consistency. Spread the surface of the work with this color, and, having some of the same prepared a little thicker, immediately take a sash tool or sponge, and put on the dark shades, and soften with the badger's-hair brush before the color is dry put on the eyes by dabbing the dotting machine on the work. When dry, put on the grain with the camel's-hair pencil on the prominent parts, to imitate the small hearts of the wood. When dry, varnish.

To Imitate Curled Maple.—Prepare a light yellow for the ground, by mixing chrome yellow and white lead, tinged with Venetian red. The graining color is a mixture of equal portions of raw sienna and Vandyke, ground in ale; spread the surface to be grained in an even manner; then with a piece of cork rub across the work to and fro, to form the grains which run across the wood. When dry, varnish.

Curled Maple in Oil for Outside Work.—Prepare a rich ground by mixing chrome yellow, white lead and burnt sienna. For the graining color, grind equal parts of raw sienna and umber with a little burnt copperas in turpentine, and mix with a small quantity of grainer's cream. Thin the color with boiled oil; then fill a tool and spread the surface even, and rub out the lights with the sharp edge of a piece of buff leather, which must now and then be wiped to keep it clean; soften the edges of the work very lightly, and when dry, put on the top grain with burnt umber and raw sienna, ground in ale, with the white of an egg beat into it. When dry, varnish.

Satinwood.—This ground is prepared with white lead, stone ochre, and small quantities of chrome yellow and burnt sienna. The graining color is one-third of raw sienna and whiting, ground in pale ale, very thin; then spread the color over the surface to be grained. While wet, soften, and have ready a wet roller or mottling brush, in order to take out the lights; blend the whole with the badger's-hair brush. When the work is dry, take the flat brush, and with the same color, put on the top again. When dry, varnish.

To Imitate Yew Tree.—The ground is a reddish buff. For the graining color grind in ale equal portions of Vandyke brown and burnt sienna, with a small quantity of raw sienna. When the ground is dry, spread the surface even with the color, and soften; then with a piece of cork with a sharp edge, rub the work cross and cross in order to form the fine grain. When dry, dip the tip of your fingers in the graining color to form the eyes or knots, and put in the small touches with a camel's-hair pencil. When dry, put on the top grain, and when this is dry, varnish.

To Imitate Black and Gold Marble.—This description of marble is now in great demand. The ground is a deep jet black, or a dead color, in gold size, drop black and turps: second coat, black japan. Commence veining; mix white and yellow ochre with a small quantity of vermilion to give a gold tinge; dip the pencil in this color, and dab on the ground with great freedom some large patches, from which small threads must be drawn in various directions. In the deepest parts of the black, a white vein is sometimes seen running with a great number of small veins attached to it; but care must be taken that these threads are connected with, and run in some degree in the same direction with the thicker veins. If durability is not an object and the work is required in a short time, it may be executed very quick in distemper colors, and when varnished, it will look well.

Red Marble.—For the ground, put on a white tinged with lake or vermilion; then apply deep rich reds in patches, filling up the intermediate spaces with brown and white mixed in oil; then blend them together; if in quick drying colors, use about half turps and gold size. When dry, varnish; and while the varnish is wet, put in a multitude of the fine white threads, crossing the whole work in all directions, as the wet varnish brings the pencil to a fine point.

Jasper Marble.—Put on a white ground lightly tinged with blue; then put on patches of rich reds or rose pink, leaving spaces of the white grounds; then partly cover those spaces with various browns to form fossils, in places running veins; then put in a few spots of white in the centre of some of the red patches, and leaving in places masses nearly all white. When dry, use the clearest varnish.

Blue and Gold Marble.—For the ground put on a light blue; then lake blue, with a small piece of white lead and some dark common blue, and dab on the ground on patches, leaving portions of the ground to shine between; then blend the edges together with duster or softener; afterwards draw on some white veins in every direction, leaving large open spaces to be filled up with a pale yellow or gold-paint; finish with some fine white running threads, and a coat of varnish at last.

To Imitate Granite.—For the ground color, stain your white lead to a light lead color, with lampblack and a little rose pink. Throw on black spots, with a graniting machine, a pale red, and fill up with white before the ground is dry.

Another.—A black ground, when half dry, throw in vermilion, a deep yellow and white spots.

To Imitate Hair Wood.—For the ground color, take white lead and thin it with turpentine, and slightly stain it with equal quantities of Prussian blue and lampblack. For the graining color, grind in ale a mixture of Prussian blue and raw sienna; when the ground is dry, spread a transparent coat of the graining color on the surface of the work, and soften; then with the cork, mottle by rubbing it to and fro across the work, to form the fine long grain or mottle. When this is done, soften and top grain in wavy but perpendicular directions; varnish when dry.

Substitute for White Lead.—Sulphate of barytes ground in oil and applied like paint. It can also be used to reduce white lead to any desired extent.

Paint for Black Boards in Schools.—Common glue, 4 oz.; flour of emery, 3 oz.; and just lampblack enough to give an inky color to the preparation. Dissolve the glue in $\frac{3}{4}$ qt. of warm water, put in the lampblack and emery, stir till there are no lumps, then apply to the board with a woollen rag smoothly rolled. Three coats are amply sufficient.

Compound Iron Paint.—Finely pulverized iron filings, 1 part; brick dust, 1 part; and ashes, 1 part. Pour over them glue-water or size, set the whole near the fire, and, when warm, stir them well together. With this paint cover all the wood work which may be in danger; when dry, give a second coat, and the wood will be rendered incombustible.

Filling Compositions—12 kinds.—1. Work finished in oil should receive a substantial filling consisting of equal parts by weight of whiting, plaster of Paris, pumice-stone, and litharge, to which may be added a little French yellow, asphaltum, Vandyke brown, and *terra di sienna.* Mix with 1 part japan, 2 of boiled oil, and 4 of turpentine. Grind fine in a mill. Lay the filling on with a brush, rub it in well, let it set 20 minutes, then rub off clean. Let it harden for some time, rub smooth, and if required, repeat the process. When the filling is all right, finish with linseed oil, applying with a brush, wipe off, and rub to a polish with fine cotton, and finish with any fine fabric. Some fill with rye flour, wheat flour, corn starch, Paris white, &c., ground fine in oil and turpentine, but when work is to be varnished, such filling should previously receive one or two good coats of shellac. 2. Boiled linseed oil, 1 qt.; turpentine: 3 qts.; corn starch, 5 lbs.; japan, 1 qt.; calcined magnesia, 2 oz. Mix thoroughly. 3. Whiting, 6 ozs.; Japan, $\frac{1}{2}$ pt.; boiled linseed oil, $\frac{3}{4}$ pt.; turpentine, $\frac{1}{2}$ pt.; corn starch, 1 oz.: mix well together and apply to the wood. On walnut wood add a little burnt umber; on cherry a little Venetian red, to the above mixture. 4. On furniture apply a coat of boiled linseed oil, then immediately sprinkle dry whiting upon it, and run it in well with your hand or a stiff brush, all over the surface; the whiting absorbs the oil, and fills the pores of the wood completely. For black walnut, add a little burned umber to the whiting; for cherry, a little Venetian red, &c., according to the color of the wood. Turned work can have it applied while in motion in the lathe. Furniture can afterwards be finished with only one coat of varnish. 5. Terra alba is a very good and very cheap filling. Many painters have been most shamefully imposed on by parties selling the stuff at a high price. 6. *Furniture Pastes.*—Beeswax, spts. turpentine and linseed oil, equal parts; melt and cool. 7. Beeswax, 4 ozs.; turpentine, 10 ozs.; alkanet root to color; melt and strain. 8. Beeswax, 1 lb.; linseed oil, 5 ozs.; alkanet root, $\frac{1}{2}$ oz., melt and add 5 ozs. turpentine, strain and cool. 9. Beeswax, 4 ozs.; rosin, 1 oz.; oil of turpentine, 2 ozs.; digest until sufficiently colored, then add beeswax till dissolved, then add beeswax scraped small, 4 ozs.; put the vessel into hot water, and stir till dissolved. If wanted *pale* the alkanet root should be omitted. 10. (White.) White wax, 1 lb.; liquor of potassa, $\frac{1}{2}$ gal.; boil to a proper consistency. 11. Beeswax, 1 lb.; soap, $\frac{1}{4}$ lb.; pearlash, 3 ozs., dissolved in water, $\frac{1}{2}$ gal.; strain and boil as the last. 12. Yellow wax, 18 parts; rosin, 1 part; alkanet root, 1 part; turpentine, 6 parts; linseed oil 6 parts. First steep the alkanet in oil with heat, and, when well colored, pour off the clear on the other ingredients, and again heat till all are dissolved. 13. *Furniture Cream.*—Beeswax, 1 lb.; soap, 4 ozs.; pearlash, 2 ozs.; soft water, 1 gal., boil together until mixed.

To Repair the Silvering of Mirrors.—Pour upon a sheet of tin foil 3 drs. of quicksilver to the square foot of foil. Rub smartly with a piece of buckskin until the foil becomes brilliant. Lay the glass upon a flat table, face downwards, place the foil upon the damaged portion of the glass, lay a sheet of paper over the foil, and place upon it a block of wood or a piece of marble with a perfectly flat surface; put upon it sufficient weight to press it down tight; let it remain in this position a few hours. The foil will adhere to the glass.

Pencils for Writing on Glass.—Stearic acid, 4 pts.; mutton-suet, 3 pts.; wax 2 pts; melt together and add 6 parts of red lead, and 1 pt. purified carbonate of potassa, previously triturated together; set aside for an hour in a warm situation, stirring frequently; then pour into glass tubes or hollow reeds.

Polishes—15 kinds.—1. *Carvers' Polish.*—White resin, 2 oz.; seedlac, 2 oz.; spirits of wine, 1 pt. Dissolve. It should be laid on warm. Avoid moisture and dampness when used. 2. *French Polish.*—Gum shellac, 1 oz.; gum arabic, ¼ oz.; gum copal, ¼ oz. Powder, and sift through a piece of muslin; put them in a closely corked bottle with 1 pt. spirits of wine, in a very warm situation, shaking every *day* till the gums are dissolved; then strain through muslin, and cork for use. 3. *Polish for Dark-colored Woods.*—Seedlac, 1 oz.; gum guaiacum, 2 drs.; dragon's blood, 2 drs.; gum mastic, 2 drs.; put in a bottle with 1 pt. spirits of wine, cork close, expose to a moderate heat till the gums are dissolved; strain into a bottle for use, with ¼ gill of linseed oil; shake together. 4. *Waterproof Polish.*—Gum benjamin, 2 ozs.; gum sandarac, ¾ oz.; gum anima, ¼ oz.; spirits of wine, 1 pt.; mix in a closely stopped bottle, and place either in a sand bath or in hot water till the gums are dissolved, then strain off the mixture, shake it up with ¼ gill of the best clear poppy oil, and put it by for use. 5. *Finishing Polish.*—Gum shellac, 2 drs.; gum benjamin, 2 drs.; put into ½ pt. best rectified spirits of wine in a bottle closely corked; keep in warm place, shaking frequently till the gums are dissolved. When cold, shake up with it two teaspoonfuls of the best clear poppy oil. 6. *Polish for Removing Stains, Spots, and Mildew from Furniture.*—Take of 98 per cent. alcohol, ½ pint; pulverized resin and gum shellac, of each, ¼ oz. Let these cut in the alcohol; then add linseed oil, ½ pt.; shake well, and apply with a sponge, brush, or cotton flannel, or an old newspaper, rubbing it well after the application, which gives a nice polish. 7. *Polish for Reviving Old Furniture.*—Take alcohol, 1½ oz.; spirits of salts (muriatic acid), ½ oz.; linseed oil, 8 oz,; best vinegar, ½ pt.; and butter of antimony, 1½ oz.; mix, putting in the vinegar last. 8. *Jet or Polish for Wood or Leather, Black, Red, or Blue.*—Alcohol (98 per cent.), 1 pt.; sealing wax, the color desired, 3 sticks; dissolve by heat, and have it warm when applied. A sponge is the best to apply it with. 9. *Polish for Turners' Work.*—Dissolve sandarac, 1 oz., in spirit of wine, ½ pt.; next shave beeswax, 1 oz.; and dissolve it in a sufficient quantity of spirits of turpentine to make it into a paste, add the former mixture by degrees to it, then with a woolen cloth apply it to the work while it is in motion in the lathe, and with a soft linen rag polish it. It wil appear as if highly varnished. 10. *Furniture Polish.*—Beeswax, ½ lb., and ¼ of an oz. of alkanet root; melt together in a pipkin until the former is well colored. Then add linseed oil and spirits of turpentine, of each half a gill; strain through a piece of coarse muslin. 11. *French Polishes.*—1. Shellac, 3 lbs.; wood naphtha, 3 pts.; dissolve. 2. Shellac, 2 lbs.; powdered mastic and sandarac, of each 1 oz.; copal varnish, ½ pint; spirits of wine, 1 gal. Digest in the cold till dissolved. 12. *Black Walnut Polish.*—Take pulverized asphaltum; put it in a jar or bottle, pour over it about twice its bulk of turpentine or benzole, put in a warm place, and shake occasionally; when dissolved, strain, and apply it to the wood with a cloth or stiff brush; should it prove too dark, dilute with turpentine or benzole. If desired to bring out the grain still more, apply a mixture of boiled oil and turpentine; this is better than oil alone When the oil is dry, the wood can be polished with the following: shellac varnish, 2 parts, boiled oil, 1 part; shake it well before using Apply with a cloth, rubbing briskly. 13. *To Polish Wood.*—Take a piece of pumice-stone and water, and pass repeatedly over the work until the rising of the grain is cut down. Then take powdered tripoli and boiled linseed oil, and polish the work to a bright surface 14. *Clock Case and Picture Frame Finish.*—Copal varnish, 2 lbs.; linseed oil varnish, ½ oz.; mix well, shake often, and place in a warm spot The wood to be varnished is prepared with a thin coat of glue-water, and rubbed down with fine pumice-stone or something equivalent In light-colored wood, a light pigment, such as chalk, is added to the glue-water; in dark wood, a dark pigment is added When ready, the articles are varnished with the above mixture, and, after drying, rubbed with a solution of wax in ether, thereby receiving a high polish 15 *White Polish for White Woods.*—White bleached shellac, 3 ozs.; white gum benzoin, 1 oz.; gum sandarac, ½ oz.; spirits of wine or naphtha, 1 pt. Dissolve.

Oil Finishes.—1. Linseed oil, 16 ozs.; black resin, 4 ozs.; vinegar, 4 ozs.; rectified spirits, 3 ozs.; butter of antimony, 10 ozs.; spirit of salts, 2 ozs.; melt the resin, add the oil, take it off the fire, and stir in the vinegar; let it boil for a few minutes, stirring it; when cool, put it into a bottle, add the other ingredients, shaking all together. 2. Linseed oil, 1 pt.; oil of turpentine, ½ pt.; rectified spirits, 4 ozs.; powdered resin, 1½ oz.; rose pink, ½ oz.; mix. 3. Acetic acid, 2 drs.; oil of lavender, ½ dr.; rectified spirits, 1 dr.; linseed oil, 4 ozs. 4. Linseed oil, 1 pt.; alkanet root, 2 ozs.; heat, strain, and add lac varnish, 1 oz. 5. Linseed oil, 1 pt.; rectified spirits, 2 ozs.; butter of antimony, 4 ozs. 6. Linseed oil, 1 gal.; alkanet root, 3 ozs.; rose pink, 1 oz. Boil them together ten minutes, and strain so that the oil be quite clear.

Fancy Figures on Wood.—Slake some lime in stale urine. Dip a brush in it, and form on the wood figures to suit your fancy. When dry, rub it well with a rind of pork.

Stains for Wood.—1. *Cheap Black Walnut Stain.*—Burnt umber, 2 parts; rose pink, 1 part; glue, 1 part; water sufficient; heat all together and dissolve completely, apply to the work first with a sponge, then go over it with a brush, and varnish over with shellac. 2. *Ebony Stain.*—Drop black, 2 parts; rose pink, 1 part; turpentine, a sufficient quantity. 3. *Bright Yellow Stain.*—1. Brush over with the tincture of turmeric. 4. Warm the work, and brush it over with weak aquafortis; varnish or oil as usual. 5. A very small bit of aloes put into the varnish will give a rich yellow color to the wood. 6. *Extra Black Stain for Wood.*—Pour 2 quarts boiling water over 1 oz. of powdered extract of logwood, and, when the solution is affected, 1 dr. of yellow chromate of potash is added, and the whole well stirred. It is then ready for use as a wood-stain, or for writing ink. When rubbed on wood, it produces a pure black. Repeat with 2, 3, or 4 applications, till a deep black is produced. 7. *Imitation of Mahogany.* Let the first coat of painting be white lead, the second orange, and the last burnt umber or sienna: imitating the veins according to your taste and practice. 8. *To Imitate Wainscot.*—Let the first coat be white; the second, half white and yellow ochre; and the third, yellow ochre only; shadow with umber or sienna. 9. *To Imitate Satin Wood.*—Take white for your first coating, light blue for the second, and dark blue or dark green for the third. 10. *Rosewood Stain, very bright shade—Used Cold.*—Take alcohol, 1 gal.; camwood, 2 oz.; set them in a warm place 24 hours; then add extract of logwood, 3 oz.; aquafortis, 1 oz.; and when dissolved, it is ready for use; it makes a very bright ground like the most beautiful rosewood; 1, 2, or more coats as you desire. 11. *Cherry Stain.*—Rain water, 3 qts.; annatto, 4 oz.; boil in a copper kettle till the annatto is dissolved, then put in a piece of potash the size of a walnut; keep it on the fire about half an hour longer, and it is ready to bottle for use. 12. *Rosewood Stain, very bright shade.*—Equal parts of logwood and redwood chips, boil well in water sufficient to make a strong stain; apply it to the furniture while hot; 2 or 3 coats according to the depth of color desired. 13. *Rose Pink Stain and Varnish.*—Put 1 oz. of potash in 1 qt. water, with red sanders, 1½ ozs.; extract the color from the wood and strain: then add gum shellac, ½ lb., dissolve it by a brisk fire. Used upon logwood stain for rosewood imitation. 14. *Blue Stain for Wood.* 1. Dissolve copper filings in aquafortis, brush the wood with it, and then go over the work with a hot solution of pearlash (2 oz. to 1 pt. of water) till it assumes a perfectly blue color. 15. Boil 2 ozs. of indigo, 2 lbs. wood, and 1 oz. alum, in 1 gal. water, brush well over until thoroughly stained. 16. *Imitation of Botany-Bay Wood.*—Boil ½ lb. French berries (the unripe berries of the *Rhamnus infectorius*) in 2 qts. water till of a deep yellow, and while boiling hot, give 2 or 3 coats to the work. If a deeper color is desired, give a coat of logwood decoction over the yellow. When nearly dry, form the grain with No. 8, *black stain*, used hot, and, when dry, rust and varnish. 17. *Mahogany Color—Dark.*—1. Boil ½ lb. of madder and 2 ozs. logwood chips in a gallon of water, and brush well over while hot; when dry go over the whole with pearlash solution, 2 drs. to the quart. 2. Put 2 ozs. dragon's blood, bruised, into a quart of oil of turpentine; let the bottle stand in a warm place, shake frequently, and, when dissolved, steep the work in the mixture. 18. *Box-wood Brown Stain.*—Hold your work to the fire, that it may receive a gentle warmth; then take aquafortis, and, with a feather, pass it over the work till you find it change to a fine brown (always keeping it near the fire), you may then varnish or polish it. 19. *Light Red Brown.* Boil ½ lb. madder and ¼ lb. fustic in 1 gal. water:

brush over the work, when boiling hot, until properly stained. 20. The surface of the work being quite smooth, brush over with a weak solution of aquafortis, $\frac{1}{3}$ oz. to the pint; then finish with the following:—Put $4\frac{1}{2}$ ozs. dragon's blood and 1 oz. soda, both well bruised, to 3 pts spirits of wine, let it stand in a warm place, shake frequently, strain and lay on with a soft brush, repeating until of a proper color; polish with linseed oil or varnish. 21. *Purple.*—Brush the work several times with the logwood decoction used for *No. 6 Black;* and, when dry, give a coat of pearlash solution, 1 dr. to a quart; lay it on evenly. 22. *Red.*—1. Boil 1 lb. Brazil wood and 1 oz. pearlash in a gal. of water; and, while hot, brush over the work until of a proper color. Dissolve 2 ozs. alum in 1 qt. water, and brush the solution over the work before it dries. 23. Take a gallon of the above stain, add 2 ozs. more pearlash; use hot, and brush over with the alum solution. 24. Use a cold solution of archil, and brush over with the pearlash solution for *No. 1, Dark mahogany.* 25. *Mahogany Stain on Wood.*—Take nitric acid, dilute with 10 parts of water, and wash the wood with it. To produce *rosewood* finish, glaze the same with carmine of Munich lake. Asphaltum, thinned with turpentine, forms an excellent mahogany color on new work. 26. *Mahogany Stain on Maple.*—Dragon's blood, $\frac{1}{2}$ oz.; alkanet, $\frac{1}{4}$ oz.; aloes, 1 dr.; spirits of wine, 16 ozs.; apply it with a sponge or brush. 27. *Crimson Stain for Musical Instruments.*—Ground Brazil wood, 1 lb.; water, 3 qts.; cochineal, $\frac{1}{2}$ ounce; boil the Brazil with the water for an hour, strain, add the cochineal; boil gently for half an hour, when it will be fit for use. If you wish a *scarlet tint,* boil an ounce of saffron in a quart of water, and pass over the work before you stain it. 28. *Purple Stain.*—Chipped logwood, 1 lb.; water, 3 qts.; pearlash, 4 ounces; powdered indigo, 2 ounces. Boil the logwood in the water half an hour, add the pearlash and indigo, and when dissolved, you will have a beautiful purple. 29. *Green Stain.*—Strong vinegar, 3 pts.; best verdigris, 4 ounces, ground fine; sap green, $\frac{1}{2}$ ounce; mix together.

BLACK STAINS FOR WOOD.—1 Drop a little sulphuric acid into a small quantity of water; brush over the wood and hold it to the fire; it will be a fine black and receive a good polish. 2. For a beautiful black, on wood, nothing can exceed the *black Japan* mentioned under Tinsmiths' Department. Apply two coats; after which, varnish and polish it. 3. To 1 gal vinegar, add a quarter of a pound of iron rust; let it stand for a week; then add a pound of dry lampblack, and three-quarters of a pound copperas; stir it up for a couple of days. Lay on five or six coats with a sponge, allowing it to dry between each; polish with linseed-oil and a soft woollen rag, and it will look like ebony. Incomparable for iron work, ships' guns, shot, &c. 4. Vinegar, $\frac{1}{2}$ gal; dry lampblack, $\frac{1}{2}$ lb.; iron-rust sifted, 3 lbs.: mix and let stand for a week. Lay three coats of this on hot, and then rub with linseed oil, and you will have a fine deep black. 5. Add to the above stain, nut-galls, 1 oz.; logwood-chips, $\frac{1}{2}$ lb.; copperas, $\frac{1}{4}$ lb.; lay on three coats; oil well, and you will have a black stain that will stand any kind of weather, and is well adapted for ships' combings, &c. 6. Logwood-chips, $\frac{1}{2}$ lb.; Brazil-wood, $\frac{1}{4}$ lb.; boil for $1\frac{1}{2}$ hours in 1 gal. water. Brush the wood with this decoction while hot; make a decoction of nut-galls, by gentle simmering, for three or four days, a quarter of a pound of the galls in 3 qts. water; give the wood three coats, and, while wet, lay on a solution of sulphate of iron (2 ozs. to a quart), and, when dry, oil or varnish. 7. Give three coats with a solution of copper filings in aquafortis, and repeatedly brush over with the logwood decoction until the greenness of the copper is destroyed. 8. Boil ½ lb. logwood-chips in 2 quarts water; add an ounce of pearlash, and apply hot with a brush. Then take 2 qts. of the logwood decoction, and ½ oz. of verdigris, and the same of copperas; strain, and throw in ½ lb. of iron rust. Brush the work well with this, and oil.

BLACK WALNUT STAIN.—Spirits of turpentine, 1 gal.; pulverized asphaltum, 2 lbs.; dissolve in an iron kettle on a stove, stirring constantly. Can be used over a red stain to imitate rosewood. To make a perfect black add a little lampblack. The addition of a little varnish with the turpentine improves it.

CRYSTAL VARNISH, FOR MAPS, &c.—Canada balsam, 1 oz.; spirits of turpentine, 2 oz.; mix together. Before applying this varnish to a drawing or colored print, the paper should be placed on a stretcher, and sized with a thin solution of isinglass in water, and dried. Apply with a soft camel's-hair brush.

TO EBONIZE WOOD.—Mix up a strong stain of copperas and logwood, to which add powdered nut-gall. Stain your wood with this solution, dry, rub down well, oil, then use French polish made tolerably dark with indigo or finely powdered stone blue.

MISCELLANEOUS STAINS.—*Yellow* is produced by diluted nitric acid. *Red* is produced by a solution of dragon's blood in spirits of wine. *Black* is produced by a strong solution of nitric acid. *Green* is produced by a solution of verdigris in nitric acid; then, dipped in a hot solution pearlash produces a *Blue stain*. *Purple* is produced by a solution of sal-ammoniac in nitric acid.

BEAUTIFUL VARNISH FOR VIOLINS, &c.—Rectified spirits of wine, ½ gal.; add 6 oz. gum sandarac, 3 oz. gum mastic, and ½ pt. turpentine varnish; put the above in a tin can by the stove, frequently shaking till well dissolved: strain and keep for use. If you find it harder than you wish, thin with more turpentine varnish.

ANOTHER.—Heat together at a low temperature 2 qts. of alcohol, ½ pt. turpentine varnish, and 1 lb. clean gum mastic; when the latter is thoroughly dissolved, strain through a cloth.

VARNISH FOR FRAMES, ETC.—Lay the frames over with tin or silver foil by means of plaster of Paris, glue or cement of some kind, that the foil may be perfectly adherent to the wood; then apply your gold lacquer varnish, which is made as follows: Ground turmeric, 1 lb.; powdered gamboge, 1½ ounces; powdered sandarac, 3½ lbs.; powdered shellac, ¾ lbs.; spirits of wine, 2 gals.; dissolve and strain; then add turpentine varnish, 1 pt.; and it is ready for use.

DYES FOR VENEERS.—*A fine Black.*—Put 6 lbs. of logwood chips into your copper, with as many veneers as it will hold without pressing too tight, fill it with water, let it boil slowly for about 3 hours, then add ½ lb. of *powdered verdigris*, ½ lb. copperas, bruised gall-nuts 4 ozs.; fill the copper up with vinegar as the water envaporates; let it boil gently 2 hours each day till the wood is dyed through. *A fine Blue.*—Put oil of vitriol, 1 lb., and 4 ozs. of the best powdered indigo in a glass bottle. Set it in a glazed earthen pan, as it will ferment. Now put your veneers into a copper or stone trough; fill it rather more than one-third with water, and add as much of the vitriol and indigo (stirring it about) as will make fine blue, testing it with a piece of white paper or wood. Let the veneers remain till the dye has struck through. Keep the solution of indigo a few weeks before using it; this improves the color. *Fine Yellow.*—Reduce 4 lbs. of the root of barberry to dust by sawing, which put in a copper or brass trough; add turmeric, 4 ozs.; water, 4 gals.; then put in as many white holly veneers as the liquor will cover. Boil them together 3 hours, often turning them. When cool, add aquafortis, 2 oz., and the dye will strike through much sooner. *Bright Green.*—Proceed as in the previous receipt to produce a yellow; but, instead of aquafortis, add as much of the vitriolated indigo (see above, under blue dye) as will produce the desired color. *Bright Red.*—Brazil dust, 2 lbs.; add water, 4 gals. Put in as many veneers as the liquid will cover; boil them for 3 hours, then add alum, 2 oz., aquafortis, 2 oz.; and keep it luke-warm until it has struck through. *Purple.*—To 2 lbs. of chip logwood and ½ lb. Brazil dust, add 4 gals. of water; and after putting in your veneers, boil for 3 hours; then add pearlash, 9 ozs., and alum 2 oz.; let them boil for 2 or 3 hours every day till the color has struck through. *Orange.*—Take the veneers out of the above yellow dye, while still wet and saturated, transfer them to the bright red dye till the color penetrates throughout.

To improve the Color of Stains.—Nitric acid, 1 oz.; muriatic acid, ¼ teaspoonful; grain tin, ¼ oz.; rain water, 2 oz. Mix it at least 2 days before using, and keep your bottle well corked.

Strong Glue for Inlaying or Veneering.—Select the best light brown glue, free from clouds and streaks. Dissolve this in water, and to every pint add half a gill of the best vinegar and ½ oz. of isinglass. For other glues see Engineers' Department.

Inlaid Mother of Pearl Work, on sewing machines and other fancy work, is performed by selecting the thin scales of the shell and cementing them to the surface of the material; the rest of the surface is covered with successive coats of Japan varnish, generally black, being subjected to a baking process after each application. When the varnish is as thick as the shell, it is polished, the gilding and painting added, and a flowing coat of varnish put over the whole.

Another Method.—Prepare the job with a heavy coat of black Japan, then, before it is dry, procure flakes of pearl and lay them on the black surface, pressing them into the Japan until they are level with the surface; then with colors form vines and flowers, allowing the pearl to form the body of the flower leaf, and shade up all nicely.

Transparent Painting on Window Shades.—The muslin is spread on a frame and secured tightly with tacks, then sized with a mixture of fine flour paste, white glue, and white bar soap; the soap renders the muslin pliable and soft. A thin coat is applied, which is nearly invisible when dry. A coat of pure linseed oil, diluted with spirits of turpentine, is then applied, to the whole, or part, as desired; lay it on quickly and smoothly, to insure an even transparent surface. The colors used are, ivory black, ultramarine, Paris green, sienna, umber, verdigris, asphaltum, or other suitable colors. An outline of the design is drawn with a small pencil with black or umber, after which the colors may be applied, more or less diluted, as more or less transparency is desired. In general, the brightest colors should be applied first, and the darker shades over them. These colors must be laid evenly and smoothly with soft brushes, and should any part be made too dark, the best way is to scrape off with a stick before the color gets too dry. The best designs for shades consists of landscape views, and should always be designed to accommodate the form and position of the ground on which they are drawn. Stencils will be found useful on this work, in making corners or stripes for borders.

To Paint Magic Lantern Sides.—Transparent colors only are used for this work, such as lakes, sap-green, ultramarine, verdigris, gamboge, asphaltum, &c., mixed in oil, and tempered with light colored varnish (white Demar). Draw on the paper the design desired, and stick it to the glass with water or gum; then with a fine pencil put the outlines on the opposite side of the glass with the proper colors; then shade or fill up with black or Vandyke brown, as you find best.

Marine Paint for Metals in Salt Water.—Red lead 55 parts; quicksilver, 30 parts; thick turpentine, 7 parts. Mix with boiled linseed oil to the proper consistency. The quicksilver must be thoroughly amalgamated with the thick turpentine by grinding or rubbing, and this mixture must be ground with red lead and more boiled oil. As little oil as is necessary to make the paint lay well must be used. To make the paint adhere more firmly, a previous coat of oxide of iron paint may be used.

To Imitate Tortoise Shell.—Paint a ground of salmon color; then when dry and smoothed off, coat it over with rose pink, mixed in varnish and turpentine; then with a flat piece of glass, press on the surface, and remove the glass quickly, being careful not to push it over the paint so as to disturb the curious figures which the pressure will form thereon. Varnish when dry, and you will find you have a beautiful imitation of tortoise shell.

Banner Painting.—Lay out the letters very accurately with charcoal or crayon, then saturate the cloth with water to render the painting easy. On large work a stencil will be found useful. Take a piece of tin, lay the straight edge to the mark, brush over with a sash tool, and by this means you will make a very clean-edged letter. Use stiff bristle pencils in painting on canvas.

Oil Cloth Painting.—To paint canvas for floors, the canvas should first be saturated with glue-water or flour paste, and allowed to dry first. Then paint it with any color desired. To put in the figures, cut out designs in tin plates or stiff paper, and stencil them on in various colors.

To Imitate Marble.—*For white marble*, get up a pure white ground, then hold a lighted candle near the surface, and allow the smoke to form the shades and various tints desired. This will make a very handsome imitation. *Black* marble imitation is made by streaking a black surface with colors, using a feather and pencil. Another plan is to get up a smooth black surface; then take the colors, green, yellow, red, white, &c., ground thick in gold size, and streak the surface with a stick or pencil. Allow it to dry, and apply a heavy coat of lampblack and yellow ochre, mixed with rough stuff. When all is hard, rub down to a level surface with lump pumice-stone, varnish, and a beautiful varigated marble will be the result.

Etching on Glass.—Druggists' bottles, bar-tumblers, signs, and glassware of every description, can be lettered in a beautiful style of art, by simply giving the article to be engraved, or etched, a thin coat of the engraver's varnish (see next receipt), and the application of fluoric acid. Before doing so, the glass must be thoroughly cleaned and heated, so that it can hardly be held. The varnish is then to be applied lightly over, and made smooth by dabbing it with a small ball of silk, filled with cotton. When dry and even, the lines may be traced on it by a sharp steel, cutting clear through the varnish to the glass. The varnish must be removed clean from each letter, otherwise it will be an imperfect job. When all is ready, pour on or apply the fluoric acid with a feather, filling each letter. Let it remain until it etches to the required depth, then wash off with water, and remove the varnish.

ETCHING VARNISH.—Take of virgin wax and asphaltum, each 2 oz.; of black pitch and Burgundy pitch, each ½ oz.; melt the wax and pitch in a new earthenware glazed pot, and add to them, by degrees, the asphaltum, finely powdered. Let the whole boil, simmering gradually, till such time as, taking a drop upon a plate, it will break when it is cold, or bending it double two or three times betwixt the fingers. The varnish, being then boiled enough, must be taken off the fire, and, after it cools a little, must be poured into warm water that it may work the more easily with the hands, so as to be formed into balls, which must be kneaded, and put into a piece of taffety for use. The sand blast is now in extensive use for ornamenting on glass.

FLUORIC ACID TO MAKE FOR ETCHING PURPOSES.—You can make your own fluoric (sometimes called hydro-fluoric) acid, by getting the fluor or Derbyshire spar, pulverizing it, and putting all of it into sulphuric acid which the acid will cut or dissolve. Inasmuch as fluoric acid is destructive to glass, it cannot be kept in common bottles, but must be kept in lead or gutta percha bottles.

GLASS-GRINDING FOR SIGNS, SHADES, &c.—After you have etched a name or other design upon uncolored glass, and wish to have it show off to better advantage by permitting the light to pass only through the letters, you can do so by taking a piece of flat brass sufficiently large not to dip into the letters, but pass over them when gilding upon the surface of the glass; then, with flour of emery, and keeping it wet, you can grind the whole surface, very quickly, to look like the ground-glass globes often seen upon lamps, except the letter, which is eaten below the general surface.

TO DRILL AND ORNAMENT GLASS.—Glass can be easily drilled by a steel drill, hardened but not drawn, and driven at a high velocity. Holes of any size, from the 16th of an inch upwards, can be drilled, by using spirits of turpentine as a drip; and, easier still, by using camphor with the turpentine. Do not press the glass very hard against the drill. If you require to ornament glass by turning in a lathe, use a good mill file and the turpentine and camphor drip, and you will find it an easy matter to produce any shape you choose.

GILDING GLASS SIGNS, &c.—Cut a piece of thin paper to the size of your glass, draw out your design correctly in black lead-pencil on the paper, then prick through the outline of the letters with a fine needle; tie up a little dry white lead in a piece of rag; this is a pounce-bag. Place your design upon the glass, right side up, dust it with the pounce-bag; and, after taking the paper off, the design will appear in white dots upon the glass; these will guide you in laying on the gold on the opposite side, which must be *well cleaned* preparatory to laying on the gold. *Preparing the size.*—Boil perfectly clean water in an enamelled saucepan, and while boiling, add 2 or 3 shreds of best selected isinglass, after a few minutes strain it through a clean linen rag; when cool, it is ready for use. *Clean the glass perfectly.*—When this is done, use a flat camel's-hair brush for laying on the size; and let it drain off when you put the gold on. When the gold is laid on and perfectly dry, take a ball of the finest cotton wool and gently rub or polish the gold; you can then lay on another coat of gold if desirable, it is now ready for writing. In doing this, mix a little of the best vegetable black with black japan; thin with turpentine to proper working consistency; apply this when thoroughly dry; wash off the superfluous gold, and shade as in sign-writing.

GLASS GILDING, ANOTHER METHOD.—Clean and dry the glass thoroughly, then lay out the lines for letters with a piece of hard scented soap, then paint the letters on the *right* side of the glass with lampblack mixed with oil, in order to *form a guide for the work*, then on the inside lay on a coat of the size mentioned in the preceding receipt, using a camel's-hair brush, covering the whole of the letters; next lay on the gold leaf with a tip, until every part of the letters is covered well. Let the leaf remain until the size is dry, when you will find that the letters on the front side can be easily seen and traced. This is done with quick drying black, mixed with a little varnish. Paint over the whole directly over the gold; allow it to dry; then wipe off with soap and water, the lampblack letters from the front side; with pure cold water and a clean sponge, wash the superfluous gold leaf and size from the back, and you will have a splendid gold letter on the glass; next, shade your letter to suit the taste, always remembering to shade to the edge of the gold, for then you have only *one* edge to make straight. The other edge may be left rough, and when dry may be straightened by scraping with a knife.

ORNAMENTAL DESIGNS ON GLASS.—In making scrolls, eagles &c., on glass, some painters put on the outlines and shades first, and then lay the gold leaf over all; another good way is to scratch the shades on to the gold leaf after it is dry, and put the colors on the back of the gold. Silver leaf may be used in the same manner as gold, but it will not wear as well. A very pretty letter may be made by incorporating silver with gold; take paper and cut any fancy design to fit the parts of the letter; stick it on the size before laying the leaf, allowing it to dry and wash off as before; then with a penknife raise the paper figure, and the exact shape or form of the figure will be found cut out of the gold letter; clean off nicely, apply more size, and lay *silver* leaf to cover the vacant spots; wash off when dry, and a very handsome letter will be the result. Colors may be used instead of silver, if desired, or a silver letter edged or "cut up" with gold, will look well,

GLASS AND PORCELAIN GILDING.—Dissolve in linseed oil an equal weight either of copal or amber; add as much oil of turpentine as will enable you to apply the compound or size thus formed, as thin as possible, to the parts of the glass intended to be gilt. The glass is to be placed in a stove till it will almost burn the fingers when handled; at this temperature the size becomes adhesive, and a piece of gold leaf, applied in the usual way, will immediately stick. Sweep off the superfluous portions of the leaf, and when quite cold it may be burnished; taking care to interpose a piece of India paper between the gold and the burnisher.

Drilling China, Glass, &c.—To drill china use a copper drill and emery, moistened with spirits of turpentine. To drill glass, use a steel drill tempered as hard as possible and camphor and water as a lubricant.

Gold Lustre for Stoneware, China, &c.—Gold, 6 parts; aqa-regia, 36 parts. Dissolve, then add tin, 1 part; next add balsam of sulphur, 3 parts; oil of turpentine, 1 part. Mix gradually into a mortar, and rub it until the mixture becomes hard; then add oil of turpentine, 4 parts. It is then to be applied to a ground prepared for the purpose.

Gilding China and Glass.—Powdered gold is mixed with borax and gum-water, and the solution applied with a camel's-hair pencil. Heat is then applied by a stove until the borax fuses, when the gold is fixed and afterwards burnished.

Useful Hints for Carriage Painters.—It is usual to apply three coats of oil paint as a priming to commence with, and it is safe to use, say $\frac{2}{3}$ drying oil and $\frac{1}{3}$ turpentine, with a little fine litharge ground in, about 2 ozs. to every 20 lbs. of paint. This hardens the priming better than patent dryer, and works better under the sand-paper. When the first coating is hard and dry, rub down with your sand-paper and be sure to make perfectly level work among the irregularities, deficiencies and ridges on the surface of your work.

Next dust your work carefully, and with your putty knife go over the whole surface and putty up every crevice, split, crack or knot-hole with the hard drying putty hereafter mentioned. Be very careful not to overlook the slightest flaw, but bring every spot to a true and perfect level. Now dust off the work again, preparatory to second coating. Thin your color with turpentine, if too stout or thick, but do not use thin colors, for it neither covers well, nor rubs down well. For dark colors, use a dark lead color for the oil coats, but, for preparing for such a color as light green, let the color be light lead color, if for a yellow, begin with white, or slightly tinted with chrome yellow.

Be careful with your second coat, to lay it fair, regular, and equal, over each and every part of the work, and when it is thoroughly dry, rub down with a finer quality of sand-paper than the last, being careful to make the surface perfectly smooth and even. Now commence to give the third coat (after dusting off), putting on the paint, not lavishly, but rub it out well.

The next step, when the last is hard and dry, is to apply the filling up coats. For a good composition see receipt for "*Rough Stuff*" for carriage work. Another good filling consists of dry French yellow, a small quantity of white lead, the same amount of whiting, a little red lead, about one-sixteenth of litharge, and of drying Japan enough to nearly mix it, put in a very little drying oil, and turpentine to thin to a suitable thickness to make it spread like a stiff coat of paint. Thin so that it can be applied easily, and flow on full and free. Apply this composition, giving the body, shafts, wheels, springs, &c., a good coat levelling off any hollows, &c., existing in the parts, and when this coat becomes perfectly hard give it another. The next step, after this last coat dries hard, is to rub it down with lump pumice-stone, first rubbing the pumice flat upon a stone before commencing to use it. In rubbing down with lump pumice use plenty of water, freely supplied from the sponge in your left hand; be very cautious to avoid cutting through, and feel the parts frequently as the work progresses, to ascertain when all is sufficiently smooth and hard, then with your sponge wash off the work nicely, and with your wash leather wrung out, dry it off clean and smooth.

The next step is to paint the carriage. See to it that your colors are freshly ground, your paint mill, pots, tins, brushes, &c., perfectly clean. Apply your color the proper thickness, expeditiously and neatly, so that the work will present a good clean appearance. The following directions will be found useful in mixing the designated colors. *Dark Green, Olive Shade.* Take deep chrome yellow and powdered drop black, mix in a pot with the drying Japan, and a little turpentine, grind all together, test to be sure that the color is right, if wished lighter, add more chrome yellow, if darker, more drop black, grade the color to the proper thickness and apply at once. Two coats will be required. *Ultramarine blue.* For your ground color, grind good Prussian blue in oil, and add to white lead as much of the blue as will make it sufficiently dark to form a ground for the ultramarine blue, two coats of this will be required. When hard and dry, grind some of the best ultramarine blue on the stone with a quantity of varnish, add enough of this to your body flowing varnish to impart the right color. Two good coats of this beautiful color will be necessary; use sugar of lead as a dryer. Before giving the second coat rub down with ground pumice and water, using a cloth; the next coat will flow all the better for this treatment. After a few days rub down again with ground pumice and water, wash, and dry with your chamois skin, when the work will be all ready for picking out and striping. *Claret or Lake.* Vermilion and rose pink, in oil, same as the last, for first coat. When hardened dry, give another light coat, previously rubbing down with ground pumice and water, as directed for blue. For a rich light claret be sparing of your rose pink in the ground color; for dark claret, use more rose pink. For darker shades use more rose pink in the ground color, then use the best crimson lake, same way as for the light claret two good coats will do. For a purple shade of claret use vermilion, rose pink a spice of ultramarine blue, for a ground color. Then add the proper quantity of ground purple lake to body flowing varnish and apply two coats. *Japan Brown.* Grind drop black in Japan using enough vermilion to be visible. *Chrome Greens.* Grind your greens in Japan, or use greens composed of chrome yellow and Prussian blue. *Carmine Color on Fire Engines, &c. Cheap method.* For a ground, use the best English vermilion, then add pure carmine, ground in a little drying oil, to your body flowing varnish, and apply two coats carefully. This method extends the precious color so that an ounce will suffice for a carriage or machine. *Oxford Brown.* Use a little chrome yellow, India red, best ochre, white lead, burned umber, just white enough to be seen; yellow is the leading color; red to warm it, and umber to impart the brown shade. *Rich Purple.* Vermilion and Prussian blue, with a little white, a very cheap, nice color. *Fawn Color.* Use yellow, red, a little black, a little tierra de sienna, or burned umber may be added to obtain the right shade. *Drab Color.* White and raw umber form a cool drab which may be varied with chrome, or red, as may be desired. *Plum Brown.* Drop black and vermilion makes a very good color at a cheap rate.

STRIPING OR "PICKING OUT," FOR CARRIAGE WORK.—Great care is required in this part of the work to carry a steady hand so that the lines may be drawn equidistant, clean and neat. For fine lines, grind the color in drying oil, as it makes the best work. Japan color will do for broad or coarse lines, *on blue* ground. If a large carriage, with heavy wheels, draw lines with Frankfort-black, Japan mixed color from three quarter inch to one inch broad, on all parts of the carriage, wheels, springs, spokes, hubs, &c., then draw fine lines of light orange or light primrose color about three-eighths or a quarter inch from the broad black line, with one fine line around the edges of the black nuts and bolt heads. On superior work, pure white, gold, or deep orange lines may be drawn down the middle of the black lines, producing a very fine effect; *on greens*, pick out with black, if a light green, black lines will be sufficient, if desired better, run up the centre of the black lines with white, not too fine. On dark green, pick out with black, running very fine lines on each side of the black three-eighths of an inch off the black. This also sets off a very bright green to good advantage. *On Clarets*, pick out with black, with vermilion or rich orange fine side lines, or light orange side lines with vermilion line run up the centre of the black; or light gold line up the centre of one large black line. *On Oxford Brown*, pick out with black, fine line with vermilion or medium tint of chrome yellow with slight tint of red in it; or part the black line with white down the centre. *On Fawn Colors*, pick out with broad black, fine line with white on each edge, or brown drab shade. *On Japan or Plum Browns*, vermilion line has the best appearance. *On Olives or Quakers' Greens*, pick out with black, with white for fine lines, or orange, or light green. *On Drabs*, pick out with black, fine line with vermilion, or high colored orange, or white centre line for extra finish. *On Purple*, pick out with black, fine line with a bright tint of orange or vermilion.

VARNISHING OF COACHES AND CARRIAGES.—In this, as well as in the painting department, absolute cleanliness is indispensable, as regards brushes, pots, freedom from dust, &c. When your work is ready, if it is the under carriage, apply a good full coat of carriage varnish, and when through with this part of the process, go over it again, this time using body varnish. After it is hard and dry proceed to "flat" the work by lightly removing the gloss with ground pumice, water, and a woollen cloth, being careful not to cut into the lines or ground; then clean away all the pumice, and dry off nicely with the chamois leather slightly wet. If you have cut through in any part, repair with Japan color previous to second coating. Let your second coat be very full and well laid on, but be careful that it does not run. A very superior gloss will be obtained on the wheels, if after the application of a good coat you spin them until the varnish is nearly set.

If the second coat is not satisfactory, repeat the flattening process with your pumice, cloth and water, clean off as before and varnish again.

In more costly polished work, commence with the very finest ground pumice or Tripoli, rub until you bring the work to a very smooth state, then wash off very clean and nice, dry and dust well. Use every precaution against dust, by sweeping and sprinkling your floor in every stage of polishing and varnishing. The next step in polishing is to use a fine cloth for a rubber, rotten-stone, sifted fine through muslin and mixed with olive oil; rub with this until the gloss is restored, occasionally examining the progress of the work. This step being finished, wipe off with a perfectly clean cotton cloth, with a piece of the finest flax full of fine wheat flour or putty powder go over the work, rubbing well to polish it still farther, and remove every particle of the oil and rotten-stone previously used. Finish off by rubbing the work briskly with an old silk handkerchief, which will induce a beautiful fine gloss. In every instance when a polish and varnish finish is required, do not omit to lay on an extra coat of varnish, as it will greatly enhance the appearance of the work.

Gilding and Ornamenting Carriages.—English gold size is the best for this purpose. If you cannot get it ready prepared, make a substitute by using English varnish and Japan in equal parts. If the gilding is for striping, you should mix a little chrome yellow with it, to be able to see the lines the better, but for lettering no coloring is required. Rub your job down smoothly, take a piece of muslin and tie up in it a little whitening to form a "pounce bag;" with this dust over every part of the work where the gold leaf is to be put, to prevent the leaf sticking to the surface not covered by the size, or wash the job over with starch water, or rub it over with the raw surface of a potato cut in halves; the juice of the potato soon dries, and leaves a thin film to which the gold will not adhere. Either of the above methods will do, and the coating will wash off when the gilding is dry. The surface prepared, take the size and put on the stripes, figures, or ornaments, and allow it to dry just enough to enable you to pass your finger over it without sticking, but if it is "tacky" when you place your finger upon it, it is ready for the gold leaf, which is to be applied in the way directed for gilding letters on wood. The gold letters may be shaded with ultramarine, carmine, asphaltum, lake, Paris green, verdigris, &c., to suit the taste.

Bronzing.—Gold bronze is used on carriage parts for striping and ornamenting, using the same size as that used for gold leaf. For taking up and applying the bronze, take a piece of plush or velvet and make a "pounce bag," by tying up a wad of cotton, rubbing the bronze gently over the size. To vary the appearance, a mixture of copper, gold, and silver bronze may be applied. For fancy work in bronze, cut out any desired pattern on thin sheet brass, pasteboard, or paper, and apply it to any nearly dry varnished surface; rub the bronze on through the apertures in the pattern.

Good Colors for Business Wagons.—No. 1. *Body.*—Chrome green; frame or ribs black striped with white or cream color. *Running gear.*—Cream color striped with red, blue or dark green, or black, and red fine line. No. 2. *Body.*—Yellow; frame black, striped with blue or white. *Running gear.*—Light vermilion, striped with black and white. No. 3. *Body.*—Carmine glaze over Indian red. *Running gear.*—Vermilion. No. 4. *Body.*—Deep vermilion. *Running gear.*—Light vermilion.

MIXTURE TO REMOVE OLD PAINT.—Dissolve 1 lb. potash in 3 pts. water over the fire, then add yellow ochre or some common dry paint until it is as thick as rough stuff; spread this over your old paint, and after a little it will come off quite easily, then wash the wood with soap and water to remove all the potash, dry off and sand-paper, then give a coat of clean raw oil. Another method is to heat a heavy piece of iron and apply to the paint, which will cause it to become loose and soft, so that it may be scraped off with a knife. Still another method is to direct the flame of a spirit lamp (which may be constructed for the purpose) on the old paint, scraping it off as it softens.

TO BLEACH OIL.—Pour as much linseed oil into a shallow earthen vessel as will stand one inch deep, then pour in 6 inches of water, cover with a fine cloth, and let the whole stand in the sun for a few weeks until the liquid becomes thick, when it should be poured into a phial and submitted to a gentle heat; after which the clear is to be poured off and strained through a flannel cloth.

TO COPY AN ORNAMENT.—Place the paper or other article containing the ornament against a pane of glass; then laying a sheet of thin paper over it, you can copy it exactly with a lead pencil.

ORNAMENTS, in the shape of decalcomine or other gilded pictures, may be easily transferred to carriages or coaches by following the directions given in transferring pictures. See farther on.

VERMILION.—To prevent vermilion from fading, add to the dry color, before mixing, $\frac{1}{8}$ part of flour of sulphur. Light English vermilion is used for striping, ornamenting or lettering; the deep vermilion having less body, will not cover good. English vermilion gives the best color on carriage work when mixed with rubbing varnish and oil. American vermilion should not be ground, as the process would change it to an orange color; while green, Indian red, chrome yellow, and all heavy body colors are all the better for being ground as fine as possible. Raw oil is preferable to boiled, as it is more volatile, and penetrates and fills the pores of the wood better.

PRIMING FOR CARRIAGE WORK.—*First coat of lead.* Mix white lead with raw oil, 2 parts, Japan, 1 part, to make it proper for a thick coat, adding a very little turpentine to make it work easily. For carriage parts add a little Indian black, but not for bodies.—*Second coat of lead.* Mix white lead with 1 part raw oil and 2 parts Japan, and a little turpentine, as before, adding lampblack for carriage parts, but none for the body.—*Third and fourth coat.* Mix white lead into a thick paste with turpentine, add a little oil, Japan and rubbing varnish to bind the paint well; add, for the carriage parts, a little lampblack and a little red lead.

HARD DRYING PUTTY.—*For carriage work.* Mix dry white lead with Japan and rubbing varnish equal parts, to the proper consistency, beating it with a small mallet to bruise the lumps. Keep it, when not in use, in water, to prevent it drying.

ROUGH STUFF.—*For carriage work.* Take 3 parts of English filling (ground state), 2 parts dry white lead, 1 part white lead in oil. Mix with Japan, 2 parts, rubbing varnish, 1 part. Mix and crush thoroughly by running all through the mill together.

FACING LEAD FOR CARRIAGE WORK.—Mix dry white lead with 2 parts Japan, 1 part rubbing varnish, and thin with spirits of turpentine, adding a little lampblack to make a clean lead color, and run all through the mill.

COACH PAINTING.—The panels of such work are generally painted in color, while the pillars, top strip, quarters, deck, &c., are always black; umber colors, lakes, greens, and blues are some of the best colors used on this work. To prepare the body for any of these colors, a *ground* color is used in the place of lampblack on black work. The following are a few approved *grounds*. *Lake.*—Indian red and vermilion mixed to a dark brown, but some prefer a black ground for lake. *Ultramarine.*—Mix a medium blue with white lead and Prussian blue. *Vermilion.*—A light pink color is generally used as a ground for vermilion. *Green.*—Green and all heavy-bodied colors will cover well on the lead colors without any ground color. Victoria lake and black Japan makes a fine color for carriages.

PREPARED OIL FOR CARRIAGES, &C.—To 1 gal. linseed oil add 2 lbs. gum shellac; litharge, ½ lb.; red lead, ¼ lb.; umber, 1 oz. Boil slowly as usual until the gums are dissolved; grind your paints in this (any color), and reduce with turpentine.

PORCELAIN FINISH, VERY FINE FOR PARLORS.—To prepare the wood for the finish, if it be pine, give one or two coats of transparent varnish, which prevents the pitch from oosing out, causing the finish to turn yellow; next, give the room at least four coats of pure zinc, which may be ground in only sufficient oil to enable it to grind properly; then mix to a proper consistence with turpentine or naphtha. Give each time to dry. When it is dry and hard, sand-paper it to a perfectly smooth surface, when it is ready to receive the finish, which consists of two coats of French zinc ground in, and thinned with Demar varnish, until it works properly under the brush.

JAPAN DRIER BEST QUALITY.—Take linseed oil, 1 gal.; put into it gum shellac, ¾ lb.; litharge and burned Turkey umber, each ½ lb.; red lead, ½ lb.; sugar of lead, 9 oz. Boil in the oil till all are dissolved, which will require about 4 hours; remove from the fire, and stir in spirits of turpentine, 1 gal., and it is done. 2. Linseed oil, 5 gals.; add red lead and litharge, each 3½ lbs.; raw umber, 1¼ lbs.; sugar of lead and sulphate of zinc, each, ½ lb.; pulverize all the articles together, and boil in the oil till dissolved; when a little cool, thin with turpentine, 6 gals. 3. Linseed oil, 4 gals. red lead and umber, of each 8 ozs.; sulphate of zinc, 4 ozs.; sugar of lead, 4 ozs. Boil until it will scorch a feather, when it is ready for use. 4. Nut or linseed oil, 1 gal.; litharge, 12 oz.; sugar of lead and white vitriol, of each 1 oz.; simmer and skim until a pellicle forms; cool, and, when settled, decant the clear. 5. Oil 1 gal.; litharge, 12 to 16 oz.; as last. 6. Old nut or linseed oil, 1 pint; litharge, 3 oz. Mix; agitate occasionally for 10 days; then decant the clear. 7. Nut oil and water, of each 2 lbs.: white vitriol, 2 oz.; boil to dryness. 8. Mix oil with powdered snow or ice, and keep it for 2 months without thawing.

TO REDUCE OIL PAINT WITH WATER.—Take 8 lbs. of pure unslaked lime, add 12 qts. water, stir it and let it settle, turn it off gently and bottle it; keep it corked till used. This will mix with oil, and in proportion of half will render paint more durable.

OIL PAINT.—TO REDUCE WITH WATER.—Gum shellac, 1 lb.; sal-soda, $\frac{1}{2}$ lb.; water, 3 parts; boil all together in a kettle, stirring till dissolved. If it does not all dissolve, add a little more sal-soda; when cool, bottle for use; mix up 2 quarts of oil paint as usual, any color desired, using no turpentine; put 1 pint of the gum shellac mixture with the oil paint when if becomes thick; it can then be reduced with water to a proper thickness to lay on with a brush.

ANOTHER METHOD.—Soft water, 1 gal.; dissolve it in pearlash, 3 oz.; bring to a boil, and slowly add shellac, 1 lb.; when cold, it is ready to be added to oil paint in equal proportions.

FLEXIBLE PAINT FOR CANVAS.—Yellow soap, $2\frac{1}{2}$ lbs.; boiling water, $1\frac{1}{2}$ gals.; dissolve; grind the solution while hot with *good oil paint*, $1\frac{1}{4}$ cwt.

PAINTERS' CREAM.—Pale nut oil, 6 oz.; mastic, 1 oz.; dissolve; add of sugar of lead, $\frac{1}{4}$ oz., previously ground in the least possible quantity of oil; then add of water *q. s.* gradually, until it acquires the consistency of cream, working it well all the time. Used to cover the unfinished work of painters. It will wash off with water.

SMALT.—Roast cobalt ore to drive off the arsenic; make the residuum into a paste with oil of vitriol, and heat it to redness for an hour; powder, dissolve in water, and precipitate the oxide of iron by carbonate of potash, gradually added until a rose-colored powder begins to fall; then decant the clear, and precipitate by a solution of silicate of potash, prepared by fusing together for 5 hours a mixture of 10 parts of potash, 15 parts of finely-ground flints, and 1 part charcoal. The precipitate, when dry, may be fused and powdered very fine. It is much the cheapest way to buy smalts ready made.

FACTITIOUS LINSEED OIL.—Fish or vegetable oil, 100 gallons; acetate of lead, 7 lbs.; litharge, 7 lbs.; dissolved in vinegar, 2 galls. Well mixed with heat, then add boiled oil, 7 gallons; turpentine, 1 gallon. Again well mix.

VARNISHES.—*Common Oil Varnish.*—Resin, 4 lbs.; beeswax, $\frac{1}{2}$ lb.; boiled oil, 1 gallon; mix with heat; then add spirits of turpentine, 2 quarts. *Chinese Varnish.*—Mastic, 2 oz.; sandarac, 2 oz.; rectified spirits, 1 pt.; close the matrass with bladder, with a pinhole for the escape of vapor; heat to boiling in a sand or water bath, and when dissolved, strain through linen. *Metallic Varnish For Coach Bodies.*—Asphaltum, 56 lbs.; melt, then add litharge, 9 lbs., red lead, 7 lbs. Boil, then add boiled oil, 12 gals.; yellow resin, 12 lbs. Again boil until, in cooling, the mixture may be rolled into pills; then add spts. of turpentine, 30 gals.; lampblack, 7 lbs. Mix well. *Mastic Varnish.*—Mastic, 1 lb.; white wax, 1 oz.; spirits turpentine, 1 gallon; reduce the gums small; then digest it with heat in a close vessel till dissolved. *Turpentine Varnish.*—Resin, 1 lb.; boiled oil, 1 lb.; melt; then add turpentine, 2 lbs. Mix well. *Pale Varnish.*—Pale African copal, 1 part; fuse. Then add hot pale oil, 2 parts. Boil the mixture till it is stringy; then cool a little, and add spirits of turpentine, 3 parts. *Lacquer Varnish.*—A good lacquer is made by coloring lac varnish with turmeric and annatto. Add as much of these two coloring substances to the varnish as will give the proper color; then squeeze the varnish, through a cotton cloth when it forms lacquer. *Gold Varnish.*—Digest shellac, sixteen parts, gum sandarac, mastic, of each three parts; crocus, one part; gum gamboge, two parts; all bruised, with alcohol, one hundred and forty-four parts. Or, digest seedlac, sandarac, mastic, of each eight parts; gamboge, two parts; dragon's blood, one part; white turpentine, six parts; turmeric, four parts; bruised with alcohol, one hundred and twenty parts. *Deep Gold-Colored Lacquer.*—Seed lac, 3 oz.; turmeric, 1 oz.; dragon's blood, one-fourth ounce; alcohol, 1 pt.; digest for a week, frequently shaking: decant, and filter. Lacquers are used upon polished metals and wood to impart the appearance of gold. if yellow is required, use turmeric, aloes, saffron or gamboge; for red, use annatto, or dragon's blood, to color. Turmeric, gamboge, and dragon's blood generally afford a sufficient range of colors. *Gold Lacquer.*—Put into a clean 4 gal. tin 1 lb. of ground turmeric, 1½ oz. of gamboge, 3½ lbs. powdered gum sandarac, ¾ pound of shellac, and 2 gals. of spirits of wine. When shaken, dissolved, and strained, add 1 pint of turpentine varnish, well mixed. *Varnish For Tools.*—Take tallow, 2 oz.; resin, 1 oz.; and melt together. Strain while hot, to get rid of specks which are in the resin; apply a slight coat on your tools with a brush, and it will keep off rust for any length of time. *Gold Varnish.*—Turmeric, 1 dram; gamboge, 1 dram; turpentine, 2 pints; shellac, 5 oz.; dragon's blood, 8 drams; thin mastic varnish, 8 oz.; digest with occasional agitation for 14 days; then set aside to fine, and pour off the clear. *Beautiful Pale Amber Varnish.*—Amber, pale and transparent, 6 lbs.; fuse; add hot clarified linseed oil, 2 gals.; boil till it strings strongly, cool a little, and add oil of turpentine, 4 gals. This soon becomes very hard and is the most durable of oil-varnishes. When wanted to dry quicker, drying oil may be substituted for linseed, or "driers" may be added during the cooling. *Black Coach Varnish.*—Amber, 1 lb.; fuse; add hot *drying* oil, ½ pt.; powdered black resin and Naples asphaltum, of each 3 oz. When properly incorporated and considerably cooled, add oil of turpentine, 1 pt. *Body Varnish.*—Finest African copal, 8 lbs.; fuse carefully; add clarified oil, 2 gals.; boil gently for 4½ hours, or until quite stringy; cool a little, and thin with oil of turpentine, 3½ gals. *Dries slowly.* *Carriage Varnish.*—Sandarac, 19 oz.; pale shellac, 9½ oz.; very pale transparent resin, 12½ oz.; turpentine, 18 oz.; 85 per cent. alcohol, 5 pts.: dissolve. Used for the internal parts of carriage, &c. Dries in ten minutes. *Cabinetmakers' Varnish.*—Very pale shellac, 5 lbs.; mastic, 7 oz.; alcohol, 90 per cent. 5 or 6 pts.; dissolve in the cold with frequent stirring. Used for French polishing, &c. *Japanners' Copal Varnish.*—Pale African copal, 7 lbs.; fuse; add clarified linseed oil, ½ gal.; boil five minu es, remove it into the open air, add boiling oil of turpentine, 2 gals,; mix well, strain it into the cistern, and cover it up immediately. Used to varnish furniture, and by japanners, coach-makers, &c. *Copal Varnish.*—Pale hard copal, 8 lbs.; add hot and pale drying oil, 2 gals.; boil till it strings strongly, cool a little, and thin with hot rectified oil of turpentine, 3 gals.; and strain immediately into the store can. Very fine. *Gold Varnish of Watin, for Gilded Articles.*—Gum lac in grains, gamboge, dragon's blood, and annatto, of each 12½ oz.; saffron, 3¼ oz. Each resin must be dissolved separately in 5 pts. of 90 per cent. alcohol, and 2 separate tinctures must be made with the dragon's blood and annatto in a like quantity of spirits; and a proper proportion of each mixed together to produce the required shade. *Transparent Varnish for Ploughs,* &c.—Best alcohol, 1 gal.; gum sandarac, 2 lbs.; gum mastic, ½ lb.; place all in a tin can which admits of being corked; cork tight, shake it frequently, occasionally placing the can in hot water. When dissolved, it is ready for use. *Fine Black Varnish for Coaches.*—Melt in an iron pot, amber, 32 oz.; resin, 6 oz.; asphaltum, 6 oz.; drying linseed oil, 1 pt.; when partly cooled, add oil of turpentine, warmed, 1 pint. *Mordant Varnish.*—dissolve 1 oz. mastic, 1 oz. sandarac, ½ oz. gum gamboge, and ¼ oz. turpentine in 6 oz. spirits turpentine. One of the simplest mordants is that procured by dissolving a little honey in thick glue. It has the effect of greatly heightening the color of the gold, and the leaf sticks extremely well. *Changing Varnish.—To imitate Gold or Silver, &c.* Put 4 oz. best gum gamboge into 32 oz. spirits of turpentine; 4 oz. dragon's blood into 32 oz. spirits of turpentine; and 1 oz. of annatto into 8 oz. spirits of turpentine. Make the 3 mixtures in different vessels. Keep them in a warm place, exposed to the sun as much as possible, for about 2 weeks, when they will be fit for use. Add together such quantities of each liquor as the nature of the color you are desirous of obtaining will point out. *Transparent Varnish, for Wood.*—Best alcohol, 1 gal.; nice gum shellac, 2½ lbs. Place the jug or bottle in a situation to keep it just a little warm, and it will dissolve quicker than if hot, or left cold. *Patent Varnish for Wood or Canvas.*—Take spirits of turpentine, 1 gal; asphaltum, 2½ lbs.; put them into an iron kettle which will fit upon a stove, and dissolve the gum by heat. When dissolved and a little cool add copal varnish, 1 pt.; and boiled linseed oil, 1 pt.; when cold, it is ready for use. Perhaps a little lampblack would make it a more perfect black.

Mosaic Gold Powder for Bronzing, &c.—Melt 1 lb. tin in a crucible, add ½ lb. of purified quicksilver to it: when this is cold, it is reduced to powder, and ground, with ½ lb. sal-ammoniac and 7 oz. flour of sulphur, till the whole is thoroughly mixed. They are then calcined in a matrass; and the sublimation of the other ingredients leaves the tin converted into the mosaic gold powder which is found at the bottom of the glass. Remove any black or discolored particles. The sal-ammoniac must be very white and clear, and the mercury of the utmost purity. When a deeper red is required, grind a very small quantity of red lead with the above materials. *True Gold Powder.*—Put some gold leaf, with a little honey, or thick gum water made with gum arabic, into an earthen mortar, and pound the mixture till the gold is reduced to very small particles; then wash out the honey or gum repeatedly with warm water, and the gold in powder will be left behind. When dry, it is fit for use. *Dutch Gold Powder* is made from Dutch gold leaf, which is sold in books at a very low price. Treat in the manner described above for true gold powder. When this inferior powder is used, cover the gilding with a coat of clear varnish, otherwise it will soon lose its bright appearance. *Copper Powder* is prepared by dissolving filings or slips of copper with nitrous acid in a receiver. When the acid is saturated, the slips are to be removed; or, if filings be employed, the solution is to be poured off from what remains undissolved. Small bars are then put in, which will precipitate the copper powder from the saturated acid; and, the liquid being poured from the powder, this is to be washed clean off the crystals by repeated waters.

Bronze Powder of a *pale gold* color is produced from an alloy of

13¼ parts of copper and 2¾ parts zinc, of a *crimson metallic* lustre from copper, of a *paler* color, copper, and a very little zinc, *green* bronze with a proportion of verdigris, of a fine *orange* color, by 14½ parts copper and 1¾ parts zinc ; another orange color, 13¾ parts copper and 2¼ zinc The alloy is laminated into very fine leaves with careful annealing, and these are levigated into impalpable powders, along with a film of fine oil, to prevent oxidizement, and to favor the levigation.

GENERAL DIRECTIONS FOR BRONZING.—The choice of the above powders is of course determined by the degree of brilliancy you wish to obtain. The powder is mixed with strong gum water or isinglass. and laid on with a brush or pencil ; and, not so dry as to have still certain clamminess; a piece of soft leather wrapped round the finger is dipped into the powder, and rubbed over the work. When the work has been all covered with the bronze, it must be left to dry, and and loose powder then cleared away by a hair-pencil.

BRONZING IRON.—The subject should be heated to a greater degree than the hand can bear, and German gold, mixed with a small quantity of spirit of wine varnish, spread over it with a pencil; should the iron be already polished, you must heat it well, and moisten it with a linen rag dipped in vinegar.

GILDER'S PARCHMENT SIZE.—The best is made from cuttings of fine parchment. Wash them clean, cover them with water, and allow them to simmer for about 2 hours over a slow fire: when brought to the proper strength or tenacity, which may be tested by the trial of a portion between the thumb and finger; if it proves adhesive pour it into a clean vessel for use. When solidified, it resembles a jelly; if very stiff, it will require dilution with water. Some gilders use a lactometer and a deep glass to determine the proper strength of size. When the float indicates a little higher than 1, for burnish size, and near 2, for *matt* gold size, excellent work will result. In the United States, some gilders substitute a *white glue* for parchment cuttings in the making of size. For OIL GOLD SIZE, consult that item.

MATT GOLD SIZE is usually purchased from dealers ready made; it is prepared for use by intermixture, (in a clean vessel) over a slow fire, with parchment size, to the density of a thickish cream, and used while warm.

BURNISH GOLD SIZE is often bought ready made from the dealer. Good results may be obtained by using red chalk, black lead, and deer suet, of each 2 ozs., finely ground to a stiff paste, with 2 lbs. of pipe clay, and for use prepared like matt size.

THICK WHITE for application to the parts intended to be burnished, previous to putting on the burnish size, is a composition of parchment size and whitening, about the density of cream.

GILDER'S ORMOLU.—Red Sanders wood 2 drs., turmeric 1 dr., garnet shellac 1 oz., spirits of wine ½ pt.: mix all together thoroughly and strain. This is added to medium strength parchment size in order to impart a more beautiful appearance to the matt and oil gilding.

CLAY FOR GILDER'S USE is usually purchased from the dealers and is prepared similar to burnish size.

THE STOPPING COMPOSITION used for filling holes and deficiencies in the work is a compound of size and whitening, brought to the density of putty.

TO WHITEN MOULDINGS.—On gilded work to be exposed to the weather, paint is used as a foundation, and the gilding is done in oil as *burnished gilding* is unfit to withstand exposure. This last named description of work must have a good base of whitening applied to the moulding previous to gilding. First apply a very hot thin priming coat of fine whitening and parchment size; after this is dry, fill the holes, blemishes, and irregularities with the *stopping* composition; then apply a good coat of *thick white*, dry, and apply another. After applying several coats of the thick white, which should be in all about 1-16th of an inch in thickness, pumice-stone should be applied to smooth off all irregularities and the surplus whiting. Make thorough work to ensure a fine smooth surface on the moulding, paying great attention to the different hollows, beads, &c.

COMPOSITION FOR ORNAMENTS.—Best glue, 9 lbs. 6 ozs.; water 5 pts.; rosin (white) 4 lbs.; raw linseed oil 4 pts. Boil the glue in the water until dissolved; dissolve the rosin in the oil, add the whole to the glue mixture. Boil the whole slowly for 25 minutes longer, and pour the mixture into a large vessel among finely sifted whiting, and mix up to the consistency of thin putty. Set away in a damp place, and cover with a wet cloth ready for use. The ornaments are made by selecting a portion of the mixture, steaming it to a soft plastic condition (for the mixture becomes very hard when cold), and pressing with the hands into a boxwood mould, previously well lubricated or smeared with oil and turpentine. The composition being fitted into the mould, a board thoroughly wet, is placed against the mixture outside the mould, and the whole is submitted to pressure in an iron screw press, which drives the mixture into the minutest parts of the mould. This done, the pressure is relaxed, and the mould taken from the press and the ornament withdrawn from it. The ornaments may be attached to the frame with glue or white lead; and when they compose the corners on frames, require to have the vacant space between *backed* or *filled up* with composition softened in boiling water.

GILDING IN OIL.—The ornaments being properly adjusted and allowed full time to harden on the frame, the first step taken by the gilder is to wash and cleanse them, together with the frame, from the adherent oil and dust. This done, when dry, apply a uniform coat of thin white to the frame, and, after drying, fill all the holes and defective parts with the stopping described above. When this becomes hard, go over every part of the work and bring it to the utmost smoothness with fine glass paper. This part of the work must not be slighted if a good job is wanted, for it cannot be dispensed with. Now dust off the work and apply the clay prepared as described above; allow it to dry and rub smooth with fine glass paper once more. A coat of *clear cole* is now applied, consisting of parchment size diluted to a thinnish consistency with water. It is usual to apply 2 coats of this size in a warm condition. It effectually prevents the absorption of the succeeding coat of oil size. The gilder prepares the oil size (boiled linseed oil and ochre well ground together) by bringing it to a creamy consistency, and purifies it by straining through a clean rag held under pressure, squeezing out the size. This preparation is spread very evenly over the prepared surface, and allowed to stand until it becomes slightly sticky or tacky, when the knife, cushion and gold leaf are brought into requisition, and the leaf applied with the tip to the entire surface covered with the size. This process requires careful management; the gilder blows the gold leaf out on the cushion with his breath, divides and subdivides it with his knife to cover the different wants of various parts of the work. The leaf is dabbed down with a dabber of cotton wool or other soft material, and finished with a badger. See *Gilding Letters on Wood.* The frame being now covered with the leaf, is brushed off to clear it from the small gold particles still adhering, and is finally finished by applying the finish, size evenly with a hog's-hair brush over the work. The finish consists of a somewhat weak, clear size, which may be tempered with a little ormolu if it is desired to impart a finer color to the gold.

WATER AND OIL GILDING ON LARGE, BROAD FRAMES, &c.—Remove all dust and dirt from the frame and ornaments, by thorough washing and brushing with plenty of clear water, being careful not to damage the ornaments while doing so, dry, and apply a coat of thin white, fill all holes and defects by *stopping*, and treat the parts intended to be burnished with three or four coats of thick *white*, smoothing down the last coat when nearly dry, by passing the fingers over it. When dry, go over it with glass paper, making a complete smooth job; next apply a coat of *clay*, and smooth down with glass paper once more. Next, apply an even coat of size, and when dry, apply another. The frame is next "put in oil" as above described, and subsequently, the parts intended to be burnished, which have received the coats of *thick white*, must be thoroughly cleaned from oil by careful rubbing with a wet piece of cotton applied by the finger, turning the rag at short intervals so as to present a clean surface to the work. Guard against touching any other parts of the frame with the wet cloth, as the mistake will have to be corrected with the oil brush. To make sure that no trouble will result from grease, it is necessary before laying the gold, to apply clay to all parts intended to be burnished, in order to prevent any of the gold leaf from sticking, as it would have to be removed with glass paper previous to applying other preparations. The frame is then gilded as previously described, the leaf pressed into the cavities of the ornaments, &c., the defects corrected, the work brushed off, and size finished as above. The parts to be burnished or *water gilded*, previously noted as being coated with clay, must now be treated to three or four coats of *mat gold size*, laid on evenly with a camel's-hair brush. When dry, polish with fine glass paper, brush down, and pass over it afterwards with a damp sponge. Now apply 2 even coats of burnish gold size, and apply the leaf as soon as the last coat becomes dry. This is applied in a manner entirely different from that previously described. The frame being elevated at a proper angle to allow the surplus water to drain off, and the gold leaf, cushion, knife, tip, camel's-hair pencils, glass of clean water, &c., being ready, proceed to gild the bead which passes around the frame between those parts which have previously been oil-gilt, by dipping a proper sized camel's-hair pencil into the glass of water, wipe it on the edge, commence at the left hand extremity of the bead, wetting it for a space of 4 or 5 inches or more down, saturating it thoroughly with the water, and apply the gold leaf (previously cut to the proper size and held in readiness on the tip) very neatly and quickly to the spot while it is covered with water. Go over the bead, ornaments, and all parts intended to be burnished in this way, being extremely careful to allow no water to come in contact with the gilded part of the frame. When done, examine closely for faults, and repair all defects discovered, dry, and *proceed to burnish* by applying the curved part of the burnisher to the work, passing it hither and thither over the gold with the right hand, assisting the pressure and steadying the movement by the thumb of the left. This results in bringing out a splendid burnish. Go over the work with particular care, bring out the full lustre of the gold, cover deficiences, *finish, size* the frame once more, carefully avoiding the burnished parts; finally, tinge the edge of the frame with ochre. In burnish gilding, on large frames, the conspicious parts of the frame, such as the beads, ornaments, &c., should be selected for operation.

Brush Polish.—Shellac 4 ozs., white rosin 4 ozs., dissolve in 2 pts. spirits of wine and apply while warm, with a brush.

Cabinet Maker's Varnish.—Gum shellac 3 ozs., gum mastic 1 oz., gum sandarac, 3 ozs., spirits of wine, 40 ozs. Dissolve the last 2 in the spirits, then dissolve the shellac and pour off the clear for use.

French Polish Reviver.—Linseed oil 1 pint, vinegar 4 ozs., spts. camphor 2 ozs., spts. hartshorn ½ oz., butter of antimony, 1 oz. *Another.*—Dissolve 8 ozs. shellac and ½ an oz. of oxalic acid in 2 lbs. naphtha, then add 3 ozs. linseed oil.

Ebonized Black for Ebonizing Moulding Frames, &c.—Strong vinegar, 1 gal., ext. of logwood, 2 lbs., green copperas, ¼ lb., China blue, ¼ lb., nut-gall, 2 ozs. Simmer over a slow fire until all is dissolved; set off and cool. Add to the above ½ pt. iron rust obtained by steeping iron filings in strong vinegar. An unequalled jet black.

Satinwood Stain for the Inside of Drawers. — Alcohol 2 pts., powdered gamboge, 3 ozs., ground turmeric, 6 ozs. Steep to obtain full strength, and strain through muslin. Apply 2 coats with a fine sponge, sandpaper when dry and varnish or French polish.

Walnut Stain on Pine or Whitewood.—Take 2 gals. of very thin sized shellac; add burnt sienna, 2 lbs., burnt umber, 2 lbs., lamp-black, ½ lb.; shake all together and mix well in a stone jug. Apply 1 coat with a brush, dry; sandpaper smooth, and apply a coat of common varnish or shellac. A fine imitation of walnut.

Cheap Black Stain on Pine or Whitewood.—Water, 2 gals., black copperas, 1 lb., logwood chips, 1 lb., ext. logwood, 1 lb., indigo blue, 1 lb., lamp-black, 2 ozs.; simmer over a slow fire, cool off, strain, and add 1 oz. nut-gall. A splendid black stain for cheap work.

To Gild a Wooden Flower Stand.—Rub the wood smooth, prime with glue size, then put on 2 coats of oil paint and one of flatting. Smooth over, when dry, with wash-leather. Put on gold size, and when it is sticky to the touch, it is ready for the leaf, which put on carefully and dab down with cotton-wool. A transparent glazing can be used to deaden the gold in places.

Old Oak Imitation on White Deal.—Burnt umber, 1 part, brown ochre, 1 part, mix thoroughly with a very thin glue size and apply. A good *oak stain* is made by adding 1 lb. each of potash and pearlash to 1 gal. water, adding *more* water if a *lighter* stain is required.

Rosewood Imitation on White Deal.— Apply Venetian red and a little lamp-black in solution, with thin glue size. A good *mahogany stain* is Venetian red, 1 lb., yellow lead, 2 lbs.; mix with thin glue size. *Walnut stain on deal.*—Burnt umber and yellow ochre in thin size. The above may be applied while warm with a soft rag or by dipping the wood into a vat containing the solution, as is done with chairs, etc., in many manufactories.

MAHOGANY IMITATION ON BEECH.—Pulverized dragon's blood, 2 ozs., rectified spts. of wine, 1 qt.

FILLING FOR FRENCH POLISHED WORK.—A creamy paste composed of water and plaster of Paris, applied with a coarse rag to the grain of the wood forms a good filling. Apply vigorously to the wood to fill the pores thoroughly, and wipe off the surplus. Finely sifted whitening, mixed with painter's drying oil, is another good filling composition.

SPLENDID CRIMSON SPIRIT STAIN. — Brazil-wood, 1oz., cochineal, 1 oz., dragon's-blood, 1 oz., saffron, 2 ozs.; steep to obtain full strength, in 2 qts. alcohol and strain.

BEST MOUNTING MATERIAL.—Good Bermuda arrow root, 1 ¾ ozs; sheet gelatine, 80 grains: mix the arrow root to a creamy consistence with a spoon, in 1 oz. of water; then add 14 ozs. of water and the gelatine broken into fragments. Boil for 4 or 5 minutes, set it aside until partially cool, then add 1 oz. of methylated spirit, and 6 drops of carbolic acid, the former quite slowly. This article has no superior and will keep for years.

TO CLEAN ENGRAVINGS.—Place the engraving on a smooth board with a sheet of clean paper between, damp the picture on both sides with a sponge and clean water; then soak it well with the following solution applied with a clean sponge: Water, 1 pt, chloride of lime, 4 ozs.; oxalic acid, 1 oz. This imparts a fine white appearance to discolored prints, but it must not be applied to water colors in any case, as it will certainly destroy them.

TO REVIVE THE COLORS OF OLD PAINTINGS.—Mix linseed oil, 2 ozs., with methylated chloroform, 1 oz.; and apply a little over the painting, previously washing it with clean water applied with a little cotton wool; wipe off the composition with a soft silk handkerchief during the next day. The mixture possesses the valuable property of restoring the faded colors of paintings. The vapor of alcohol has a like effect.

TO PRESERVE A SCALING OR CRACKED PAINTING.—Clean the painting very carefully with pure soft water, and pour over, or gently apply, a mixture of equal parts of methylated chloroform and linseed oil. Allow it to remain a day or two; carefully wipe off the excess of oil, and apply more of the fresh mixture, wiping it off as before. Repeat the process until the colors become fixed, and the painting becomes flexible, when it may be cleaned and varnished.

VARNISH FOR PAINTINGS.—No better varnish for paintings can be had than that made from good, ripe, clean, gum mastic and rectified turpentine, fully matured by an exposure of several months in a wide mouthed glass bottle. Cover the bottle so as to admit air, but no dust, and set it in the light, but out of the sun.

TO PRESERVE PAINTINGS INDEFINITELY.—Varnish the painting on both sides, and hermetically seal with well fitting sheets of polished glass on the front, and apply a good coat of air proof material to the back. According to Wagner, the real cause of the ultimate destruction of pictures as well as of paint, is the gradual, but continuous, yet slow, oxidation of the linoxine, resulting in the crumbling to powder of pulverulent matters—pigments used as colors. It may not be out of place to state that one of the best solvents of linoxine (dried paint) is a mixture of alcohol and chloroform, which may be advantageously used to remove stains of paint, and also of wagon and carriage grease from silks and woollen tissues.

TO REMOVE OLD BLACK VARNISH FROM PAINTINGS.—Various articles as soda, naptha, spirits of wine, oil of tartar, &c., will effect this, if carefully handled by an experienced person, or the following mixture may be applied to the painting with a dabber of cotton wool: Wood spirits, 4 ozs.; linseed oil ½ pt. spirits of salts, 2 ozs. Go over the painting, imparting a spiral movement to the rubbing wad, keeping the picture level and the rubber clean. Watch the progress of the work, taking care not to go too far, and finish by wiping with a clean rag wet with spirits of turpentine.

TO WHITEN PLASTER CASTS, &c.—If the uncalcined plaster is immersed for 15 minutes in water containing 8 or 10 per cent. of sulphuric acid previous to burning it, it will after being calcined, set more slowly, and make splendid casts, which will be perfectly white. *Semi-transparent casts* of fancy articles can be made of unbaked gypsum, 2 parts, bleached bees-wax, 1 part; paraffine, 1 part. It is very tough and becomes plastic at 120°. Plaster casts will bear a nail driven in them without fracture if they are immersed in a *hot solution of glue* long enough to become saturated. To *mend Plaster Models*, use sandarac varnish, saturating the broken surfaces well, then pressing them together, then drying. As an application to the *inside Plaster Moulds* use glycerine, or a mixture of lard and oil.

TO POLISH PIANOS, FURNITURE, FRENCH POLISH, &c.—The following method of polishing pianos is in use in all first class factories. The same process will answer for any other piece of furniture, by merely substituting for the scraping, where scraping is not practicable, a filling, properly colored: First, give the work three coats of scraping or No. 2 furniture varnish, allowing each coat to become perfectly hard before applying the next; then scrape off the varnish with a steel scraper, properly sharpened on an oilstone, and in scraping be careful not to cut into the wood, but merely remove the varnish from the surface, leaving the pores filled. Smooth with No. 1 sandpaper, and the work will be ready for the polishing varnish, four coats of which must be put on, allowing each coat to harden. To determine the proper time required for the hardening. I would say that one coat will not be ready for the next until it is so hard that you cannot make an impression on it with your thumb nail. The four coats having been put on, and the work having stood a few days—and the longer the better—rub down with fine-ground pumice-stone and water, applied with a woolen rag. The work must be rubbed until all lumps and marks of the brush are removed; wash off with a sponge and dry with a chamois-skin: let the work stand out in the open air for a day or two, taking it into the shop at night. The work should now receive two coats more of polishing varnish and a second rubbing, after which it is ready for polishing.

Furniture may be polished after the first rubbing, and in that case the polishing is performed with lump rotten-stone and water applied with a woollen rag. Put plenty of rotten-stone on your work, with water enough to make it work easy. Rub until all marks and scratches are removed. Rub the rotten-stone off with your bare hand keeping the work wet. What cannot be removed with the hand should be washed off with a sponge. After drying with a chamois-skin, bring up the polish with the palm of your hand, moving it lightly and quickly with a circular motion, over the work. Clean up the work with a piece of soft cotton, dipped into sweet oil, and lightly touch all the white spots and marks of the rotten-stone. Remove the oil with wheat flour, applied with soft cotton, and finally dust off with a soft rag or silk handkerchief.

The following method is known as the Shellac or French Polish. In preparing for this process, add to one pint of Shellac varnish two tablespoonfuls of boiled oil; the two to be thoroughly mixed. If you want the work dark, add a little burnt umber; or you can give the work any desired shade by mixing with the shellac the proper pigment in the dry state. Apply the shellac thus prepared with a small bunch of rags held between your fingers. In applying it be particular in getting it on smooth and even, leaving no thick places or blotches. Repeat the process continually until the grain is filled and the work has received sufficient body. Let it stand a few hours to harden, and then rub your work lightly with pumice-stone and oil, applied with a rag. A very little rubbing is required, and this is to be followed by the cleaning of the work with rags as dry as possible. With a piece of muslin wet with alcohol, go over the work two or three times, for the purpose of killing the oil. Have ready ¼ lb. of pure gum shellac dissolved in one pint of 95 per cent. alcohol. With this saturate a pad made of soft cotton, covered with white muslin, and with the pad thus formed go over your work two or three times. To become proficient in this work, practice and close attention are required.

Walnut Stain for Wood.—Water, 1 gal.; Vandyke brown, 10 ozs.; bichromate of potash, 1 oz.; washing soda, 6 ozs.; boil 10 minutes, immerse the article, or apply with a brush as desired.

Gold Bronze for Furniture.—Mix copal varnish with gold-colored bronze powder. This is made from bisulphate of tin.

To Ebonize Wood.—Mix lampblack with good French polish and apply in the usual way. The lampblack may be collected on a tin held over a kerosene oil lamp, or lighted candle.

Reviver for Gilt Frames.—White of eggs, 2 ozs.; chloride of potash or soda, 1 oz.; mix well; blow off the dust from the frames; then go over them with a soft brush dipped in the mixture, and they will be equal to new.

Bad Smell from Animal Size.—To remove bad smell pass it through powdered charcoal. To preserve it, dissolve one ounce of sulphate of zinc, generally known as white copperas, in hot water, and add to every ½ cwt. It will keep any length of time. Melt your size, and thoroughly mix it.

Polishing Brass and Stone.—Plate-glass may be polished by rubbing with emery and water, the emery being of a greater degree of fineness as the work progresses, until at last by employing an impalpable variety prepared by suspending emery in water for an hour or more. Of course no scratches must exist in the work when the polishing operation begins; such must have been removed by means of a coarser emery flour. Stones, such as Brighton pebbles, &c., are often cut and polished on a rapidly revolving leaden disc, the surface of which is loaded with diamond dust, emery, or tripoli, according to the stone under operation.

Soluble Glass.—1. Silica, 1 part, carbonate of soda, 2 parts; fuse together. 2. Carbonate of soda (dry) 54 parts; dry carbonate of potassa, 70 parts; silica, 192 parts; soluble in boiling water, yielding a fine, transparent semi-elastic varnish. 3. Carbonate of potassa (dry), 10 parts; powdered quartz (or sand free from iron or alumina), 15 parts; charcoal, 1 part; all fused together. Soluble in 5 or 6 times its weight of *boiling* water. The filtered solution evaporated to dryness, yields a transparent glass, permanent in the air.

GLASS STAINING.—The following colors after having been prepared, and rubbed upon a plate of ground-glass, with the spirits of turpentine or lavender thickened in the air, are applied with a hair-pencil. Before using them, however, it is necessary to try them on small pieces of glass, and expose them to the fire, to ascertain if the desired tone of color is produced. The artist must be guided by these proof-pieces in using his colors. The glass proper for receiving these pigments must be colorless, uniform, and difficult of fusion. A design must be drawn on paper, and placed beneath the plate of glass. The upper side of the glass, being sponged over with gum-water, affords, when dry, a surface proper for receiving the colors without the risk of running irregularly, as they would otherwise do on the slippery glass. The artist draws on the plate (usually in black), with a fine pencil, all the traces which mark the great outlines or shades of the figures. Afterwards, when it is dry, the vitrifying colors are laid on by means of larger hair-pencils; their selection being regulated by the burnt specimen-tints above mentioned. The following are all fast colors, which do not run, except the yellow, which must therefore be laid on the opposite side of the glass. The preparations being all laid on, the glass is ready for being fired in a muffle, in order to fix and bring out the proper colors. The muffle must be made of very refractory fire-clay, flat at its bottom, and only five or six inches high, with a strong arched roof, and close on all sides, to exclude smoke and flame. On the bottom, a smooth bed of sifted lime, freed from water, about half an inch thick, must be prepared for receiving the glass. Sometimes, several plates of glass are laid over each other, with a layer of lime powder between each. The fire is now lighted, and very gradually raised, lest the glass should be broken; then keep it at a full heat for three or four hours, more or less, according to the indications of the trial slips; the yellow coloring being principally watched, it furnishing the best criterion of the state of the others. When all is right, let the fire die out, so as to anneal the glass.

STAINED-GLASS PIGMENTS.—No. 1. *Flesh-color.*—Red lead, 1 oz.; red enamel (Venetian glass enamel, from alum and copperas calcined together): grind them to a fine powder, and work this up with alcohol upon a hard stone. When slightly baked, this produces a fine flesh-color. No. 2. *Black color.*—Take 14½ oz. of smithy scales of iron; mix them with 2 oz. of white glass: antimony, 1 oz. manganese, ½ oz.; pound and grind these ingredients together with strong vinegar. No. 3. *Brown color.*—White glass or enamel, 1 oz.; good manganese. ½ oz.; grind together. No. 4. *Red, Rose and Brown colors* are made from peroxide of iron, prepared by nitric acid. The flux consists of borax, sand, and minium, in small quantities. *Red color* may likewise be obtained from 1 oz. of red chalk, pounded, mixed with 2 oz. white, hard enamel, and a little peroxide of copper. A *red* may also be composed of rust of iron, glass of antimony, yellow glass of lead, such as is used by potters, or litharge, each in equal quantities, to which a little sulphuret of silver is added. This composition, well ground, produces a very fine red color on glass. No. 5. *Green.*—2 oz. of brass, calcined into an oxide; 2 oz. of minium, and 8 oz. of white sand; reduce them to a fine powder, which is to be enclosed in a well-luted crucible, and heated strongly in an air furnace for an hour. When the mixture is cold, grind it in a brass mortar. Green may, however, be advantageously produced, by a yellow on one side and a blue on the other. Oxide of chrome has also been employed; to stain glass green. No. 6. A *fine yellow stain.*—Take fine silver, laminated thin, dissolve in nitric acid, dilute with abundance of water, and precipitate with solution of sea-salt; mix this chloride of silver in a dry powder, with three times its weight of pipe-clay well burnt and pounded. The back of the glass pane is to be painted with this powder; for, when painted on the face, it is apt to run into the other colors. A *pale yellow* can be made by mixing sulphuret of silver with glass of antimony and yellow ochre, previously calcined to a red brown tint. Work all these powders together, and paint on the back of the glass. Or silver *laminæ*, melted with sulphur and glass of antimony, thrown into cold water and afterwards ground to powder, affords a yellow. A *pale yellow* may be made with the powder resulting from brass, sulphur, and glass of antimony, calcined together in a crucible till they cease to smoke, and then mixed with a little burnt ochre. The *fine yellow* of M. Meraud is prepared from chloride of silver, oxide of zinc, and rust of iron. This mixture, simply ground, is applied on the glass. *Orange color.*—Take 1 part of silver powder, as precipitated from the nitrate of that metal, by plates of copper, and washed; mix with 1 part of red ochre, and 1 of yellow, by careful trituration; grind into a thin pap, with oil of turpentine or lavender: apply this with a brush, and burn in.

TO SILVER LOOKING GLASSES.—A sheet of tin-foil corresponding to the size of the plate of glass is evenly spread on a perfectly smooth and solid marble table, and every wrinkle on its surface is carefully rubbed down with a brush: a portion of mercury is then poured on, and rubbed over the foil with a clean piece of soft woollen stuff, after which, two rules are applied to the edges, and mercury poured on to the depth of a crown piece; when any oxide on the surface is carefully removed, and the sheet of glass, perfectly clean and dry, is slid along over the surface of the liquid metal, so that no air, dirt, or oxide can possibly either remain or get between them. When the glass has arrived at its proper position, gentle pressure is applied, and the table sloped a little to carry off the waste mercury; after which it is covered with flannel, and loaded with heavy weights; in twenty-four hours it is removed to another table, and further slanted, and this position is progressively increased during a month, till it becomes perpendicular.

PORCELAIN COLORS.—The following are some of the colors used in the celebrated porcelain manufactory of Sevres, and the proportions in which they are compounded. Though intended for porcelain painting, nearly all are applicable to painting on glass. Flux No. 1 minum or red lead, 3 parts; white sand, washed, 1 part. This mixture is melted, by which it is converted into a greenish-colored glass. Flux No. 2. *Gray flux.*—Of No. 1, 8 parts; fused borax in powder, 1 part. This mixture is melted. Flux No. 3. *For carmines and green*

—Melt together fused borax, 5 parts , calcined flints, 3 parts ; pure minum, 1 part. No. 1. *Indigo blue.*—Oxide of cobalt, 1 part ; flux No. 3, 2 parts. *Deep azure blue.*—Oxide of cobalt, 1 part; oxide of zinc, 2 parts ; flux No. 3, 5 parts. No. 2. *Emerald Green.*—Oxide of copper, 1 part ; antimonic acid, 10 parts ; flux No, 1, 30 parts. Pulverize together, and melt. No. 3. *Grass green.*—Green oxide of chromium, 1 part ; flux No. 3, 3 parts. Triturate and melt. No. 4. *Yellow.*—Antimonic acid, 1 part ; subsulphate of the peroxide of iron, 8 parts ; oxide of zinc, 4 parts ; flux No. 1, 36 parts. Rub up together and melt. If this color is too deep the salt of iron is diminished. No. 5. *Fixed yellow for touches.*—No. 4, 1 part ; white enamel of commerce, 2 parts. Melt and pour out ; if not sufficiently fixed, a little sand may be added. No. 6. *Deep Nankin yellow.*—Subsulphate of iron, 1 part ; oxide of zinc, 2 parts ; flux No. 2, 8 parts. Triturate without melting. No. 7. *Deep red.*—Subsulphate of iron, calcined in a muffle until it becomes of a beautiful capucine red, 1 part ; flux No. 2, 3 parts. Mix without melting. No. 8. *Liver brown.*—Oxide of iron made of a red brown, and mixed with three times its weight of flux No. 2. A tenth of sienna earth is added to it, if it is not deep enough. No. 9. *White.*—The white enamel of commerce, in cakes. No. 10. *Deep black.*—Oxide of cobalt, 2 parts ; copper, 2 parts ; oxide of manganese, 1 part ; flux No. 1, 6 parts ; fused borax, ½ part. Melt, and add oxide of manganese, 1 part ; oxide of copper, 2 parts. Triturate without melting. *The Application.*—Follow the general directions given in another part of this work, in relation to staining glass.

How to Write on Glass in the Sun.—Dissolve chalk in aquafortis to the consistency of milk, and add to that a strong dissolution of silver. Keep this in a glass decanter well stopped. Then cut out from a paper the letters you will have appear, and paste the paper on the decanter or jar, which you are to place in the sun in such a manner that its rays may pass through the spaces cut out of the paper, and fall on the surface of the liquor. The part of the glass through which the rays pass will turn black, whilst that under the paper will remain white. Do not shake the bottle during the operation. Used in lettering jars.

To Stain or Color Glass.—For *amethyst*, oxide of manganese is used ; *blue*, oxide of cobalt ; for *brown*, oxide of iron ; for *green*, black oxide of copper ; for *purple*, oxide of gold ; for *ruby red*, suboxide of copper ; for *white*, oxide of tin ; for *yellow*, oxide of silver, &c. These substances pure and well powdered, are either added to the melted contents of the glass-pot, or are applied to the surface as in glass staining. *Fine Blue.* To 10 lbs. of flint glass, previously melted and cast into water, add zaffer, 6 drs. ; calcined copper, ½ oz. ; prepared by putting sheet copper into a crucible, and exposing it to the action of a fire not strong enough to melt the copper, and you will have the copper in scales, which you pound.—*Bright Purple.* Use 10 lbs. flint glass as before ; zaffer 5 drs. ; precipitate of calcium. 1 dr. *Gold Yellow.* Flint glass 28 lbs., of the tartar which is found in urine, ¼ lb., purify by putting in a crucible on the fire until it ceases to smoke, and add manganese, 2 ozs.

Bottle Glass.—No. 1. *Dark Green.*—Fused glauber-salts, 11 lbs. ; soaper salts, 12 lbs. ; waste soap-ashes, ½ bush. ; silicious sand, ⅓ cwt. ; glass-skimmings, 22 lbs. ; broken green glass, 1 cwt. to 1½ cwt. ;

basalt, 25 lbs. to ¼ cwt. No. 2. *Pale Green.*—Pale sand, 100 lbs.; kelp, 35 lbs.; lixiviated wood-ashes, 1¼ cwt.; fresh do., 40 lbs.; pipe-clay, ¾ cwt.; cullet, or broken glass, 1 cwt. No. 3. Yellow or white sand, 120 parts; wood-ashes, 80 parts; pearl-ashes, 20 parts; common salt, 15 parts; white arsenic, 1 part; very pale. *Crystal Glass.*—No.1. Refined potashes, 60 lbs.; sand, 120 lbs.; chalk, 24 lbs.; nitre and white arsenic, of each, 2 lbs.; oxide of manganese, 1 to 2 oz. No. 2. Pure white sand, 120 parts; refined ashes, 70 parts; saltpetre, 10 parts; white arsenic, ½ part; oxide of manganese, ½ part. No. 3. Sand, 120 parts; red-lead, 50 parts; purified pearlash, 40 parts; nitre, 20 parts; manganese, ½ part. *Flask Glass (of St. Etienne).*—Pure silicious sand, 61 parts; potash, 3½ parts; lime, 21 parts; heavy spar, 2 parts; oxide of manganese, *q. s.* *Best German Crystal Glass.*—Take 120 lbs. of calcined flints or white sand; best pearlash, 70 lbs.; saltpetre, 10 lbs.; arsenic, ½ lb.; and 5 oz magnesia. No. 2. (*Cheaper.*)—Sand or flint, 120 lbs.; pearlash, 46 lbs.; nitre, 7 lbs.; arsenic, 6 lbs.; magnesia, 5 oz. This will require a long continuance in the furnace, as do all others when much of the arsenic is used. *Plate Glass.*—No. 1. Pure sand, 40 parts; dry carbonate of soda, 26½ parts; lime, 4 parts; nitre, 1½ parts; broken plate glass, 25 parts. No. 2. *Ure's.*—Quartz-sand, 100 parts; calcined sulphate of soda, 24 parts; lime, 20 parts; cullet of soda-glass, 12 parts. No. 3. *Vienna.*—Sand, 100 parts; calcined sulphate of soda, 50 parts; lime, 20 parts; charcoal, 2¾ parts. No. 4. *French.*—White quartz sand and cullet, of each 300 parts; dry carbonate of soda, 100 parts; slaked lime, 43 parts. *Crown Glass.*—No. 1. Sand, 300 lbs.; soda-ash, 200 lbs.; lime 30 to 35 lbs.; 200 to 300 lbs. of broken glass. No. 2. (*Bohemian.*)—Pure silicious sand, 63 parts; potash, 22 parts; lime, 12 parts; oxide of manganese, 1 part. No. 3. (*Prof. Schweiggers.*)—Pure sand, 100 lbs.; dry sulphate of soda, 50 parts; dry quicklime in powder, 17 to 20 parts; charcoal, 4 parts. *Product*, white and good.

Best Window-Glass.—No. 1. Take of white sand, 60 lbs.; purified pearlashes, 30 lbs.; of saltpetre, 15 lbs.; of borax, 1 lb.; of arsenic, ½ lb. This will be very clear and colorless if the ingredients be good, and not be very dear. No. 2. (*Cheaper.*)—White sand, 60 lbs.; unpurified pearl-ashes, 25 lbs.; of common salt, 10 lbs.; nitre, 5 lbs.; arsenic, 2 lbs.; magnesia, 1½ oz. No. 3. *Common green window-glass.*—White sand, 60 lbs.; unpurified pearlashes, 30 lbs.; common salt, 10 lbs.; arsenic, 2 lbs.; magnesia, 2 oz. *Looking-Glass Plate.*—No. 1. Cleansed white sand, 60 lbs.: pearlashes, purified, 25 lbs.; saltpetre, 15 lbs.; borax, 7 lbs. This composition should be continued long in the fire, which should be sometimes strong and afterwards more moderate, that the glass may be entirely free from bubbles before it be worked. No. 2. White sand, 60 lbs.; pearlashes, 20 lbs.; common salt, 10 lbs.; nitre, 7 lbs.; borax, 1 lb. This glass will run with as little heat as the former; but it will be more brittle, and refract the rays of light in a greater degree. No. 3. Washed white sand, 60 lbs.; purified pearlashes, 25 lbs.; nitre, 15 lbs.; borax, 7 lbs. If properly managed, this glass will be colorless. *Window Glass.*—No. 1. Dried sulphate of soda, 11 lbs.; soaper salts, 10 lbs.; lixiviated soap waste, ½ bush.; sand, 50 to 60 lbs.; glass-pot skimmings, 22 lbs.; broken *pale* green glass, 1 cwt. No. 2. (*Paler.*)—White sand, 60 lbs.; pearl-ashes, 30 lbs.; common salt 10 lbs.; arsenic, 10 lbs.; oxide of manganese, 2 to 4 oz. No. 3. (*Very Pale.*)—White sand, 60 lbs.; good pot ashes, 25 lbs.; common salt 10 lbs.; nitre, 5 lbs.; arsenic, 2 lbs.: manganese, 2 to 4 oz. as required; broken *pale* window glass, 14 lbs.

COLORED POTTERS' GLAZINGS.—*White;* prepare an intimate mixture of 4 parts of massicot, 2 of tin ashes, 3 fragments of crystal glass, and ½ part of sea salt. The mixture is suffered to melt in earthenware vessels, when the liquid flux may be used. *Yellow;* take equal parts of massicot, red lead and sulphuret of antimony, calcine the mixture, and reduce it again to powder, add then 2 parts of pure sand, and 1½ parts of salt; melt the whole. *Green;* 2 parts of sand, 3 parts massicot, 1 part of salt and copper scales, according to the shade to be produced: melt and use. *Violet;* 1 part massicot, 3 parts sand, 1 of smalt, ⅛ part of black oxide of manganese; melt. *Blue;* white sand and massicot, equal parts; blue smalt, ⅓ part; melt. *Black;* black oxide of manganese, 2 parts; smalt ½ part; burned quartz, 1 part; massicot, 1½ parts; melt. *Brown;* green bottle glass, 1 part; manganese, 1 part; lead, 2 parts, melt.

MORTAR, PLASTER, &C.—22 KINDS.—1. *Stone Mortar.*—Cement, 8 parts; lime, 3 parts; sand, 31 parts. 2. *Mortar.*—Lime, 1 part; sharp, clean sand, 2½ parts. An excess of water in slaking the lime swells the mortar, which remains light and porous, or shrinks in drying: an excess of sand destroys the cohesive properties of the mass. 3. *Brown Mortar.*—Lime, 1 part; sand, 2 parts, and a small quantity of hair. 4. *Brick Mortar.*—Cement, 3 parts; lime, 3 parts; sand, 27 parts. Lime and sand, and cement and sand, lessen about ⅓, in volume when mixed together. 5. *Turkish Mortar.*—Powdered brick and tiles, 1 part; fine sifted lime, 2 parts; mix to a proper consistency with water, and lay on layers of 5 or 6 inches thick between the courses of brick or stone. Very useful on massive or very solid buildings. 6. *Interior Plastering—Coarse Stuff.*—Common lime mortar as made for brick masonry, with a small quantity of hair; or by volumes, lime paste (30 lbs. lime,) 1 part; sand, 2 to 2½ parts; hair, ⅛ part. When full time for hardening cannot be allowed, substitute from 15 to 20 *per cent.* of the lime by an equal portion of hydraulic cement. For the second or *brown* coat the proportion of hair may be slightly diminished. 7. *Fine Stuff.*—(Lime putty): Lump lime slaked to a paste with a moderate volume of water, and afterwards diluted to the consistency of cream, and then harden by evaporation to the required consistency for working. In this state it is used as a *slipped coat,* and when mixed with sand or plaster of Paris, it is used for the *finishing coat.* 8. *Gauge Stuff or Hard Finish* is composed of 3 or 4 volumes of fine stuff and 1 volume of plaster of Paris, in proportions regulated by the degree of rapidity required in hardening for cornices, &c., the proportions are equal volumes of each, fine stuff and plaster. 9. *Stucco* is composed of from 3 to 4 volumes of white sand to 1 volume of fine stuff or lime putty. 10. *Scratch Coat.*—The first of 3 coats when laid upon laths, and is from ¼ to ⅜ of an inch in thickness. 11. *One Coat Work.*—Plastering in 1 coat without finish, either on masonry or laths that is rendered or laid. Work on well. 12. *Two Coat Work.*—Plastering in 2 coats is done either in a *laying coat and set* or in *a screed coat and set.* The *Screed Coat* is also termed a *Floated Coat.* *Laying* the first coat in two coat work is resorted to in common work instead of *screeding*, when the finished surface is not required to be exact to a straight edge. It is laid in a coat of about ½ inch in thickness. The laying coat, except for very common work, should be *hand floated*, as the tenacity and firmness of the work is much increased thereby. *Screeds* are strips of mortar, 26 to 28 inches in width, and of the required thickness of the first coat, applied to the angles of a room or edge of a wall and parallelly, at intervals of 3 to 5 feet over the surface to be covered. When these have become sufficiently hard to withstand the pressure of a straight edge, the interspaces between the screeds should be filled out flush with them, so as to produce a continuous and straight, even surface. *Slipped Coat* is the smoothing off of a brown coat with a small quantity of lime putty, mixed with three per cent of white sand so as to make a comparatively even surface. This finish answers when the surface is to be finished in distemper or paper. *Hard Finish:* Fine stuff applied with a trowel to the depth of about ⅛ of an inch. 13. *Cement for External Use.*—Ashes, 2 parts; clay, 3 parts; sand, 1 part; mix with a little oil. Very durable. 14. *Compositions for Streets and Roads.*—Bitumen, 16.875 parts; asphaltum, 2.25 parts; oil of resin, 6.25; sand, 1.35 parts. Thickness from 1¼ to 1⅝ inches. Asphaltum, 55 lbs., and gravel 28.7 lbs. will cover an area of 10.75 square feet. 15. *Asphalt Composition.*—Mineral pitch, 1 part; bitumen, 11 parts; powdered stone or wood ashes, 7 parts. 16. *Asphalt Mastic* is composed of nearly pure carbonate of lime and about 9 or 10 per cent. of bitumen. When in a state of powder it is mixed with about 7 per cent. of bitumen or mineral pitch. The powdered asphalt is mixed with the bitumen in a melted state along with clean gravel, and consistency is given to pour it into moulds. The asphalt is ductile, and has elasticity to enable it, with the small stones sifted upon it, to resist ordinary wear. Sun and rain do not affect it, wear and tear do not seem to injure it. The pedestrian in many cities in the United States and Canada, can readily detect its presence on the sidewalk by its peculiar yielding to the foot as he steps over it. It is also a most excellent roofing material when rightly applied, it being on record in France that a stout roof of this material withstood the accidental fall of a stack of chimneys, with the only effect of bruising the mastic, readily repaired. 17. *Asphalt for Walks.*—Take 2 parts very dry lime rubbish, and 1 part coal ashes, also very dry, all sifted fine. In a dry place, on a dry day, mix them, and leave a hole in the middle of the heap, as bricklayers do when making mortar. Into this pour boiling hot coal tar; mix, and when as stiff as mortar, put it three inches thick where the walk is to be; the ground should be dry and beaten smooth; sprinkle over it coarse sand. When cold, pass a light roller over it; in a few days the walk will be solid and waterproof. 18. *Mastic Cement for Covering the Fronts of Houses.*—Fifty parts, by measure, of clean dry sand, 50 of limestone (not burned) reduced to grains like sand, or marble dust, and 10 parts of red lead, mixed with as much boiled linseed oil as will make it slightly moist. The bricks to receive it, should be covered with three coats of boiled oil, laid on with a brush, and suffered to dry before the mastic is put on. It is laid on with a trowel like plaster, but it is not so moist. It becomes hard as stone in a few months. Care must be exercised not to use too much oil. 19. *Cement for Tile-Roofs.*—Equal parts of whiting and dry sand, and 25 per cent. of litharge, made into the consistency of putty with linseed oil. It is not liable to crack when cold, nor melt, like coal-tar and asphalt, with the heat of the sun. 20. *Cement for Outside of Brick Walls.*—Cement for the outside of brick walls, to imitate stone, is made of clean sand, 90 parts; litharge, 5 parts; plaster of Paris, 5 parts; moistened with boiled linseed oil. The bricks should receive two or three coats of oil before the cement is applied. 21. *Water Lime at Fifty Cents per Barrel.*—Fine clean sand, 100 lbs.; quick-lime in powder, 28 lbs.; bone ashes, 14 lbs.; for use, beat up with water, and use as quick as possible. 22. *Cement for Seams in Roofs.*—Take equal quantities of white lead and white sand, and as much oil as will make it into the consistence of putty. It will in a few weeks become as hard as stone.

SILVER POLISH KALSOMINE.—Take 7 lbs. of Paris white and ¼ lb. of light colored glue. Set the glue in a tin vessel containing 3 pts. of water, let it stand over night to soak, then put it in a kettle of boiling water over the fire, stirring till it is well dissolved and quite thin. Then, after putting the Paris white into a large water pail, pour on hot water and stir it till appears like thick milk. Now mingle the glue liquid with the whiting, stir it thoroughly and apply with a whitewash brush, or a large paint brush.

MEASUREMENT OF STONE OR BRICK WORK.

1. *Perch, Masons' or Quarrymens' Measure.*

16½ feet long 16 inches wide 12 " high	=	22 cubic feet. To be measured in wall.
16½ feet long, 18 inches wide 12 " high	=	24.75 cubic feet. To be measured in pile.

1 cubic yard = 3 feet × 3 feet × 3 feet = 27 cubic feet. The cubic yard has become the standard for all contract work of late years. Stone walls less than 16 inches thick count as if 16 inches thick to masons; over 16 inches thick, each additional inch is counted.

NUMBER OF BRICK REQUIRED IN WALL PER SQUARE FOOT FACE OF WALL.

Thickness of wall.		Thickness of wall.	
4 inches	7½	24 inches	46
8 "	15	28 "	52½
12 "	22½	32 "	60
16 "	30	36 "	67½
20 "	37½	42 "	75

Cubic yard = 600 bricks in wall.
Perch (22 cubic feet) = 500 bricks in wall.
To pave 1 sq. yard on flat requires 48 bricks.
" " 1 " " edge " 68 "

BEST WASH FOR BARNS AND HOUSES.—Water lime, 1 peck; freshly slaked lime, 1 peck; yellow ochre in powder, 4 lbs.; burnt umber, 4 lbs. To be dissolved in hot water, and applied with a brush.

DURABLE OUTSIDE PAINT.—Take 2 parts (in bulk) of water lime, ground fine; 1 part (in bulk) of white lead, in oil. Mix them thoroughly, by adding *best* boiled linseed oil, enough to prepare it to pass through a paint-mill; after which, temper with oil till it can be applied with a common paint brush. Make any color to suit. It will last 3 times as long as lead paint. IT IS SUPERIOR.

FARMERS' PAINT.—Farmers will find the following profitable for house or fence paint: skim milk, two quarts; fresh slaked lime 8 oz.; linseed oil, 6 oz.; white Burgundy pitch, 2 oz.; Spanish white, 3 lbs. The lime is to be slaked in water, exposed to the air, and then mixed with about one-fourth of the milk; the oil in which the pitch is dissolved to be added a little at a time, then the rest of the milk, and afterwards the Spanish white. This is sufficient for twenty-seven yards, 2 coats. This is for white paint. If desirable, any other color may be produced; thus, if a cream color is desired, in place of part of the Spanish white use the other alone.

ESTIMATE OF MATERIALS AND LABOR FOR 100 SQUARE YARDS OF LATH AND PLASTER.

Materials and Labor.	Three coats hard finish.	Two Coats Slipped.	Materials and Labor.	Three coats hard finish.	Two coats Slipped.
Lime . . .	4 Casks.	3½ casks.	White Sand	2½ bushs.	
Lump Lime	⅔ "		Nails . . .	13 lbs.	13 lbs.
Plaster of			Masons . .	4 days.	3½ days.
Paris . .	½ "		Laborer .	3 "	2 "
Laths. . .	2000	2000	Cartage . .	1 "	¾ "
Hair . . .	4 bushs.	3 bushs.			
Sand . . .	6 loads.	6 loads.			

PAINTING IN MILK.—Skimmed milk, ½ gallon; newly slaked lime, 6 oz.; and 4 oz. of poppy, linseed, or nut oil; and 3 lbs. Spanish white. Put the lime into an earthen vessel or clean bucket; and having poured on it a sufficient quantity of milk to make it about the thickness of cream, add the oil in small quantities a little at a time, stirring the mixture well. Then put in the rest of the milk, afterwards the Spanish white finely powdered, or any other desired color. For out-door work add 2 oz. each more of oil and slaked lime, and 2 oz. of Burgundy pitch dissolved in the oil by a gentle heat.

PREMIUM PAINT WITHOUT OIL OR LEAD.—Slake stone-lime with boiling water in a tub or barrel to keep in the steam; then pass 6 quarts through a fine sieve. Now to this quantity add 1 quart of coarse salt, and a gallon of water; boil the mixture, and skim it clear. To every five gallons of this skimmed mixture, add 1 lb. alum; ½ lb. copperas; and by slow degrees ¾ lb. potash, and 4 quarts sifted ashes or fine sand; add any coloring desired. A more durable paint was never made.

GREEN PAINT FOR GARDEN STANDS, BLINDS, ETC.—Take mineral green, and white lead ground in turpentine, mix up the quantity you wish with a small quantity of turpentine varnish. This serves for the first coat. For the second, put as much varnish in your mixture as will produce a good gloss. If you desire a brighter green, add a little Prussian blue, which will much improve the color.

MILK PAINT, FOR BARNS, ANY COLOR.—Mix water lime with skim milk, to a proper consistence to apply with a brush, and it is ready to use. It will adhere well to wood, whether smooth or rough, to brick, mortar, or stone, where oil has not been used (in which case it cleaves to some extent), and forms a very hard substance, as durable as the best oil paint. It is too cheap to estimate, and any one can put it on who can use a brush. Any color may be given to it, by using colors of the tinge desired. If a red is preferred, mix Venetian red with milk, not using any lime. It looks well for fifteen years.

PAINT.—TO MAKE WITHOUT LEAD OR OIL.—Whiting, 5 lbs.; skimmed milk, 2 qts.; fresh slaked lime, 2 oz. Put the lime into a stoneware vessel, pour upon it a sufficient quantity of the milk to make a mixture resembling cream; the balance of the milk is then to be added; and lastly, the whiting is to be crumbled upon the surface of the fluid, in which it gradually sinks. At this period it must be well stirred in or ground, as you would other paint, and it is fit for use.

PARIS GREEN.—Take unslaked lime of the best quality, slake it with hot water; then take the finest part of the powder, and add alum water as strong as it can be made, sufficient to form a thick paste; then color it with bichromate of potash and sulphate of copper until the color suits your fancy, and dry it for use. N.B.—The sulphate of copper gives a blue tinge; the bichromate of potash, a yellow. Observe this, and you will get it right.

BEAUTIFUL GREEN PAINT FOR WALLS.—Take 4 lbs. Roman vitriol, and pour on it a teakettleful of boiling water. When dissolved, add 2 lbs. pearlash, and stir the mixture well with a stick until the effervescence ceases; then add ¼ lb. pulverized yellow arsenic, and stir the whole together. Lay it on with a paint brush; and if the wall has not been painted before, 2 or even 3 coats will be requisite. If a pea-green is required, put in less, if an apple-green, more, of the yellow arsenic. This paint does not cost the quarter of oil paint, and looks better.

BLUE COLOR FOR CEILINGS, &c.—Boil slowly for 3 hours 1 lb. blue vitriol and ½ lb. of the best whiting in about 3 qts. water; stir it frequently while boiling, and also on taking it off the fire. When it has stood till quite cold, pour off the blue liquid, then mix the cake of color with good size, and use it with a plasterer's brush in the same manner as whitewash, either for walls or ceilings.

TO HARDEN WHITEWASH.—To ½ pail of common whitewash add ½ pint of flour. Pour on boiling water in quantity to thicken it. Then add 6 gals. of the lime water, and stir well.

WHITEWASH THAT WILL NOT RUB OFF.—Mix up half a pailful of lime and water, ready to put on the wall; then take ¼ pt. flour, mix it up with water; then pour on it boiling water, a sufficient quantity to thicken it; then pour it while hot into the whitewash, stir all well together, and it is ready for use.

SLATING.—The pitch of a slated roof should be about 1 in height to 4 in length; the usual lap is about 3 ins., but it is sometimes 4. Each slate should be fastened by 2 nails, either of copper or zinc. A square of slate is 100 superficial feet, allowances being made for the trouble of cutting the slates at the hips, eaves, round chimneys, etc. The sides and bottom edges of the slates should be trimmed, and the nail holes punched as near the head as possible; they should be sorted in sizes, when they are not all of one size, and the smallest size placed near the ridge. The thickness of slates varies from 3-16 to 5-16 of an inch, and their weight from 2.6 to 4.53 lbs. per square foot. The following table of sizes, etc., of roofing slates is very useful:

Description.	Size. Length	Size. Bre'th.	Av'rage guage in inches.	No. of squares 1200 will cover.	Weight per 1200 in tons.	No. required to cover one square.	No. of nails required to one square.
	ft. in.	ft. in.					
Doubles	1 1	0 6	5½	2	¾	480	480
Ladies	1 4	0 8	7	4½	1¼	280	280
Countesses ..	1 8	0 10	9	7	2	176	352
Duchesses ...	2 0	1 0	10½	10	3	127	254
Imperials....	2 6	2 0	a ton will cover 2¼ to 2½ squares.				
Rags and Queens Westmorelands, of various sizes.	3 0	2 0					

The next table exhibits the comparative weight of various roof coverings.

	Weight.	Least Slope.
Plain tiles, per square of 100 sup'l feet....	8 to 18 cwt.	26½ to 30°
Pantiles	9¼ cwt.	....
Slating, an average.........................	7 to 9 cwt.	25½ to 30°
Lead, 7 lbs. per sup'l feet..................	6½ cwt.	4°
Corrugated iron.............................	3 cwt.	4°
Copper, or zinc, 16 ozs. per sup'l feet......	1 cwt.	4°
Timber framing for slated or tiled roofs ...	560 to 672 lbs.	....
Boarding, ¾ in. thick.......................	2½ cwt.	25°
Boarding, 1½ in. thick	5 cwt.	25°
Additional load for pressure of wind......	35 cwt.	....
Gothic roofs, steepest angle................	....	60°

CEMENT FOR MARBLE AND ALABASTER.—Mix 12 parts of Portland cement, 6 parts slacked lime, 6 parts of fine sand, and 1 part of infusorial earth, and make up into a thick paste with silicate of soda. The object to be cemented does not require to be heated. It sets in 24 hours, and the fracture can not readily be found.

SUPERIOR BLASTING COMPOUND.—The English mining engineer, Mr. W. B. Brain, has found that one of the most available blasting compounds consists of equal parts of potash chlorate, potash nitrate, charcoal, and dry oak saw-dust; 3 parts of this mixture is made to about 2 parts nitroglycerine of 1.6 specific gravity.

TO THAW FROZEN SINK PIPES, &C.—Place the end of a piece of lead pipe against the ice to be thawed, and then through a funnel in the other end pour boiling water. Keep the pipe constantly against the ice and it will soon disappear. Or stiffen rubber tubing with fine wire and introduce it into the pipe as far as possible, and direct a jet of steam from a small boiler over a portable charcoal furnace, as is done by plumbers in many cases.

EXTINGUISHING FIRES.—A solution of pearlash in water, thrown upon a fire, extinguishes it instantly; the proportion is 4 ozs., dissolved in hot water, and then poured into a bucket of cold water. In extinguishing kerosene fires, use no water, but smother the flames with blankets or rugs.

In clapboarding, 1 bundle laid 3½ ins. to the weather will cover 26 square feet. To be laid with 5-penny nails.

COMPARATIVE WEIGHT OF DIFFERENT WOODS IN GREEN AND SEASONED STATES IN POUNDS AND OUNCES PER CUBIC FOOT.—Ash, green, 58.3; do., seasoned, 50. Beech, green, 60; do., seasoned, 50. American pine, green, 44.12; do., seasoned, 30.11. Cedar, green, 32; do., seasoned, 28.4. English oak, green, 71.10; do. seasoned, 43,8. Riga Fir, green, 48.12; do., seasoned, 35.8.

SHRINKAGE IN DIMENSIONS OF TIMBER BY SEASONING.

Woods.	Ins.	Woods.	Ins.
Pitch pine, South...	18⅜ to 18¼	Cedar, Canada.......	14 to 13¼
Spruce..............	8½ to 8⅜	Elm.................	11 to 10¾
White pine, America	12 to 11⅞	Oak, English........	12 to 11⅝ [9¾
Yellow pine.........	18 to 17⅞	Pitch pine..........	10x10 to 9¾ by

PERCENTAGE OF WATER IN DIFFERENT WOODS.

Alder...............41.6	Larch...............48.6	Red pine............45.2
Ash.................28.7	Mountain ash........28.3	White oak...........36.2
Birch...............30.8	Oak.................34.7	White pine..........37.1
Elm.................44.5	Pine................39.7	White poplar........50.6
Horse chestnut......38.2	Red beech...........39.7	Willow..............26.0

In shingling, 1 bundle of 16-inch shingles will cover 30 square ft.; 1 bundle of 18-inch shingles will lay 33 square ft., when laid 5½ ins. to the weather; 6 lbs. 4-penny nails will lay 1000 split pine shingles.

PLASTERER'S MEMORANDA.—130 yards of lath, lay and set, require 1 load of laths, 10,000 nails, 2½ cwt. of lime, 1½ double load of sand, and 7 bushels of hair; plaster, laborers and boy, 6 days each.

Render and Set.—100 yards requires 1½ cwt. of lime, 1 double load of sand, and 4 bushels of hair; plasterer, laborer and boy, 3 days each.

Setting.—375 yards require 1½ cwt. of lime and 5 bushels of hair.

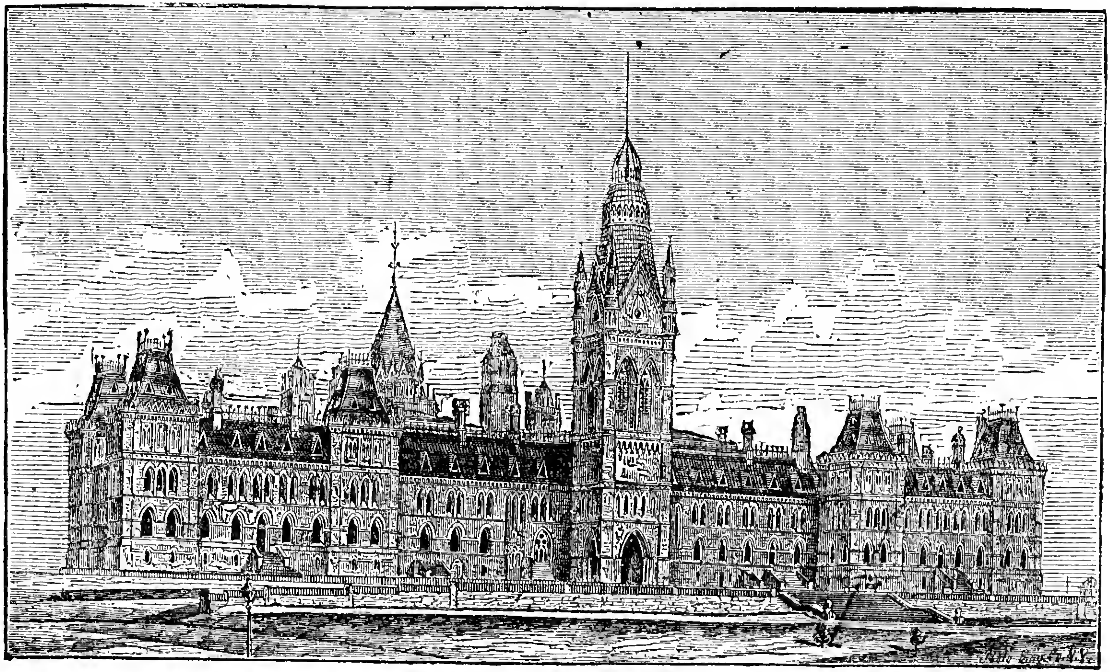
In lathing, 1 bundle of laths and 384 nails will cover 5 yards. In *rendering,* 187½ yards require 1½ cwt. of lime, 2 double loads of sand and 5 bushels of hair. *Floating* requires more labor, but only half as much material as rendering.

1000 bricks, closely stacked, occupy 56 cubic feet; 1000 old bricks, cleaned and loosely stacked, occupy 72 cubic ft.

1 rod of brickwork requires 126 gals. water to slack the lime and mix the mortar. Bricks absorb 1-15 of their weight in water. No. of bricks in cubic yard, 384. A bricklayer's hod will hold 20 bricks, or ⅔ cubic ft. of mortar, or ½ bushel, nearly.

SAFE LOAD IN STRUCTURES, INCLUDING WEIGHT OF STRUCTURE.

In cast-iron columns........................	¼	breaking	weight.
Wrought-iron structures.....................	¼	"	"
In cast-iron girders for tanks..............	¼	"	"
In cast-iron for bridges and tanks..........	1-6	"	"
In timber...................................	1-10	"	"
Stone and bricks............................	⅛	"	"



DOMINION PARLIAMENT BUILDINGS, OTTAWA, CANADA.

WHITEWASH.—The best method of making a whitewash for outside exposure is to slake $\frac{1}{2}$ bushel of lime in a barrel, add 1 lb. of common salt, $\frac{1}{2}$ lb. of the sulphate of zinc, and a gallon of sweet milk. Any desired color may be imparted to whitewash by adding coloring matter to suit. See *Compound Colors*.

TERRA COTTA MANUFACTURE.—In the terra cotta manufacture of the north of England and Scotland, the purest lumps of fire clay are selected by their color and texture, and used alone without any other clay, while the firms near London prepare more carefully a mixture of clays, which produce a body of better texture. One of the chief difficulties met in manufacturing terra cotta figures and ornamental works is the contraction the clay suffers after it has left the mould ; first, in drying, afterwards in firing ; By mixing the clays, a further advantage is gained in the diminished shrinkage, as fire clay terra cotta (that is, unmixed) shrinks in lineal dimensions about 12 per cent. from the time it leaves the mould until it leaves the kiln ; the mixed clay terra cotta shrinks 6 per cent. or less, and red clays shrink 3 per cent. To enhance the durability of the body of terra cotta, a partial vitrification of the mass is aimed at by adding clays and substances which contain a small amount of alkalies which act as a flux to fuse the body harder ; also vitrifying ingredients, pure white river sand, old fire brick, ground fine, previously ground clay called "grog," are added in various proportions, amounting even to 25 per cent. They counteract excessive shrinkage, act as vitrifying elements, and keep the color lighter. In the manufacture the mixture of clays is ground under an edge runner to the consistency of flour. The mills have either revolving or stationary pans ; the former do the most work. In order to mix and incorporate the different clays, a subsequent careful pugging is required, for hot water is sometimes used. The mixture when brought to the proper homogeneous consistency, is placed in a plaster mould, dried near the kilns or otherwise, and baked in a kiln for five or seven days, during which time it is slowly brought to a white heat, and is gradually cooled down again. In order to avoid twisting and warping during the firing, it is necessary, besides complete mixing of clays, that the mould be shaped so as to give a uniform thickness of material throughout, and if the temperature of the kilns be well graded, the homogeneous body will not warp. To cheapen terra cotta building blocks, they are made hollow, and filled, during the construction, with concrete or cement. Although in the kilns the productions are separated from the wares, it is found that the use of sulphurous fuel darkens and tarnishes the surface, and it is to be avoided. This material admits of being used with the greatest facility in the formation of the most elaborate architectural ornaments and other beautiful designs which can be multiplied to any required extent at a very cheap rate. A piece of four inch column tested at the 1851 Exhibition required a pressure of 400 tons per square foot to crush it, or as much as good granite and two or three times as much as most building stone.

EXCELLENT CHEAP ROOFING.—Have your roof stiff, rafters made of stuff $1\frac{1}{2}$ by 8 inches, well supported and 6 feet apart, with ribs 1 inch by 2 inches, set edgeways, well nailed to the rafters, about 18 inches apart. The boards may be thin but must be well seasoned, and nailed close together: this done, lay down and cover the roof with thin

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soft, spongy straw paper used in making paper-boxes, which comes in rolls and comes very low. Lay in courses up and down the roof, and lap over, nailing down with common No. 6 tacks, with leather under the heads like carpet tacks. Then spread on several coatings of the following composition, previously boiled, stirred, and mixed together: good clean tar, 8 gals.; Roman cement, 2 gals. (or in its place very fine, clean sand may be used); resin, 5 lbs.; tallow, 3 lbs.; apply hot: and let a hand follow, and sift on sharp grit sand, pressing it into the tar composition. If wished fire-proof, go over the above with the following preparation; slake stone lime under cover with hot water till it falls into a fine powder, sift and mix 6 qts. of this with 1 qt. salt; add 2 gals. water, boil and skim. To 5 gals. of this add 1 lb of alum, and 1½ lb. of copperas, slowly while boiling, 1½ lbs. potash and 4 qts. of clean, sharp sand, and any color desired. Apply a thick coat with a brush, and you have a roof which no fire can injure from the outside.

How to Build Gravel Houses.—This is the best building material in the world. It is four times cheaper than wood, six times cheaper than stone, and superior to either. Proportions for mixing: to eight barrows of slaked lime, well deluged with water, add 15 barrows of sand; mix these to a creamy consistency, then add 60 barrows of coarse gravel, which must be worked well and completely; you can then throw stones into this mixture, of any shape or size, up to ten inches in diameter. Form moulds for the walls of the house by fixing boards horizontally against upright standards, which must be immovably braced so that they will not yield to the immense pressure outwards as the material settles; set the standards in pairs around the building where the walls are to stand, from six to eight feet apart, and so wide that the inner space shall form the thickness of the wall. Into the moulds thus formed throw in the concrete material as fast as you choose, and the more promiscuously the better. In a short time the gravel will get as hard as the solid rock.

Varnish for Plaster Casts.—White soap and white wax, each ½ oz., water 2 pts., boil together in a clean vessel for a short time. This varnish is to be applied when cold with a soft brush.

The Bronzing of Plaster Casts is effected by giving them a coat of oil or size varnish, and when this is nearly dry, applying with a dabber of cotton or a camel-hair pencil any of the metallic bronze powders; or the powder may be placed in a little bag of muslin, and dusted over the surface, and afterwards finished with a wad of linen. The surface must be afterwards varnished.

Substitute for Plaster of Paris.—Best whiting, 2 lbs.; glue, 1 lb.; linseed oil, 1 lb. Heat all together, and stir thoroughly. Let the compound cool, and then lay it on a stone covered with powdered whiting, and heat it well till it becomes of a tough and firm consistence; then put it by for use, covering with wet cloths to keep it fresh. When wanted for use, it must be cut in pieces adapted to the size of the mould, into which it is forced by a screw press. The ornament may be fixed to the wall, picture-frame, &c., with glue or white lead. It becomes in time as hard as stone itself.

Modelling Clay.—Knead dry clay with glycerine instead of water, and a mass is obtained which remains moist and plastic for a considerable time, being a great convenience to the modeller.

ROMAN CEMENT.—Drift sand, 94 parts; unslaked lime, 12 lbs.; and 4 lbs. of the poorest cheese grated; mix well; add hot (not boiling) water to reduce to a proper consistence for plastering. Work well and quick with a thin smooth coat.

TO POLISH PLASTER OF PARIS WORK.—The addition of 1 or 2 per cent. of many salts, such as alum, sulphate of potash, or borax, confers upon gypsum the property of setting slowly in a mass capablo of receiving a very high polish.

TO MAKE PLASTER OF PARIS AS HARD AS MARBLE.—The plaster is put in a drum, turning horizontally on its axis, and steam admitted from a steam boiler: by this means the plaster is made to absorb in a short space of time the desired quantity of moisture, which can be regulated with great precision. The plaster thus prepared is filled into suitable moulds; and the whole submitted to the action of an hydraulic press: when taken out of the moulds, the articles are ready for use, and will be found as hard as marble, and will take a polish like it.

TO TAKE A PLASTER OF PARIS CAST FROM A PERSON'S FACE.—The person must lie on his back, and his hair be tied behind; into each nostril put a conical piece of paper, open at each end, to allow of breathing. The face is to be lightly oiled over, and the plaster, being properly prepared, is to be poured over the face, taking particular care that the eyes are shut, till it is a quarter of an inch thick. In a few minutes the plaster may be removed. In this a mould is to be formed, from which a second cast is to be taken, that will furnish casts exactly like the original.

WATCHMAKERS, JEWELLERS AND GILDERS' RECEIPTS, TABLES, &c.

ON WATCH CLEANING.—The greatest care is necessary in taking the watch down, and separating its parts. First, remove the hands carefully, so as not to bend the slight pivots on which they work, next, remove the movement from the case, and take off the dial and dial wheels; next, let down the main spring by placing your bench key upon the arbor, or winding post, and turning as though you were going to wind the watch until the click rests lightly upon the ratchet; then with your screw-driver press the point of the click away from the teeth and ease down the springs; next, draw the screws, or pins, and remove the bridges of the train or the upper plate, as the case may be, next, remove the balance with the greatest care to avoid injuring the hair spring. The stud or small post into which the hair spring is fastened may be removed from the bridge or plate of most modern watches without unkeying the spring, by slipping a thin instrument, like the edge of a blade knife, under the corner of it and prying upward, this will save much trouble, as you will not have the hair-spring to adjust when you reset the balance. If the watch upon which you propose to work has an upper plate, as an American or an English lever for instance, loosen the lever before you have entirely separated the plates, otherwise it will hang and probably be broken. The watch being now taken apart, brush the dust away from its different parts, and subject them to a careful examination with your eye-glass. Assure yourself the teeth of the wheels and leaves of the pinions are all perfect and smooth; that the pivots are all straight, round, and highly polished; that the holes through which they are to work are not too large, and have not become oval in shape; that every jewel is smooth and perfectly sound; and that none of them are loose in their settings. See also that the escapement is not too deep or too shallow; that the lever or cylinder is perfect; that all the wheels have sufficient play to avoid friction, but not enough to derange their coming together properly; that none of them work against the pillar-plate; that the balance turns horizontally and does not rub: that the hair-spring is not bent or wrongly set so that the coils rub on each other on the plate, or on the balance; in short, that everything about the whole movement is just as reason would teach you it should be. If you find it otherwise, proceed to repair in accordance with a carefully weighed judgment and the processes given in this chapter, after which clean; if not, the watch only needs to be cleaned, and, therefore, you may go on with your work at once.

To Clean.—The best process is to simply blow your breath upon the plate or bridge to be cleaned, and then to use your brush with a little prepared chalk. The wheels and bridges should be held between the thumb and finger in a piece of soft paper while undergoing the process; otherwise the oil from the skin will prevent their becoming clean. The pinions may be cleaned by sinking them several times into a piece of pith, and the holes by turning a nicely shaped piece of pivot wood into them, first dry, and afterwards oiled a very little with watch oil. When the holes pass through jewels, you must work gently to avoid breaking them.

The "Chemical Process."—Some watchmakers employ what they call the "Chemical Process" to clean and remove discoloration from watch movements. It is as follows :—

Remove the screws and other steel parts ; then dampen with a solution of oxalic acid and water. Let it remain a few minutes, after which immerse in a solution made of one-fourth pound cyanuret potassa to one gallon rain water. Let remain about five minutes, and then rinse well with clean water, after which you may dry in sawdust, or with a brush and prepared chalk, as suits your convenience. This gives the work an excellent appearance.

TO PREPARE CHALK FOR CLEANING.—Pulverize your chalk thoroughly, and then mix it with clear rain water in the proportion to two pounds to the gallon. Stir well, and then let stand about two minutes. In this time the gritty matter will have settled to the bottom. Pour the water into another vessel slowly so as not to stir up the settlings. Let stand until entirely settled, and then pour off as before. The settlings in the second vessel will be your prepared chalk, ready for use as soon as dried. Spanish whiting, treated in the same way, makes a very good cleaning or polishing powder. Some operatives add a little jeweller's rouge, and we think it an improvement; it gives the powder a nice color at least, and therefore adds to its importance in the eyes of the uninitiated. In cases where a sharper polishing powder is required, it may be prepared in the same way from rotten-stone.

PIVOT WOOD.—Watchmakers usually buy this article of watch-material dealers. A small shrub known as Indian arrow-wood, to be met with in the northern and western states, makes an excellent pivot wood. It must be cut when the sap is down, and split into quarters so as to throw the pith outside of the rod.

PITH FOR CLEANING.—The stalk of the common mullen affords the best pith for cleaning pinions. Winter, when the stalk is dry, is the time to gather it. Some use cork instead of pith, but it is inferior

TO PIVOT.—When you find a pivot broken, you will hardly be at a loss to understand that the easiest mode of repairing the damage is to drill into the end of the pinion or staff, as the case may be, and having inserted a new pivot, turn it down to the proper proportions. This is by no means a difficult thing when the piece to be drilled is not too hard, or when the temper may be slightly drawn without injury to the other parts of the article.

TO TELL WHEN THE LEVER IS OF PROPER LENGTH.—You may readily learn whether or not a lever is of proper length, by measuring from the guard point to the pallet staff, and then comparing with the roller or ruby-pin table; the diameter of the table should always be just half the length measured on the lever. The rule will work both ways, and may be useful in cases where a new ruby-pin table has to be supplied.

TO CHANGE DEPTH OF LEVER ESCAPEMENT.—If you are operating on a fine watch, the best plan is to put a new staff into the lever, cutting its pivots a little to one side, just as far as you desire to change the escapement. Common watches will not, of course, justify so much trouble. The usual process in their case is to knock out the staff, and with a small file cut the hole oblong in a direction opposite to that in which you desire to move your pallets: then replace the staff, wedge it to the required position, and secure by soft soldering. In instances where the staff is put in with a screw, you will have to proceed differently. Take out the staff, pry the pallets from the lever, file the pin holes to slant in the direction you would move the pallets, without changing their size on the other side of the lever. Connect the pieces as they were before, and, with the lever resting on some solid substance, you may strike lightly with your hammer until the bending of the pins will allow the pallets to pass into position.

COMPENSATION BALANCE OF CHRONOMETERS.—The balance is a small piece of steel covered with a hoop of brass. The rim, consisting of the two metals, is divided at the two extremities, the one diametrical arm of the balance, so that the increase of temperature which weakens the balance springs contract, in a proportionate degree, the diameter of the balance, leaving the spring less resistance to overcome. This occurs from the brass expanding much more by heat than steel, and it therefore curls the semicircular arcs inwards, an action that will be immediately understood, if we conceive the compound bar of steel to be straight, as the heat would render the brass side longer and convex, and in the balance it renders it more curved. In the compensation balance, the two metals are united as follows: the disk of steel when turned and pierced with a central hole is fixed by a little screw-bolt and nut at the bottom of a small crucible, with a central elevation smaller than the disk; the brass is now melted and the whole allowed to cool. The crucible is broken, the excess of brass is turned off in the lathe, the arms are made with the file as usual, the rim is tapped to receive the compensation screws or weights, and, lastly, the hoop is divided in two places at the opposite ends of its diametrical arm. The balance springs of marine chronometers, which are in the form of a screw, are wound into the square thread of a screw of the appropriate diameter and coarseness; the two ends of the spring are retained by side screws, and the whole is carefully enveloped in platinum foil, and lightly bound with wire. The mass is next heated in a piece of gun barrel closed at one end, and plunged into oil, which hardens the spring almost without discoloring it, owing to the exclusion of the air by the close platinum covering, which is now removed, and the spring is let down to the blue before removal from the screwed block. The balance or hair spring of *common* watches are frequently left soft, those of the *best* watches are hardened in the coil upon a plain cylinder and are then curled into the spiral form between the edge of a blunt knife and the thumb, the same as in curling up a narrow ribbon or paper, or the filaments of an ostrich feather. The soft springs are worth 60 cents each, those hardened and tempered $1.26 each. This raises the value of the steel; originally less than 4 cents, to $2000 and $8000 respectively. It takes 3200 balance springs to weigh an ounce.

WATCH SPRING MANUFACTURE.— Watch springs are hammered out of round steel wire, of suitable diameter until they fill the gauge, for width, which at the same time insures equality of thickness. The holes are punched in their extremities, and they are trimmed on the edge with a smooth file. The springs are then tied up with binding wire, in a loose *open* coil and heated over a charcoal fire upon a perforated revolving plate. They are hardened in oil and blazed off. The spring is now distended in a long metal frame, similar to that used for a saw blade, and ground and polished with emery and oil between lead blocks. By this time its elasticity appears quite lost, and it may be bent in any direction; its elasticity is, however, entirely restored by a subsequent hammering on a very bright anvil which puts the "*nature into the spring*." The coloring is done over a flat plate of iron, or hood, under which a small spirit lamp is kept burning; the spring is continually drawn backward and forward, about two or three inches at a time, until it assumes the orange or deep blue tint throughout, according to the taste of the purchaser. By many the coloring is considered to be a matter of ornament and not essential. The last process is to coil the spring into the spiral form, that it may enter the barrel in which it is to be contained. This is done by a tool with a small axis and winch handles, and does not require heat.

TO TELL WHEN LEVER PALLETS ARE OF PROPER SIZE.—The clear space between the pallets should correspond with the outside measure, on the points of three teeth of the scape wheel. The usual mode of measuring for new pallets is to set the wheel as close as possible to free its self when in motion. You can arrange it in your depthing tool, after which the measurement between the pivot holes of the two pieces, on the pillar plate, will show you exactly what is required.

TO LENGTHEN LEVERS OF ANCHOR-ESCAPEMENT WATCHES WITHOUT HAMMERING OR SOLDERING.—Cut square across with a screw-head file, a little back from the point above the fork, and, when you have thus cut into it to a sufficient depth, bend forward the desired distance the piece thus partially detached. In the event of the piece snapping off while bending—which, however, rarely happens—file down the point level with the fork, and insert a pin English lever style.

TO TEMPER CASE AND OTHER SPRINGS OF WATCHES.—Draw the temper from the spring, and fit it properly in its place in the watch; then take it out and temper it hard in rain-water (the addition of a little table-salt to the water will be an improvement); after which place it in a small sheet-iron ladle or cup, and barely cover it with linseed-oil; then hold the ladle over a lighted lamp until the oil ignites, let it burn until the oil is nearly, not quite consumed; then re-cover with oil and burn down as before; and so a third time; at the end of which, plunge it again into water. Main and hair springs may, in like manner, be tempered by the same process; first draw the temper, and properly coil and clamp to keep it in position, and then proceed the same as with case-springs.

TO MAKE RED WATCH HANDS.—1 oz. carmine, 1 oz. muriate of silver, ½ oz. of tinner's Japan; mix together in an earthen vessel, and hold over a spirit-lamp until formed into a paste. Apply this to the watch hand, and then lay it on a copper plate, face side up, and heat the plate sufficiently to produce the color desired.

TO DRILL INTO HARD STEEL.—Make your drill oval in form, instead of the usual pointed shape, and temper as hard as it will bear without breaking; then roughen the surface where you desire to drill with a little diluted muriatic acid, and, instead of oil, use turpentine or kerosene, in which a little gum camphor has been dissolved with your drill. In operating, keep the pressure on your drill firm and steady; and if the bottom of the hole should chance to become burnished that the drill will not act, as sometimes happens, again roughen with diluted acid as before; then clean out the hole carefully, and proceed again.

TO PUT TEETH IN WATCH OR CLOCK WHEELS WITHOUT DOVETAILING OR SOLDERING.—Drill a hole somewhat wider than the tooth, square through the plate, a little below the base of the tooth;

cut from the edge of the wheel square down to the hole already drilled; then flatten a piece of wire so as to fit snugly into the cut of the saw, and with a light hammer form a head on it like the head of a pin. When thus prepared, press the wire or pin into possession in the wheel, the head filling the hole drilled through the plate, and the projecting out so as to form the tooth; then with a sharp-pointed graver cut a small groove each side of the pin from the edge of the wheel down to the hole, and with a blow of your hammer spread the face of the pin so as to fill the grooves just cut. Repeat the same operation on the other side of the wheel, and finish off in the usual way. The tooth will be found perfectly riveted in on every side, and as strong as the original one, while in appearance it will be equal to the best dovetailing.

TO CASE-HARDEN IRON.—If you desire to harden to any considerable depth, put the article into a crucible with cyanide of potash, cover over and heat altogether, then plunge into water. This process will harden perfectly to the depth of one or two inches.

TO TIGHTEN A CANNON PINION ON THE CENTRE ARBOR WHEN TOO LOOSE.—Grasp the arbor lightly with a pair of cutting nippers, and, by a single turn of the nippers around the arbor, cut or raise a small thread thereon.

TO FROST WATCH MOVEMENTS.—Sink that part of the article to be frosted for a short time in a compound of nitric acid, muriatic acid, and table salt, one ounce of each. On removing from the acid, place it in a shallow vessel containing enough sour beer to merely cover it, then with a fine scratch brush scour thoroughly, letting it remain under the beer during the operation. Next wash off, first in pure water and then in alcohol. Gild or silver in accordance with any recipe in the plating department.

RULE FOR DETERMINING THE CORRECT DIAMETER OF A PINION BY MEASURING TEETH OF THE WHEEL THAT MATCHES INTO IT.—The term FULL, as used below, indicates full measure from outside to outside of the teeth named, and the term CENTRE, the measure from centre of one tooth to centre of the other tooth named, inclusive.

For diameter of a pinion of 15 leaves measure, with calipers, a shade less than 6 teeth of the wheel, *full*.

For diameter of a pinion of 14 leaves measure, with calipers, a shade less than 6 teeth of the wheel, *centre*.

For diameter of a pinion of 12 leaves measure, with calipers. 5 teeth of the wheel, *centre*.

For diameter of a pinion of 10 leaves measure, with calipers, 4 teeth of the wheel, *full*.

For diameter of a pinion of 9 leaves measure, with calipers, a little less than 4 teeth of the wheel, *full*.

For diameter of a pinion of 8 leaves measure, with calipers, a little less than 4 teeth of the wheel, *centre*.

For diameter of a pinion of 7 leaves measure, with calipers, a little less than 3 teeth of the wheel, *full*.

For diameter of a pinion of 6 leaves measure, with calipers, 3 teeth of the wheel, *centre*.

For diameter of a pinion of 5 leaves measure, with calipers, 3 teeth of the wheel, *centre*.

As a general rule, pinions that lead, as in the hour wheel, should be somewhat larger than those that drive, and pinions of clocks should generally be somewhat larger proportionally than those of watches.

For diameter of a pinion of 4 leaves measure, with calipers, one half of one space over 2 teeth of the wheel, *full*.

TO POLISH WHEELS PERFECTLY WITHOUT INJURY.—Take a flat burnishing file, warm it over a spirit lamp, and coat it lightly with beeswax. When cold, wipe off as much of the wax as can be readily removed, and with your file thus prepared, polish the wheel, resting the wheel while polishing on a piece of cork. The finish produced will be quite equal to the finest buff polish, while there will be no clogging, and the edges of the arms and teeth will remain perfectly square.

SANDOZ' METHOD OF PRODUCING ISOCHRONISM IN FLAT AND BREGUET SPRINGS.—*Isochronism*, from the Greek, meaning *equal time*, is the property possessed by the pendulum and the hair spring to accomplish their arcs of vibration of different amplitudes in the same space of time. In a pendulum, the only condition required is that its length be such as to make the centre of gravity move according to the cycloid curve; but in the hair spring the means change with the forms effected by the spring. In the spherical or conical springs, the extreme curves constructed after the mathematical rules discovered by Prof. Phillipps, of the Polytechnic School of Paris, will produce an Isochronism very nearly perfect. In the flat spring, these curves cannot exist, therefore other means must be resorted to. I shall give now the results of several years of experiment and study, which can be embodied in the two following theorems:

1. *In the flat spring, every coil has theoretically a point where the vibrations are Isochronal.* 2. *That point of Isochronism is determined by the relative position of the two points connecting the hair spring with the collet and stud, called Points d'attache.*

These two propositions form the base of Isochronism in the flat spring; therefore the idea generally accredited among watchmakers that the Isochronal properties of a flat spring depend on its length is incorrect, since the 10th as well as the 20th coil of the spring is able to produce the Isochronism, the only limit being such sizes of springs that would prevent the perfect freedom of its action.

Freedom of action being necessary for the Isochronal properties of the spring to develop themselves, the spring must be bent to the centre, according to Fig. II.—the first coil being too near or the curve too flat, so that even a minute part of the spring could touch the collet, would hinder the Isochronism. Next, the spring must be pinned perfectly tight in the collet and stud, and move freely between the regulator pins.

These conditions fulfilled, the watch is run 3, 6 or 12 hours with just strength enough to keep it going; the result is compared with a regulator and set down. Next, the watch is fully wound up, and after a space of time equal to the first trial, the result is again set down. Most generally the watch will run slower in the short vibrations than in the wide ones, and consequently lose time in the pocket in the last twelve hours of its running. Having set down as a principle that every coil has an Isochronal point, we have now to determine that point, remembering that as a general rule, *every increase of length of the* *spring over that point, will cause the watch to gain in the short vibrations, and every decrease back of that point will cause it to gain in the wide vibrations.* This rule is correct only for certain limits, as I am going to explain. Supposing that a hair spring of 15 coils is perfectly Isochronal with the two *points d'attache* just opposite each other, as shown in Fig. III., the 14th and the 16th coil, as well as the 15th, will produce the Isochronism very nearly at the same point. Supposing that we increase gradually the length of that hair spring of 15 coils, pinned up so that the two *points d'attache* are primitively opposite each other—*so that its length will now be* $15\frac{1}{2}$ *coils*—the two *points d'attache* are now in the position shown in Fig. IV., or what is called pinned to the *half coil.* The result will be that the hair spring will cause the watch to gain in the short vibrations as much as it is in its power to do.

But if we go further than the half coil, we now enter the ground that belongs to the 16th coil, and every increase of length in that half coil will cause the hair spring to lose in the short vibrations, in the same proportion that it has been gaining in increasing the length of the first half. That change will continue until we reach the same point on the 16th coil that we started from on the 15th., the two pins opposite each other; at that point we shall have again the Isochronism. The same operation is applicable to the 14th coil, with the same results.

Now it is immaterial whether we take that half coil to the centre, or to the outside of the spring, because both of these operations will produce the same results, viz., the change of the relative places of the *points d'attache* of the spring. Therefore the artist has his choice, and is guided by the size of the spring and the weight of the balance; for taking half a coil to the centre of the spring will not much affect the rate of the watch, but taken outside, the difference will be great. On the other hand, a very short cut to the centre will greatly affect the Isochronism, and at the outside, a full half-coil will generally produce from 15 to 25″ difference in 24 hours. If then the watchmaker would produce the greatest possible changes of Isochronism in a watch, the change of position of the two *points d'attache* of the spring of one coil around, will give him the two highest degrees of gaining and losing in the short vibrations.

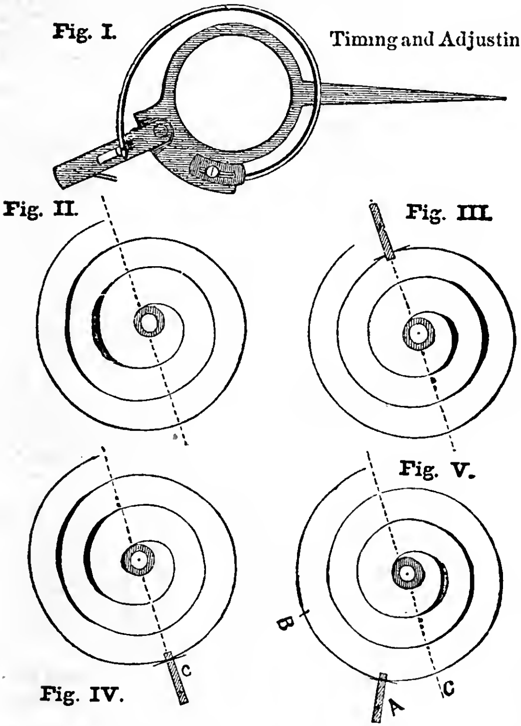
It follows from the following pages, that if a watch loses in the last running (short vibrations), the first thing to do is to increase the length of the hair spring from the outside; if the result is better, but not yet good, give still more length; if the result is worse, it shows that you are too far on the coil. Take back the whole length that you had given in the first operation, and draw more length, so as to affect the spring the other way; or if your spring is already small or your balance pretty heavy, cut to the centre so as to come around to the required positions.

Some springs cannot produce the Isochronism; this comes from a defect in making the spring, or a want of homogeniety in the metal; the only remedy is a new spring.

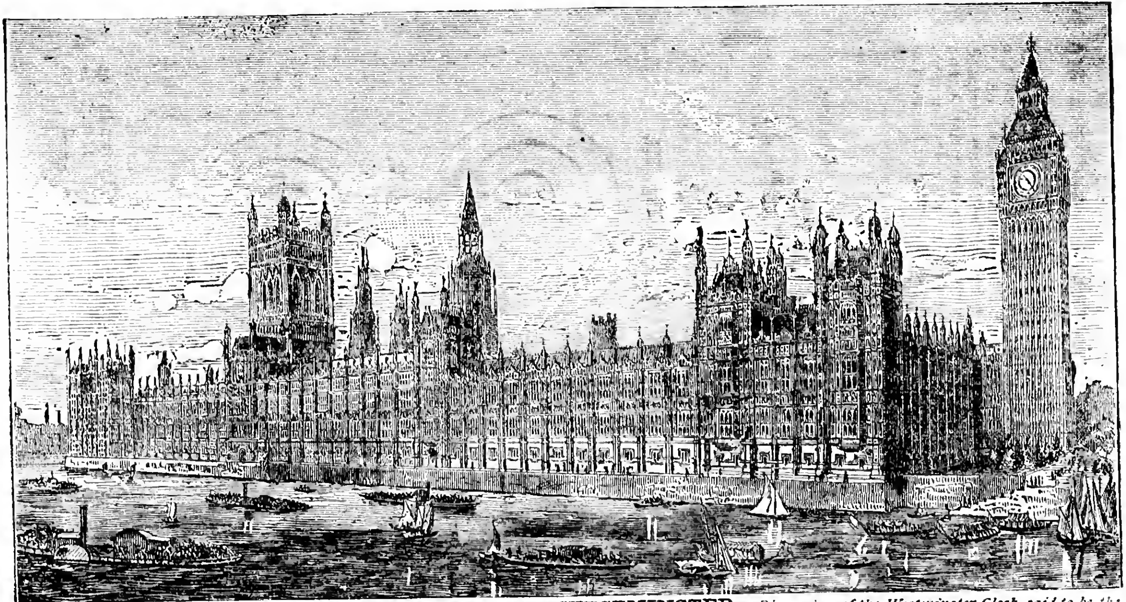
In the Breguet Spring, the Isochronism is produced in the same manner as the flat springings, but great care must be taken in making the curve, for if it is not made in conformity to the principle of Phillipps, the Isochronism will be disturbed.

For instance, in Fig. V., the spring being pinned in A, and the watch losing 7″ in the last 12 hours (short vib.), I first increase the length of the hair spring to the point B; but as I am already on the ground belonging to the *losing* action, the result will be an increased loss of time in the last running. I then go back to the point A, and moreover pin the spring to C, and then I shall approximate Isochronism. However, in most cases the increase of length will make the watch gain in its last running.

Timing and Adjusting.



Adjustments to Positions.—This adjustment is known to but few watchmakers, and they make it a regular business. It requires of the operator considerable manual skill and reflective powers. The



THE NEW HOUSES OF PARLIAMENT, AT WESTMINSTER.—*Dimensions of the Westminster Clock, said to be the largest in the world*—The dials are 4, one on each side of the clock-tower, 22½ feet in diameter, and the iron frame-work of each weighs 4 tons. The hour figures are 2 feet high and 6 feet apart; the minute marks are 14 inches apart, and the minute hand makes a sudden and visible leap of 7 inches every half-minute; the minute hand is 16 feet long, the hour hand 9 feet, and the two together weigh 2 cwt. The going and striking parts are wound up once a week. The weights hang down a shaft 160 feet deep. The pendulum is 15 feet long, and weighs 680 lbs.; for compensation during changes of temperature, there is a zinc inner tube to an iron outer one; it swings in a vibrating arc of only 14 inches, and a weight of 1 ounce, applied at a particular part, will alter the going of the clock 1 second per day. *Maker*—Dent, London.

great principle is to equalize the frictions, so that the pivots will offer to the action of the spring the same resistance in the four positions generally required, viz., dial up, XII up, cock up and III up. After having inspected and corrected the train so that the motive power is transmitted uniformly to the balance, the pivots and jewels of the lever should be polished and shortened so as to have very little friction; next, the lever should be poised as nearly perfect as possible, and the slot also in the fork where the ruby pin acts should be polished. The balance jewels ought to be made short enough to have the holes *square*, rounded inside, and perfectly polished, the balance pivots well burnished and their ends *half rounded*, and the balance poised very carefully. The English method of throwing the balance out of poise to obtain the same rate in different positions is not accepted generally, and is considered a bad practice by the most eminent watchmakers. The hair spring is put in its position without the balance, and bent so that the collet and the cock jewel will have the same centres. The watch being now in good running order, is put under trial for 12 or 24 hours, and the rate in each position carefully noted. If there is any difference in the running with the cock up, or dial up, making the ends of the pivots even and equally well polished will remove the discrepancy. If the watch *loses* with XII up, which is generally the case, and the friction on the balance jewels being reduced as much as possible, the remedy is to increase the friction when the watch is either dial or cock up. This is done by *throwing the hair spring a little out of the centre of the cock jewel*, thereby adding to the friction on the pivot end, a lateral pressure against the balance jewels. If the watch is well regulated with XII up, and loses with III up, *throw the spring a little towards the figure III;* this operation lifts up the balance when the watch is in losing position and diminishes the friction of the pivots in that particular case. Making the ends of the pivots perfectly flat has a tendency to make the watch gain with dial or cock up. The sound of the watch must be clear in all positions, else it indicates a friction, as for instance rough jewels or pivots, safety pin rubbing against the roller, etc.

How to Regulate a Watch in a few Minutes, and a Practical Method to put a new Hair Spring, of the right size and Perfectly Regulated in a Watch without Running It.—First, ascertain how many vibrations the watch beats in one minute, by counting every other vibration and comparing that time with a well-regulated watch or regulator. In general, Swiss watches beat 18,000 in one hour, viz., 300 in one minute; American watches, either 18,000 either 16,200, or 270 per minute; and the English levers, 14,400, or 240 per minute. If there is any doubt, it is better to count up leaves and teeth, and ascertain the right number· but these cases are scarce where watches will beat odd numbers.

Having found out the right number, examine the balance carefully for one or two minutes, counting every vibration going from *right to left*, and in the mean time examining the regulator or clock, to see when one minute is up. If the watch is well regulated, the number of vibrations must be exactly half of the regular first number, viz., 150, 135, or 120, as only every other vibration has been recorded to facilitate the observation. If not so, move the regulator, right or left, until a perfect coincidence comes.

To pick up a new hair spring, after having recorded the right number of beats—either by the old hair spring or by the numbers of the train—lay first the spring with its centre well in the centre of the cock jewel, and having ascertained where the coil will enter between the pins of the regulator, note the place. Stick to the pivot of the balance a small round piece of beeswax; then stick it to the centre of the spring, so as to establish a temporary but firm connection of the two pieces, and having pinched with the tweezers the hair spring to the place indicated by the regulator pins, cause it to vibrate gently; then count up the vibrations for one minute, and when you have got a spring that will produce nearly the required number of beats, pin it to the collet, and cause it again to vibrate, moving the tweezers forward and backward, until the right number of beats is produced; with another pair of tweezers, pinch the hair spring about one-eighth of an inch back of the regulating point, so as to counterbalance the gain produced by the regulator pins, and bend slightly the wire, which is the place where the hair spring must be pinned to the stud. Having then trued up the spring, proceed to put the regulator to the right place, by using the way indicated in the beginning of this article, and the work is done. Success is certain, when the operation has been carefully performed. The balance must be made to vibrate on some hard and well polished substance, so as to keep up the vibration to about the standard of regular running. A little practice will soon enable the watchmaker to change a hair spring very quick, and without any trouble whatever.

OF COMPENSATION.—A most accurate way of counterbalancing effects produced on the running of watches by different temperatures, is the expansion balance, formed of two concentric rings, one interior, of steel, and one exterior, of brass, joined together by hard soldering or smelting. The general proportion of these two metals is one part of steel, two of brass. The stronger dilation of brass, causes the rim of the balance to head inwardly when the heat, increasing, diminishes the strength of the hair spring; the greater contraction bends the rim outwardly when cold comes to increase the rigidity of the spring's coils. Pushing forward or backward the screws of the rim will affect the compensating powers of the balance, by causing their weight to be more active as they come nearer the end of the cut arm. The thinner and higher the rim, the greater the action. A few trials will bring the balance to compensate the effect of temperature from 30° to 100° Fahrenheit. For extreme temperatures another compensation, called *auxiliary*, is used, but only in ship chronometers. A soft spring will be less affected by changes of temperature than a hardened one; this affords a way to compensate certain balances, where otherwise new ones would have to be used. A precaution to observe in compensating is to make the screws go freely on the balance, and not screw them too tight, else the action of the rim not being free, a good compensation could not be attained, until the combined actions of dilation and contraction of the rim have freed the screws.

For watchmakers who would want to compensate a watch without having an expansion balance, I give the following process, which I have successfully used : After having cut off the greater part of the regulator's arm, another arm is to be fitted with a screw on the rim of the regulator, so as to revolve freely around that screw as an axis. The pins are put in the same position as on the old arm. A ring, of two parts of brass and one of steel, is then fastened to one end on that movable arm, and the other end is screwed at any convenient place, either on the regulator itself, or on the cock. See Fig. 1. By placing the whole ring on the regulator, the latter may be moved as in any other watch, the ring opening or shutting itself under the changes of temperature, will push backward and forward the regulator pins, and so effect the compensation which is to be regulated by varying either the proportion of brass and steel, or the size of the ring.

To try the running of the watches, a common refrigerator is used to produce the low temperature, and then an apparatus, self-regulating, will produce the high temperature. It is commonly a square box of tin or copper, hermetically closed, under which is a gas burner. A compensating arm of the form of a U, made of brass and steel, is fastened inside the box, and is connected by a string with a lever attached to the key of the burner, and acts so that at the high temperature, say 100° Fah., the gas is nearly shut off, the compensating arm gradually releasing itself and consequently letting out more gas when the heat diminishes inside the box. Use steel pins to secure spring to collet and stud.

TO MAKE POLISHING BROACHES.—These are usually made of ivory, and used with diamond dust, loose, instead of having been driven in. You oil the broach lightly, dip it into the finest diamond dust, and proceed to work it into the jewel the same as you do the brass broach. Unfortunately, too many watchmakers fail to attach sufficient importance to the polishing broach. The sluggish motion of watches now-a-days is more often attributable to rough jewels than to any other cause.

TO POLISH STEEL.—Take crocus of oxide of tin and graduate it in in the same way as in preparing diamond dust, and apply it to the steel by means of a piece of soft iron or bell metal, made proper form, and prepared with flour of emery, same as for pivot burnishers; use the coarsest of the crocus first, and finish off with the finest. To iron or soft steel a better finish may be given by burnishing than can be imparted by the use of polishing powder of any kind whatever. *The German Method of Polishing Steel* is performed by the use of crocus on a buff wheel. Nothing can exceed the surpassing beauty imparted to steel or even cast iron by this process.

CROCUS POWDER FOR POLISHING.—Chloride of sodium and sulphate of iron are well mixed in a mortar. The mixture is then put into a shallow crucible and exposed to a red heat; vapor escapes and the mass fuses. When no more vapor escapes, remove the crucible and let it cool. The color of the oxide of iron produced, if the fire has been properly regulated, is a fine violet; if the heat has been too high it becomes black. The mass when cold is to be powdered and washed, to separate the sulphate of soda. The powder of crocus is then to be submitted to a process of careful elutriation, and the finer particles reserved for the more delicate work. An excellent powder for applying to razor strops is made by igniting together in a crucible, equal parts of well dried green vitrol and common salt. The heat must be slowly raised and well regulated, otherwise the materials will boil over in a pasty state, and be lost. When well made, out of contact with air, it has the brilliant aspect of black lead. It requires to be ground and elutriated, after which it affords, on drying, an impalpable powder, that may be either applied on a strop of smooth buff leather, or mixed up with hog's lard or tallow into a stiff cerate.

To Remove Rust from Iron or Steel, &c.—For cleaning purposes, &c., kerosene oil or benzine are probably the best things known. When articles have become pitted by rust, however, these can of course, only be removed by mechanical means, such as scouring with fine powder, or flour of emery and oil, or with very fine emery paper. To prevent steel from rusting, rub it with a mixture of lime and oil, or with mercurial ointment, either of which will be found valuable.

To Make Burnishers.—Proceed the same as in making pivot files, with the exception that you are to use fine flour of emery on a slip of oiled brass or copper, instead of the emery paper. Burnishers which have become too smooth may be improved vastly with the flour of emery as above without drawing the temper.

To Prepare a Burnisher for Polishing.—Melt a little beeswax on the face of your burnisher. Its effect then on brass or other finer metals, will be equal to the best buff. A small burnisher prepared in this way is the very thing with which to polish up watch wheels. Rest them on a piece of pith while polishing.

Rules for Determining the Correct Length of the Lever, size of Ruby-pin Table, size of the Pallets, and depth of Escapement of Lever Watches.—A lever, from the guard point to the pallet staff, should correspond in length with twice the diameter of the ruby-pin table, and when a table is accidentally lost, the correct size thereof may be known by measuring half the length of the lever between the points above named. For correct size of pallet, the clear space between the pallets should correspond with the outside measure on the points of three teeth of the escapement wheel. The only rule that can be given, without the use of diagrams, for correct depth of the escapements, is to set it as close as it will bear, and still free itself perfectly when in motion. This may be done by first placing the escapement in your depthing tool, and then setting it to the correct depth. Then by measuring the distance between the pivots of the lever staff and escapement wheel, as now set, and the corresponding pivot holes in the watch, you determine correctly how much the depth of the escapement requires to be altered.

To Prevent Watches losing Time from Action of Pendulum Spring.—Pin the pendulum spring into the stud, so that that part, the part of the eye immediately emerging from the collet, and the centre of the collet, are in a line; then you will have the spring pinned in, in equal terms, as it is called by those who are versed in the higher branches of springing. Bring the watch to time by adding to or taking from the balance, and poise it; try the watch with the 12 up for 2 hours, then with the 6 up for 2 hours, then lying down for the same time; the trials here described will be sufficient if the watch has seconds; keep the curb pin close so as to allow the spring only a little play; the vibration of the balance should be 1¾ turn or 1½ lying.

LIST OF TRAINS OF WATCHES.

SHOWING THE NUMBER OF TEETH IN THE WHEELS, LEAVES IN THE PINIONS BEATS IN A MINUTE, AND TIME THE FOURTH WHEEL REVOLVES IN.

Trains, for Seven Teeth in the Escapement Wheel.

No. of Teeth in the Centre Wheel.	Teeth in 3d Wheel.	Leaves in 3d Wheel Pinion.	Teeth in 4th Wheel	Leaves in 4th Wheel Pinion.	Teeth in the Escapement Wheel.	Leaves in the Escapement Wheel Pinion.	No. of Beats in one minute.	No. of Seconds the 4th Wheel revolves in.
72	66	6	58	6	7	6	298—	27
66	64	6	64	6	7	6	292+	31
66	64	6	63	6	7	6	287+	31
66	63	6	63	6	7	6	283—	31
66	63	6	62	6	7	6	278+	31
66	63	6	61	6	7	6	274—	31
66	63	6	60	6	7	6	269+	31

Trains, for Nine Teeth in the Escapement Wheel.

63	60	6	57	6	9	6	299+	34
66	60	6	54	6	9	6	297	33
63	60	6	56	6	9	6	294	34
66	60	6	53	6	9	6	291+	33
63	60	6	55	6	9	6	289—	34
66	60	6	52	6	9	6	286	33
63	60	6	54	6	9	6	283+	34
66	60	6	51	6	9	6	280+	33
63	60	6	53	6	9	6	278+	34
66	60	6	50	6	9	6	275	33
63	60	6	52	6	9	6	273	34

Trains, for Eleven Teeth in the Escapement Wheel.

60	60	6	49	6	11	6	300—	36
60	54	6	54	6	11	6	297	40
60	56	6	52	6	11	6	230—	30
64	52	6	52	6	11	6	294—	30
58	56	6	53	6	11	6	292+	40
60	54	6	53	6	11	6	291+	40
62	54	6	51	6	11	6	290—	39
58	54	6	54	6	11	6	287+	41
58	55	6	53	6	11	6	287	41
59	54	6	53	6	11	6	286+	41
60	54	6	52	6	11	6	286	40
60	55	6	51	6	11	6	286—	39
61	55	6	50	6	11	6	285—	39
63	55	6	48	6	11	6	282+	33
59	54	6	52	6	11	6	281+	41
60	54	6	51	6	11	6	281+	40
61	54	6	50	6	11	6	280—	39
56	54	6	54	6	11	6	277+	43
60	60	6	48	6	11	6	293+	36
62	54	6	52	6	11	6	295+	39
63	54	6	50	6	11	6	289—	33
63	48	6	56	6	11	6	287+	43
70	70	7	56	7	11	7	293+	33
70	70	7	48	7	11	6	293+	36
70	60	7	48	6	11	6	293+	36

No. of Teeth in the Centre Wheel.	Teeth in 3d Wheel.	Leaves in 3d Wheel Pinion.	Teeth in 4th Wheel	Leaves in 4th Wheel Pinion.	Teeth in the Escapement Wheel.	Leaves in the Escapement Wheel Pinion.	No. of Beats in one Minute.	No. of Seconds the 4th Wheel revolves in.
60	70	6	48	7	11	6	293+	36
63	50	6	56	7	11	6	287+	40
63	63	6	50	7	11	6	289—	38
80	80	8	64	8	11	8	293+	36
80	80	8	56	8	11	7	293+	36
80	80	8	48	8	11	6	293+	36
80	70	8	56	7	11	7	293+	36
80	70	8	48	7	11	6	293+	38
80	60	8	48	6	11	6	293+	36
70	80	7	56	8	11	7	293+	38
70	80	7	48	8	11	6	293+	33
60	80	6	48	8	11	6	293+	36
84	72	8	50	8	11	6	289—	38
84	63	8	50	7	11	6	289—	38
84	54	8	50	6	11	6	289—	38
63	72	6	50	8	11	6	289—	38
63	63	6	50	7	11	6	289—	38
84	64	8	56	8	11	6	287+	40
84	56	8	56	7	11	6	287+	40
84	48	8	56	6	11	6	287+	40
63	64	6	56	8	11	6	287+	40
63	56	6	56	7	11	6	287+	40

Trains, for Thirteen Teeth in the Escapement Wheel.

54	53	6	52	6	13	6	298+	45
56	53	6	50	6	13	6	298—	44
58	51	6	49	6	13	6	296—	43
60	51	6	48	6	13	6	294+	42
54	53	6	51	6	13	6	293—	45
56	53	6	49	6	13	6	292—	44
56	54	6	48	6	13	6	291+	44
57	53	6	48	6	13	6	291—	43
54	52	6	51	6	13	6	287+	46
54	43	6	50	6	13	6	287+	45
50	51	6	50	6	13	6	286+	45
54	52	6	50	6	13	6	282—	46
56	51	6	49	6	13	6	281—	45
57	51	6	48	6	13	6	280—	44
52	52	6	51	6	13	6	277—	48
53	52	6	50	6	13	6	276+	46
52	52	6	52	6	13	6	293—	46
55	51	6	51	6	13	6	287	46
58	50	6	51	6	13	6	286+	46
56	52	6	48	6	13	6	280+	44
56	52	6	50	6	13	6	292+	44
60	48	6	48	6	13	6	277+	45
60	50	6	48	6	13	6	289—	43
60	54	6	60	8	13	6	292+	53
60	58	7	56	7	13	6	287+	51
60	60	8	64	6	13	6	300	44
62	56	7	66	7	13	6	296+	47
63	52	7	61	6	13	6	285	60
63	60	7	60	7	13	6	290	60
64	60	7	60	7	13	6	285	60
72	70	8	68	8	13	6	280	60
71	63	8	68	8	13	6	286+	60

Trains, for Fifteen Teeth in the Escapement Wheel.

No. of Teeth in the Centre Wheel.	Teeth in 3d Wheel.	Leaves in 3d Wheel Pinion.	Teeth in 4th Wheel	Leaves in 4th Wheel Pinion.	Teeth in the Escapement Wheel.	Leaves in the Escapement Wheel Pinion.	No. of Beats in one Minute.	No. of Seconds the 4th Wheel revolves in.
54	50	6	48	6	15	6	286	48
58	48	6	46	6	15	6	290	50
48	45	6	59	6	15	6	291—	60
48	45	6	58	6	15	6	300	62
48	45	6	57	6	15	6	288	62
48	45	6	56	6	15	6	288	50
56	48	6	46	6	15	6	289—	50
63	56	7	56	7	15	7	288	50
60	56	8	58	7	15	6	288	50
62	60	8	60	8	15	6	288	50
72	64	8	50	8	15	6	288	50
72	64	8	56	8	15	7	288	50
72	64	8	64	8	15	8	288	50
52	50	6	48	6	15	6	288	50
54	48	6	48	6	15	6	288	50
72	64	8	48	8	16	6	288	50
72	80	8	64	10	15	8	288	50
72	80	8	56	10	15	7	288	50
72	80	8	48	10	15	6	288	50
63	80	7	64	10	15	8	288	50
63	80	7	56	10	15	7	288	50
63	80	7	48	10	15	6	288	50

Trains, for Seventeen Teeth in the Escapement Wheel.

No. of Teeth in the Centre Wheel.	Teeth in 3d Wheel.	Leaves in 3d Wheel Pinion.	Teeth in 4th Wheel	Leaves in 4th Wheel Pinion.	Teeth in the Escapement Wheel.	Leaves in the Escapement Wheel Pinion.	No. of Beats in one Minute.	No. of Seconds the 4th Wheel revolves in.
64	80	8	48	10	17	6	299+	53
54	48	6	44	6	17	6	299+	50
51	48	6	45	6	17	6	295+	53
54	48	6	43	6	17	6	292+	50
48	48	6	43	6	17	6	290+	53
51	48	6	45	6	17	6	289	53
54	48	6	42	6	17	6	286—	53
48	48	6	47	6	17	6	284+	53
51	48	6	44	6	17	6	283—	53
48	48	6	46	6	17	6	278	53
48	48	6	45	6	17	6	272	53
64	64	8	64	8	17	8	290+	50
72	64	8	56	8	17	8	286—	50
64	64	8	60	8	17	8	289—	53
56	56	7	56	7	17	7	290+	53
63	56	7	49	7	17	7	286—	50
64	56	8	48	7	17	6	290+	53
80	80	10	64	10	17	8	290+	53
80	64	10	64	8	17	8	290+	53
80	64	10	56	8	17	7	290+	53
80	64	10	48	8	17	6	290+	53
80	56	10	56	7	17	7	290+	53
80	56	10	48	7	17	6	290+	53
64	80	8	64	10	17	8	290+	53
64	80	8	56	10	17	7	290+	53

To Remove Soft Solder from Gold.—Place the work in spirits of salts, or remove as much as possible with the scraper, using a gentle heat to enable you to get off the solder more easily. Very useful to be known where hard soldering is required, either in bright or colored work.

Trains, for Third Wheel and Patent Seconds.

No. of Teeth in the Centre Wheel	Teeth in 3d Wheel.	Leaves in 3d Wheel Pinion.	Teeth in 4th Wheel	Leaves in 4th Wheel Pinion.	Teeth in the Escapement Wheel.	Leaves in the Escapement Wheel Pinion.	No. of Beats in one Minute.	No. of Seconds the 4th Wheel revolves in.
60	72	6	60	12	..	6	300	60
60	60	6	60	10	..	6	300	60
60	48	6	60	8	..	6	3 0	60
48	60	6	60	8	..	6	300	60
60	72	6	54	12	..	6	270	60
60	60	6	54	10	..	6	270	60
48	60	6	54	8	..	6	270	60
60	72	6	48	12	..	6	240	60
60	60	6	48	10	..	6	240	60
48	60	6	48	8	..	6	240	60

Trains, for Fourth Wheel Seconds, with Eleven Teeth in the Escapement Wheel.

48	45	6	71	6	11	6	260+	60
48	45	6	74	6	11	6	271+	60
48	45	6	76	6	11	6	279—	60
48	45	6	78	6	11	6	286	60
60	49	7	74	7	11	6	271+	60
60	49	7	76	7	11	6	279—	60
60	49	7	78	7	11	6	286	60
45	56	6	74	7	11	6	271+	60
45	56	6	76	7	11	6	279—	60
45	56	6	78	7	11	6	286	60
64	60	8	74	8	11	6	271+	60
64	60	8	76	8	11	5	279—	60
64	60	8	78	8	11	6	286	60
60	56	8	74	7	11	6	271+	60
60	56	8	76	7	11	6	279—	60
60	56	8	78	7	11	6	286	60
60	48	8	74	6	11	6	271+	60
48	48	8	78	6	11	6	286	60
48	60	6	74	8	11	6	271+	60
48	60	6	78	8	11	6	286	60
56	60	7	74	8	11	6	271+	60

Trains, for Fourth Wheel Seconds, with Thirteen Teeth in the Escapement Wheel.

64	60	8	66	8	13	6	286	60
64	60	8	67	8	13	6	290+	60
64	60	8	68	8	13	6	295—	60
64	60	8	69	8	13	6	299	60
60	49	7	77	7	13	7	286	60
60	49	7	66	7	12	6	286	60
60	49	7	67	7	13	6	290+	60
48	45	6	66	6	13	6	286	60
48	45	6	67	6	13	6	290+	60
48	45	6	68	6	13	6	264—	60
48	45	6	69	6	13	6	299	60
60	56	8	66	7	13	6	283	60
80	60	10	66	8	13	6	286	60
64	75	8	66	10	13	6	286	60
48	60	6	66	8	13	6	286	60
48	75	6	66	10	13	6	286	60
45	56	6	66	7	13	6	283	60
56	75	7	68	10	13	6	295—	60

Trains, for Fourth Wheel Seconds, with Fifteen Teeth in Escapement Wheel.

No. of Teeth in the Centre Wheel.	Teeth in 3d Wheel.	Leaves in 3d Wheel Pinion.	Teeth in 4th Wheel	Leaves in 4th Wheel Pinion.	Teeth in the Escapement Wheel.	Leaves in the Escapement Wheel Pinion.	No of Beats in one Minute.	No. of Seconds the 4th Wheel revolves in.
64	60	8	70	8	15	7	300	60
64	60	8	60	8	15	6	300	60
64	45	8	60	6	15	6	300	60
60	56	8	60	7	15	6	300	60
48	60	6	60	8	15	6	300	60
60	70	7	70	7	15	7	300	60
60	49	7	60	7	15	6	300	60
48	49	6	60	6	15	6	300	60
80	45	10	70	8	15	7	300	60
75	60	10	60	8	15	6	300	60
64	64	8	70	10	15	7	300	60
64	75	8	60	10	15	6	300	60
56	75	7	70	10	15	7	300	60
56	75	7	60	10	15	6	300	60
64	75	8	54	8	15	6	270	60
60	60	8	54	7	15	6	270	60
64	56	8	54	6	15	6	270	60
48	45	6	54	8	15	6	270	60
60	60	7	63	7	15	7	270	60
60	49	7	54	7	15	6	270	60
48	49	6	54	6	15	6	270	60
64	45	8	48	8	15	6	240	60
60	60	8	48	7	15	6	240	60
48	50	6	48	8	15	6	240	60
64	60	8	48	6	15	6	240	60
60	45	7	56	7	15	7	240	60
60	49	7	48	7	15	6	240	60
48	45	6	48	6	15	6	240	60
60	56	8	48	7	15	6	240	60

Trains, for Fourth Wheel Seconds, with Seventeen Teeth in Escapement Wheel.

64	60	8	51	8	17	6	289	60
64	60	8	50	8	17	6	283+	50
60	56	8	51	7	17	6	289	60
80	60	10	50	8	17	6	283+	60
75	64	10	50	8	17	6	283+	60
75	56	10	68	7	17	8	289	60
75	68	10	68	8	17	8	289	60
80	75	10	68	10	17	8	289	60

Train of the American Watch Company's Watch.

64	60	8	64	8	15	7	300	60

NOTE.—By use of the foregoing set of Trains, and the rule for sizes of pinions, on page 312, all difficulty of calculating is obviated; and at one view, in case of the accidental loss of a wheel and pinion, may be known the correct size and count of the pinion, and number of teeth in the wheel lost.

To Put Watches in Beat.—If a cylinder escapement, or a detached lever, put the balance into a position, then turn the regulator so that it will point directly to the pivot-hole of the pallet staff, if a lever, or of the scape-wheel, if a cylinder. Then lift out the balance with its bridge or clock, turn it over and set the ruby-pin directly in line with the regulator, or the square cut of the cylinder at right angles with it. Your watch will then be in perfect beat. In case of an American or an English lever, when the regulator is placed upon the plate, you will have to proceed differently. Fix the balance into its place, cut off the connection of the train, if the mainspring is not entirely down, by slipping a fine broach into one of the wheels, look between the plates and ascertain how the lever stands. If the end farthest from the balance is equi-distant between the two brass pins, it is all right; if not, change the hair-spring till it becomes so. If dealing with a duplex watch, you must see that the roller notch, when the balance is at rest, is exactly between the locking tooth and the line of centre; that is, a line drawn from the centre of the roller to the centre of the scape-wheel. The balance must start from its rest and move through an arc of about ten degrees before bringing the locking tooth into action.

To Frost Watch Plates.—Watch plates are frosted by means of fine brass wire scratch brushes fixed in a lathe, and made to revolve at great speed, the end of the wire brushes striking the plate producing a beautiful frosted appearance.

To Restore Watch Dials.—If the dial be painted, clean the figure off with spirits of wine, or anything else that will render the dial perfectly clean; then heat it to a bright red, and plunge it into a strong solution of cyanide of potassium, then wash in soap and water, and dry in box dust. Repeat if not a good color. India ink, ground with gum water, will do for the figures.

To Whiten Silver Watch Dials.—Flatten a piece of charcoal by rubbing it on a flat stone: on this place the dial face upwards, apply a gentle heat carefully with the blow-pipe, allowing the flame to play all over the surface of the dial without touching it, so as to thoroughly heat without warping the dial. Then pickle and rinse, using acid enough to make the water very tart, and immersing but for a few seconds. Silver dials may also be annealed by heating them red hot on a flat piece of copper over a clear fire.

To make a Watch Keep Good Time when the Cylinder Edges are Worn Off, by Altering the Escapement without Putting a new Cylinder in.—Look at the cylinder, and see if there is room, either above or below the old wears, to shift the action of the wheel. If the wheel holes are brass, making one a little deeper, and putting a shallower one on the other side, will perhaps be sufficient. This must be done according as you want your wheel up or down. If the holes are stone, shift your wheel on the pinion by a new collet, or turning away more of the old one, as the case may require. If you raise your wheel see that it works free of plate and top of cylinder, and that the web of wheel clears the top of passage. This last fault may be altered by polishing the passage a little wider, if the rub be slight. If shifted downwards, see to freedom at bottom of cylinder, &c.

Poising Watch Balance.—This may be done with sufficient accuracy by scraping one arm of the callipers with a file when the balance is set in motion. This will cause the heaviest part to settle downwards with certainty, observing always that the pivots are nicely rounded and formed at the ends. In some cases it becomes necessary to put a balance out of poise, in order to make the watch go equally in various positions. The rule for this is: to make the watch gain, the balance should be heaviest on the lower side when hanging up: to make it lose, the reverse.

To Prevent a Chain Running off the Fusee.—In the first place, you must look and ascertain the cause of the difficulty. If it results from the chain being too large, the only remedy is a new chain. If it is not too large, and yet runs off without any apparent cause, change it end for end—that will generally make it go all right. In cases where the channel in the fusee has been damaged and is rough, you will be under the necessity of dressing it over with a file the proper size and shape. Sometimes you find the chain naturally inclined to work away from the body of the fusee. The best way to remedy a difficulty of this kind is to file off a very little from the outer lower edge of the chain the entire length; this, as you can see, will incline it to work on instead of off. Some workmen, when they have a bad case and a common watch, change the standing of the fusee so as to cause the winding end of its arbor to incline a little from the barrel. This, of course, cannot do otherwise than make the chain run to its place.

To Weaken the Hair-Spring.—This is often effected by grinding the spring down. You remove the spring from the collet, and place it upon a piece of pivot wood cut to fit the centre coil. A piece of soft steel wire, flattened so as to pass freely between the coils, and armed with a little pulverized oil-stone and oil, will serve as your grinder, and with it you may soon reduce the strength of the spring. Your operations will, of course, be confined to the centre coil, for no other part of the spring will rest sufficiently against the wood to enable you to grind it, but this will generally suffice. The effect will be more rapid than one would suppose, therefore it will stand you in hand to be careful, or you may get the spring too weak before you suspect it.

To Tighten a Ruby Pin.—Set the ruby pin in asphaltum varnish. It will become hard in a few minutes, and be much firmer and better than gum shellac, as generally used.

To Temper Brass, or to Draw its Temper.—Brass is rendered hard by hammering or rolling; therefore, when you make a thing of brass necessary to be in temper, you must prepare the material before shaping the article. Temper may be drawn from brass by heating it to a cherry red, and then simply plunging it into water, the same as though you were going to temper steel.

To Temper Gravers.—Gravers, and other instruments larger than drills, may be tempered in quicksilver as above; or you may use lead instead of quicksilver. Cut down into the lead, say half an inch; then, having heated your instrument to a light cherry red, press it firmly into the cut. The lead will melt around it, and an excellent temper will be imparted.

To Temper Drills.—Select none but the finest and best steel for your drills. In making them, never heat higher than a cherry red, and always hammer till nearly cold. Do all your hammering in one way, for if, after you have flattened your piece out, you attempt to hammer it back to a square or a round, you spoil it. When your drill is in proper shape, heat it to a cherry red, and thrust it into a piece of resin or into quicksilver. Some use a solution of cyanuret potassa and rain-water for tempering their drills, but the resin or quicksilver will work best.

OTHER METHODS TO TEMPER SPRINGS.—Having fitted the spring into the case according to your liking, temper it hard by heating and plunging into water. Next polish the small end so that you may be able to see when the color changes; lay it on a piece of copper or brass plate, and hold it over your lamp, with the blaze directly under the largest part of the spring. Watch the polished part of the steel closely, and when you see it turn blue, remove the plate from the lamp, letting all cool gradually together. When cool enough to handle, polish the end of the spring again, place it on the plate, and hold it over the lamp as before. The third bluing of the polished end will leave the spring in proper temper. Any steel article to which you desire to give a spring temper may be treated in the same way. Another process, said to be good, is to temper the spring as in the first instance; then put it into a small iron ladle, cover it with linseed oil, and hold over a lamp till the oil takes fire. Remove the ladle, but let the oil continue to burn until nearly all consumed, then blow out, re-cover with oil, and hold over the lamp as before. The third burning out of the oil will leave the spring in the right temper.

TO TEMPER CLICKS, RATCHETS, &C.—Clicks, ratchets, or other steel articles requiring a similar degree of hardness, should be tempered in mercurial ointment. The process consists in simply heating to a cherry red and plunging into the ointment. No other mode will combine toughness and hardness to such an extent.

TO DRAW THE TEMPER FROM DELICATE STEEL PIECES WITHOUT SPRINGING THEM.—Place the articles from which you desire to draw the temper into a common iron clock key. Fill around it with brass or iron filings, and then plug up the open end with a steel, iron, or brass plug, made to fit closely. Take the handle of the key with your pliers and hold its pipe into the blaze of a lamp till near hot, then let it cool gradually. When sufficiently cold to handle, remove the plug, and you will find the article with its temper fully drawn, but in all other respects just as it was before.

You will understand the reason for having the article thus plugged up while passing it through the heating and cooling process, when you know that springing always results from the action of changeable currents of atmosphere. The temper may be drawn from cylinders, staffs, pinions, or any other delicate pieces, by this mode with perfect safety.

TO TEMPER STAFFS, CYLINDERS, OR PINIONS, WITHOUT SPRINGING THEM.—Prepare the articles as in the preceding process, using a steel plug. Having heated the key-pipe to a cherry red, plunge it into water; then polish the end of your steel plug, place the key upon a plate of brass or copper, and hold it over your lamp with the blaze immediately under the pipe till the polished part becomes blue. Let cool gradually, then polish again. Blue and cool a second time, and the work will be done.

TO DRAW THE TEMPER FROM PART OF A SMALL STEEL ARTICLE.—Hold the part from which you wish to draw the temper with a pair of tweezers, and with your blow-pipe direct the flame upon them—not the article—till sufficient heat is communicated to the article to produce the desired effect.

TO BLUE SCREWS EVENLY.—Take an old watch barrel and drill as many holes into the head of it as you desire to blue screws at a time. Fill it about one-fourth full of brass or iron fillings, put in the head, and then fit a wire, long enough to bend over for a handle, into the arbor holes—head of the barrel upwards. Brighten the heads of your screws, set them point downwards, into the holes already drilled, and expose the bottom of the barrel to your lamp till the screws assume the color you wish.

TO REMOVE BLUING FROM STEEL.—Immerse in a pickle composed of equal parts muriatic acid and elixir vitriol. Rinse in pure water, and dry in tissue paper.

TO MAKE DIAMOND BROACHES.—Make you broaches of brass the size and shape you desire; then, having oiled them slightly, roll their points into fine diamond dust till entirely covered. Hold them then on the face of your anvil, and tap with a light hammer till the grains disappear in the brass. Great caution will be necessary in this operation. Do not tap heavy enough to flatten the broach. Very light blows are all that will be required; the grains will be driven in much sooner than one would imagine. Some roll the broach between two small pieces of steel to imbed the diamond dust. It is a very good way, but somewhat more wasteful of the dust. Broaches made on this plan are used for dressing out jewels.

JEWELLING.—In using the broaches, press but lightly into the jewel hole, and turn the broach rapidly with your fingers. For polishing, use a bone or ivory point, lightly coated with the finest diamond dust and oil, and while using it with the one hand, accompany the motion with a slight oscillating motion of the other hand, in which the jewel is held. This will insure a more even polish to the hole, with less liability to press the jewel out of its place in the plate, than if held firm and steady.

TO MAKE DIAMOND FILES.—Shape your file of brass, and charge with diamond dust, as in case of the mill. Grade the dust in accordance with the coarse or fine character of the file desired.

TO MAKE PIVOT FILES.—Dress up a piece of wood file-fashion, about an inch broad, and glue a piece of fine emery paper upon it. Shape your file then, as you wish it, of the best cast steel, and before tempering pass your emery paper heavily across it several times, diagonally. Temper by heating to a cherry red, and plunging into linseed oil. Old worn pivot files may be dressed over and made new by this process. At first thought, one would be led to regard them too slightly cut to work well, but not so. They dress a pivot more rapidly than any other file.

TO MAKE A DIAMOND MILL.—Make a brass chuck or wheel, suitable for use on a foot-lathe, with a flat even surface or face of about $1\frac{1}{2}$ or 2 inches in diameter; then place a number of the coarsest pieces of your diamond dust on different parts of its face, and with smooth faced steel hammer drive the pieces of dust all evenly into the brass to nearly or quite level with the surface. Your mill, thus prepared, is now used for making pallet jewels or for grinding stone and glass of any kind. For polishing, use a bone or boxwood chuck or wheel, of simillar form to your mill, and coat it lightly with the finest grade of your diamond-dust and oil; with this a beautiful polish may be given to the hardest stone.

TO MAKE DIAMOND DUST.—Place a few small pieces of common or cheap diamond on a block of hard polished steel, in a suitable vessel, and cover it with water to prevent it flying or scattering, then place a flat steel punch on each piece separately, and strike the punch with a mallet or hammer, with sufficient force to crush the diamond. When reduced sufficiently fine in this way, the dust may be collected and dried for use; after drying, it may be graduated for different purposes, by mixing it with a little watch oil; when agitated, the finest particles will float near the surface, while the coarsest pieces will sink at once to the bottom; and thus by decanting the oil in which the dust floats, as many grades of fineness as desired may be obtained. The dust may be separated from the oil by pouring on a piece of smooth clean paper; the paper will absorb the oil, or allow it to filter through, while the dust will remain on the surface; but to prevent waste, the better way is to leave it in the oil and use directly therefrom as required, or the oil may be washed out of the dust with alcohol.

TO PRESERVE PINIONS OR BEARINGS FROM CORROSION AND RUST.—In case of the lower centre bearing under the cannon pinion corroding or rusting, when you clean the watch, be particular to take the central wheel off. Clean it thoroughly; if the pivot is scratched, polish it, then make a little hollow in the top hole; put good fresh oil on it, and the pivot will not corrode or rust for two or three years. As to the other pivots in the watch, they should all be thoroughly cleaned, and old oil cleaned out; then if no dust gets in, and no accident happens the watch, it will run for years.

TO CLEAN A CLOCK.—Take the movement of the clock "to pieces." Brush the wheels and pinions thoroughly with a stiff coarse brush; also the plates which the trains work. Clean the pivots well by turning in a piece of cotton cloth held tightly between your thumb and finger. The pivot holes in the plates are generally cleansed by turning a piece of wood into them, but I have always found a strip of cloth or a soft cord drawn tightly through them to act the best. If you use two cords, the first one slightly oiled, and the next dry, to clean the oil out, all the better. Do not use salt or acid to clean your clock—it can do no good, but may do a great deal of harm. Boiling the movement in water, as is the practice of some, is also foolishness.

TO BUSH.—The hole through which the great arbors, or winding axles, work, are the only ones that usually require bushing. When they have become too much worn, the great wheel on the axle before named strikes too deeply into the pinions above it and stops the clock. To remedy this, bushing is necessary, of course. The most common way of doing it is to drive a steel point or punch into the plate just above the axle hole, thus forcing the brass downwards until the hole is reduced to its original size. Another mode is to solder a piece of brass upon the plate in such a position as to hold the axle down to its proper place. If you simply wish your clock to run, and have no ambition to produce a bush that will look workmanlike, about as good a way as any is to fit a piece of hard wood between the post which comes through the top of the plate and axle. Make it long enough to hold the axle to its proper place, so that the axle will run on the end of the grain. Cut notches where the pivots come through, and secure by wrapping around it and the plate a piece of small wire or a thread.

TO REMEDY WORN PINION.—Turn the leaves or rollers, so the worn places upon them will be towards the arbor or shaft, and fasten them in that position. If they are "rolling pinions" and you cannot secure them otherwise, you had better do it with a little soft solder.

TO OIL PROPERLY.—Oil only, and very lightly, the pallets of the verge, the steel pin upon which the verge works, and the point where the loop of the verge wire works over the pendulum wire. Use none but the best watch oil. Though you might be working constantly at the clock-repairing business, a bottle costing you but twenty-five cents would last you two years at least. You can buy it at any watch-furnishing establishment.

TO MAKE THE CLOCK STRIKE CORRECTLY.—If not very cautious in putting up your clock you will get some of the striking-train wheels in wrong, and thus produce a derangement in the striking. If this should happen, pry the plates apart on the striking side, slip the pivots of the upper wheels out, and having disconnected them from the train, turn them part around and put them back. If still not right, repeat the experiment. A few efforts at most will get them to working properly. The sound in cuckoo clocks is caused by a wire acting on a small bellows which is connected with two small pipes like organ pipes.

A DEFECT TO LOOK AFTER.—Always examine the pendulum wire at the point where the loop of the verge wire works over it. You will generally find a small notch, or at least a rough place worn there. Dress it out perfectly smooth, or your clock will not be likely to work well. Small as this defect may seem, it stops a large number of clocks.

FIGURES ON GOLD AND SILVER DIALS.—Hold a small piece of copper over a gas flame for a few minutes till it is coated with soot; clear this off on to a piece of finely ground glass, add fat oil and a small quantity of oil of spike lavender, and grind up; paint with a small-camel hair pencil.

TO DETERMINE THE EXACT FOCAL DISTANCE OF SPECTACLE GLASSES.—Place the end of a measure of thirty or forty inches in length against a smooth wall, or other suitable ground, in plain view of some well-defined object a few rods distant, as for instance a building or window on the opposite side of the street. Then place the edge of your lens on the measure, and move it backwards or forwards until a spectrum is formed, or, in other words, until a clear and distinct outline of the distant object is produced on the ground against which your measure rests. This point will represent sufficiently near, for all practical purposes, the exact focal distance of the lens, and will correspond in inches with the number on all properly marked convex spectacles. For mending fine steel spectacle frames, use the best gold solder in preference to silver or brass solder.

VALUABLE RECEIPTS FOR GOLDSMITHS.—Standard gold is compounded of 440 grains of fine gold, and 40 grains (Troy weight,) to the oz. alloy ; therefore, when you judge how much gold a piece of work will take, compound it to the standard weight by the following directions : *Assay Weight.*—The weight of gold is a pound, which is divided into 12 ozs. each oz. into 24 carats, each carat into 4 grains, and, lastly, each grain into 4 quarters ; then you see the assay quarter-grain, is in reality 1¼ grain Troy.

ON MELTING AND REFINING.—In melting *Brass Gold*, urge the fire to a great heat, and stir the metal with the long stem of a tobacco pipe to prevent honey-combing. If *Steel* or *Iron filings* get into gold while melting, throw in a piece of sandiver the size of a common nut ; it will attract the iron or steel from the gold into the flux, or, sublimate of mercury will destroy the iron or steel. To cause *Gold to roll well*, melt with a good heat, add a teaspoonful of sal ammoniac and charcoal, equal quantities, both pulverized, stir up well, put on the cover for 2 minutes, and pour.

TO REFINE SWEEPINGS CONTAINING GOLD OR SILVER.—To 8 ozs. of the dirt, which has been washed and burnt, add salt, 4 ozs. ; pearlash 4 ozs. ; red tartar 1 oz. ; saltpetre ½ oz., mix thoroughly in a mortar, melt in a crucible, and dissolve out the precious metals in a button.

QUANTITY OF STANDARD GOLD TO COMPOUND AN OZ. OF ANY OF THE FOLLOWING ALLOYS CALCULATED TO THE ¼ OF A GRAIN, AS FOLLOWS :

Carat,	Dwts.	Grs.	Qrs.	ALLOY TO BE ADDED.	Dwts.	Grs.	Qrs.
1	0	21	9		19	2	2
2	1	19	7		18	4	4
3	2	17	5		17	6	6
4	3	15	3		16	8	8
5	4	13	1		15	10	10
6	5	10	10		14	13	1
7	6	8	8		13	15	3
8	7	6	6		12	17	5
9	8	4	4		11	19	7
10	9	2	2		10	21	9
11	10	0	0		10	0	0
12	10	21	9		9	2	2
13	11	19	7		8	4	4
14	12	17	5		7	6	6
15	13	15	3		6	8	8
16	14	13	1		5	10	10
17	15	10	10		4	13	1
18	16	8	8		3	15	3
19	17	6	6		2	17	5
20	18	4	4		1	19	7
21	19	2	2		0	21	9
22	22	0	0				

TO FUSE GOLD DUST.—Use such a crucible as is generally used for melting brass ; heat very hot ; then add your gold dust mixed with powdered borax ;—after some time a scum or slag will arise on the top, which may be thickened by the addition of a little lime or bone ash. If the dust contains any of the more oxidizeable metals, add a little nitre, skim off the slag or scum very carefully ; when melted, grasp the crucible with strong iron tongs ;

and pour off immediately into cast iron moulds, slightly greased. The slag and crucibles may be afterwards pulverized, and the auriferous matter recovered from the mass through cupellation by means of lead.

GOLD ALLOYS.—The "New Standard" for watch cases, &c., is 18 carats of fine gold and 6 of alloy. No gold of inferior quality can receive the "Hall mark;" and gold of lower quality is generally described by its commercial value. The alloy may be entirely silver, which will give a green color, or entirely copper for a red color, but the copper and silver are more usually mixed in one alloy according to the taste of the jeweller. It will be understood that these are all made with fine gold, fine silver, and fine copper, direct from the refiner. Gold of 22 carats fine being so little used, is intentionally omitted. 1. *Gold of* 18 *carats, of yellow tint.* Gold 15 dwt., silver, 2 dwt., 18 grs., copper 2 dwt., 6 grs. 2. *Gold of* 18 *carats, red tint.* Gold 15 dwt., silver, 1 dwt. 18 grs., copper, 3 dwt. 6 grs. 3. *Spring gold of* 16 *carats.* Gold 1 oz. 16 dwt., silver, 6 dwt., copper, 12 dwt. This when drawn or rolled very hard makes springs little inferior to steel; 4 *Jewellers' Fine Gold, yellow tint,* 16 *carats nearly.* Gold, 1 oz. silver, 7 dwt., copper, 5 dwt. 5. *Gold of red tint* 16 *carats.* Gold, 1 oz. silver, 2 dwt., copper, 8 dwt.

STERLING GOLD ALLOY, 78s. PER oz.—1. Fine gold, 18 dwts., 12 grs., fine silver, 1 dwt., fine copper, 12 grs. 2.—*Dry colored Gold Alloys.* 17 *Carat.* Fine gold, 15 dwts., fine silver, 1 dwt. 10 grs., fine copper, 4 dwts. 17 grs.—3. *Another,* 18 *Carat.* Fine gold, 1 oz., fine silver, 4 dwts. 10 grs., fine copper, 2 dwts. 5 grs.—4. *Another,* 18 *Carat.* Fine gold, 15 dwts., fine silver, 2 dwts. 4 grs., fine copper, 2 dwts. 19 grs.—5. *Another,* 18 *Carat.* Fine gold, 18 dwts., fine silver, 2 dwts. 18 grs., fine copper, 3 dwts. 18 grs.—6. *Another,* 19 *Carat.* Fine gold, 1 oz., fine silver, 2 dwts. 6 grs., fine copper, 3 dwts. 12 grs.—7. *Another,* 20 *Carat.* Fine gold, 1 oz., fine silver, 2 dwts., fine copper, 2 dwts. 4 grs.—8. *Another,* 22 *Carat.* Fine gold, 18 dwts., fine silver, 12 grs., fine copper, 1 dwt. 3 grs.—9. *Gold solder for the foregoing Alloys.* Take of the alloyed gold you are using, 1 dwt., fine silver, 6 grs.—10. *Alloy for Dry Colored Rings.* Fine gold, 1 oz., fine silver, 4 dwts. 6 grs., fine copper, 4 dwts. 6 grs.—11. *Solder for ditto.* Scrap gold, 2 ozs., fine silver, 3 dwts., fine copper, 3 dwts.—12. *Dry Colored Scrap reduced to* 35s. *Gold.* Colored scrap, 1 oz., 9 dwts. 12 grs., fine silver, 2 dwts., fine copper, 17 dwts. 12 grs., spelter, 4 dwts.

DRY COLORING FOR THE FOREGOING.—Polish your work well and for every 2 ozs., take saltpetre, 8 ozs., alum, 4 ozs., salt, 4 ozs., melt all together in a black lead pot, stirring with a thin iron bar when dissolving. Use the fire on a forge and urge it well with the bellows, as you can not make it too hot. Your polished work being well cleaned with soda, soap, and hot water, is dried in box sawdust, is afterwards covered, with a thin layer of borax; annealed and boiled out, and again dried in box sawdust, and finally hung on platinum or silver wire. When the "color" in the pot assumes a brown yellow flame, the work is dipped in for two or three seconds, and quenched with hot water diluted with muriatic acid, which removes any "color" that may adhere to the work. This ought to produce the desired color, but if it does not, repeat the process, previously drying the work before re-immersion in the "color." The color-pot must be emptied immediately upon the forge, so that it may be ready for future use.

WET COLORED ALLOYS.—1. Fine gold, 1 oz., fine silver, 3 dwts. 12 grs., fine copper, 9 dwts. 2. Fine gold, 1 oz., fine silver, 4 dwts. 12 grs., fine copper, 10 dwts. 3. Fine gold, 1 oz., fine silver, 4 dwts. 12 grs., fine copper, 10 dwts. 12 grs. 4. Fine Gold, 1 oz., fine silver, 4 dwts., fine copper, 9 dwts. 12 grs. 5 *Green Gold for Fancy Work.* Fine gold, 1 oz., fine silver, 6 dwts. 16 grs. 6. *Another Green Gold* Fine gold, 10 dwts., fine silver, 2 dwts. 2 grs. 7. *Red Gold, for fancy work.* Fine gold, 5 dwts., fine copper, 2 dwts. 12 grs. 8. *Another Red Gold.* Fine gold, 5 dwts., fine copper, 1 dwt. 6 grs. 9. *Gold solders for the foregoing Alloys.* Take of the alloyed gold you are using, 1 dwt., fine silver, 6 grs., or, 5 grs. silver and 1 gr. copper may be used. 10. *Solder for Repairing.* Gold alloyed, 1 dwt., fine silver, 5 grs., pin brass, 1 gr. 11. *Wet Colored Solder.* Wet colored scrap, 3 ozs., fine silver, 10 dwts., fine copper, 5 dwts. 12. *Gold, 15 carat, cost 56s. or $14 per oz.* Fine gold, 1 oz. 18 dwts., fine silver, 12 dwts. 12 grs., fine copper, 10 dwts. 13. Fine gold, 1 oz., fine silver, 8 dwts. fine copper, 4 dwts. 14. Fine gold, 1 oz., fine silver, 8 dwts., fine copper, 4 dwts. 15. Fine gold, 1 oz., fine silver, 6 dwts., fine copper, 8 dwts. 16. *Gold solder for the last.* Gold scrap, 1 oz., fine silver, 5 dwts. 17. *Gold good color.* Fine gold, 1 oz., fine silver, 6 dwts., fine copper, 4 dwts. 18. *Gold cost 60s. or $15, good color.* Fine gold, 1 dwt., fine silver, 6 dwts., fine copper, 4 dwts. 19. *Wet colored solder.* Scrap gold, 4 ozs., fine silver, 13 dwts., fine copper, 6 dwts. 16 grs. 20. *To reduce 22 carat into Wet colored Gold.* Gold coins 4 ozs. 8 dwts., fine silver, 13 dwts., fine copper, 1 oz. 13 dwts. 21. *To reduce 22 carat to ordinary wet colored Gold with scrap.* Coins 1 oz., fine gold, 3 ozs., fine silver, 17 dwts. 12 grs., fine copper, 2 ozs. 1 dwt. 12 grains., scrap, 3 ozs. 1 dwt. 22. *Another way with scrap.* Coins, 3 ozs. 1 dwt. 6 grs., fine gold, 2 ozs., fine silver, 1 oz. 1 dwt., fine copper, 2 ozs. 11 dwts., scrap, 1 oz. 6 dwts. 18 grs. 23. *Another way with scrap.* Coins, 2 ozs., fine gold, 3 ozs. 3 dwts. 8 grs., fine silver, 1 oz. 1 dwt. 4 grs., fine copper, 2 ozs. 10 dwts. 12 grs., scrap, 1 oz. 5 dwts. 24. *To reduce 22 carat to ordinary wet colored Gold without scrap.* Coins, 1 oz., fine gold, 8 ozs., fine silver, 2 ozs., fine copper, 4 ozs. 14 dwts. 25. *Another way without scrap.* Coins, 1 oz., fine gold, 2 ozs., fine silver, 13 dwts., fine copper, 1 oz. 11 dwts. 26. *Another way without scrap.* Coins, 2 ozs., fine gold, 6 ozs., fine silver, 1 oz. 14 dwts., fine copper, 4 ozs. 2 dwts.

TO WET-COLOR THE FOREGOING ALLOYS.— For 5 ozs. of work take saltpetre, 16 ozs., alum, 8 ozs., salt, 8 ozs., all pulverized and muriatic acid 2 ozs., dissolve the ingredients gradually in a black lead pot. When it boils up, add the acid, and stir the whole with a wooden spoon. Having annealed your work and made it perfectly clean, tie in small parcels with platinum or fine silver wire, and when the color boils up immerse it therein for four minutes, moving it about to ensure a perfect contact with all parts of the surface. Then take it out and rinse it well in boiling water, then immerse in the color again for for $1\frac{1}{2}$ minutes and rinse well once more in fresh hot water. Now add 2 ozs. of fresh hot water to the color in the pot, which will cause it to sink. When it rises put in your work for 1 minute, rinsing in fresh hot water again, when it will begin to brighten. Now immerse your work for half a minute longer, and rinse for the last time in clean hot water, when it will appear of a most beautiful color.

ALLOYS, CONTINUED. 1. *Pale gold for coloring Enamelling, or Lapping*—Fine gold, 1 oz., fine silver, 9 dwts, fine copper, 2 dwts. 12 grs. 2. *Another ditto*—Fine gold 1 oz., fine silver 9 dwts., fine copper 3 dwts. 12 grs. 3. *Another ditto*—Fine gold 1 oz., fine silver 10 dwts., fine copper 3 dwts. 12 grs. 4. *Enamelling Gold No.* 1—Fine gold 1 oz., fine silver 1 dwt. 12 grs., fine copper 2 dwts. 12 grs. 5. *enamelling Gold from Sterling*—Sterling 1 oz., fine silver 8 grs., fine copper 2 dwts. 6. *Enamelling Gold Solder*—Gold alloyed, 1 dwt., fine silver 4 grs. 7. *Another ditto, cost* 43s. *stg.*, *or* $10.75 *per oz.*—Fine gold 12 dwts., fine silver 7 dwts. 3 grs., fine copper 6 dwts. 8. *Enamelling Gold No.* 2. *cost* 50s *stg. per oz.*—Fine gold 1 oz., fine silver 9 dwts. 12 grs., fine copper 7 dwts. 12 grs. 9. *Enamelling Gold No.* 3.—Fine gold 1 oz., fine silver 14 dwts., fine copper 8 dwts. 10. *Enamelling Gold No.* 4.—Fine gold 2 ozs. 5 dwts., fine silver 1 oz. 6 dwts., fine copper 1 oz., pin brass 5 dwts. 11. *Enamelling Gold No.* 5.—Fine gold 1 oz., fine silver 12 dwts., fine copper 6 dwts. 12. *Enamelling Gold No.* 6. *for transparent enamelling*—Fine gold 1 oz., fine silver 14 dwts., fine copper 6 dwts. 13. *Gold solder for enamelled work*—Fine gold 1 oz., fine silver 1 oz., fine copper 10 dwts., silver solder 8 dwts. 8 grs. 14. *Pale Gold alloys for polishing, &c., No* 1.—Fine gold 1 oz., fine silver 8 dwts., fine copper 3 dwts. 12 grs. 15. *Another, No.* 2.—Fine gold 1 oz., fine silver 1 dwt. 20 grs., fine copper 1 dwt. 4 grs. 16. *Pale* 18 *Carat Gold*—Fine gold 1 oz., fine silver 4 dwts., fine copper 2 dwts. 15 grs. 17. *Another Pale* 18 *Carat Gold*—Fine gold 1 oz. 12 grs., fine silver 3 dwts. 8 grs., fine copper 3 dwts. 8 grs. 18. *Pale Gold Solder*—Gold alloyed 1 dwt. 6 grs., fine silver 1 dwt. 19. *Alloy for best Pens*—Fine gold 1 oz., fine silver 5 dwts., fine copper 7 dwts. 18 grs., spelter 1 dwt. 6 grs. 20. *Solder for ditto*—Fine gold 12 dwts., fine silver 7 dwts. 3 grs., fine copper 6 dwts. 21. *Medium quality pens*—Fine gold 1 oz., composition 1 oz., 13 dwts. 22. *Composition for the last*—Fine silver 1 oz. 17 dwts., fine copper 5 ozs. 15 dwts., spelter 18 dwts. 20 grs. 23. *Solder for ditto*—Fine gold 1 oz., fine silver 2 ozs., pin brass 1 oz. 24. *Gold for common pens*—Fine gold 1 oz., fine silver 2 ozs., fine copper 1 oz. 25. *Solder for ditto*. Fine gold 1 oz., fine silver 2 ozs., pinbrass 1 oz. 26. *Alloys of Gold with Brass, No.* 1.—Fine gold 1 oz., fine silver 5 dwts. 6 grs., fine copper 3 dwts. 12 grs., pin brass 18 dwts. 27. *Another ditto. No.* 2.—Fine gold 1 oz., fine silver 4 dwts., fine copper 4 dwts., pin brass 16 dwts. 28. *Another ditto. No.* 3. —Fine gold 1 oz., fine silver 5 dwts. 12 grs., fine copper 3 dwts. 12 grs., pin brass 19 dwts. 6 grs. 29. *Another alloy.*—Fine gold 1 oz., fine silver 3 dwts. 21 grs., fine copper 9 dwts. 3 grs., composition 5 dwts. 6 grs. 30. *Another ditto*—Fine gold 15 dwts. 9 grs., fine silver 5 dwts. 19 grs., fine copper 3 dwts. 21 grs., composition 15 dwts. 31. *Composition for the last two alloys*—Finest copper 1 oz., spelter 5 dwts. 32. *Solder for foregoing alloys*—Gold alloyed, 1 dwt., fine silver 12 grs. 33. *Imitation Gold, costs* 87c. *per oz.*—Fine silver 2 oz. 5 dwts., fine copper 1 oz., composition 1 oz., keeps its color very well. 34. *Composition for ditto*—Fine copper 11 ozs., spelter 2 ozs. 35. "*California*" *Gold*—Fine gold 5 ozs. 12 dwts. composition 7 ozs. 17 dwts 36. *Composition for* "*California*"—Fine silver, 7 ozs. 17 dwts. fine copper 33 ozs. 12 dwts., spelter 5 ozs. 12 dwts. 37. *Medium Gold*—Fine gold 1 oz., fine silver 12 dwts., fine copper 13 dwts. 38. *Bright Gold*—Fine gold 1 oz., fine silver 7 dwts., composition marked No. 34, 1 dwt. 6 grs. 39. *Common Gold No.* 1.—Fine gold 1 oz., fine silver 8 dwts., composition No. 34. 1 oz. 12 dwts. 41. *Common Gold, No.* 2.—Fine gold 5 dwts., fine silver 3 dwts. 6 grs., fine copper 6 dwts. 12 grs. 42. *Gold for Pins*—Fine gold 1 oz., fine silver 5 dwts., fine copper 1 oz., spelter 5 dwts. 43. *Dry Colored Scrap reduced to 35s. or $8.75 Gold*—Colored scrap 1 oz. 9 dwts. 12 grs., fine silver 2 dwts., fine copper 17 dwts. 12 grs., spelter 4 dwts. 44. *Alloy for Gold Chains.*—Fine gold 11 dwts. 6 grs., fine silver 2 dwts. 5 grs., fine copper 6 dwts. 13 grs. 45. *Another ditto*—Fine gold 1 oz., fine silver 9 dwts., fine copper 8 dwts. 46. *Gold worth* 45 *stg. or* $11.25.—Fine gold, 1 oz., composition (see No. 22) 1 oz. 47. *Solder for ditto.*—Fine gold 1 oz., fine silver 15 dwts., fine copper 15 dwts. 48. 12 *Carat Gold,*—Fine gold 1 oz., fine silver 10 dwts., fine coppor 9 dwts. 6 grs. 49. *Common Gold from "California"*—"California," (see No. 35) 8 ozs. fine silver 13 ozs. 16 dwts., fine copper 6 ozs. 16 dwts. 50. 29*s or* $7.25 *Gold.*—Fine gold 1 oz. 13 dwts. 6 grs., fine silver 1 oz. 12 dwts. 12 grs., fine copper 1 oz. 16 dwts. 6 grs., spelter 4 dwts. Stands nitric acid very well.

ORDINARY BRIGHT GOLD WIRE, TABLE SHOWING THE PROPORTIONS OF ALLOY FROM 1 OZ. UP TO 21 OZ.

Fine Gold.			Fine Silver.			Fine Copper.			Total.		
Oz.	Dwts.	Grs.	Oz.	Dwts.	Grs.	Oz.	Dwts.	Grs.	Oz.	Dwts.	Grs.
0	5	21	0	6	6	0	6	21	1	0	0
0	11	18	0	14	12	0	13	18	2	0	0
0	17	15	1	1	18	1	0	15	3	0	0
1	15	6	2	3	12	2	1	6	6	0	0
2	12	21	3	5	6	2	1	21	9	0	0
3	10	12	4	7	0	4	2	12	12	0	0
4	8	3	5	8	18	5	3	3	15	0	0
5	4	18	6	10	12	6	3	18	18	0	0
6	3	8	7	12	6	2	4	9	21	0	0

TO RECOVER THE GOLD LOST IN COLORING.—Dissolve a handful of sulphate of iron in boiling water, then add this to your "color" water, it precipitates the small particles of gold. Now draw off the water, being very careful not to disturb the auriferous sediment at the bottom. You will now proceed to wash the sediment from all trace of acid with plenty of boiling water; it will require 3 or 4 separate washings, with sufficient time between each to allow the water to cool and the sediment to settle, before pouring the water off. Then dry in an iron vessel by the fire and finally fuse in a covered skittle pot with a flux as directed on page 202.

ALLOYS FOR GOLD.—1. *Red gold.*—Copper, 66.67 parts; gold, 33.33 parts. 2. *Yellow gold.*—Copper, 12.50 parts; silver, 37.50 parts; gold, 50 parts. 3. *Green gold.*—Silver, 25 parts; gold, 75 parts. 4. *Yellow gold.*—Silver, 66.67 parts; gold, 33.33 parts. 5. *Gray gold.*—

Silver, 5.89 parts ; gold, 88.23 parts ; iron, 5.89 parts. 6. *Dentists' gold.*—Silver, 8.34 parts ; platinum, 66.67 parts ; gold, 24.29 parts. 7. *English gold coin.*—Copper, 8.34 parts ; gold, 91.66 parts. 8. *American gold coin.*—Copper, 10 parts ; gold, 90 parts. French gold coin same as American. 10. *Alloys for Silver Coin and Plate.—English standard.*—Copper, 7.50 parts ; silver, 92.50 parts. 11. *American ditto.*—Copper, 10 parts ; silver 90 parts. French, the same.

GILDING METAL for common jewelry is made by mixing 4 parts copper with one of calamine brass. Sometimes 1 lb. copper, with 6 oz. of brass. *Dentists' Plate.*—No. 1 Gold, 20 dwts. ; silver, 1 dwt. ; copper, 2 dwts. 2. Gold, 21, silver, 2, copper. *Gold for Springs.*—Gold, 18 dwts. 12 grs. ; silver, 6 dwts. ; copper, 5 dwts.

JEWELLERS' SOLDERING FLUID.—Muriatic acid, ½ pt. ; grain zinc, 1½ oz. Dissolve, and add a little common solder and sal-ammoniac.

JEWELLERS' GOLD COMPOSITIONS.—*Common Gold.*—Silver, 1 part; Spanish copper, 16 parts, gold, 2 parts; mix. *Ring Gold.*—Spanish copper, 6 parts; silver, 3 parts; gold, 5 parts; mix. *Manheim Gold.*—copper, 3 parts; zinc, 1 part. Melt, and stir well. *Mosaic Gold.*—copper and zinc, equal parts; melt at the lowest temperature that will fuse the former, then mix by stirring, and add 5 per cent. more zinc. *Parker's Mosaic Gold.*—Copper, 100 parts; zinc, 54 parts. *For common Jewelry.*—Copper, 3 parts; 1 of old brass, and 4 oz. of tin to every lb. of copper. *Factitious Gold.*—Copper, 16 parts; platinum, 7 parts; zinc, 1 part; fused together. This alloy resembles gold of 16 carats fine, or ⅔, and will resist the action of nitric acid, unless very concentrated and boiling. *Harmstadt's True Imitation of Gold.*—is stated not only to resemble gold in color, but also in specific gravity and ductility. Platinum, 16 parts; copper, 7 parts; zinc, 1 part; put it in a crucible, cover with charcoal powder, and melt into a mass. *Do. of Silver.*—Copper, ½ oz. ; brass, 2 oz. ; pure silver, 3 oz. ; bismuth, 2 oz. ; saltpetre, 2 oz. ; common salt, 1 oz. ; arsenic, 1 oz. ; potash, 1 oz. ; melt in a crucible with powdered charcoal. This compound, used by a German chemist for unlawful purposes, was so perfect that he was never discovered.

ARTIFICIAL GOLD.—This is a new metallic alloy which is now very extensively used in France as a substitute for gold. Pure copper, 100 parts; zinc, or, preferably, tin, 17 parts; magnesia, 6 parts; sal-ammoniac, 3-6 parts; quick-lime, ⅛ part; tartar of commerce, 9 parts; are mixed as follows : The copper is first melted, and the magnesia, sal-ammoniac, lime and tartar are then added separately, and by degrees, in the form of powder; the whole is now briskly stirred for about ½ an hour, so as to mix thoroughly; and when the zinc is added in small grains by throwing it on the surface, and stirring till it is entirely fused; the crucible is then covered, and the fusion maintained for about 35 minutes. The surface is then skimmed, and the alloy is ready for casting. It has a fine grain, is malleable, and takes a splendid polish. It dose not corrode readily, and for many purposes, is an excellent substitute for gold. When tarnished, its brilliancy can be restored by a little acidulated water. If tin be employed instead of zinc, the alloy will be more brilliant. It is very much used in France, and must ultimately attain equal popularity here.

NEW FRENCH PATENT ALLOY FOR SILVER.—Messieurs De Ruolz & Fontenay have invented the following alloy, which may be used for almost all purposes in which silver is usually applied. Silver, 20 parts; purified nickel, 28 parts; copper, 52 parts. Melt the copper and nickel in the granular state, then introduce the silver. The flux to be employed is charcoal and borax, both in the state of powder; and the ingots obtained are to be rendered malleable by annealing for a considerable time in powdered charcoal.

GOLD.—To find the number of carats of gold in an object, first weigh the gold and mix with seven times its weight in silver. This alloy is beaten into thin leaves, and nitric acid is added; this dissolves the silver and copper. The remainder (gold) is then fused and weighed; by comparing the first and last weights the number of carats of pure gold is found. This operation is always repeated several times, and if any difference occurs in the result, all is done over again.

JEWELLERS' ALLOYS.—SOLDER, &C. *Eighteen-carat gold for rings*—Gold coin, 19½ gr.; pure copper, 3 grs.; pure silver, 1½ gr. *Cheap gold, twelve carat.*—Gold coin, 25 gr.; pure copper, 13½ gr.; pure silver, 7⅓ grs. *Very cheap four-carat gold.*—Copper, 18 parts; gold, 4 parts; silver, 2 parts. *Imitations of gold.*—1 Platina, 4 dwt.; pure copper, 2¼ dwt.; sheet-zinc, 1 dwt.; block-tin, 1¾ dwt.; pure lead, 1½ dwt. If this should be found too hard or brittle for practical use, re-melting the composition with a little sal-ammoniac will generally render it malleable as desired. 2. Platina, 2 parts; silver, 1 part; copper, 3 parts. These compositions, when properly prepared, so nearly resemble pure gold it is very difficult to distinguish them therefrom. A little powdered charcoal, mixed with metals while melting, will be found of service. *Best oreide of gold.*—Pure copper, 4 oz.; sheet zinc, 1¾ oz.; magnesia, ⅝ oz.; sal-ammoniac, $\frac{1\frac{1}{2}}{32}$ oz.; quick-lime, 9-32 oz.; cream tartar, ⅞ oz. First melt the copper at as low a temperature as it will melt; then add the zinc, and afterwards the other articles in powder, in the order named. Use a charcoal fire to melt these metals. *Bushing Alloy for Pivot-holes, &c.*—Gold coin, 3 dwts.; silver, 1 dwt. 20 grs.; copper, 3 dwts. 20 grs.; palladium, 1 dwt. The best composition known for the purpose named. *Gold Solder for Fourteen to Sixteen-carat Work.*—Gold coin, 1 dwt.; pure silver, 9 grs.; pure copper, 6 grs.; brass, 3 grs. *Darker solder.*—Gold coin, 1 dwt.; pure copper, 8 grs.; pure silver, 5 grs.; brass, 2 grs.; melt together in charcoal fire. *Solder for Gold.*—Gold, 6 dwts.; silver, 1 dwt.; copper, 2 dwts. *Soft Gold Solder.*—Gold, 4 parts; silver, 1 part; copper 1 part. *Solders for Silver.*—(For the use of jewellers.)—Fine silver, 19 dwts.; copper, 1 dwt.; sheet brass, 10 dwts. *White Solder for Silver.*—Silver, 1 oz.; tin, 1 oz. *Silver Solder, for Plated Metal.*—Fine silver. 1 oz.; brass 10 dwts. *Solders.—For Gold.*—1. Silver, 7 parts; copper, 1 part, with borax. 2. Gold, 2 parts; silver, 1 part; copper, 1 part. 3. Gold, 3 parts; silver, 3 parts; copper, 1 part; zinc ½ part. *For Silver.*—Silver, 2 parts; brass, 1 part, with borax; or, silver, 4 parts; brass, 3 parts; zinc, 1-18 part, with borax. *Gold Solders.*—1. Copper, 24.24 parts; silver, 27.57 parts; gold, 48.19 parts. 2. *Enamel Solder.*—Copper, 25 parts; silver, 7.07 parts; gold, 67.93 parts. 3. Copper, 26.55 parts; zinc, 6.25 parts; silver, 31.25 parts; gold, 36 parts. 4. *Enamel Solder.*—Silver, 19.57 parts; gold, 80.43 parts. *Solder.—For 22 carat gold.*—Gold of 22 carats, 1 dwt.; silver, 2 gr.; copper, 1 gr. *For 18 carat gold.*—Gold of 18 carats, 1 dwt.; silver. 2 gr.; copper, 1 gr. *For cheaper gold.*—Gold, 1 dwt; silver, 10 gr.; copper, 8 gr. *Cheaper still.*—Fine gold, 1 dwt.; silver, 1 dwt.; copper, 1 dwt.

SILVER SOLDERS.—1. (*hard.*) Copper, 30 parts; zinc, 12.85 parts; silver, 57.15 parts. 2. Copper, 23.33 parts; zinc, 10.00 parts; silver, 66.67 parts. 4. Copper, 26.66 parts; zinc, 10.00 parts; silver, 63.34 parts. 5. (*soft.*) Copper 14.75 parts; zinc 8.50 parts: silver, 77.05 parts. 6. Copper, 22.34 parts; zinc, 10.48 parts; silver, 67.18 parts. 7. Tin, 63.00 parts; lead, 37 parts.

COLORED GOLD.—1. *Full red gold.*—Gold, 5 dwts.; copper, 5 dwts. 2. *Red gold.*—Gold, 5 dwts.; silver, 1 dwt.; copper, 4 dwts. 3. *Green Gold.*—Gold, 2 dwt.; silver, 21 gr. 4. *Gray gold.*—Gold, 3 dwts. 15 gr; silver, 1 dwt. 9 gr. 5. *Blue gold.*—Gold, 5 dwt.; steel filings, 5 dwt. 6. *Antique gold, greenish-yellow color.*—Gold, 18 dwts. 9 gr.; silver, 21 gr.; copper 18 gr. These all require to be submitted to the process of wet coloring. 7. *Fictitious gold, very bright.*—Copper, 16 parts; platina, 7 parts; zinc, 1 part; fused together.

ENGLISH STANDARD FOR SILVER.—Pure silver, 11 ozs. 2 dwts.; copper, 22 dwts.: melt. *Silver Imitation,*—Copper, 1 lb.; tin, ¾ oz., melt. This composition will roll and ring very near to silver.

FRENCH GOLD PLATE.—1. Gold, 92 parts; copper, 8 parts. 2. Gold, 84 parts; copper, 16 parts. 3. Gold, 75 parts; copper, 25 parts. *Jewellers' Metal.*—Copper, 30 parts; tin, 7 parts; brass, 10 parts; mix.

ALLOY FOR WATCH PINION SOCKETS.—Gold, 31 parts; silver, 19 parts; copper 39 parts; palladium, 1 part.

COLORING OF JEWELRY.—1. *To Heighten the Color of Yellow gold.*—Saltpetre, 6 ozs; green copperas, 2 ozs.; white vitriol and alum, of each 1 oz. If wanted redder, a small quantity of blue vitriol must be added, 2. *For Green Gold.*—Saltpetre, 1 oz. 10 dwts.; sal-ammoniac, 1 oz. 4 dwts.; Roman vitriol, 1 oz. 4 dwts.; verdigris, 18 dwts. 3. *To Clean Gilt Jewelry.*—Boiling water in a clean flask, ½ pt.; cyanide of potassium, 1 oz.; shake the flask to dissolve the potassium. Add, when cold, liquor ammonia, ½ oz.; rectified alcohol, 1 oz. Used by brushing over gilded articles. 4. *Coloring Jewelry.*—Boil the articles in a dilute solution of terchloride of gold, to which some bicarbonate of soda has been added. 5. *Coloring of Gilding.*—Defective colored gilding may also be improved by the help of the following mixture: nitrate of potash, 3 ozs.; alum 1½ ozs.; sulphate of zinc, 1½ ozs.; common salt, 1½ ozs. These ingredients are to be put into a small quantity of water to form a sort of paste which is put upon the articles to be colored; they are then placed upon an iron plate over a clear fire, so that they will attain nearly to a black heat, when they are suddenly plunged into cold water; this gives them a beautiful high color. Different hues may be had by a variation in the mixture. 6. *For Red Gold.*—To 4 ozs. melted yellow wax, add, in fine powder, 1½ ozs. of red ochre, ; 1½ ozs. verdigris, calcined till it yields no fumes; and ½ oz. of calcined borax. Mix them well together. Dissolve either of above mixtures in water, as the color is wanted, and use as required. 7. *Fine color for Heavy Gilt Work.*—Alum, 3 ozs.; saltpetre, 6 ozs.; sulphate of zinc, 3 ozs.; common salt, 3 ozs. Mix all into a thick paste, dip the articles into it, and heat them until nearly black on a piece of sheet iron over a clear coke or charcoal fire, then plunge them into cold water. 8. *Fine Color For Light Plated work.*—Sulphate of copper, 2 dwts.; best verdigris, 4 dwts. 12 grs.; sal-ammoniac, 4 dwts.; saltpetre, 4 dwts.; acetic acid, 1 oz.; pulverize the solid articles, add the acetic acid gradually, stirring all the time. Dip your articles into this mixture and heat them to a black color on a sheet of copper. When cold, place them in a middling strong sulphuric acid pickle, which dissolves the coloring salts and induces a very fine gold color. 9. *Etruscan Gold Coloring.*—Alum, 1 oz.; fine table-salt, 1 oz.; saltpetre (powdered), 2 oz.; hot rain-water, sufficient to make the solution, when dissolved, about the consistency of thick ale; then add sufficient muriatic acid to produce the color desired. The degree of success must always depend, in a greater or less degree, upon the skill or judgment of the operator. The article to be colored should be from fourteen to eighteen carats fine, of pure gold and copper only, and be free from coatings of tin, or silver solder. The solution is best used warm, and when freshly made the principle on which it acts is to eat out the copper alloy from the surface of the article, leaving thereon pure, frosted gold only. After coloring, wash off, first in rain-water, then in alcohol, and dry without rubbing, in fine clean sawdust. Fine Etruscan jewelry, that has been defaced or tarnished by use, may be perfectly renewed by the same process.

FOR SILVERSMITHS, *Sterling Silver.*—1. Fine silver 11 oz. 2 dwts., fine copper 18 dwts. 2. *Equal to Sterling*—Fine silver 1 oz., fine copper 1 dwt. 12 grs. 3. *Another ditto*—Fine silver 1 oz., fine copper 5 dwts. 4. *Common Silver for Chains*—Fine silver 6 dwts., fine copper 4 dwts. 5. *Solder for ditto*—Fine silver 16 dwts., fine copper 12 grs., pin brass, 3 dwts. 12 grs. 6. *Alloy for Plating.*—Fine silver 1 oz., fine copper 10 dwts. 7. *Silver Solder*—Fine silver 1 oz., pin brass, 10 dwts., pure spelter, 2 dwts. 8. *Copper Solder for Plating*—Fine silver, 10 dwts., fine copper 10 dwts. 9. *Common Silver Solder*—Fine silver 10 ozs., pin brass, 6 ozs. 12 dwts., spelter, 12 dwts. 10. *Silver Solder for Enamelling, $1 per oz.*—Fine silver 14 dwts., fine copper, 8 dwts. 11. *Ditto, for filling Signet Rings.*—Fine silver, 10 ozs., fine copper, 1 oz. 16 dwts., fine pin brass, 6 ozs. 12 dwts., spelter, 12 dwts. 12. *Silver Solder for Gold Plating*—Fine silver, 1 oz., fine copper, 5 dwts., pin brass, 5 dwts. 13. *Quick Silver Solder*—Fine silver, 1 oz., pin brass, 10 dwts., bar tin, 2 dwts. 14. *Imitation Silver* — Fine silver, 1 oz., nickel, 1 oz. 11 grs., fine copper, 2 ozs. 9 grs. 15. *Another ditto*—Fine silver, 3 ozs., nickel, 1 oz. 11 dwts., fine copper, 2 ozs. 9 grs., spelter, 10 dwts. 16. *Fine Silver Solder for Filigree Work*—Fine silver, 4 dwts. 6 grs., pin brass, 1 dwt. 17. *Bismuth Solder*—Bismuth, 3 ozs., lead, 3 ozs. 18 dwts., tin, 5 ozs. 6 dwts.

DEAD WHITE ON SILVER ARTICLES.—Heat the article to a cherry red, or a dull red heat and allow it to cool, then place it in a pickle of 5 parts sulphuric acid to 100 parts of water, and allow it to remain for an hour or two. If the surface is not right, rinse in cold water, and repeat the heating and pickling operation as before. This removes the copper from the *surface* of the article, leaving *pure* silver on the surface. When sufficiently whitened, remove from the pickle, well rinse in pure hot water and place in warm box sawdust.

PICKLE, FOR FROSTING AND WHITENING SILVER GOODS.—Sulphuric acid, 1 dr.; water, 4 oz.; heat the pickle, and immerse the silver in it until frosted as desired; then wash off clean, and dry with a soft linen cloth, or in fine clean sawdust. For whitening only, a smaller proportion of acid may be used.

TO FROST POLISHED SILVER.—Cyanide of potassium 1 oz.; dissolved in ½ pt. of water. Do not hold the silver in your hands, but use pliers made of lance wood or box wood, and apply the mixture with a brush to the polished surface.

SILVERING HOOKS AND EYES, &c.—The small iron articles are suspended in dilute sulphuric acid until the iron shows a bright clean surface. After rinsing in pure water they are placed in a bath of a mixed solution of sulphate of zinc, sulphate of copper and cyanide of potassium, and there remain until they receive a bright coating of brass. Lastly, they are transferred to a bath of nitrate of silver, cyanide of potassium and sulphate of soda, in which they quickly received a coating of silver.

ORNAMENTAL DESIGNS ON SILVER.—Select a smooth part of the silver, and sketch on it a monogram or any other design you choose, with a sharp lead pencil, then place the article in a gold solution with the battery in good working order, and in a short time all the parts not sketched with the lead pencil will be covered with a coat of gold. After cleansing the article, the black lead is easily removed by the fingers, and the silver ornament disclosed. A gold ornament may be produced by reversing the process.

TO EXTRACT SILVER FROM WASTE PRODUCTS.—Mix your refuse with an equal quantity of wood charcoal, place in a crucible and submit to a bright red heat, and in a short time a silver button will be found at the bottom. Carbonate of soda is another good flux.

TO SOLDER TORTOISE SHELL.—Bring the edges of the pieces of shell to fit each other, observing to give the same inclination of grain to each, then secure them in a piece of paper, and place them between hot irons or pincers; apply pressure, and let them cool. The heat must not be so great as to *burn* the shell, therefore try it first on a white piece of paper.

ARTIFICIAL PEARLS.—Are made from beads of opaline glass filled with gum, the polish of the glass being reduced by the vapor if hydrofluoric acid.

REVIVER FOR OLD JEWELRY.—Dissolve sal-ammoniac in urine, and put the jewelry in it for a short time; then take it out, and rub with chamois leather, and it will appear equal to new.

TO RECOVER GOLD FROM GILT METAL.—Take a solution of borax water, apply to the gilt surface, and sprinkle over it some finely powdered sulphur; make the article red hot, and quench it in water; then scrape off the gold, and recover it by means of lead.

POLISHING POWDER FOR GOLD AND SILVER.—Rock alum burnt and finely powdered, 5 parts; levigated chalk, 1 part. Mix; apply with a dry brush.

SILVER-PLATING FLUID.—Dissolve 1 ounce of nitrate of silver, in crystals, in 12 ounces of soft water; then dissolve in the water 2 oz. cyanuret of potash; shake the whole together, and let it stand till it becomes clear. Have ready some half-ounce vials, and fill half full of Paris white, or fine whiting; and then fill up the bottles with the liquor, and it is ready for use. The whiting does not increase the coating powder; it only helps to clean the articles, and save the silver fluid, by half filling the bottles.

TO REDUCE ENGLISH SOVEREIGNS TO LOWER FINENESS.—No. 1. 15 *Carat gold*, Coins, 2 ozs.; gold, 8 ozs.; silver, 2 ozs. 3 dwts.; copper, 5 ozs. 3 dwts. 2. *Another ditto.* Coins, 4 ozs.; gold, 6 ozs.; silver, 2 ozs. 2 dwts.; copper, 5 ozs. 2 dwts. 3. *Another ditto.* Coins, 2 ozs.; gold, 6 ozs.; silver, 1 oz. 14 dwts.; copper, 4 ozs.; 2 dwts. 4. 14 *Carat gold.* Coins, 3 ozs.; gold, 5 ozs.; silver, 1 oz. 9 dwts. 12 grs.; copper, 11 dwts. 12 grs. 5. *Another ditto.* Coins, 1 oz.; gold, 2 ozs.; silver, 13 dwts.; copper, 1 oz. 11 dwts. 6. *Another ditto.* Coins, 1 oz.; gold, 8 ozs.; silver 2 ozs.; copper, 4 ozs. 14 dwts.

STERLING VALUE OF GOLD OF DIFFERENT DEGREES OF FINENESS.

Carats Fine.	Value per. oz. Troy. £	Carats Fine.	Value per. oz. Troy. £
24	4 4 11½	12	2 2 5½
23	4 1 5	11	1 18 11
22 British Standard.	3 17 10½	10	1 15 4½
21	3 14 4	9	1 11 10
20	3 10 9	8	1 8 3
19	3 7 3	7	1 4 9
18 (Lowest Hall Mark).	3 3 8½	6	1 1 2½
17	3 0 2	5	0 17 8
16	2 17 7½	4	0 14 2
15	2 13 1	3	0 10 7½
14	2 9 6½	2	0 7 1
13	2 6 0	1	0 3 6½

Note.—The BRITISH STANDARD for gold, is gold, 22-24 of a pound, equal to 11 parts pure gold and 1 of alloy; a pound is estimated to be divided into 24 equal parts or carats, hence the proportion is rated equal to 22 carats. The *Standard of Silver* is 222-240 of a pound, equivalent to 37 parts pure silver and 3 of alloy. A Troy ounce of Standard gold is coined into £3.17.10.2f., and an ounce of Standard silver into 5*s.* 6*d.* A lb. Troy of gold yields 46 19-240 sovereigns. A lb. Troy of silver 66 shillings. £150,000 in gold weighs over a ton. £75,000,000 weighs 500 tons.

The American STANDARD of Gold and Silver is 900 parts of pure metal and 100 of alloy in 1,000 parts of coin, the fineness being expressive of the quantity of pure metal in 1000 parts. The value of 1 ounce of *pure gold* is $20.67.183½, as standard gold coin it is worth $18.60.465. The value of 1 ounce of pure silver is $1.29.29., as standard silver coin it is worth $1 16.36-36.

TO MELT GOLD.—Prepare a good fire, and heat the ingot in which you wish to cast the gold, a little hotter than boiling water; next put the alloy in the crucible, add a small quantity of pulverized borax, and leave on the fire until melted. Cast this in a clean ingot, and after breaking the bar into small fragments, return to the pot and remelt the gold, not adding borax this time, but when the gold looks clear and smooth on the top, add, for every 6 ozs. gold, a piece of saltpetre about the size of a pea, and in about a minute pour the gold. Keep up the heat after adding the saltpetre, and, previous to pouring the gold, pour a few drops of oil into the iron ingot. If the stock was clean when you commenced, the gold will roll well. Much depends on the first rolling of the stock; 18 carat should be subjected to a very heavy strain; the first and second draughts, which imparts a grain to the stock; light draughts stretch the gold on the surface, and the middle portion remaining as cast, causes the gold to crack; many good bars having been condemned, when the trouble was in the rolling. After the 18 carat has been rolled to about twice its original length, it must be annealed, then rolled to the size you require. Proceed with melting 14 carat as above described for 18 carat, giving it as heavy strains in the rolls, but not rolling so much before annealing as the 18 carat. The other carats of cheaper grade, do not require the use of saltpetre to toughen; instead of which, use a little salammoniac, and then proceed as above. When you anneal red gold, do not quench it when red hot, but allow the gold to blacken before quenching, otherwise it will slit or seam. Melt new alloys in every case twice; treat solder the same way, to ensure a thorough admixture of the copper with the gold.

To Remove Tin from the Stock.—Just previous to pouring the gold, throw a small piece of corrosive sublimate in the pot, stir well with a long piece of pointed charcoal, and allow the pot to remain on the fire about half a minute afterward. This will take tin from the alloy; while the tin is in, the gold will not roll without cracking. To remove emery or steel filings from gold, add a small piece of glass-gall, while melting; it will collect them in the flux.

Making Brittle Gold Strong.—Gold is sometimes so brittle that the jeweller cannot well work it; this is probably due to phosphorus, which, being no metal, is of course not detected in the assay. The remedy is to pass chlorine gas through the molten gold, by which treatment most of the gold which had otherwise to be set aside as unfit for certain kinds of work, can be redeemed.

To Make Plated Stock.—Cast the bar you wish to plate the breadth you require, and roll to the thickness of the 8th of an inch. If you plate on silver, cast the silver the same width as the gold, and roll a little longer than the gold. Generally the lower, cheaper grade metal, is 2 or 3 times the thickness of the dearer, therefore use as much of each as will make the desired proportions. Polish as nearly flat and straight as possible, then file one face of silver and one face of gold, until they are bright. Previous to this you have rolled a piece of plate solder very thin, say, 36 in. round size plate, and cut a strip a little wider and longer than your gold. Emery paper can be used to clean each side of this from dirt and grease. Cover the surface with ground borax from the slate, on each side; do the same on the bright faces of the gold and silver; place the solder between them, and have a piece of iron wire about $\frac{3}{8}$ of an inch in thickness, and 3 feet long, in readiness, place this lengthwise on the gold, and squeeze the whole tightly together in a vice, and bind every inch or so with heavy binding wire very secure. Next make a good charcoal fire in the forge, shaped so as to be like an oven, and then solder; when the solder melts on each side the whole length, all is ready to roll like any other stock. If you make gold plating that is 18 carat, or 16 carat, or 14 carat, and 12 carat, you must use a gold solder about 5 or 6 carats less than the inferior gold. If gold on silver or composition, use copper solder. The clippings from the above, when the gold is on silver, may be placed in an enamelled vessel, and covered with nitric acid, 2 parts; water, 1 part. The silver will be taken in solution, which must be saved in an earthen pot. Precipitate the silver from the solution, or after the solution has been diluted, a bar of copper placed in it will collect it; this sediment must be well washed and dried, then melted. The gold after being well dried, can be melted in a bar, a small amount of copper being added, so that it will be of the same quality as before.

JEWELLERS' ARMENIAN CEMENT.—Isinglass soaked in water and dissolved in spirit, 2 oz. (thick) ; dissolve in this 10 grs. of very pale gum ammonia (in tears) by rubbing them together ; then add 6 large tears of gum mastic, dissolved in the least possible quantity of rectified spirits. When carefully made this cement resists moisture and dries colorless. Keep in a closely stopped phial.

JEWELLERS' CEMENT.—Put in a bottle 2 ozs. of isinglass and 1 oz. of the best gum arabic, cover them with proof spirits, cork loosely, and place the bottle in a vessel of water, and boil it till a thorough solution is effected ; then strain it for use.

GOLD is taken from the surface of silver by spreading over it a paste made of powdered sal-ammoniac, with aquafortis, and heating it till the matter smokes, and is nearly dry ; when the gold may be separated by rubbing it with a scratch brush.

TO SEPARATE GOLD AND SILVER FROM LACE, &C.—Cut in pieces the gold or silver lace, tie it tightly, and boil in soap ley till the size appears diminished ; take the cloth out of the liquid, and after repeated rinsings of cold water, beat it with a mallet to draw out the alkali. Open the linen, and the pure metal will be found in all its beauty.

TARNISH ON ELECTRO-PLATE Goods may be removed by immersing the article from one to ten or fifteen minutes, or until the tarnish has been removed, but no longer, in the following solution : Rain water, 2 gals. ; cyanuret potassa, $\frac{1}{2}$ lb. ; dissolve and put into a stone jug or jar and closely cork. After immersion, the articles must be taken out and thoroughly rinsed in two or three waters, then dried with a soft linen cloth, or, if frosted or chased work, with fine clean sawdust. Tarnished jewelry may be speedily restored by this process ; but make sure work of removing the alkali, otherwise it will corrode the goods.

A BRIGHT GOLD TINGE may be given to silver by steeping it for a suitable length of time in a weak solution of sulphuric acid and water strongly impregnated with iron-rust.

TO REFINE GOLD.—If you desire to refine gold from the baser metals, swedge or roll it out very thin, then cut into narrow strips and curl up so as to prevent its lying flatly. Drop the pieces thus prepared into a vessel containing good nitric acid, in the proportion of acid, 2 ozs., and pure rain-water $\frac{1}{2}$ oz. Suffer to remain until thoroughly dissolved, which will be the case in from $\frac{1}{2}$ an hour to 1 hour. Then pour off the liquid carefully, and you will find the gold, in the form of yellow powder, lying at the bottom of the vessel. Wash this with pure water till it ceases to have an acid taste, after which you may melt and cast into any form you choose. Gold treated in this way may be relied on as perfectly pure.

In melting gold use none other than a charcoal fire, and during the process sprinkle saltpetre and potash into the crucible occasionally. Do not attempt to melt with stone coal, as it renders the metal brittle and otherwise imperfect.

TO REFINE SILVER.—Dissolve in nitric acid as in the case of the gold. When the silver has entirely disappeared, add to the $2\frac{1}{2}$ oz. of solution nearly 1 quart of pure rain-water. Sink, then, a sheet of clean copper into it; the silver will collect rapidly upon the copper, and you can scrape it off and melt into bulk at pleasure.

In the event of your refining gold in accordance with the foregoing formula, and the impurity was silver, the only steps necessary to save the latter would be to add the above named proportion of water to the solution poured from the gold, and then to proceed with your copper plate as just directed.

TO REFINE COPPER.—This process differs from the one employed to refine silver in no respects save the plate to be immersed; you use an iron instead of a copper plate to collect the metal.

If the impurities of gold refined were both silver and copper, you might, after saving the silver as above directed, sink your iron plate into the solution yet remaining, and take out the copper. The parts of alloyed gold may be separated by these processes, and leave each in a perfectly pure state.

COLD SILVERING OF METALS.—Mix 1 part of chloride of silver with 3 parts of pearlash, 1½ parts common salt, and 1 part whiting; and well rub the mixture on the surface of brass or copper (previously well cleaned), by means of a piece of soft leather, or a cork moistened with water and dipped in the powder. When properly silvered, the metal should be well washed in hot water, slightly alkalized; then wiped dry.

TO HARD SOLDER GOLD, SILVER, COPPER, BRASS, IRON, STEEL OR PLATINA.—The solders to be used for gold, silver, copper and brass are given in the preceding part. You commence operations by reducing your solder to small particles, and mixing it with powdered sal-ammoniac and powdered borax in equal parts, moistened to make it hold together. Having fitted up the joint to be soldered, you secure the article upon a piece of soft charcoal, lay your soldering mixture immediately over the joint and then with your blow-pipe turn the flame of your lamp upon it until fusion takes place. The job is then done, and ready to be cooled and dressed up. Iron is usually soldered with copper or brass in accordance with the above process. The best solder for steel is pure gold or pure silver, though gold or silver solders are often used successfully. Platina can only be soldered well with gold; and the expense of it, therefore, contributes to the hindrance of a general use of platina vessels, even for chemical purposes, where they are of so much importance.

TO SOFT SOLDER ARTICLES.—Moisten the parts to be united with soldering fluid; then, having joined them together, lay a small piece of solder upon the joint and hold over your lamp, or direct the blaze upon it with your blow-pipe until fusion is apparent. Withdraw them from the blaze immediately, as too much heat will render the solder brittle and unsatisfactory. When the parts to be joined can be made to spring or press against each other, it is best to place a thin piece of solder between them before exposing to the lamp. Where two smooth surfaces are to be soldered one upon the other, you may make an excellent job by moistening them with the fluid, and then, having placed a sheet of tin foil between them, holding them pressed firmly together over your lamp till the foil melts. If the surfaces fit nicely, a joint may be made in this way so close as to be almost imperceptible. The bright looking lead which comes as a lining to tea boxes works better in the same way than tin foil.

TO CLEANSE GOLD TARNISHED IN SOLDERING.—The old English mode was to expose all parts of the article to a uniform heat, allow it to cool, and then boil until bright in urine and sal-ammoniac. It is now usually cleaned with diluted sulphuric acid. The pickle is made in about the proportion of one-eighth of an ounce of acid to one ounce of rain water.

To Clean Silver Tarnished in Soldering.—Some expose to a uniform heat, as in the case of gold, and then boil in strong alum water. Others immerse for a considerable length of time in a liquid made of ½ oz. of cyanuret potassa to 1 pint rain water, and then brush off with prepared chalk.

Nickel Plating.—The following is the substance of the patent granted to Dr. Isaac Adams, March 22, 1870. The process is highly successful. "This improvement consists in the use of 3 new solutions from which to deposit nickel by the electric current. 1. A solution formed of the double sulphate of nickel and alumina, or the sulphate of nickel dissolved in a solution of soda, potash, or ammonia alum, the three different varieties of commercial alum. 2. A solution formed of the double sulphate of nickel and magnesia, with or without an excess of ammonia. I have found that a good coating of nickel can be deposited from the solution before mentioned, provided they are prepared and used in such a manner as to be free from any acid or alkaline reaction. When these solutions are used, great care must be taken, lest by the use of too high battery power, or from the introduction of some foreign matters, the solution becomes acid or alkaline. I prefer to use these solutions at a temperature above 100° Fah., but do not limit my invention to the use of these solutions at that temperature. I therefore claim, 1. The electro deposition of nickel by the means of solution of the double sulphate of nickel and alumina, prepared and used in such a manner as to be free from the presence of ammonia, potash, soda, lime or nitric acid or from any other acid, or from any acid or alkaline reaction. 2. The electro deposition of nickel by means of a solution of the double sulphate of nickel and potash, prepared and used in such a manner as to be free from the presence of ammonia, soda, alumina, lime or nitric acid, or from any acid or alkaline reaction. 3. The electro deposition of nickel by means of a solution of the double sulphate of nickel and magnesia, prepared and used in such a manner as to be free from the presence of potash, soda, alumina, lime or nitric acid, or from any acid or alkaline reaction."

Stalba's Nickel Plating Process.—Consists in plating with nickel, by the action of zinc upon salts of nickel, in the presence of chloride of zinc and the metal to be plated. By this process, Stalba states that he has succeeded in plating objects of wrought and cast iron, steel, copper, brass, zinc, and lead. It is only necessary that the size of the objects should permit them to be covered entirely by the plating liquid, and that their surfaces should be free from dirt. The following is the *modus operandi*:—A quantity of concentrated chloride of zinc solution is placed in a clean metallic vessel, and to this is added an equal volume of water. This is heated to boiling, and hydrochloric acid is added drop by drop, until the precipitate which had formed on adding the water has disappeared. A small quantity of zinc powder is now added, which produces a zinc coating on the metal as far as the liquid extends. Enough of the nickel salt (the chloride or sulphate answers equally well, is now introduced to color the liquid distinctly green ; the objects to be plated are placed in it together with some zinc clippings, and the liquid is brought to boiling. The nickel is precipitated in the course of 15 minutes, and the objects will be found to be completely coated. The coating varies in lustre with the character of the metallic surface; when this is polished, the plating is likewise lustrous and *vice versa.* Salt of cobalt affords a cobalt plating, which is steel gray in color, not so lustrous as the nickel, but more liable to tarnish.

To Make Silver Solution for Electro-Plating.—Put together into a glass vessel 1 oz. good silver, made thin and cut into strips; 2 oz. best nitric acid, and ½ oz. pure rain water. If solution does not begin at once, add a little more water—continue to add a very little at a time till it does. In the event it starts off well, but stops before the silver is fully dissolved, you may generally start it up again all right by adding a little more water. When solution is entirely effected, add 1 quart of warm rain water and a large tablespoonful of table salt. Shake well and let settle, then proceed to pour off and wash through other waters as in the case of the gold preparation. When no longer acid to the taste, put in an ounce and an eighth cyanuret potassa and a quart pure rain water: after standing about 24 hours, it will be ready for use.

To make Gold Solution for Electro-Plating.—Dissolve five pennyweights gold coin, 5 grains pure copper, and 4 grains pure silver in 3 ozs. nitro-muriatic acid; which is simply 2 parts muriatic acid and 1 part nitric acid. The silver will not be taken into solution as are the other 2 metals, but will gather at the bottom of the vessel. Add 1 oz. pulverized sulphate of iron, ½ oz. pulverized borax, 25 grains pure table salt, and 1 quart hot rain water. Upon this the gold and copper will be thrown to the bottom of the vessel with the silver. Let stand till fully settled, then pour off the liquid carefully, and refill with boiling rain water as before. Continue to repeat this operation until the precipitate is thoroughly washed ; or, in other words, fill up, let settle, and pour off so long as the accumulation at the bottom of the vessel is acid to the taste. You now have about an 18 carat chloride of gold. Add to it an ounce and an eighth cyanuret potassa, and 1 quart rain water—the latter heated to the boiling point. Shake up well, then let stand about 24 hours, and it will be ready for use. Some use platina as an alloy instead of silver, under the impression that plating done with it is harder. I have used both, but never could see much difference. Solution for a darker colored plate to imitate Guinea gold may be made by adding to the above 1 oz. dragon's blood and 5 grs. iodide or iron. If you desire an alloyed plate, proceed as first directed, without the silver or copper, and with an ounce and a half of sulphuret potassa in place of the iron, borax, and salt.

To Plate with a Battery.—If the plate is to be gold, use the gold solution for electro-plating; if silver, use the silver solution. Prepare the article to be plated by immersing it for several minutes in a strong ley made of potash and rain water, polishing off thoroughly at the end of the time with a soft brush and prepared chalk. Care should be taken not to let the fingers come in contact with the article while polishing, as that has a tendency to prevent the plate from adhering; it should be held in two or three thicknesses of tissue paper. Attach the article, when thoroughly cleansed, to the positive pole of your battery, then affix a piece of gold or silver, as the case may be, to the negative pole, and immerse both into the solution in such a way as not to hang in contact with each other.

After the article has been exposed to the action of the battery about ten minutes, take it out and wash or polish over with a thick mixture of water and prepared chalk or jewellers' rouge. If, in the operation, you find places where the plating seems inclined to peel off, or where it has not taken well, mix a little of the plating solution with prepared chalk or rouge, and rub the defective part thoroughly with it. This will be likely to set all right.

Govern your time of exposing the article to the battery by the desired thickness of the plate. During the time, it should be taken out and polished up as just directed about every ten minutes, or as often at least as there is an indication of a growing darkness on any part of its surface. When done, finish with the burnisher or prepared chalk and chamois skin, as best suits your taste and convenience. In case the article to be plated is iron, steel, lead, pewter, or block tin, you must, after first cleaning with the ley and chalk, prepare it by applying with a soft brush—a camels'-hair pencil is best suited—a solution made of the following articles in the proportion named:—Nitric acid, ½ oz.; muriatic acid, ⅓ oz.; sulphuric acid, 1-9th oz.; muriate of potash, 1-7th oz.; sulphate of iron, ⅓ oz.; sulphuric ether, 1-5th oz.; and as much sheet zinc as it will dissolve. This prepares a foundation, without which the plate would fail to take well, if at all.

To make Gold Amalgam.—Eight parts of gold and one of mercury are formed into an amalgam for plating, by rendering the gold into thin plates, making it red hot and then putting it into the mercury while the latter is also heated to ebullition. The gold immediately disappears in combination with the mercury, after which the mixture may be turned into water to cool. It is then ready for use.

To Plate with Gold Amalgam.—Gold amalgam is chiefly used as a plating for silver, copper or brass. The article to be plated is washed over with diluted nitric acid or potash lye and prepared chalk, to remove any tarnish or rust that might prevent the amalgam from adhering. After having been polished perfectly bright, the amalgam is applied as evenly as possible, usually with a fine scratch brush. It is then set upon a grate over a charcoal fire, or placed into an oven and heated to that degree at which mercury exhales. The gold, when the mercury has evaporated, presents a dull yellow color. Cover it with a coating of pulverized nitre and alum in equal parts, mixed to a paste with water, and heat again till it is thoroughly melted, then plunge into water. Burnish up with a steel or bloodstone burnisher.

To Make and Apply Gold-Plating Solution.—Dissolve ½ oz. of gold amalgam in 1 oz. of nitro-muriatic acid. Add 2 oz. of alcohol, and then, having brightened the article in the usual way, apply the solution with a soft brush. Rinse and dry in sawdust, or with tissue paper, and polish up with chamois skin.

To Make and Apply Gold-Plating Powder.—Prepare a chloride of gold the same as for plating with a battery. Add to it, when thoroughly washed out, cyanuret potassa in a proportion of 2 oz. to 5 pennyweights of gold. Pour in a pint of clean rain water, shake up well and then let stand till the chloride is dissolved. Add then 1 lb. of prepared Spanish whiting and let it evaporate in the open air till dry, after which put away in a tight vessel for use. To apply it you prepare the article in the usual way, and having made the powder into a paste with water, rub it upon the surface with a piece of chamois skin or cotton flannel.

An old mode of making a gold-plating powder was to dip clean linen rags into solution prepared as in the second article preceding this, and having dried, to fire and burn them into ashes. The ashes formed the powder, and were to be applied as above.

To Make and Apply Silver-Plating Solution.—Put together in a glass vessel 1 oz. nitrate of silver, 2 ozs. cyanuret potassa, 4 ozs. prepared Spanish whiting, and 10 ozs. pure rain water. Cleanse the article to be plated as per preceding directions, and apply with a soft brush. Finish with the chamois skin or burnisher.

To Make and Apply Silver-Plating Powder.—Dissolve silver in nitric acid by the aid of heat; put some pieces of copper into the solution to precipitate the silver; wash the acid out in the usual way; then, with 15 grains of it mix 2 drams of tartar, 2 drams of table salt, and ½ dram of pulverized alum. Brighten the article to be plated with ley and prepared chalk, and rub on the mixture. When it has assumed a white appearance, expose to heat as in the case of plating with gold amalgam, then polish up with the burnisher or soft leather.

To Destroy the Effects of Acid on Clothes.—Dampen as soon as possible, after exposure to the acid, with spirits ammonia. It will destroy the effect immediately.

To Wash Silverware.—Never use a particle of soap on your silverware, as it dulls the lustre, giving the article more the appearance of pewter than silver. When it wants cleaning, rub it with a piece of soft leather and prepared chalk, the latter made into a kind of paste with pure water, for the reason that water not pure might contain gritty particles.

To Cleanse Brushes.—The best method of cleansing watchmakers' and jewellers' brushes is to wash them out in a strong soda water. When the backs are wood, you must favor that part as much as possible; for being glued, the water may injure them.

To Cut Glass Round or Oval without a Diamond.—Scratch the glass around the shape you desire with the corner of a file or graver; then, having bent a piece of wire in the same shape, heat it red hot and lay it upon the scratch, sink the glass into cold water just deep enough for the water to come almost on a level with its upper surface. It will rarely ever fail to break perfectly true.

To Re-Black Clock Hands.—Use asphaltum varnish. One coat will make old rusty hands look as good as new, and it dries in a few minutes.

To Gild Steel.—Pour some of the ethereal solution of gold into a wineglass, and dip into it the blade of a new penknife, razor, lancet, &c.; withdraw the instrument and allow the ether to evaporate. The blade will then be found covered with a beautiful coat of gold.

The blade may be moistened with a clean rag, or a small piece of very dry sponge dipped in the ether, and the same effects will be produced.

SILVERING SHELLS.—Silver leaf and gum water, a sufficient quantity; grind to a proper thickness, and cover the inside of the shells. For a GOLD COLOR, grind up gold-leaf with gum water, and apply to the inside of the shells.

LIQUID FOIL FOR SILVERING GLASS GLOBES, &c.—Lead, 1 part; tin, 1 part; bismuth, 1 part; melt, and, just before it sets, add mercury, 10 parts. Pour this into the globe, and turn it rapidly round.

SILVER-PLATERS' STRIPPING LIQUID.—Sulphuric acid, 8 parts; nitre, 1 part. Used to recover silver from old plated ware.

TO SILVER CLOCK FACES, &c.—Old silver lace, ½ oz.; nitric acid, 1 oz. Boil them over a gentle fire for about 5 minutes in an earthen pot. After the silver is dissolved, take the mixture off, and mix it in a pint of clean water, then pour it into another vessel free from sediment; then add a tablespoonful of common salt, and the silver will be precipitated in the form of a white powder of curd; pour off the acid, and mix the curd with 2 oz. salt of tartar, and ½ oz. whiting, all together, and it is ready for use. TO USE.—Clean your brass or copper plate with rotten-stone and a piece of old hat; rub it with salt and water with your hand. Then take a little of the composition on your finger, and rub it over your plate, and it will firmly adhere and completely silver it. Wash it well with water. When dry, rub it with a clean rag, and varnish with this VARNISH FOR CLOCK FACES. Spirits of wine, 1 pt.; divide in three parts, mix one part with gum-mastic in a bottle by itself; 1 part spirits and ½ oz. sandarac in another bottle; and 1 part spirits and ½ oz. of whitest gum benjamin, in another bottle; mix and temper to your mind. If too thin, some mastic; if too soft, some sandarac or benjamin. When you use it, warm the silvered plate before the fire, and, with a flat camels'-hair pencil, stroke it over till no white streaks appear, and this will preserve the silvering for many years.

REFINING GOLD AND SILVER.—The art of assaying gold and silver is founded upon the feeble affinity which these have for oxygen in comparison with copper, tin, and other cheap metals, and on the tendency which the latter metals have to oxidize rapidly in contact with lead at a high temperature, and sink with it into any porous, earthy vessel in a thin, glassy, vitrified mass. The precious metal having previously been accurately weighed and prepared, the first process is CUPELLATION. The *muffle*, with cupel properly arranged on the "*muffle plate*," is placed in the furnace, and the charcoal added, and lighted at the top by means of a few ignited pieces thrown on last. After the cupels have been exposed to a strong white heat for about half an hour, and have become white hot, the lead is put into them by means of tongs. As soon as this becomes bright red and "*circulating*," as it is called, the specimen for assay, wrapped in a small piece of paper or lead-foil, is added; the fire is now kept up strongly until the metal enters the lead and "*circulates*" well, when the heat, slightly diminished, is so regulated that the assay appears convex and more glowing than the cupel itself, whilst the "*undulations*" circulate in all directions, and the middle of the metal appears smooth, with a margin of litharge, which is freely absorbed by the cupel. When the metal becomes bright and shining, or, in technical language, begins to "*lighten*," and prismatic hues suddenly flash across the globules, and undulate and cross each other, followed by the metal becoming very brilliant and clear, and at length bright and solid (called the *brightening*), the separation is ended, and the process complete. The cupels are then drawn to the mouth of the "muffle," and allowed to cool slowly. When quite cold, the resulting "*button*," if of SILVER, is removed by the "pliers" or "tongs" from the cupels, and, after being flattened on a small *anvil of polished steel*, with a polished steel hammer, to detach adhering oxide of lead, and cleaned with a small, hard brush, is very *accurately weighed*. The weight is that of *pure silver*, and the difference between the weight before cupellation and that of the pure metal represents the proportion of alloy in the sample examined. In the case of GOLD, the metal has next to undergo the operations of QUARTATION. The cupelled sample is fused with 3 times its weight of pure silver (called the "*witness*"), by which the gold is reduced to one-fourth of the mass less, and in this state may easily be removed by PARTING. The alloy, after quartation, is hammered or rolled out into a thin strip or leaf, curled into a spiral form, and boiled for a quarter of an hour with about $2\frac{1}{2}$ to 3 ozs. of nitric acid (specific gravity, 1.3); and the fluid being poured off, it is again boiled in a similar manner, with $1\frac{1}{2}$ to 2 ozs. more nitric acid (sp. gr., 1.2); after which the gold is carefully collected, washed in pure water, and dried. When the operation of parting is skilfully conducted, the acid not too strong, the metal preserves its spiral form; otherwise it falls into flakes or powder. The second boiling is termed the "*reprise*." The loss of weight by parting corresponds to the quantity of SILVER originally in the specimen.

FOR ALLOYS CONTAINING PLATINUM, which usually consist of copper, silver, platinum, and gold, the method of assaying is as follows: The alloy is cupelled in the usual way, the loss of weight expresses the amount of *copper*, and the "button," made into a riband and treated with sulphuric acid, indicates by the portion dissolved that also of the *silver* present. By submitting the residuum to quartation, the *platinum* becomes soluble in nitric acid. The loss after digestion in this menstruum expresses the weight of that metal, and the weight of the portion now remaining is that of pure gold. Gold containing PALLADIUM may be assayed in the same manner. ANNEALING.—This consists in putting the pure gold into a small, porous crucible, or cupel, and heating it to redness in the muffle. WEIGHING must be done with the utmost accuracy. The weight in grains Troy, doubled or quadrupled, as the case may be, gives the number of *carats fine* of the alloy examined, without calculation. According to the OLD FRENCH METHOD of assaying gold, the following quantities were taken; For the *assay pound*, 12 gr.; fine silver, 30 grs.; lead, 108 gr. These having been cupelled together, the perfect button is rolled into a leaf ($1\frac{1}{2} \times 5$ inches), twisted on a quill and submitted to parting with $2\frac{1}{2}$ oz. and $1\frac{1}{2}$ oz. of nitric acid, sp. gr., 1.16 (20° Baumé.) The remainder of the process is similar to that above decribed. The usual weight of silver taken for the *assay pound*, when the fineness is reckoned in ·1000ths, is ·20 grs., every real grain of which represents 50-1000ths of fineness, and so on of smaller divisions.

ENAMELLING ON GOLD OR COPPER.—The basis of all enamels is a highly transparent and fusible glass, called FRIT, FLUX, or PASTE, which readily receives a color on the addition of the metallic oxides. *Preparation.*—Red lead, 16 parts; calcined borax, 3 parts; pounded flint glass, 12 parts; flints, 4 parts. Fuse in a Hessian crucible for 12 hours, then pour it out into water, and reduce it to powder in a biscuit-ware mortar. The following directions will serve to show how the coloring preparations are made: *Black* enamels are made with peroxide of manganese, or protoxide of iron, to which more depth of color is given with a little cobalt. *Violet* enamel of a very fine hue is made from peroxide of manganese, in small quantity, with saline or alkaline fluxes. *Red* enamel is made from the protoxide of copper. Boil a solution of equal parts of sugar and acetate of copper in four parts of water. The sugar takes possession of a portion of the cupreous oxide, and reduces it to the protoxide; when it may be precipitated in the form of a granular powder of a brilliant red. After about two hours of moderate boiling, the liquid is set aside to settle, decanted off the precipitate, which is washed and dried. By this pure oxide any tint may be obtained from red to orange by adding a greater or smaller quantity of peroxide of iron. The oxide and purple of Cassius are likewise employed to color red enamel. This composition resists a strong fire very well. *Green* enamel can be produced by a mixture of yellow and blue, but is generally obtained direct from the oxide of copper, or, better still, with the oxide of chrome, which last will resist a strong heat. *Yellow.*—Take one part of white oxide of antimony, with from one to three parts of white lead, one of alum, and one of sal-ammoniac. Each of these substances is to be pulverized, then all are to be exactly mixed, and exposed to a heat adequate to decompose the sal-ammoniac. This operation is judged to be finished when the yellow color is well brought out. *Blue.*—This color is obtained from the oxide of cobalt, or some of its combinations, and it produces it with such intensity that only a very little can be used lest the shade should pass into black. A *white* enamel may be prepared with a *calcine* formed of 2 parts of tin and 1 of lead, calcined together: of this combined oxide, 1 part is melted with two parts of fine crystal and a very little manganese, all previously ground together. When the fusion is complete, the vitreous matter is to be poured into clear water, and the frit is then dried and melted anew. Repeat the pouring into water three or four times, to insure a perfect combination. Screen the crucible from smoke and flame. The smallest portions of oxide of iron or copper admitted into this enamel will destroy its value. The artist prepares his enamel colors by pounding them in an agate mortar, with an agate pestle, and grinding them on an agate slab, with oil or lavender rendered viscid by exposure to the sun, in a shallow vessel, loosely covered with gauze or glass. He should have alongside of him a stove, in which a moderate fire is kept up, for drying his work whenever the figures are finished. It is then passed through the muffle.

BLACK ENAMEL ON GOLD OR SILVER.—Take ½ pennyweight of silver, 2½ pennyweights of copper, 3½ pennyweights of lead, and 2½ pennyweights of muriate of ammonia. Melt together, and pour into a crucible with twice as much pulverized sulphur; the crucible is then to be immediately covered that the sulphur may not take fire, and the mixture is to be calcined over a smelting fire until the superfluous sulphur is burned away. The compound is then to be coarsely pounded, and, with a solution of muriate of ammonia, to be formed into a paste which is to be placed upon the article it is designed to enamel. The article must then be held over a spirit lamp till the compound upon it melts and flows. After this it may be smoothed and polished up in safety.

SILVER-PLATING.—File the parts which are to receive the plate very smooth; then apply over the surface the muriate of zinc, which is made by dissolving zinc in muriatic acid; now hold this part over a dish containing hot soft solder, and with a swab apply the solder to the part to which it will adhere, brush off all superfluous solder, so as to leave the surface smooth; you will now take No. 2 fair silver plate, of the right size to cover the prepared surface, and lay the plate upon it, and rub down smooth with a cloth moistened with oil; then, with a tinned soldering iron, pass slowly over all the surface of the plate, which melts the solder underneath it, causing the plate to adhere as firmly as the solder does to the iron; then polish the surface, and finish with buckskin.

PLATING WITH NICKEL may be effected by placing the object to be plated, either of iron, steel, copper, bronze, zinc or lead in a boiling neutral solution of zinc chloride containing a salt of nickel and granulated zinc. If the zinc solution is acid, the coating of nickel is dull. A plating of cobalt may be made in the same manner.

ELKINGTON'S PATENT GILDING.—Fine gold, 5 oz. (troy); nitro-muriatic acid, 52 oz. (avoirdupois); dissolve by heat, and continue the heat until red or yellow vapors cease to be evolved; decant the clear liquor into a suitable vessel; add *distilled* water, 4 gals.; pure bi-carbonate of potassa, 20 lb.; and boil for 2 hours. N. B.—The nitro-muriatic acid is made with *pure* nitric acid (sp. gr., 1.45) 21 oz.; *pure* muriatic acid (sp. gr., 1.15), 17 oz.; and *distilled* water, 14 oz. The articles, after being perfectly cleaned from scale or grease, and receiving a proper *face*, are to be suspended on wires, dipped into the liquid *boiling hot*, and moved about therein, when, in from a few seconds to a minute, depending on the newness and strength of the liquid, the requisite coating of gold will be deposited on them. By a little practice the time to withdraw the articles is readily known; the duration of the immersion required to produce any given effect gradually increases as the liquid weakens by use. When properly gilded, the articles are withdrawn from the solution of gold, washed in clean water and dried; after which they undergo the usual operation of coloring, &c.

A "*dead gold*" *appearance* is produced by the application to the articles of a *weak* solution of *nitrate of mercury* previously to the immersion in the gilding liquor, or the *deadening* may be given by applying a solution of the nitrate to the *newly gilded* surface, and then expelling the mercury by heat.

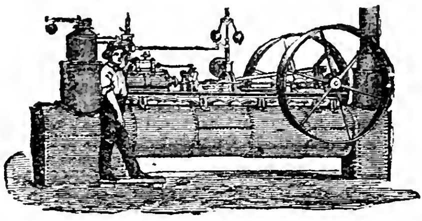
SPOT GILDING, or gilding in spots, producing a very fine appearance, is done by putting a thin coat of oil on those parts of the metal where you do not wish the gilding to appear, the gold will then be deposited in those spots only where there is no oil, and the oil is easily removed when the job is finished.

WATCHMAKERS' OIL.—Put thin sheet lead into olive oil in a bottle, expose it to the sun for a few weeks, and pour off the clear.

SOLUTION FOR DIPPING STEEL ARTICLES, PREVIOUSLY TO ELECTRO-PLATING.—Nitrate of silver, 1 part; nitrate of mercury, 1 part; nitric acid (sp. gr., 1.384), 4 parts; water, 120 parts. *For copper articles.*—Sulphuric acid, 64 parts; water, 64 parts; nitric acid, 32 parts; muriatic acid, 1 part; mix. The article, free from grease, is dipped in the pickle for a second or two.

ARRANGEMENT OF LAPIDARIES CUTTING PLATES.—1. Soft iron (very thin) with diamond dust in oil. 2. Pewter, with coarse emery and water. 3. Pewter, with fine emery and water. 4. Wood with sand and water. 5. Pewter with rotten-stone and water. 6. Leather with putty powder slightly wet.

POLISHING DIAMONDS.—The plan in use at all the large diamond cutters is simply a cast iron disc of good metal, with a vertical spindle run through its centre, balanced, and turned, and faced true in a lathe. The disc revolves at about 1000 revolutions per minute. With a little diamond dust and oil, the stone is set in a small brass cup filled with common soft solder; it is then screwed up in the clamps and applied to the skive till the facets is formed.



RECEIPTS FOR MACHINISTS, ENGINEERS, MILLOWNERS, BLACKSMITHS, LOCOMOTIVE BUILDERS AND METAL WORKERS OF EVERY KIND.

INSTRUCTIONS TO ENGINEERS—*Getting up Steam.*—Before lighting the fire in the morning, raise your safety valve, brushing away all the ashes and dust which may impair its free action, and if it leaks steam grind it on its seat with fine emery or grindstone grit. Valves with vibratory stems are safer than those with rigid stems, as they are not so liable to bind by the lever and weight getting out of true. To guard against loss by leakage and evaporation, leave the water up to the third guage at night and keep it up to the second gauge during working hours. Clean all ashes and cinders from the furnace and ash pit, and spread a layer of two or three inches of coal over the grate bars; pile on plenty of shavings over the coal, with dry sawdust, split wood, &c., then start your fire. Keep the fire even and regular over the grate bars, about 5 inches thick with soft coal, and about 3 inches with anthracite, and always avoid excessive firing. Moderate charges or firings at intervals of 15 to 20 minutes give the best results. In getting up steam from *cold* water the fire should be raised gradually, to avoid damaging the boiler by unequal expansion of the iron. Do not keep the damper and furnace door open at the same time, as the extreme draught expels the heat from the furnace into the chimney, and the cold air entering through the door induces a damaging contraction of the boiler plates wherever it strikes. The current of air enters the ash pit with a velocity of 12 feet per second, and every 100 lbs. coal requires about 15.524 cubic feet for its combustion. With *wood* for fuel, the area of grate surface should be 1.25 to 1.4 that for coal. Volume of furnace for *coal* burning should be from 2.75, to 3 cubic feet for every square foot of its grate surface, for *wood* 4.6 to 5 cubic feet. The use of the pyrometer has satisfactorily established the following facts. 1st. That the admission of a certain quantity of air behind the bridge developes a greater amount of heat for raising steam by assisting combustion and consuming the smoke, the existence of smoke being always a sure sign of waste. 2. A regular and continuous supply of air to the furnace increases its heating powers 33⅓ per cent. 3. The supply of air may enter behind the bridge, through the bars, or through the furnace doors, as long as it is properly regulated. 4. The supply of air may vary with the nature of the fuel; light burning coal requiring less air than caking coal, because the latter becomes a compact mass in the furnace, excluding the air from the bars, while the latter is the reverse. 5. For perfect combustion a high temperature is necessary. In all cases see that the bars are well covered and the fuel kept from caking. Knock away the clinkers as soon as formed, keeping the spaces open between the bars. Regulate the supply of air either by the dampers, ashpit, furnace doors, or by an orifice behind the bridge. A jet of steam from a pipe placed across the top of, and inside the door, will greatly assist in consuming the smoke and intensifying the heat, by yielding up its oxygen and hydrogen.

If steam commences to blow off at the safety valve while the engine is at rest, start your pump or injector to create a circulation, cover or bank your fire with a charge of ashes or fresh coal to absorb the heat, and allow the steam to have free egress through the safety valve. If by neglect the water gets very low, and the boiler dangerously hot, the fire should either be drawn, or drenched with water. Should the fire be very hot and the water supply temporarily cut off, stop the engine and cover the fire quite thickly with fresh fuel to absorb the heat, keeping the usual allowance of water in the boiler until the supply is renewed. Boilers should be blown out every 2 or 3 weeks, or as often as mud appears in the water, but never until after the fire has been drawn at least one hour, and the damper closed, otherwise the empty boiler might be damaged by the heat. Never fill a *hot* boiler with *cold* water, as the sudden contraction many times repeated will eventually cause it to leak. Never blow out a boiler with a higher pressure than 50 lbs. to the square inch, as steam at a high pressure indicates a high temperature in the iron, which under careful management should always be let down gradually. Previous to filling a boiler raise the valve to permit the free egress of the air which might otherwise do manifold damage.

Use every possible precaution against using foul water as it induces foaming in the boiler; soapy or oily substances and an insufficiency of steam room have a like effect, causing the boiler to burn on the spots where the water is lifted from it, and the glass gauges to indicate falsely, besides damaging the cylinder by priming, carrying mud, grit, water and slush into it through the pipe, and rendering the cylinder heads liable to be knocked out. Steam from pure water at 212° Fahr. supports a 30 inch column of mercury. Steam from sea, or impure water at the same temperature, will support only 22 inches.

Pure soft water derived from lakes and large streams, rain water from cisterns, reservoirs, &c., and springs *outside of limestone districts*, is the best for steam purposes. Water from wells and springs *in limestone districts* and small streams, hold in solution large quantities of chloride of sodium, carbonate of lime, sulphate of lime, &c., besides quantities of vegetable matter in suspension. The carbonic acid in the water, which holds the carbonate of lime, &c., in solution, being driven off by boiling, the latter is precipitated and forms an incrustation which adheres with obstinate tenacity to the boiler plates. By continual accretion the deposit of scale becomes thicker and thicker, and being a non-conductor of heat it requires 60 per cent. more fuel to raise the water to any given temperature when the scale is $\frac{1}{4}$ of an inch thick; the conducting power of scale compared with that of iron being as 1 to 37. The red scale formed from water impregnated with salts of iron, derived from percolation through iron ore, is still more mischievous and destructive to steam boilers. In no way can the evil be completely averted except by boiling the water to drive off the carbonic acid, but this is sometimes impracticable, although many feed water heaters are in successful operation. A list of scale preventives can be found in another part of this work.

In tubular boilers, the hand holes should be opened frequently and all sediment removed from over the fire; keep the sheets, flues, tubes, gauge cocks, glass gauges and connections well swept and perfectly clean, and the boiler and engine-room in neat condition. Keep a sharp look out for leaks, and repair them if possible without delay, and allow no water to come in contact with the exterior of the boiler under any circumstances. Examine and repair every blister as soon as it appears, and make frequent and thorough examinations of the boiler with a small steel hammer.

In case of foaming, close the throttle, and keep closed long enough to show true level of water. If the water level is right, feeding and blowing will generally stop the trouble. With muddy water it is a safe rule to blow out 6 or 8 inches every day. If foaming is violent from dirty water, or change from salt to fresh, or from fresh to salt, in addition to following the above directions, check draught, and cover the fires with ashes or fresh fuel.

Great watchfulness is necessary when steam is raised, the safety valve fixed, the fire strong, and the engine at rest. In every case there is a rapid and dangerous absorption of heat, the temperature, latent and sensible heat included, often rising to 1200° Fahr. Frequently it is but the work of an instant to convert the latent into sensible heat, thus generating an irresistible force which bursts the boiler and destroys life and property. The destruction generally coming at the moment of starting the engine, the opening of the valve inducing a commotion in the water, which flashes into steam the instant it touches the heated plates. Steam has been known to rise from a pressure of 32 lbs. to the square inch to 90 lbs. to the square inch, in the short space of *seven* minutes, with the engine at rest. It ought to quicken the vigilance of every engineer to know that the explosive energy in each and every cubic foot of water in his boiler at 60 lbs. pressure, is equal to that contained in 1 lb. of gunpowder.

From avaricious motives it has become quite common to discharge, or to decline to employ, qualified and careful engineers. Incompetent men are employed because their labor costs a few dollars less than that of the former. This is too much of a bad thing to pass over without notice. Employ good skilful men in the management of steam power, or employ none at all, and pay them decent wages. If an oversight takes place, and the best and most careful men are liable to make mistakes, never scold, reprimand, or exact service during dangerous emergencies, as in the event of lost water in the boiler. In no case risk life, limb, or property, and do not let the consideration of saving a few dollars debar you from securing intelligent assistants. The Turkish mode of driving business on a late occasion was to discharge the English engineers who brought out the war vessels which were built in England, and supply the vacancies by installing cheap green hands. After getting up steam the new "Chief" proceeded to start the engines. A lift at a crank produced no results, a pull at a lever was equally useless. At length the illustrious official espied a bright brass cock, and thinking he had got hold of a sure thing this time, proceeded to give it a twist, when he was suddenly saluted with a jet of steam full in the face, which swept the "engineer" and his assistants out of the engine room, into the fire room down stairs. So much for cheap labor and the consequent results.

Duties to the Engine when under steam.—Before starting the engine, warm the cylinder by admitting steam so as to slowly move the piston back and forth, letting the condensed water flow from the drip-cocks, which should be left open all night for this purpose; especially should this be done during cold and frosty weather, during which time all pipes and connections should have extra protection. The minimum speed of the piston should be 240 ft. per minute, and the maximum speed 700 ft. in any engine. The most economical steam pressure is from 80 to 90 lbs. to the square inch, on the piston of any high pressure steam engine. To attain this it is necessary that the boiler pressure should be considerably higher, for there is a loss of at least 30 per cent., arising from the irregularity of the steam pipes and steam ports, by radiation of heat, by improper packing, by friction of valve, by the effect of the governor and by atmospheric pressure, which of itself entails a loss of 15 lbs. per square inch on the piston. The lower the steam pressure per square inch on the piston, the greater the loss of power from the atmospheric pressure; for instance, a steam pressure of 30 lbs. per square inch on the piston, leaves only 15 lbs per square inch effective pressure for actual work, the other 15 lbs. being required to overcome atmospheric pressure.

In tightening piston rod packing, screw no tighter than merely to prevent leakage; any more consumes power by friction, and will destroy the packing. Spring packing in the cylinder should be adjusted with great care, always kept up to its place, and never allowed to become loose, or leakage will ensue, causing loss of power. On the other hand, if it is set too tight it will cut the cylinder, and loss will result from friction. Keep your packing free from grit, sand, filings, &c., as such substances will cut the cylinder and flute the rod. Remove all old packing before inserting new, observing to cut the packing into proper lengths, and breaking joints by placing each joint on opposite sides of the stuffing box. Keep the governor clean, easy in its movements, and avoid excessive tight packing around the spindle. Use good oils. Avoid waste in the use of oil, as too great profusion generates gum and dirt. Use it with judgment in combination with concentrated ley when it is required to remove gum or dirt from these or other parts of the machinery. Do not lubricate the cylinder until after starting the engine, and closing the drip cocks. If you have occasion to separate a rust joint, or any crank from a shaft on which it has been shrunk, the simplest plan is to apply heat, when the bodies being of different dimensions will expand unequally and separate. Iron when heated expands with irresistible force. Railway contractors know that the heat of the sun on a warm day will cause such an extension of the iron, that the rails, if laid with close joints, will rise with the sleepers from the ballast, and form arches 4 or 5 feet high and 50 or 60 feet in length. In accommodation to this law of expansion, spaces are left between the rails on railway tracks.

The contraction of iron by cold is equally powerful, and has been put to good use in trueing up large bulging buildings by fitting iron girders across them with strong wall plates at each end. Then, by applying gas jets all along the girders they will expand; the screws are then tightened up, and the girders allowed to cool, and the strain of these contractions several times repeated is sufficient to bring the walls to the perpendicular. Again, in hoisting heavy machinery, &c. by means of pulley-blocks, if the ropes stretch and the blocks come together too soon, wet the rope, and the object will be elevated by its contraction without any other force. These hints will be found useful when occasion offers.

In driving the kegs on the crank-pin and cross-head, use a leaden mallet, or interpose a piece of leather, or a sheet of soft metal for protection, if a steel hammer is used.

The piston should be removed every 6 months, and the parts injured by friction, &c. carefully ground, fitted, and if need be turned, trued, and made steam tight. If knocking occurs in the engine it may arise by the crank being ahead of the steam; if so, move the eccentric forward to give more lead on the valve, if caused by too much lead move the eccentric further back, if caused by the exhaust closing too soon, enlarge the exhaust chamber in the valve; if caused by the engine being out of line, or by hard or tight piston rod packing, these faults must be corrected; if caused by lost motion in the jam nuts on the valve, uncover the steam chest and adjust them correctly. It may be that knocking is caused by lost motion in the crank-pin, pillow-blocks, key of the piston in the cross-head, or boxes on the cross-head, if so, tighten the key, or file off the edges of the boxes if they are too tight. Should knocking arise from shoulders becoming worn on the ends of the guides from any cause, replace the guides. Knocking may be caused by insufficient counterboring in the cylinder, causing derangement in the movements of the piston. The remedy for this is to *re-counterbore* the cylinder to the proper depth.

Keep a close watch over the journals of the crank and cross-head, if they are loose in the boxes, or too tight, they will run badly, if tightened too much, they will heat and wear out the brass shoes, if not tight enough there is danger of the keys flying out and breaking the engine.

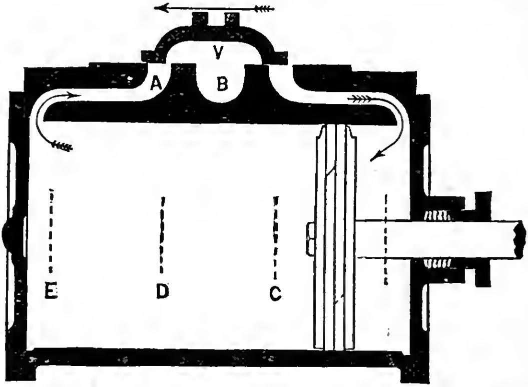
Be sure that your steam gauge indicates truthfully. It ought to tell accurately the *pressure of steam* in the boiler when the water is hotter than 212° Fahr., and indicate the *variation* in the pressure of steam from time to time; but many gauges are much worse than the contrivance used by the colored engineer, who, disdainfully dispensing with a gauge altogether, used to ascertain the critical moment when steam was up, or danger at hand, by clapping his open hand on the outside of the boiler.

STEAM PACKING.—Many varieties of packing are used, such as metallic packing, packing composed of a mixture of duck, paper and tallow in proper proportions, soapstone and loose twisted cotton coils, asbestos, jute, &c. An excellent packing is composed of hemp in long loosely twisted coils, well saturated with melted grease or tallow, with as much pulverized black lead as it will absorb. Packing is always applied with the best effect when the parts of the engine are cold, and its efficiency is promoted by soaking it in beeswax and tallow previous to use.

TO WORK STEAM EXPANSIVELY.—The volume of steam at 15 lbs. pressure to the square inch or atmospheric pressure is 1700 times greater than that of any given quantity of water from which it may be derived. When confined under pressure, as in the cylinder of a steam engine, it is always in the effort to expand itself to the fullest extent, and a vast saving of fuel is effected by cutting off the supply of steam from the piston by means of the main valve, before it reaches the end of its stroke, instead of allowing it to flow during the full length of its stroke.

The most available points at which to cut off steam is ¼, ½ and ¾ of the full travel or stroke of the piston. If steam at 75 lbs. pressure to the square inch is applied to the piston and cut off at half stroke, the average pressure, during the whole stroke, owing to the expansive quality of the steam, would be 63½ lbs., or only 11½ lbs. less than the full pressure, although but half the quantity of steam is used, requiring fully ½ less fuel.

Imagine the diagram to be a cylinder of 3 ft. in length, with steam at 60 lbs. pressure, entering the open port. During the first 4 inches of the travel of the piston the steam port is open, permitting the full pressure of the steam to operate on the piston; but at the twelfth inch marked C, the steam lap on the valve V closes the port. The imprisoned steam will now propel the piston to the end of the stroke, driving out the liberated steam through the port A into the exhaust cavity B, but by the time the piston reaches D, 12 inches



from C, the original pressure of 60 lbs. per square inch will have decreased one-half, or to 30 lbs., and when it reaches E, 24 inches from C, it will have still further decreased to 20 lbs. Average pressure 39 lbs. Two-thirds of the stroke have thus been made without any supply of steam from the boiler, and forms the saving due to working the steam expansively. The lack of this contrivance is the true reason why some engines use more fuel and steam, than others of the same capacity and power. It has been stated that the economy of the Corliss cut-off is such that it requires only 2 tons of coal instead of 6¾ tons used by other engines of the same power, but the great trouble with that engine is the liability of the complex and costly valve-gear to get out of order, entailing difficult and expensive repairs.

TABLE.—*Showing the average Pressure of Steam on the cylinder when cut off at ¼, ½ and ¾ of the stroke or travel of the Piston*, commencing with 25 lbs, advancing by 5 lbs. and ending at 100 lbs.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
¼	15	17¾	20¾	23¾	26¾	29¾	32¾	35¾	38¾	41¾	44¾	47¾	50¾	53¾	56¾	59¾
½	21	25¼	29½	33¾	38	42¼	46½	50¾	55	59¼	63½	67¾	72	76¼	80½	84¾
¾	24	28¾	33½	38½	43¼	48¼	53	57¾	62½	67½	72¼	77¼	82	87	91¾	96½

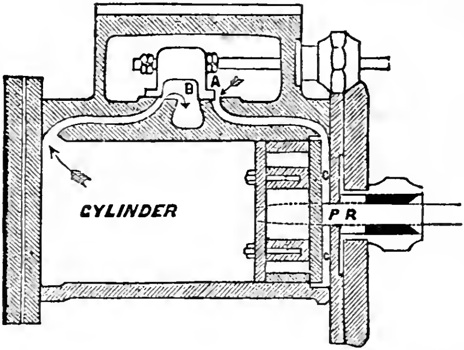
To realize the best results from steam, keep the cylinders, pipes, &c., well covered with good non-conductors. Various materials are used, such as common felting, asbestos felting, hair, old wool, tow or hemp carpets cut up into strips of the proper size and smeared over with a substantial composition of mortar, teased hair, &c. before applying to the pipes. Cover the whole with coarse canvas, finishing with several coats of white lead over the canvas. Some cover boilers with a thickish composition of clay, intermixed with grey or brown paper for a bind, to prevent cracking, &c., the paper being worked up into shreds along with the water and clay. Others use a mixture of mortar, teased hair, &c. Some use asbestos, wood ashes, &c., see "composition for covering boilers." Cylinders should be well clothed and jacketed, and cased with wood or polished metal, the latter when kept constantly bright being a most powerful protection against loss of heat by radiation. Among metals, silver is the best absorbent and conductor of heat. If we call its power of conduction 100, that of copper is 74, gold 53, iron 12, lead 9, bismuth 2.

To Set the valve of an Engine.—Place the crank at the end of its stroke, and give the valve the proper amount of lead; reverse the crank to the other end of its stroke, and if the valve has the corresponding amount of lead it is correctly set. The preponderance at either end, if any exists, must be equally divided. Be careful in adjusting the nuts attaching the valve to the rod, that they do not impinge against the valves, preventing it from seating true. In adjusting the slide valve to cut off at any point of the travel of the piston, the eccentric should be moved forward in proportion to the amount of lap given to the valve, without any reference to the expansive working of steam, the valve must open at the same point of travel of the piston.

To find the Stroke of the Valve.—Place the crank on the dead centre, and make a mark on the valve-rod, then reverse the movement to the opposite end and make another mark. The distance between the two marks constitutes the stroke of the valve. The stroke of the valve may be increased as the bearing in the rocker-arm that carries the eccentric hook is lengthened; shorten the same and the stroke is lessened.

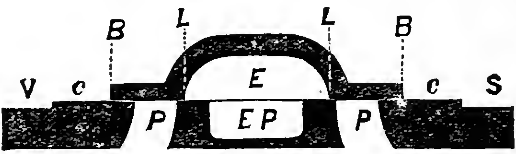
To find the Throw of the Eccentric.—Measure the eccentric on the heaviest side, then measure on the opposite or light side. The difference between the two measurements will be the throw of the eccentric.

Lead on the Slide Valve.—The lead of a valve is the width of opening which the valve allows to the steam port when the piston is at the end of its stroke, as shown on the diagram at A, which represents *outside lead*, *inside lead*, being shown into the exhaust at B, which ought to be double the amount of outside lead in order to liberate the exhaust easily, and thus reduce or prevent back pressure. Care should be taken not to liberate the exhaust too soon, as it will greatly curtail the power of the engine, especially if the labor is heavy and the speed slow, as in engines with heavy trains on up grades, &c. To ascertain whether the exhaust opens at the right time or not, uncover the steam chest; then uncouple the valve from the valve rod, place a short batten of wood lengthways on the exhaust port; then with a scratch awl lay off lines on the valve seat, on each side of the exhaust port, that will appear above the valve. Next lay the batten on the face of the valve and lay off corresponding lines on the exhaust chamber that will show on the edges of the valve, now replace the valve on its seat, and give 1-32 of an inch lead, and if the lines described on the face of the valve are past the lines described on the valve seat 1-16 of an inch, the exhaust opens at the proper time, if it does not the exhaust chamber in the valve should be enlarged to the right size.



Lead is given to a valve to enable the steam to act as a *cushion* on the piston, by admitting the steam to it previous to the end of its stroke, in order to cause it to reverse its motion easily, without jar or noise, for it is not allowed to touch the top and bottom of cylinder for fear of knocking them out. The space between the top and bottom of the cylinder and the piston, when the latter is at the end of its stroke, is called the *clearance*, shown at C C on diagram. The term clearance is also used to designate the capacity of the connecting steam ports and passages. It is necessary to guard against too much cushion as it greatly impairs the powers of the engine, causing violent thumping or knocking, and sometimes a serious breakdown. One-eighth of an inch lead is sufficient for an ordinary freight and 1-16 is sufficient for passenger locomotives, the difference being on account of the greater speed of the latter.

LAP ON THE SLIDE VALVE.—The steam lap on the slide valve is the amount by which it extends over the extreme width of the



cylinder ports, as illustrated in the diagram, the distance between the dotted lines B B LL, and the sides of the ports P P, being in each case the lap, the lines B B indicating the outside lap, and L L denoting the inside lap, E P exhaust port, E exhaust cavity in valve. V S valve seat, C C valve face. The emission of steam into the cylinder is regulated by the outer and inner edges of the valve and of the steam ports. When the valve is so contrived that at $\frac{1}{2}$ stroke the faces of the valve do not cover the steam ports internally, the space by which each face comes short of the inner edges of the ports is known as inside clearance. By means of the steam lap given to the valve the engine is enabled to use its steam expansively, as elsewhere explained.

TABLE.—*Showing the amount of Lap on the Slide valve at various points of cut off; also, the travel of the valve in inches.*

Travel or stroke of the Piston where steam is cut off.

Travel of the Valve in inches.	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{5}{12}$	$\frac{1}{2}$	$\frac{7}{12}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{10}{12}$
	The correct amount of Lap.							
2	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{11}{16}$	$\frac{5}{8}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{3}{8}$
$2\frac{1}{2}$	$1\frac{1}{16}$	1	$\frac{7}{8}$	$\frac{13}{16}$	$\frac{11}{16}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{16}$
3	$1\frac{1}{4}$	$1\frac{3}{16}$	$1\frac{1}{8}$	1	$\frac{15}{16}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{9}{16}$
$3\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{5}{16}$	$1\frac{3}{16}$	$1\frac{1}{8}$	$1\frac{1}{16}$	1	$\frac{7}{8}$	$\frac{3}{4}$
4	$1\frac{3}{4}$	$1\frac{9}{16}$	$1\frac{7}{16}$	$1\frac{5}{16}$	$1\frac{1}{4}$	$1\frac{1}{16}$	1	$\frac{13}{16}$
$4\frac{1}{2}$	2	$1\frac{13}{16}$	$1\frac{9}{16}$	$1\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{1}{8}$	$\frac{7}{8}$
5	$2\frac{1}{8}$	2	$1\frac{13}{16}$	$1\frac{9}{16}$	$1\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{1}{4}$	1
$5\frac{1}{2}$	$2\frac{5}{16}$	$2\frac{3}{16}$	2	$1\frac{13}{16}$	$1\frac{5}{8}$	$1\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{1}{8}$
6	$2\frac{1}{2}$	$2\frac{7}{16}$	$2\frac{3}{16}$	2	$1\frac{13}{16}$	$1\frac{5}{8}$	$1\frac{1}{2}$	$1\frac{3}{16}$
$6\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{9}{16}$	$2\frac{7}{16}$	$2\frac{3}{32}$	2	$1\frac{13}{16}$	$1\frac{5}{8}$	$1\frac{1}{4}$
7	3	$2\frac{11}{16}$	$2\frac{9}{16}$	$2\frac{3}{8}$	$2\frac{3}{33}$	2	$1\frac{3}{4}$	$1\frac{7}{8}$
$7\frac{1}{2}$	$3\frac{3}{16}$	3	$2\frac{11}{16}$	$2\frac{1}{2}$	$2\frac{3}{8}$	$2\frac{3}{32}$	$1\frac{7}{8}$	$1\frac{1}{2}$
8	$3\frac{5}{16}$	$3\frac{3}{16}$	3	$2\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{3}{8}$	2	$1\frac{5}{8}$
$8\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{5}{16}$	$3\frac{3}{16}$	$2\frac{13}{16}$	$2\frac{11}{16}$	$2\frac{1}{2}$	$2\frac{1}{8}$	$1\frac{3}{4}$
9	$3\frac{13}{16}$	$3\frac{5}{8}$	$3\frac{5}{16}$	3	$2\frac{13}{16}$	$2\frac{11}{16}$	$2\frac{1}{4}$	$1\frac{7}{8}$
$9\frac{1}{2}$	4	$3\frac{13}{16}$	$3\frac{5}{8}$	$3\frac{3}{16}$	3	$2\frac{13}{16}$	$2\frac{3}{8}$	2
10	$4\frac{1}{4}$	4	$3\frac{13}{16}$	$3\frac{5}{16}$	$3\frac{3}{16}$	3	$2\frac{1}{2}$	$2\frac{1}{16}$
$10\frac{1}{2}$	$4\frac{7}{16}$	$4\frac{1}{4}$	4	$3\frac{1}{2}$	$3\frac{5}{16}$	$3\frac{1}{8}$	$2\frac{5}{8}$	$2\frac{3}{16}$
11	$4\frac{9}{16}$	$4\frac{7}{16}$	$4\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{1}{2}$	$3\frac{3}{16}$	$2\frac{3}{4}$	$2\frac{1}{4}$
$11\frac{1}{2}$	$4\frac{13}{16}$	$4\frac{9}{16}$	$4\frac{7}{16}$	$3\frac{7}{8}$	$3\frac{5}{8}$	$3\frac{3}{8}$	$2\frac{7}{8}$	$2\frac{3}{8}$
12	5	$4\frac{13}{16}$	$4\frac{9}{16}$	$4\frac{1}{8}$	4	$3\frac{5}{8}$	3	$2\frac{1}{2}$

GIFFARD'S INJECTOR, as made by Wm. Sellers & Co., is a novel and reliable invention for feeding boilers, economizing the heat and dispensing with pumps. By a simple and well known combination of 2 pipes, the one conveying steam, the other water, both terminating in a third pipe or tube, a jet of steam from the boiler escaping through an orifice, of say, 1 inch in diameter, with 60 lbs. pressure, is condensed in perhaps 12 times its weight of water, which it drives through the third tube, causing it to enter the boiler through an orifice much smaller than the one by which it escaped. The momentum of the steam impels the water with great force and imparts all its heat to the water during transmission. The following table shows the maximum temperature of the feed-water admissible during different pressures of steam.

Pressure per square inch.	10	20	30	40	50	100
Temperature of feed, Fahr.	148°	130°	130°	124°	120°	110°

ON THE FORM, STRENGTH &C. OF STEAM BOILERS.—Regarding the *form* of boilers, it is now an ascertained fact that the maximum strength is obtained by adopting the cylindrical or circular form, the haycock, hemispherical, and wagon-shaped boilers, so general at one time, have now deservedly gone almost out of use. Good boiler plate is capable of withstanding a tensile strain of 50,000 lbs. or 60,000 lbs. on every square inch of section: but it will only bear a third of this strain without permanent derangement of structure, and 40,000 lbs., or 30,000 lbs. even, upon the square inch, is a preferable proportion. It has been found that the tenacity of boiler-plate increases with the temperature up to 570°, at which point the tenacity commences to diminish. At 32° cohesive force of a square inch of section was 56,000 lbs.; at 570° it was 66,500 lbs.: at 720°, 55,000 lbs.; at 1050°, 32,000 lbs.; at 1240°, 22,000 lbs.; and at 1317°, 9,000 lbs. Strips of iron, when cut in the direction of the fibre, were found by experiment to be 6 per cent. stronger than when cut across the grain. The strength of riveted joints has also been demonstrated by tearing them directly asunder. In two different kinds of joints, double and single riveted, the strength was found to be, in the ratio of the plate, as the numbers 100, 70, and 56.

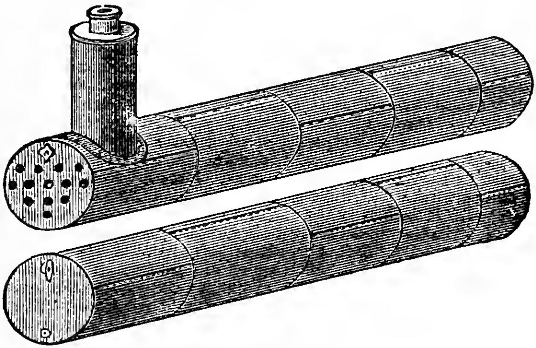
Assuming the strength of the plate to be.................. 100
The strength of a double riveted joint would be, after allowing for the adhesion of the surfaces of the plate......... 70
And the strength of a single riveted joint................. 56

These figures, representing the relative strengths of plates and joints in vessels required to be steam and water tight, may be safely relied on as perfectly correct. The accidental overheating of a boiler has been found to reduce the ultimate or maximum strength of the plates from 65,000 to 45,000 lbs. per square inch of section. Every description of boiler used in manufactories or on board of steamers should be constructed to a bursting pressure of 400 to 500 lbs. on the square inch; and locomotive engine boilers, which are subject to much harder duty, to a bursting pressure of 600 to 700 lbs. Such boilers are usually worked at 90 to 110 lbs. on the inch, but are frequently worked up to a pressure of 120, and, when rising steep grades sometimes even as high as 200 lbs. to the square inch. In a boiler subject to such an enormous working pressure, it requires the utmost care and attention on the part of the engineer to satisfy himself that the flat surfaces of the fire box are capable of resisting that pressure, and that every part of the boiler is so nearly balanced in its powers of resistance as that, when one part is at the point of rupture, every other part is at the point of yielding to the same uniform force: for we find that, taking a locomotive boiler of the usual size, even with a pressure of 100 lbs. on the square inch, it retains an expanding force within its interior of nearly 60,000 tons, which is rather increased than diminished at a high speed. To show the strain upon a high-pressure boiler, 30 feet long, 6 feet diameter, having 2 centre flues, each 2 feet 3 inches diameter, working at a pressure of 50 lbs. on the square inch, we have only to multiply the number of the square feet of surface, 1030, exposed to pressure, by 321, and we have the force of 3319 tons, which such a boiler has to sustain. To go farther, and estimate the pressure at 450 lbs. on the square inch, which a well-constructed boiler of this size will bear before it bursts, and we have the enormous force of 29,871, or nearly 30,000 tons, bottled up within a cylinder 30 feet long and 6 feet diameter. Boilers in actual use should be tested at least once a year, by forcing water into them by the hand feed-pump, until the safety-valve is lifted, which should be loaded with at least twice the working pressure for the occasion. If a boiler will not stand this pressure it is not safe, and either its strength should be increased or the working pressure should be diminished. Internal flues, such as contain the furnace in the interior of the boiler, should be kept as near as possible to the cylindrical form; and, as wrought iron will yield to a force tending to crush it about one-half of what would tear it asunder, the flues should in no case exceed one-half the diameter of the boiler, with the same thickness of plates they may be considered equally safe with the other parts. The force of compression being so different from that of tension, greater safety would be ensured if the diameter of the internal flues were in the ratio 1 to 2½ instead of 1 to 3 of the diameter of the boiler. As regards the relative size and strength of flues, it may be stated that a circular flue 18 inches in diameter will resist double the pressure of one 3 feet in diameter. Mill owners, with plenty of room and a limited experience with steam power, would do well to dispense with boilers containing many flues, the expense is greater and the durability less than where there is one or two only. The foam caused by a large number of flues is apt to deceive an inexperienced engineer, causing him to believe that there is plenty of water in the boiler when he tries the gauge cock when there is but very little, often causing an explosion. Some mill-owners insert a fusible plug in the crown of the furnace to indicate danger from low water. As common lead melts at 620°, a rivet of this metal, 1 inch in diameter, inserted immediately over the fire place, will give due notice, so that relief may be obtained before the internal pressure of the steam exceeds that of the resisting power of the heated plates. In France, an extensive use is made of fusible metal plates, generally covered by a perforated metallic disc, which protects the alloy of which the plate is composed, and allows it to ooze through as soon as the steam has attained the temperature necessary to insure the fusion of the plate, which varies from 280° to 350°. The reader will find a number of such alloys under the tabular view of alloys and their melting heats, further on. Another method is the bursting plate, fixed in a frame and attached to some convenient part of the upper side of the boiler, of such thickness and ductility as to cause rupture when the pressure exceeds that on the safety valve. But, beyond all question, constant use should be made on all boilers of a good and reliable system of steam gauges, glass tubes, gauge cocks, safety valves, &c. By means of the glass tubes affixed to the fronts of the boilers, the height of the water within the boiler is indicated at once, for the water will stand at the same height in the tube that it stands in the boiler, communication being established with the water below and the steam above, by means of stop cocks.

When dry steam is an object, the use of the steam dome on boilers is strongly recommended; opinions are divided as to the real value of mud drums, some reason strongly in their favor while others discard them entirely; but there can be no question as to the true economy of heating the feed water previous to emission into the boiler; it should always be done when practicable to do so, by means of some one of the many contrivances for that purpose which are now in the market. Regarding the *power* of boilers, it may be stated that a boiler 30 feet long and 3 feet in diameter, will afford $30 \times 3 \times 3.14 \times 2 — 141.30$ square feet of surface, or steam for 14 horse-power, if 10 feet are assumed for one horse-power. Two short boilers are preferable to one long one, on account of having more fire surface,—it being always necessary to have as much fire surface as possible to make the best use of the fuel—as the hotter the surface is kept, the less fuel it takes to do the same amount of work. When there is a large furnace it gives the fireman a better chance to keep the steam regular, for when clearing out one part of the furnace, he can keep a hot fire in the other. For each horse-power of the engine there ought to be at least one square foot of grate, and three feet would be better. In setting a boiler, arrangement should be made to carry on combustion with the greatest possible heat. This requires good non-conductors of heat, such as brick, with which to surround the fire. If these bricks are of a white color, the combustion is more perfect than if of a dark color. The roof, as well as the sides, of the furnace should be of white fire-brick. The bars of the furnace should be 18 or 20 inches below the boiler or crown of the furnace. They should slope downward toward the back part, about half an inch to the foot. A crack in a boiler plate may be closed by boring holes in the direction of the crack and inserting rivets with large heads, so as to cover up the imperfection. If the top of the furnace be bent down, from the boiler having been accidentally allowed to get short of water, it may be set up again by a screw-jack, a fire of wood having been previously made beneath the injured plate; but it will in general be nearly as expeditious a course to remove the plate and introduce a new one, and the result will be more satisfactory. There is one object that requires very particular attention, and which must be of a certain size to produce the best effect, and that is the flue leading from the boiler to the chimney, as well as the size and elevation of the chimney itself. Every chimney should be built several feet above the mill house, so that there is no obstruction to break the air from the top of the chimney. In England a factory chimney suitable for a 20 horse-power boiler is commonly made about 20 inches square inside, and 80 feet high, and these dimensions are correct for consumption of 15 lbs. coal per horse-power per hour, a common consumption for factory engines. In the Dominion of Canada and the United States, chimneys of sheet iron, from 30 to 50 feet high, are in quite common use by owners of saw, and other mills, and they seem to answer every requirement.

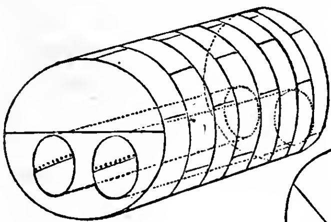
PROPORTION OF STEAM BOILERS.—*Cylinder Boilers.* The length should never exceed 7 times its diameter; the unit for it is 12 sq. ft. of heating surface, and $\frac{3}{4}$ of a square foot of grate surface for each horse-power; a fair evaporation is 6 lbs. of water for 1 lb of coal.

Tubular Boiler.

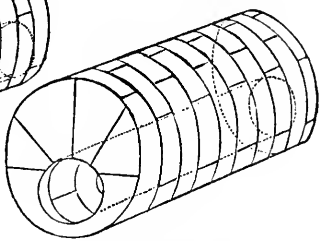


Cylinder Boiler.

Very long cylinder boilers should have a central support. All boilers should have an inclination of 1 inch in every 20 ft. towards the blow-off end. *Tubular Boilers*—Length 4 times the diameter. Evapora-



Lancashire Boiler.



Cornish Boiler.

tion about 9 lbs. of water to 1 lb. of coal. Heating surface 15 square ft. and grate surface, $\frac{1}{2}$ square ft. per horse-power. *Flue Boilers* require from 14 to 15 square ft. of heating surface, and $\frac{1}{2}$ square ft. of grate per horse-power. Evaporation 7 lbs. water to every lb. of coal. Length of flue boilers should not exceed 5 times their diameter, diameter of flues not more than 12 to 14 in.; if made larger, use heavier iron than that used in the shell of boiler, and construct with butt joints. *Cornish and Lancashire Boilers.* In England, Cornish boilers are known as those furnished with one internal flue, and are usually of great capacity and power, having plenty of steam room. Lancashire boilers have 2 flues. *Return Flue Boiler.* When a boiler is fitted with a flue curving round at the rear, and returning to the front, it is called a return flue boiler. See diagrams of boilers.

BOILER SHELLS.—For a boiler of 48 in. in diameter, to carry 90 lbs. per square in. pressure, use ¼ in. to ⅜ in. good plates. Wrought iron heads for ditto, ⅜ to ¾ inch. *Tube Sheets and Crown Sheets for ditto.* ⅜ to ¾ inch. *Rivets* on boilers up to 42 in. diam. and ⅜ in. iron, should be ⅝ in. for curvilinear, and ⅝ in. for longitudinal rivets for *single riveted work.* On *double riveted* work, ⅝ in. rivets will answer for both kinds of seams. For 5-16 iron down to 3-16 in. smaller rivets will answer. Drilled rivet holes are preferable to punched. It is highly beneficial to *heat* the boiler plates before rolling to form the shell of the boiler. The fibre of the iron should always run *around* the boiler, never across it. A *steel shell boiler* 4 ft. in diam. and ¼ in. thick, is as strong as an iron boiler of same diam. and ⅜ in. thick, and will evaporate 25 per cent. more water, besides being more free from incrustation and corrosion. The working pressure of boilers should be 5 times less than the bursting pressure.

COMPOSITION FOR COVERING BOILERS, &c.—Road scrapings, free from stones, 2 parts; cow manure, gathered from the pasture, 1 part; mix thoroughly, and add to each barrowful of the mixture 6 lbs of fire clay; ½ lb. of flax shoves or chopped hay, and 4 ozs. teased hair. It must be well mixed and chopped; then add as much water as will bring it to the consistency of mortar,—the more it is worked the tougher it is. It may either be put on with the trowel or daubed on with the hand, the first coat about 1 inch thick. When thoroughly dry, another the same thickness, and so on, three inches is quite enough, but the more the better. Let each coat be scored like plaster, to prevent cracks, the last coat light and smooth, so as to receive paint, whitewash, &c. The boiler, or pipes, must first be brushed with a thin wash of the mixture to insure a catch.

TO PREVENT INCRUSTATION IN BOILERS.—1. Charcoal has a great affinity for any thing that causes scale or incrustation in boilers. That made from hard wood is the best, broken in lumps of ¼ to ½ inch in size, and the dust sifted out. Two bushels of this will generally protect a boiler of 30 horse-power for 3 weeks when running, after which the old coal should be removed and fresh coal used. 2. Throw into the tank or reservoir from which your boiler is fed, a quantity of rough bark, in the piece, such as tanners use, sufficient to turn the water of a brown color; if you have no tank, put into the boiler from a half to a bushel of ground bark when you blow off, repeat every month, using only half the quantity after the first time. 3. Add a very small quantity of muriate of ammonia, about 1 lb. for every 1,500 or 2,000 gals. of water evaporated. It will have the effect of softening and disintegrating the carbonate of lime and other impurities deposited by the water during the evaporation. 4. Potatoes and some other vegetable substances introduced into the boiler are most effectual in preventing incrustation, and animal substances, such as refuse skins, are still more so. 5. An English firm put oak sawdust into their boiler in order to stop a leak, and to their surprise it also resulted in preventing incrustation. I should say if oak sawdust could prevent scale in boilers, that there is no visible reason why hemlock and various other kinds of sawdust will not do the same thing. 6. Cows' feet, with the shanks attached, are strongly recommended as a preventive of scale. Two in a large boiler is amply sufficient, and those who wish to do business economically, can get their oil for lubricating purposes cheaply by boiling the feet and shanks for a few hours in a large kettle, setting it aside to cool, and then skimming off the oil from the surface of the water, using the feet for the boiler afterwards. If you wish to get rid of the hair on the shanks, you can get rid of that by using lime, &c., as done by tanners. 7. Sal soda, 40 lbs., gum catechu, 5 lbs., sal ammoniac, 5 lbs., is strongly recommended by an experienced person, for removing boiler scale; 1 lb. of the mixture being added to each barrel of water in the tank; after scale is removed use sal soda alone. By the use of 10 lbs. soda per week, a boiler 26 feet long, and 40 inches in diameter was cleaned from scale equal to a new boiler. 8. A rapid and effectual but not very good plan to scale boilers is to throw in a few wood shavings along the bottom of the boiler and set them on fire; the heat expands the scale more than the shell of the boiler, as the heat cannot reach the latter, the scale is loosened; what remains after this must be removed with a hammer and chisel. 9. Calcareous deposits may be entirely prevented by the use of crude pyroligneous acid combined with tar. It may be either introduced into the boiler or mixed with the feed water in very small quantity; just enough to redden litmous paper; consequently it will never injure the boiler. 10. It is on record that the engineer of the French ocean steamer St. Laurent, omitted to remove a bar of zinc when repairing or cleaning out his boilers. On opening them at the end of the voyage, to his great surprise he found that the zinc had disappeared, that his boilers were entirely free from scale, and the boiler plates uninjured.

AVERAGE PROPORTION OF VARIOUS PARTS OF ENGINES.—*Steam Pipe* should be $\frac{1}{4}$ the diameter of cylinder, but varies on large engines. *Exhaust Pipe* should be $\frac{1}{3}$ the diameter of cylinder. *Piston Rod* should be $\frac{1}{8}$ the diameter of cylinder, if of iron, and smaller, if of steel. For high speeds, steel piston rods are the best. *Steam Ports* vary according to speed, fro 1-16 to 1-10 the area of piston. *Safety Valves* should possess an area of $\frac{1}{2}$ square in. of surface for every foot of grate surface, and should be constructed with loose vibratory stems, for the reason that they are not so liable to get out of order as those with rigid stems.

RULE FOR SIZE OF CYLINDER.—The requisite diameter of cylinder for a 25-horse beam engine is 28 inches, and about 5 feet stroke. The nominal horse-power of any sized cylinder can be found by the following formulæ:—For low pressure or beam engines, divide the area of cylinder by 25, which will give the number of horse-power. For high pressure horizontal engines, divide the area of cylinder's diameter by 12·5, which will give the number of horse-power, including all friction.

STROKE OF ENGINES.—The stroke of an engine varies according to circumstances, which the designer must take into consideration; but the general rule is to make the stroke about twice the diameter of the cylinder. The diameter of the fly-wheel should be about 4 times the stroke of the engine, and the rim should weigh about 3 cwt. per horse-power.

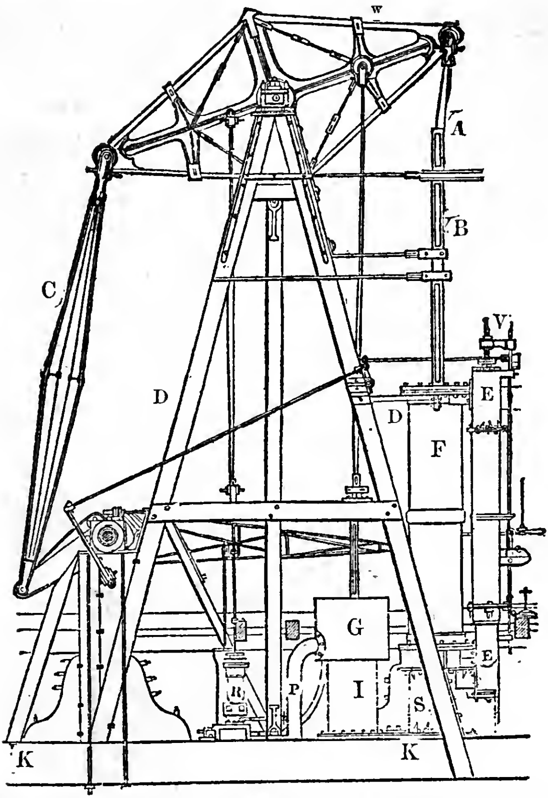
RULE TO FIND THE HORSE-POWER OF STATIONARY ENGINES.—Multiply the area of the piston by the average pressure in lbs. per square inch. Multiply this product by the travel of the piston in feet per minute; divide by 33,000, this will give the horse-power.—*Roper.*

EXAMPLE:

Diameter of cylinder	12
	12
	144
	7854
Area of piston .	113,0976
Pressure, 70 ; Average pressure, 50	50
	5654.880
Travel of piston in feet per min.	300
	33,000)1696464.000
	51. horse-power.

BALANCE WHEELS.—Every balance wheel should be speeded up so as to run twice or three times as fast as the crank shaft it is intended to balance. When a balance wheel is applied in this way it makes the machine run a great deal more steadily, for, when the balance wheel is geared into the crank shaft, and runs two or three times faster than the crank shaft, it forms a power of itself when going over the centre, which propels the crank shaft until it reaches the quarter, where it again takes its power from the machine. Although it takes an additional shaft and gears to apply a balance wheel in this way, the saving of metal in the balance wheel fully compensates for the extra labor; for, when a balance wheel is speeded three times as fast as the crank shaft, it needs only one third of the metal in it that it would were it not speeded up at all, and if balance wheels were applied in this way generally it would make all engines run far more steadily.

TO REVERSE AN ENGINE.—Make a legible mark on the eccentric near the shaft, make a similar mark on the shaft at the same place. Now place one point of the callipers on the mark made on the shaft, and with the other point ascertain the centre of the shaft on the opposite side, making another mark there also. Next unscrew the eccentric and move it in the direction in which you wish the engine to run, until the mark on the eccentric comes into line with the second mark on the shaft, then screw the eccentric fast and the engine will run the reverse way.



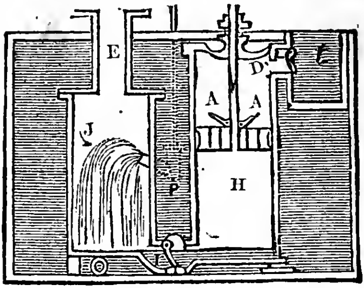
MARINE BEAM ENGINE.—The above cut represents a marine beam engine, being the kind so frequently seen on river, lake, and coasting steamers. The WORKING-BEAM, W, is a massive casting in the form of a cross, surrounded, strengthened, and stayed, in every direction by a powerful wrought-iron strap, forged in one piece, and shaped to conform to the casting, which contains sockets at each extremity fitted to receive the end journals, besides containing intermediate sockets for the main centre and air pump journal, &c., the whole mass resting on the *frame* composed of 4 stout beams of wood, forming 2 triangles as shown at DD in cut. These again rest on massive beams styled keelsons, shown at KK, and are braced and rigidly secured to the vessel and machinery by other powerful timbers, knees, straps, and iron fastenings. The guides are shown at B.

The *main link* is shown at A, the *connecting rod* at C, the *valve stem* at V, and the *cylinder* at F, in a vertical position over the condenser.

The steam cylinder F, is usually a massive casting, annular in form, bored and finished very true for the easy movements of the piston. It rests on a round flanged casting containing the lower steam port, called the *cylinder bottom*, which intervenes between it and the condenser S, and is securely attached to each, by bolts and steam tight rust joints. The elevated end of the cylinder is immovably braced to the framing above. The valve chest is shown at EE, the air pump at I, the hot well at G, the boiler feed pump at R, and the delivery pipe at P.

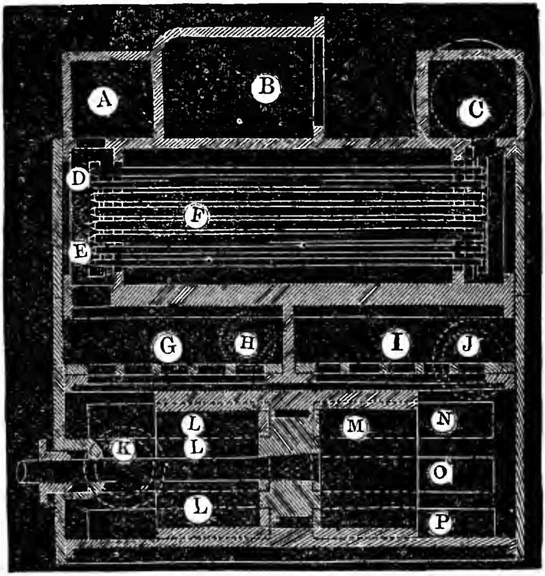
The condenser S, in which the exhaust steam is reduced to a liquid form, is of the same shape and diameter as the cylinder, flanged at both ends, and its contents should be 13–30ths of the space through which the piston moves during one stroke. The wooden frame which sustains the main beam is attached by stout bolts and keys to strong flanges which project from the condenser, the upper part is cast close and the lower end is open and fitted accurately on the bed plate to which it is attached by a rust joint and bolts.

In the method known as "surface condensing" the process is effected by causing the steam to pass through an arrangement of tubes submerged in running cold water; the other method, known as "jet condensing," and by far the cheapest arrangement, consists in bringing the steam in contact with a jet of cold water as shown in the following diagram, where J represents the jet; E, the exhaust pipe, P,



the injection pipe; H, air-pump cylinder; AA, air-pump valves, V, air-pump rod; D, delivery valve; H, hot well.

The next cut represents Sewall's surface condenser, in which the exhaust steam enters at B and is liquefied by contact with the exterior surfaces of the tubes; the injection water is admitted at the opening K, passes through the foot valves L L L and is driven through the delivery valves S. The water of condensation passes through the delivery valves N, O, P, and is driven through the delivery valves I and the outboard J, into a cistern from which the boilers are supplied by the feed pumps with their water. The apertures D F, are the ends of a pipe connecting the fresh and salt water cisterns, so that any shortage in the feed water may be furnished from the latter cistern. H represents the end of a pipe through which the auxiliary pump draws water, and A is an air chamber for the salt water cistern. The jet condenser is the lightest, simplest and cheapest of the two, only it has the fault of supplying salt water to the boilers, as the condensed steam and the sea water jet intermingle; on the con-



trary, the surface condenser preserves the water of condensation so that it may be used in the boilers many times in succession, and in this way maintains its freshness, dispensing with the necessity of frequent blowing off in order to avert the danger of salt deposits on the plates of the boilers. Care should be used to keep the steam and exhaust valves steam tight in order to prevent the leakage of steam into the condenser while the engine is at rest, thereby heating the former to such an extent that the injection water cannot find admittance owing to the pressure. In such cases the trouble may be rectified by applying cold water to the exterior of the condenser, or by starting the engine and moving it a few strokes.

The *piston* of the marine engine possesses the usual form of spring packing, and is powerfully braced by diverging arms cast on the upper and lower flanges, the cylinder head is similarly strengthened internally, while the exterior or outside is turned and usually kept highly polished. The steam chests contain the usual appliances of the receiving and exhaust steam passages, valves and valve seats; the lower chest contains the outlet or exhaust port communicating with the condenser, while the higher chest embraces the throttle valve pipe connected with the supply pipe, communicating with the boilers. The steam chests are very accurately fitted and strongly secured to the cylinder, and the valve bonnets and piston rod glands are turned and kept bright. The *valves* which control the flow of the steam are of the description styled double-balance valves, because the downward pressure on one valve is almost balanced by an opposite pressure on the other, the two being connected in pairs, and being retained in their seats, by the highest valve in the pairs on the induction side and the lowest valve of each pair on the exhaust side being somewhat larger than the others, thus inducing a very slight unbalanced pressure. The valve gear embraces the lifter rods, and lifters, the rock-shafts and their levers. The lifter rods, four in number, have a vertical movement up and down on guides attached to the steam chests and side pipes, and to these rods, eight projecting arms, called lifters, are attached by keys. Four of the lifters connect with the extremities of the valve spindles, screwed, and fitted with double jam nuts, the other four are set vertically over the levers on the rock-shaft, which imparts their motion to them. The rock-shafts, two in number, one for the induction and the other for the exhaust valves, are operated by distinct eccentrics. There are four levers on the shafts, operating and raising the rods and lifters, and to induce a smooth movement, they are bent or inflected on their working faces. Cast iron *side pipes* polished, turned, and ornamented, connect the steam chests, and are fitted with expansion rings of sheet copper to accommodate or compensate for the unequal expansion or contraction of the metal.

The lifter rods with the valves, are alternately elevated and depressed, by the rocking or reciprocating movement of the shafts. The length of the *exhaust levers* is so adjusted as to impart the exact amount of lift and lead, and are so regulated on their rock-shaft that the elevation of one rod commences at the very instant the other is completely depressed. The induction or steam levers are longer than the last noted, and are placed on thin rock-shafts so as to incline to each other, so that a space intervenes between the elevation of one rod and the depression of the other, during which time both valves are down, and the steam connection stopped. This mechanism forms the expansive cut off gear, and may be partially changed by varying the fixture or position of the eccentrics on the shaft, the pin in the eccentric lever, and the levers on the rock-shaft; the required lift of the valves may be adjusted by changing the position of the eccentric pin.

The *trip*, or *rock-shaft* is a wrought iron shaft moving in solid bearings on the lower steam chest, and is fitted with substantial projections commensurate with similar ones on the lifter rods, which when in motion elevate and depress the valves, operating in the same way as the large rock-shafts. The rock-shaft is fitted with apertures for the insertion of the starting bar, which in starting has to overcome the weight of the valves, lifter-rods and their connections.

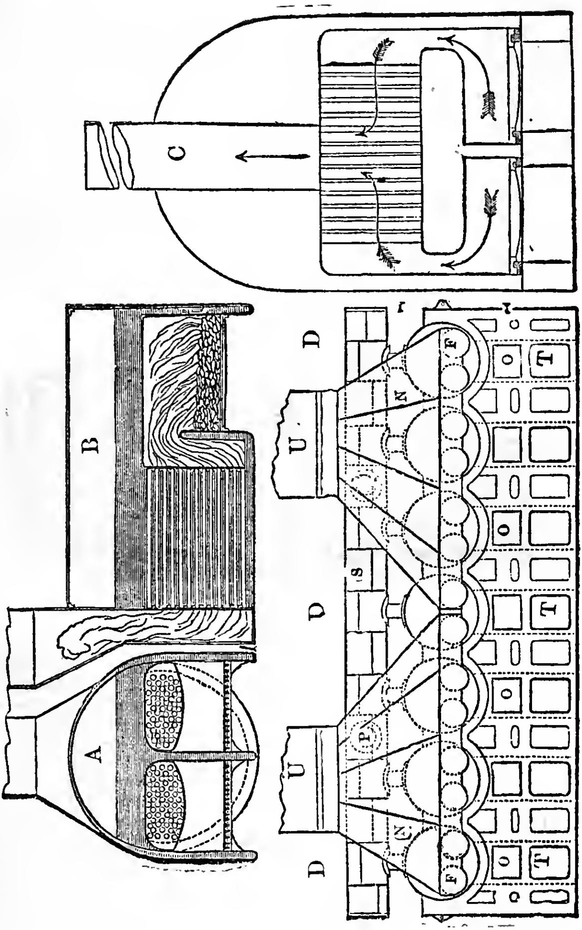
DUTIES TO MARINE AND OTHER ENGINES.—Among the varied tasks that devolve on the engineer, none of them are of more importance than the imperative watchfulness required to see that all the parts of the engine are properly adjusted, fitted, and regulated; that everything is kept in efficient order; that there is neither dangerous looseness or extreme tightness about the keys, nuts, bearings, etc. In the event of the crank-pin heating, apply a mixture of tallow, lead-filings, and black lead, or sulphur, black lead, and oil. In steam vessels, the crank-pin and the pillow-blocks are the points most liable to heat. The latter may be treated with the *cooling compound* elsewhere mentioned, or water mixed with Bath brick dust, or pulverized pumice stome, may be poured in through the holes in the bearings. In trouble caused by grit, the application of concentrated potash lye, and subsequent lubrication, has good effect.

If delayed in port, the *piston* should be removed and examined, and the faces of the rings, where they compose the joints with the flange of the piston-head and follower-plate, tried, and accurately fitted, by regrinding, etc., and the spring-packing properly adjusted. The tightness of the repairs may be tested by the admission of steam, the use of the indicator, and a few turns of the engine. The *steam chest* should be uncovered, the valves, seats, etc., examined, and any variations from truth corrected by careful fitting and scraping, and the proper amount of lead imparted to the valves, by placing the crank on the top and bottom centres, adjusting the go-ahead gear in proper place, in order to determine whether or not the valves open and close at the proper time.

The *link-motion* should be inspected and all derangements adjusted, repaired and corrected. The valves of the *air-pump* should be examined as opportunity offers, and all necessary repairs effected; the cover must be taken off and the bucket elevated for this express purpose. The *screw-shaft* should be kept true, and great care taken to guard against the glands or any other parts becoming damaged or seriously deranged in any way. Close and frequent inspection should be made of the *condenser*, which should be tested by removing the openings and pouring in cold water; and should any ooze out, the deficient tubes should be either repaired or renewed. The condition of the vacuum may be ascertained by the vacuum guage connected with the condenser. If derangement exists, search out and rectify the cause. If the temperature of the hot-well exceeds 100°, add more injection water. Test the joinings of the parts connected with the condenser with a lighted lamp or candle; if the union is imperfect, the flame will be inhaled by the internal suction. Make thorough work in searching out leaks, and repair them well whenever they are discovered. The entrance of air into the condenser and its connections, can, when ascertained, be stopped for a while, by entering in thin wedges, or using some of the numerous impervious compositions noted in this work. In the event of leakage into the condenser, it is useful occasionally to admit water through the aperture. Instances have happened where water-tight tanks have been fabricated (during long voyages at sea) between the side keelsons, in cases where the condenser had become inadequate to perform its use through corrosion, or otherwise, thereby submerging the air-pumps and condenser in a reservoir of water supplied by the ocean, excluding the air, and finding its way into the leaks, assisting the injection water in condensing the steam, the aperture of the injection-cock being partly shut, to conform to the amount of internal leakage. In the event of a violent storm imparting a rolling motion to the vessel, and consequent irregularity in the movement of the engines, owing to the alternate elevation and depression of the wheels or propeller, the machinery is liable to be stopped by a surplus of water in the condenser, and in all such cases the supply of injection water should be curtailed. As opportunity offers during occasional detentions, search out and close all leaks connected with the injection-cock or air-pump, which may cause the condenser to fill with water, causing much delay and annoyance in starting the engine. Whenever this is anticipated, the sea-cock should be shut at the same time the injection-cock is closed. When the indications of the steam gauge exhibit any excess of pressure over the atmosphere, raise the valves and permit the steam to flow through the pipes into the cylinder, to expel the air, heat the cylinder, and prevent the liquefaction of the steam on the starting of the engine. During temporary stoppage, the cylinder drip-cocks on stationary engines should be instantly opened, in order to permit the water of condensation to flow out, and they should not be closed until after starting up. Previous to starting an engine which has been stopped for some time, you should, as a precaution against danger, work the engine a few turns with the starting bar, and warm the cylinder by letting in steam. Lubricants should not be applied to the cylinder or valves until after the engine is started up and the drip-cocks closed, otherwise waste is sure to result from the expulsion of a portion of the oil or tallow through the drip-cocks. On the production of steam equivalent to produce a vacuum, and work the air-pumps, the injection-cock should be slightly opened, the eccentric-hook disconnected, and the valves moved alternately hither and thither, with the starting-bar, or the link, as either is convenient, in order to effect an interchanging movement in the piston. The engine should then be finally tested by "turning over" three or four times for the purpose of making sure that all is right, and everything trim for the anticipated voyage; after which, if everything is correct, the engine is brought to a stand, and all the parts lubricated in readiness for the start.

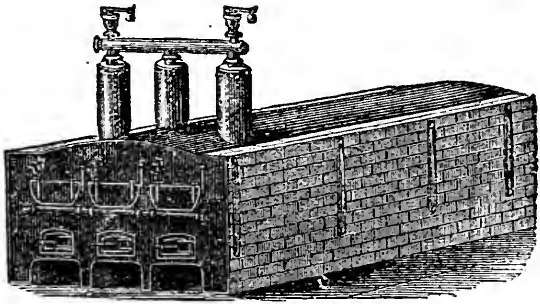
Previous to getting under way, the boilers should be filled with water to the upper gauge-cock. This can be easily effected, when the boilers are in the hold, by simply opening the blow-cock, and the water will flow into the boilers by gravitation, through the vessel's bottom, from the sea. In boilers otherwise situated, the filling may be performed by the hand-force pump, or a pump worked by a donkey engine, etc. On starting the fires, *slightly elevate the safety valve*, in order to permit the air to escape from the boilers; but on the emission of steam, which indicates the complete expulsion of the air, close them at once. In *stopping an engine*, shut off the steam, open the furnace doors, close the damper in the chimney, curtail the supply of injection-water, work the valves by hand, and unship the eccentric. *To back or reverse an engine* fitted with the link-motion, all that is requisite is to change it to the reverse-motion; but where only one eccentric is available, shut off the steam, throw the eccentric hook out of gear, and, with the starting-bar, apply the steam to the other end of the piston.

ON MARINE AND OTHER BOILERS.—In steam vessels, it is necessary, in order to maintain a proper equilibrium, that the boilers should be placed equidistant from the keelsons on either side; any



MARINE BOILERS. A, End view of horizonta. tubular marine boiler, B, side view of ditto, C, vertical tubular marine boiler. D D D, marine flue boiler, S, steam drum, U U, uptakes, P P, steam pipes, N N, bonnets F F, flues, O O O O, furnace doors, T T T, ash pit doors.

deflection from perfect truth in this arrangement entails much trouble in adjusting the proper balance of the ship. To this end they ought to be secured by rigid fastenings to the hull, with the lower face of the boilers and the extension of the flues ranging or conforming with the load line in each direction. In some places it is usual to place them on a substantial platform composed of 3 inch plank over the keelsons, on which the boilers are placed, the planks being previously coated to a depth of 1½ inches or more, with a tenacious mixture composed of drying oil and whiting, which affords a hard impervious protection to the boiler against water and rust. Another way, which has the advantage of presenting an opportunity for making incidental repairs, consists in placing the boilers on cast iron saddles attached to the boiler supporters. Boilers should be properly protected by a proper clothing of non conductors, such as asbestos, hair felt, &c., covered with a lagging of wood ; or some of the other materials elsewhere noted in this work, may be used instead. Marine boilers demand the greatest attention and care in repairing, testing, cleaning, blowing off,



GANG OF STEAM BOILERS PROPERLY SET.

and water supply. Especial care should be used at all times to keep the brine at a low degree of strength when sea water is used, by blowing off every two hours at least, frequently testing the strength of the brine by the saline hydrometer, an instrument constructed to indicate by gradations the number of ounces of salt held in solution in each gallon of water. Sea water contains 3.03 parts of its weight in saline matter, or nearly 1 lb. in every 33 lbs. of water, and saturation is complete when it contains 36.37 parts. When by evaporation the proportion of salt increases to 4 lbs. in 33 lbs. of water, the formation of scale is imminent, and should be guarded against by blowing off, and the repletion of the supply by additional fresher water. While in port, as opportunity offers, the hand-hole plates above the furnaces ought to be removed in order to permit the removal of any saline deposits on the crown sheet, and as dampness is inimical to the interior of the boiler, the bottom hand hole plates should also be removed when a long detention is anticipated, in order to permit the water to drain off, and air to circulate, so as to dissipate any dampness, which otherwise might result in the rapid oxidation of the boiler plates. If this cannot be done, it is better to keep the boilers full, rather than have them partially so.

Scale is not the only danger to be guarded against, for it is attested by the reports of the Hartford Steam Boiler Inspection and Insurance Company that almost half of the sum total of imperfect boilers became such by reason of the deposit of sediment, there being no less than 40 per cent. more hazardous cases resulting from the deposit of sediment causing the plates to be burned, or overheated, than from scale when hard water is used, the lime, etc., held in solution is precipitated, and the deposit becomes concreted, forming a terrible obstacle to the transmission of the heat to the water, and rendering the plates exposed to the action of the fire liable to be burnt through or seriously weakened.

In setting stationary boilers, it would be well to have an air space of 2 or 3 inches intervene between the boiler and the surrounding brick work, and fire-clay is every way preferable to mortar for the entire surroundings. Arrangements should be made to have convenient apertures at suitable places in order to permit access for the removal of dust, soot, ashes, and other impediments interfering with the effective action of the fire on the lower parts of the boiler. A good way of setting long stationary boilers is to attach cast-iron knees to their middle and at each end, having them about 12 feet apart, and placed on brick foundations; these knees, if placed on substantial rolls on a solid seat, would ensure ample provision for the contraction and expansion of the boilers, as well as prevent all strains resulting from unequal settling.

As to the attachments called mud drums, past experience has shown, when their great cost and short duration are taken into account, that the benefits to be derived from their use, are, to say the least, very equivocal, as they impart but a slight amount of heat to the feed water, retain none of the ruinous carbonates which induce scale on the boiler, but only the muddy matter held in suspension in the water, while the cost of renewal consequent on their rapid decay, is very heavy.

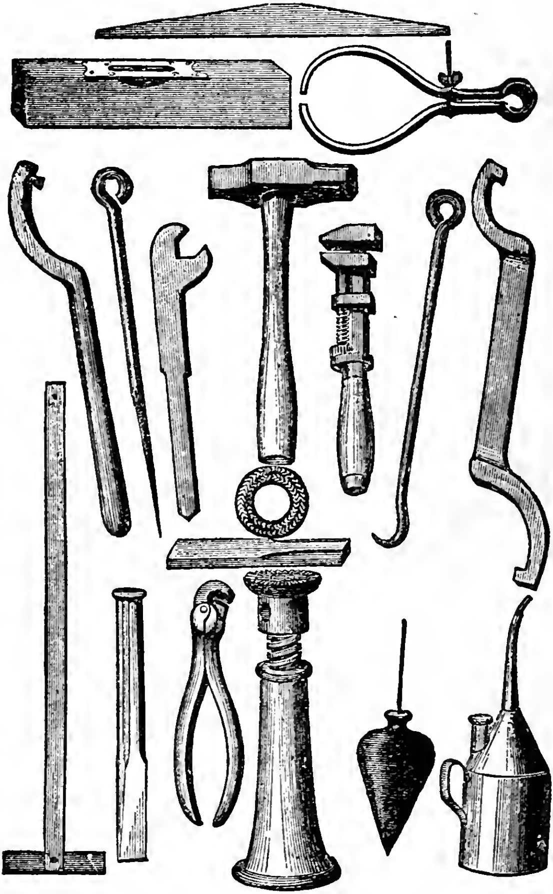
Cleaning Boiler Tubes.—Weinlig recommends a copper pipe, 5 millimetres in diameter, tapering at one end, and fitted at the other with a flexible india-rubber tube, by which it can be connected with the steam-cock of the boiler when required. The pipe is mounted on a 3ft. wooden handle, and should be long enough to reach through the fire-box. In use, the wooden handle is held firmly under the right arm, and the nozzle of the pipe introduced an inch or so within the tube to be cleaned. Steam is then turned on through the india-rubber tubing.

Steam-Pipe Jacketing.—The Stettin Vulcan Works make use of wool for clothing steam-pipes. A lead cylinder is laid around the pipe, and the space between, which is about $1\frac{1}{2}$ inches, is filled up firmly with wool. The lead cylinder being drawn back, the wool as exposed is tied down with wire, and finally linen is sewed over the whole.

Cement.—Sifted peroxide of manganese and zinc-white, equal parts; and sufficient soluble glass (commercial) to form a thin paste. Apply immediately. This cement will resist a red-heat, water, and oils.

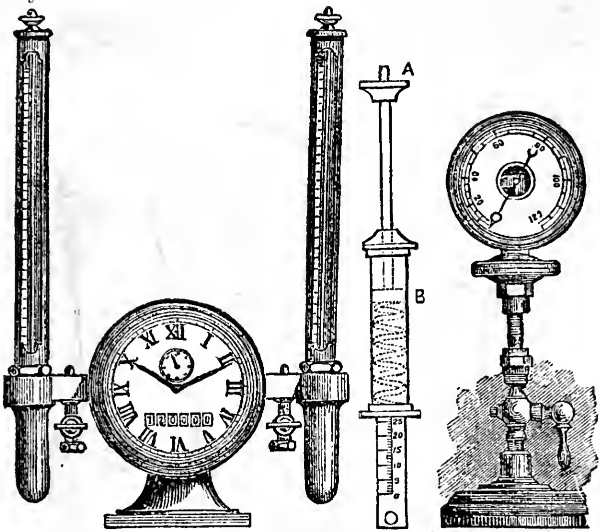
Flanges to Stand Brazing.—Copper 1 lb., zinc $\frac{1}{2}$ oz., lead $\frac{3}{8}$ oz.

Gedge's Metal.—Copper 60, zinc 38.2, iron 1.8.

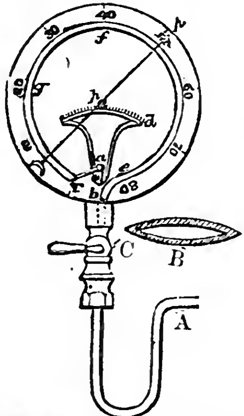


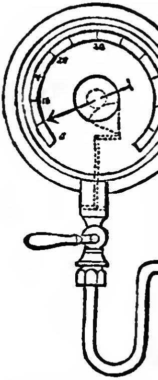
ENGINEERS' TOOLS.—The mechanical appliances represented above, should be kept within easy reach, and, if arranged on a vertical table of thick plank, fitted with recesses conformed and adapted for the reception of each tool, it would not only prove a great convenience, but also a striking ornament to the engine room.

Fire and Waterproof Cement.—Pulverized litharge 5 lbs., fine Paris white 2 lbs., yellow ochre 4 ozs., hemp cut into shreds $\frac{1}{3}$ oz., mix to the density of thick putty with boiled linseed oil, and it is ready for use.



Marine Engine Counter, Clock, Vacuum Gauge, and Steam Gauges.—The Gauge A, B, represents an adaptation applicable to Locomotives.—A, shows the point of connection with Boiler, B, the Spiral Spring and Graduated Scale.—The above cuts, together with the following ones, represent a Marine engine counter and clock, together with steam and vacuum gauges of various kinds. The counter, inclosed in an annular box of cast-iron, contains a mechanism connected by suitable attachments to the engine, which impart such a correct mechanical movement to a regular series of figures or numbers displayed through the narrow apertures in the dial, as to exhibit at a glance the exact number of revolutions performed by the engine. The steam gauges used to determine the pressure of steam, operate either by the use of mercury, thin metallic tubes, or springs, and several of these adaptations are shown in the cuts we present. As used on stationary boilers, for it cannot be used on locomotives, the mercurial gauge is formed of an upright glass tube connected with a cistern of mercury, resting on a round piece of steel or gutta percha; on marine engines it consists of an inverted siphon or tube bent in the form of a U, with one end exposed to the pressure of the steam, and the other open to the atmosphere. When not pressed by steam, the mercury will remain level in both arms of the syphon, but as the pressure rises, it will act with increasing force on the mercury exposed to the action of the steam, and forces it to rise in the limb exposed to the air, and will determine the amount of the steam pressure over and above that of the atmosphere, the indications being exhibited on the gauge, the gradations on which are one inch in length, consequently every inch that the mercury rises in the tube shows a change of 2 inches in the level of the mercury contained in the tube, and each inch of mercury on the scale represents 1 lb. pressure of steam.





Many excellent gauges, nearly thirty in all, are in use in the United States and Canada, among others, that of the American Steam Gauge Co. and Bourdon's, or, as it is better known in the United States, Ashcroft's gauge, from the name of the manufacturer, the interior of which is shown in the cut. It is composed of a thin circular metallic tube, *a*, closed at one end; the steam from the boiler is introduced at *b*. The result of the steam pressure on the interior of the circular tube is to enlarge the circle more or less in proportion to the pressure, the elastic properties of the metal operating to contract the circle to its original position on the removal of the pressure. The sealed or closed end of the tube is united by the link c, to the lever *d*, which operates a segmental gear or rack placed at the upper end in gear with a pinion, which imparts movement to a hand on a graduated circular scale as shown in the cuts above.

INTERIOR OF ASHCROFT'S GAUGE.

The same invention, when fitted to a condenser by the pipe A, see cut above, will indicate the state of the vacuum in a condensing engine. In this case the indications are caused by exterior atmospheric pressure, the gauge is graduated to extend only from 1 lb. up to 15 lbs., and the entire action is reverse from that of steam, as described above. On the opening of the tap C, as the vacuum enlarges, the band will be flattened and the hand on the dial will move in an opposite direction from that caused by the action of steam.

CARE OF STEAM GAUGES.—A little glycerine, or sulphuric acid, placed on the surface of the mercury will keep a mercurial steam gauge in good order, by lubricating both glass and metals, preventing their adhesion.

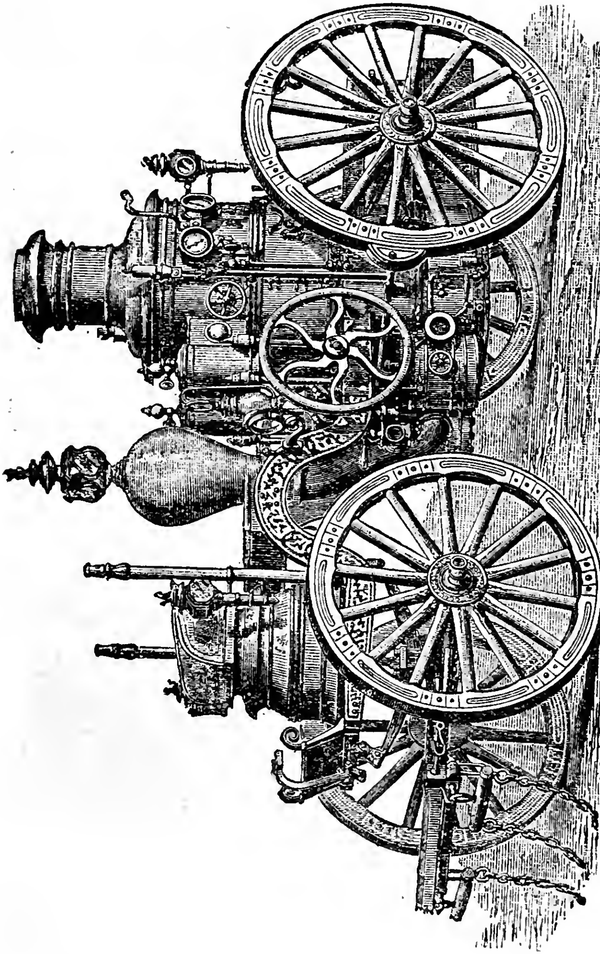
STEAM PIPES.—Ruptured steam pipes may be repaired by heating and then soldering them. The *condensation of steam in subterranean pipes* may be prevented by enclosing the pipe inside a larger one, and filling the vacant space between the two with a mixture of clay and teased hair, or plaster-of-Paris.

SUBSTITUTE FOR FIRE CLAY FOR BOILER FURNACES.—To common earth well mixed with water, add a small quantity of rock salt and allow it to stand until the salt dissolves, then use as fire clay. It answers very well.

WATCH THE LEAKS.—Engineers should keep a vigilant eye for leaks, weak spots, &c., and apply a prompt remedy by repairing all defects without delay. See that all the seams and rivets are tight, and the tubes and tube sheets in good order. Leaky tubes should be replaced or stopped, by driving a tightly fitting wooden plug at each end and binding them by means of an iron-rod passing through the tube fitted with broad washers at each end, and screwed up tight with the "*Strong cement for Steam Joints*" (see page 422) plentifully smeared on under each washer. A mirror or bright tin plate may be used advantageously to reflect light into obscure places while repairing boilers. To apply a *hard patch*, describe the proper size on the plate to be patched, allowing from $1\frac{1}{4}$ to $1\frac{1}{2}$ ins. of good iron beyond the weak part or flaw. Now drill the rivet-holes through the patch, and chip its edges. Next, apply the patch to the boiler, and mark the places for corresponding holes by means of a small brush with white paint, drill the holes in the shell with a brace and ratchet drill, remove the deficient part of the shell, rivet on the patch, or secure well with tap bolts. A *soft patch*, is applied over the weak part of the shell (after being previously coated with an intermediate layer of good cement), being fitted in the same manner as above described, and secured to its place by means of nuts, bolts, and washers, with a twist of hemp under the washers and bolt heads to ensure security, and prevent leakage. The first method is decidedly the best for parts of the boiler exposed to the direct action of the fire.

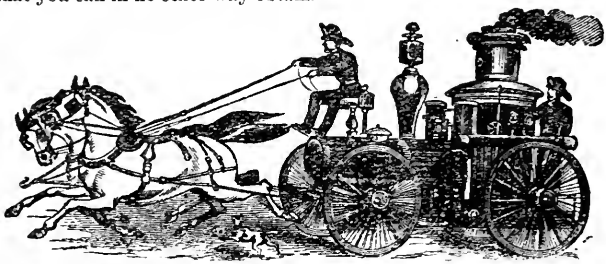
DIMENSIONS AND CAPACITY OF FIRST CLASS AMOSKEAG STEAM FIRE-ENGINE. (*See Cut.*) *Height from floor to top of smoke stack*, 8 ft. 10 ins. *Length over all, including tongue*, 23 ft. 8 ins. *Diameter of boiler*, 2 ft. 8 ins. *Diameter of pumps*, $4\frac{1}{2}$ ins. *Stroke of same*, 8 ins. *Diameter of steam cylinders* $7\frac{5}{8}$ ins. *Number of discharge gates*, 2. *Capacity in gals. per minute*, 900 gals. *Weight*, 6,500 lbs. The boiler is an upright tubular, very simple in its combination, and for strength, safety, durability, and capacity for generating steam, unsurpassed. Starting with cold water in the boiler, a working head of steam can be generated in less than five minutes from the time of kindling the fire. The engine "Amoskeag," owned by the city of Manchester, has played two streams in *three minutes and forty seconds* after touching the match ; at the same time drawing her own water. The following instructions to engineers, given by the Amoskeag Co., for running their engine, may be easily adapted to efficient use in the case of steam fire-engines constructed by other builders.

1. In laying your fuel in the fire-box, first lay plenty of shavings, then light, dry kindling wood ; filling your furnace full, which in most cases will give you steam enough, by the time you arrive at a fire to commence work, provided you light your fire when you leave the house, which, as a general rule, is advisable. 2. If you use coal, be careful to keep a thin fire, and not clog it. Use the coal in as large lumps as possible, and do not break it up unnecessarily in the furnace. The best coal for this purpose is a clean Cannel, in lumps, free from dirt and dust. 3. Be careful not to let so much fire collect under your engine as to burn the wheels ;—when working for a long time at fires there is a danger of doing so. 4. The Amoskeag boiler is an upright tubular body, with a submerged smoke-box and fire-box surrounded with water. When the engine is running, the water in the boiler should be carried so as to stand at the third gauge-cock, which is placed near the top of the tubes, and it should never be carried below the centre of the tubes at which point the first gauge-cock is located. 5. Avoid using an unnecessary amount of steam. The tendency is to use more than is required. From sixty to eighty pounds is as much as you will generally require to do good fire duty. 6 The engine has two suitable feed pumps for supplying the boiler with water. One of these pumps should be worked nearly all the time, in order to keep the water in the boiler at the proper height, and to preserve an even pressure of steam. 7. If brackish water is used for supplying the boiler, or if the boiler becomes foul from long use without being blown off, it is likely to foam or prime. If foaming occurs while the engine is working at a fire, it may be prevented or diminished by opening the surface blow-off cock, which is located between the third and fourth gauge-cocks, and blowing off from the surface of the water the scum and oily matter which usually causes foaming. In this way the difficulty can generally be prevented without any serious interruption in the working of the engine. While doing this the water in the boiler should be carried as high as the surface blow-off cock. After the engine is returned to the house, the water should be blown entirely out of the boiler through the blow-off cock near the bottom of the boiler, with a steam pressure of about twenty pounds, and the boiler refilled with fresh water. This process may be repeated until the boiler becomes clean. 8. The pump upon the Amoskeag Engine is a vertical double-acting pump, with the cylinder surrounded by a circular chamber, divided vertically outside the cylinder, so as to answer both for the suction and discharge chambers of the pump. It has a separate valve-plate at the top and bottom of the pump, carrying both the suction and discharge valves ; the suction valve upon one side of the plate, and the discharge valve upon the other. Each of these valve plates can be reached by taking off the top and bottom of the pump, which is so constructed as to be readily removed. The discharge and suction parts of the water-chamber, surrounding the cylinder, are connected by a valve in the vertical partition, which is called a relief valve. 9. With a single



FIRST-CLASS CRANE-NECK STEAM FIRE ENGINE. BUILDERS, THE AMOSKEAG CO., MANCHESTER, N. H.

long line of hose, it may be necessary to open your relief-valve a little, but at all other times be particular to have it closed, except when you want to feed your boiler without forcing any water through the hose. 10. In the smoke-pipe, directly over the upper flue-sheet, a valve is placed, which is called the variable exhaust-valve. By operating this valve the size of the aperture for the escape of the steam from the steam-cylinder is increased or diminished, thus regulating the draft of the chimney and the heat of the fire. This valve should be closed, when the engine is started, until a fair working pressure of steam is obtained, after which it may be opened. 11. Care should be taken to have the suction hose and its connections air-tight. 12. Open your discharge-gate and cylinder drain-cock before starting your engine. 13. Don't let the flues of your engine get filled up. 14. Be particular to take your engine off the springs before you work it, and to place it on the springs again when done working. 15. With a long line of hose on, be particular to open your throttle gradually. If you open it too suddenly you are liable to burst your hose. 16. The pumps of the engine should be examined at least once in six months, to see that all the valves and parts are in good condition. 17. The pump-valves should have a lift of about three-eighths of an inch, and the suction valves the same lift. 18. The inside of the steam-cylinders and the steam-valves should be oiled or tallowed always after the engine has worked at a fire, and as often as may be necessary to keep them well lubricated ; and all the parts of the engine, where liable to friction, should be kept well oiled. Be particular to use an abundance of oil on the "link-block," where there is more friction than in any other part. 18. The running-gear and every part of the engine liable to disarrangement or accident, should be thoroughly examined every time after the engine has been out of the house, whether it has been worked at a fire or not. 19. Whenever your engine is repaired, try to help to do it yourself, as by so doing you get a familiarity with it that you can in no other way obtain.



Besides the above noted, the Amoskeag Co. manufacture self propelling steam fire engines capable of attaining a continuous speed of 16 miles per hour. Steam fire engines of perfect workmanship and immense power, are also made at Seneca Falls, N. Y., Portland, Maine, Pawtucket, R. I., Boston, Mass. and many other places throughout the United States.

A Fireman's Respirator,—Consisting of an iron cylinder attached to a mask, and packed with cotton wool, glycerine. and charcoal, has been exhibited in London, by Prof. Tyndall; the wearer is enabled to remain in an atmosphere of smoke, which he could not otherwise bear, for a quarter or half an hour.

An Improved Fire Escape,—called the Jenks-Richard's fire-ladder has been adopted in many places. It is a permanent fixture to the building, and is attached to the cornice of the house, and comes down when the alarm is sounded, giving the inmates a chance to escape when other exits are cut off, and the firemen a plan to ascend with the hose, and fight the fire at the greatest possible advantage.

Cast Iron for Steam Cylinders—*very hard.*—Scrap iron, 300 lbs. Scotch pig, 40 lbs., charcoal pig, No. 5, 40 lbs. *Another*, very strong and close grained. Scrap iron, 100 lbs., Scotch pig, 100 lbs., charcoal pig No. 5, 80 lbs.

Cylinders should be bored in a vertical position whenever possible, removing a heavy cut at first and gradually cutting to within 1-32 of an inch of the finished size, and finally brought down to the proper dimensions by removing the balance with a cutter embodying in its form a combination of the circular and diamond pointed shapes. Some manufacturers used a mass of lead (cast in the cylinder to give it the proper shape) together with emery and oil between the abrading surfaces, for finishing their cylinders, the latter revolving slowly, while the operation continues.

Rule for Thickness of Steam Cylinder.—Divide the diameter of cylinder plus 2 by 16, and deduct a 1-100 part of the diameter from the quotient ; the remainder will be the proper thickness. The depth of the piston rings should be equal to ¼ the diameter of the cylinder, and the follower plate should be equal in thickness to the cylinder. The following table gives very good results.

Diameter of Cylinder.	Thickness.	Diameter of Cylinder.	Thickness.
6	5-8	14	1
8	11-16	15	1 1-16
9	3-4	17	1 1-8
10	13-16	18	1 3-16
11	7-8	19	1 1-4
12	15-16	21	1 3-8

Add to the foregoing dimensions 1-16 of an inch, when the piston speed exceeds 300 feet per minute.

Piston Rings.—To prevent rapid wear in the cylinder, the piston rings should be formed of some material softer than the latter ; cast iron is much used for this purpose, as it soon attains a fine smooth surface, has great endurance, and generates little friction. They should be fitted with judgment so as to move easily between the flange of the piston-head and the follower plate, in order that they may adjust or conform themselves to any slight unevenness in the cylinder. To *open piston rings*, hammer them lightly with a round pene hammer all round their inside faces, and, as they become leaky and corrode around the edges, remove them from the cylinder and true them up in a lathe, grind, and refit them to the flange and follower plate. *Piston springs* are in the great majority of cases, too stiff and rigid to render them in every way satisfactory, as in many instances they entail great loss of power by unnecessary pressure against the cylinder. *Steam pistons* possess the merit of low first cost, very little friction, simplicity, and after a proper adjustment by a competent person, give very little trouble. *Solid pistons* produce scarcely any friction, and when the cylinder is bored perfectly true through its whole length, produce excellent results, if they are properly fitted, but are irreparable when they become worn out, as they cannot be re-adjusted. The *piston speed of small stationary engines* ranges from 200 to 250 feet per minute; average speed 225 feet, that of *large stationary engines*, 275 to 350 feet; average speed 312 feet; that of *Corliss* Engines 400 to 500 feet per minute; average speed 400 feet; that of locomotives and Allen engines 600 to 800 feet per minute, average 700 ; that of *engines of river steamers* 400 to 500 feet, average 450 feet; that of *ocean steamers* 400 to 600 feet, average 500 feet. If the *piston rod glands become tight*, ease by revolving and sliding the gland back and forth on the rod, applying a little oil to the rod at the same time. In trueing up a gland, it should be chucked in the lathe by the flange, to ensure the turning of the bore and outside diameter at one chucking, without depending on the accuracy of a mandrel. *Piston rods* should be secured to the cross head by means of a well fitted key instead of by the screw and jam nut arrangement used in many cases. Piston rods are usually made of wrought iron, but steel is to be preferred on account of its great endurance, small friction, and extreme hardness, which render it less liable to be fluted by grit in the packing, &c. The *cross-heads* should, in every case, possess the essential element of strength, to resist strains of every kind, and also capacious anti-friction bearings on the guides, to resist the wear and tear of protracted running.

The *guides* should be powerful enough to withstand any degree of speed without springing or flinching from duty in the slightest degree, and, on horizontal engines they should be made moveable, so that they may be easily replaced by others when they become worn out.

Crank pins are usually made of wrought iron, although for obvious reasons, steel is the best material. Owing to excessive friction the crank pins are liable to become hot, and for this reason they should receive close attention from the engineer. A mixture of a little sulphur in oil, or plumbago and oil, forms a good cooling lubricant in such emergencies. The diameter of the crank pin should be from .2 to .25 that of the cylinder, and the length from .275 to .35 the diameter of the cylinder, or for a cylinder 12 ins. in diameter and 30 ins. stroke, the length of crank pin should be 3.3 to 4 ins., and the diameter 2.4 to 3 ins.

The *Steam chest* should be capacious enough to furnish sufficient room for the valve gear arrangement, the transmission of steam to the piston, &c., but not unnecessarily large to induce weakness in the parts, loss of heat by radiation, &c.

Valve rods should be constructed of substantial material to withstand the varied strains to which they are liable ; they are usually of wrought iron, but steel is to be preferred for various reasons. The *length of valve rods* may be correctly ascertained by placing the valve in a central position over the steam ports, and the rocker or intermediate bearings in a vertical position, and measuring from the centre of the rocker stud to the centre of the valve.

The dimensions of the *rock shaft-bearing*, should be, if subjected to a twisting movement, or torsion, ⅓ or ½ the diameter of the engine shaft, if not so subjected, ¼ the diameter of the engine shaft will answer. The diameter of the *rock shaft pin* ought to be no less than the valve stem; but if it is an overhanging pin, it ought to be from ¾ to 1½ the diameter of valve stem.

Eccentric rods should be substantially made of good stock, and sufficiently stiff and rigid to withstand the manifold strains to which they are liable, without being subjected to extreme vibration, so that a steady movement may be imparted by the eccentric to the valve, and they are all the better for being long.

To adjust an eccentric rod, place the crank at the end of its stroke, and the eccentric at right angles with the crank. Now regulate the eccentric-straps and adjust the rocker in a vertical position. The proper length of the eccentric may now be determined if the eccentric-catch conforms itself to the rocker pin, without moving the latter to either side. The length of the eccentric rod is the space between the centre of the crank shaft and that of the rocker pin, when the latter is vertical.

The *eccentric rod may be attached* by turning the end of the rod tapering, to adapt it to a suitable hole in a sleeve cast on the forward straps of the eccentric, to which it may be secured by a proper key; another way is to insert the rod into the sleeve and fasten with jam nuts. The diameter of the eccentric rod, should, at the neck, equal that of the valve rod, and should increase ⅛ inch to the foot of the eccentric.

The *pillow blocks or main bearings of an engine* should be the objects of close attention on the part of the engineer, as, owing to the excessive friction and wear and tear at this vital point, they are liable to become hot and cause much trouble. In such emergencies make use of the following

COOLING COMPOUND FOR HEAVY BEARINGS.—Tallow, 2 lbs; plumbago, 6 ozs; sugar of lead, 4 ozs; melt the tallow with gentle heat, and add the other ingredients, stirring until cold. For lubricating gearing, wooden cogs, &c., nothing better need be used than a thin mixture of soft soap and black lead. The following processes will prove useful to engineers and machinists in many cases:

TO PREVENT SPERM OIL GUMMING.—The addition of kerosene oil will greatly assist in preventing gumming; rummage 100 parts oil with 4 parts chloride of lime, and 12 of water; now add a small quantity of the decoction of oak-bark to destroy all traces of gelatinous matter still remaining, and allow the impurities to settle. Next, agitate the clear part with a little sulphuric acid, settle once more, and wash to remove the acid, which should never be permitted to exist in any oil used on machinery. If oil becomes rancid, boil it along with water and a little bi-carbonate of magnesia for 15 minutes or so, until it loses its power to redden litmus paper.

MACHINERY LUBRICANTS.—A patent has been taken out in France for lubricants compounded as follows: *First*, graphite, 35 parts; talc, 25; sulphur, 20; wax or paraffin, 20. *Second*, graphite 30 parts; bone-glue, 15; water, 32; sulphur, 12; wax or paraffin, 11.

The *Crank shaft* being the primary agent for the transmission of power, should, in all cases be well proportioned in order to perform effective duty and resist the shearing and twisting strains to which it is subjected. They are often made of cast iron smoothly turned, and should be 5-10 the diameter of the cylinder for efficient use, or the diameter of the shaft may be 4-10 that of the cylinder when wrought iron is used, and the *length* of the *crank shaft bearing* should be equal to $1\frac{1}{2}$ times its diameter, or, for massive machinery, twice the diameter will be required.

The *area of the crank* at the central part should be exactly that of the shaft; the *thickness* should be equivalent to that of the shaft journal multiplied by 6: the *thickness of the web of the crank* should be equivalent to 3 times the diameter of shaft journal. The boss of the crank, if of wrought iron, should be equivalent to the diameter of the shaft journal or pin multiplied by 4, and if of cast iron, should equal double that of the shaft journal, and the depth should equal that of the crank journal multiplied by 7. The *diameter of crank at the pin* should equal twice the diameter of pin, and its depth at the same part should be equivalent to the diameter of the pin multiplied by 12.

The *Governor* should be kept perfectly clean and free from all gummy deposits, or old dry packing which may retard, or impede its movements in any way whatever. The best of oil only should be used, and thorough duty should be performed when the governor spindle works through stuffing boxes, to have the boxes carefully packed at regular intervals.

To find the Diameter of Governor-Shaft Pulley.—Multiply the number of revolutions of the engine by the diameter of the engine shaft pulley and divide the product by the number of revolutions of the governor.

To find the Diameter of the Engine Shaft Pulley.—Multiply the revolutions of the governor by the diameter of the governor shaft pulley, and divide the product by the number of the revolutions of the engine.

Facts for Steam Users.—A fair horse-power in a steam boiler is an evaporation of 30 lbs. of water per hour, from a temperature of 212°. Ten pounds of water, evaporated from a temperature of 212° for each pound of coal, is high economy. Six pounds is fair work, and above the average. Under the best conditions, a horse-power can be had from an evaporation of less than 20 lbs. of water. Every owner of steam power should weigh the water evaporated in his boiler, and also the coal used to produce such evaporation. A measure of some kind that will show the weight of feed water, passing into a boiler with accuracy, should be used with all boilers when economy is an object. It should be the duty of a fireman to know the weight of the fuel used as well as the weight of water. No man has any right to find fault with the economy of his boiler until he knows the amount of water evaporated per hour and the amount of coal required to produce the same. In getting the evaporative power of a steam boiler, it is necessary that the steam should be dry to get a fair result. A boiler that carries out water with its steam may show a large apparent evaporation, but the steam, being wet, is of less value in the engine. A boiler should give dry steam in all cases. Superheating is beneficial. Boilers that are overworked, necessarily waste fuel. A boiler taxed to its full evaporative power, evaporates, say, 5 lbs. of water to 1 lb. of coal: double the size of the boiler, and you will get the same amount of steam, with probably 30 to 50 per cent.

Table showing Proportion, &c., of the various Parts of Locomotive Engines, from Actual Practice, as determined by the best Authorities.

Description of Engine.	9-in. Outside Passer.	12-in. Outside Passer.	14-in. Outside Freight.	15-in. Outside Passer.	16-in. Outside Passer.	18-inch, 6 drivers, Freight.	18-inch, 6 drivers, Anthracite.	18-inch, 6 drivers, Br'd Gauge.
Diam. of Cylinder.	9	12	14	15	16	18	18	18
Length of stroke..	15	20	22	22	24	24	24	24
Area of steam port.	8	11	13	13	15.1	14	14	14
Area of eduction port...........	16	22	23	26	30.37	31.5	31.5	31.5
Diameter of blast pipes..........	2¼	2¾	Vari-able.	3	3½	3½	4	3½
Diameter of pump ram.........	1½	1½	1¾	2	2	4½	4½	4½
Stroke of do......	15	20	22	22	24	5	5	5
Diam. of feed pipe.	1½	1½	1¾	2	2	2	2	2
Length of connecting rod........	4.6	6.4	8.	8 1	7.0¼	7.6	7	7.6
Diam. of piston rod	1¼	1¾	2¼	2⅜	3	3	3	3
Depth of piston...	3½	4¼	4¾	4¾	5	5	5	5
Diam. of crank pin	2x2½	3x2⅞	3½x3¼	3½x3¼	4½x4½	4½x4½	4½x4½	4½x4½
Diam. of back pin.	....	2⅜x2⅞	3x3	3x3	3x3	3x3	3x3	3x3
Diam. of forward pin............	0	0	0	0	0	3x3	3x3	3x3
Diameter of crank axle...........	5½	5½	6	6	6½	6½	6½	6½

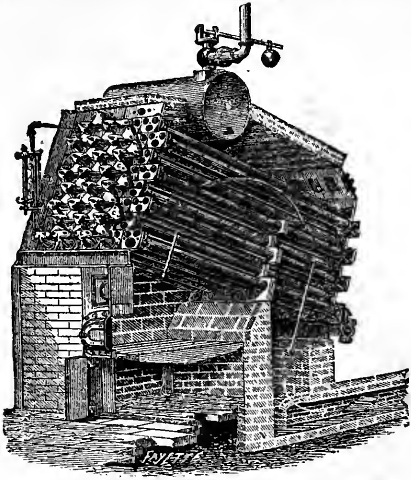
Description of Engine.	9-in. Outside Passer.	12-in. Outside Passer.	14-in. Outside Freight.	15-in. Outside Passer.	16-in. Outside Passer.	18-inch, 6 drivers, Freight.	18-inch, 6 drivers, Anthracite.	18-inch, 6 drives, Broad Guage.
Diam. of valve rod	1⅛	1⅛	1½	1½	1⅝	1⅝	1½	1[illegible]
Length eccentric rods............	4.0	4.3	5.9⅝	5.9	4.3	4.3	4.3	.3
Diameter of eccentrics............	11½	11½	11½	11½	14	14	14	14
Width of sheaves..	2½	2⅜	2⅜	2⅜	3	3	3	3
Diameter of boiler.	2.6	3.2	3 6	3.6	4.2	4.2	4.2	4.2
Length of boiler...	8.7	15.8½	18.1¾	18.4	19.6	21.	23.8	20 4
No. of tubes......	98	98	160	144	151	170	170	195
Superficial feet fire Box............	40	53.14	105.5	82	83.42	99.	90.2	108.
Do. tube surface...	277	487.06	544	725	837	1068	1005	1123
Do. total heating surface.........	317	540	650	814	927.	1176	1102	1239
Ditto, fire grate surface.........	8	16.3	12.5	14	14.3	14.5	22.86	19.83
Ratio fire surface in sq. ft. to cubic contents of cyl'r.	..	206 to 1	166.6 to 1	181 to 1	166.2 10 1	166 5 to 1	156.2 to 1	175.5 to 1
Diam. of chimney.	10	14	14	14	15	16	14½	16
Diam. truck axle..	...	4	4	4¼	4¼	5	5	5

less fuel. A boiler may generate steam with great economy, and, owing to the steam being wasted by improper application to the work, through the engine, the result in work be very unsatisfactory, and the boiler blamed unjustly. When steam is used expansively, under the best conditions, it will give double the power for the same amount of steam that can be got from it worked at full stroke, or without expansion. When steam is used in non-condensing engines at low pressure, the loss is great, owing to the pressure of the atmosphere (15 lbs.) being a greater percentage of a low than of a high pressure. The loss for *piston*—not boiler—pressures is as follows :—

Atmosphere.	Pressure steam.	Total pressure on piston.	Loss.
15	5	20	3-4
15	10	25	3-5
15	15	30	1-2
15	20	35	3-7
15	25	40	3-8
15	30	45	3-9
15	35	50	3-10
15	45	60	1-4
15	60	75	1-5
15	75	90	1-6
15	90	105	1-7

The steam, made from a certain weight of water, used through a non-condensing engine, at 10 lbs. per square inch pressure above the atmosphere, without expansion, would give only about one quarter the power that would be got from the same steam if used at 75 above the atmosphere, and with the best expansion. Boilers can scarcely be too large; 20-horse power can be obtained in a 40-horse power boiler more economically than in a 20-horse power. *John B. Root.*

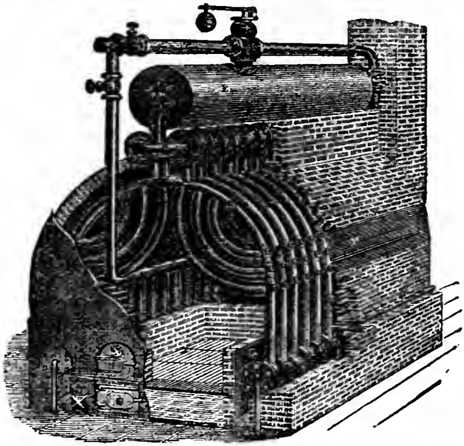
A prominent authority verifies the astounding statement, that a record of BOILER EXPLOSIONS that have occurred in the United States extending over about five years, shows the appalling results of nearly 600 explosions, about 3,000 killed, over 1,000 wounded, besides an immense loss of property. Fire insurance does not cover the loss by explosion, unless fire occurs, and, even then, litigation often ensues." The infliction of this terrible aggregation of suffering, loss of life and property, might have been averted by the exercise of common sense in the selection of boilers which possess the elements of strength and endurance in such a degree as to put the question of safety beyond a peradventure. Setting aside the beclouded theories of self-styled experts, regarding certain explosive gases, mysterious chemical changes, electricity, etc., in the boiler, the simple truth is reached when we come down to the solid basis of cause and effect; and in every case of boiler explosion we will find that the true cause is simply imperfect strength in the boiler. The deficiency may arise from defective material, or faulty workmanship, overheating, overpressure, overfiring, burning of the boiler-plates, caused by shortness of water, or the tolerance of scale or deposits in the boiler, or by criminal negligence. These are only different forms or phases of expressing the truth just noted, and whoever constructs a boiler absolutely free from liability to destructive explosion, has achieved an engineering triumph which entitles him to recognition as a public benefactor. As one who is cognizant of much suffering arising from the causes enumerated above, the writer can truthfully aver that he is moved by no motives other than those of humanity in making favorable mention of



The Root Wrought Iron Safety Boiler.

These boilers, made by the Abendroth & Root Manufacturing Company of New York, are constructed on correct scientific principles, on what is known as the sectional system, being composed entirely of wrought iron lap-welded tubes, which are tested to a pressure of 500 lbs. per square inch, and are said to be capable of withstanding two or three times that pressure. These tubes, 4 inches in diameter, and 10 feet in length, are lap-welded, consequently they have no rivetted joints, thereby enhancing their strength. The boiler is constructed entirely of these uniform and interchangeable parts, *perfectly free from explosion*, easily enlarged or diminished in size, all parts being easily accessible for cleaning, repairs, or removal; also economical, durable, and a rapid generator of steam. Of these boilers, nearly 50,000 horse-power have been sold, and are giving good satisfaction to the purchasers.

The next cut represents the Renshaw *Cast Iron Sectional Boiler*, constructed by Dougherty & Broome, New York, which embodies the possession of a perfect constellation of most excellent requirements as a generator of steam power, among others, complete immunity from explosion. As to the capacity, etc., of this boiler, limited space will only permit the insertion of the following valuable testimony, by Dr. P. H. Van der Weyde, the able editor of the *Manufacturer and Builder*: "We have had the pleasure of witnessing the rapidity with which steam may be raised in a boiler of this kind, in one rated at 25 horse-power, at the establishment of Messrs. Dougherty & Broome, 143-147 Bank street, New York. The fire was started while cold, and in half an hour there was a pressure of 70 pounds, and the engine started. As the water used was for the purpose of measurement inclosed in a tank of 2 by 4 feet, and 3 feet high, we could easily measure the evaporating capacity, and found it to be 600 pounds per hour, for which duty the furnace consumed 50 pounds of coal. This



THE RENSHAW CAST IRON SECTIONAL BOILER.

agreed with the testimony of the engineer, that ¼ ton of coal was used per day of ten hours, while it showed the capacity of the boiler and furnace to be the evaporation of 12 pounds of water with 1 pound of coal. This is a very high ratio, when we consider that theoretical maximum, when no heat whatsoever is lost, is 14 pounds of water for 1 of coal, (see "Theory of Steam-Engineering," on page 26 of our February number for this year)."

Proportion of Land Boilers—For each nominal horse power a land boiler requires: 1 cubic foot of water per hour; 1 square yard of heating surface; 1 square foot of fire grate surface; 1 cubic yard capacity; 28 square inches of flue area; 18 square inches of area over bridge wall.

For Cylindrical Double-flued Boilers—Length multiplied by diameter divided by 6 = nominal horse power.

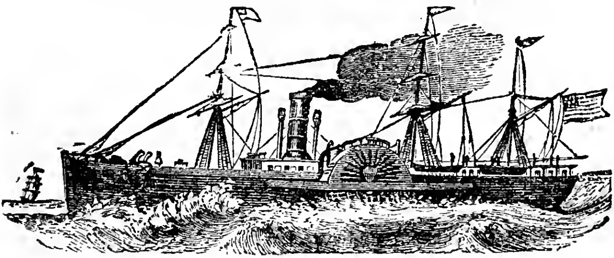
Tubular Boilers require for each Horse Power—1 cubic foot of water per hour; 10 square feet of heating surface; ½ square foot fire grate; 10 square inches sectional area of tube; 13 square inches flue area; 7 square inches chimney area; 8 cubic feet total boiler capacity; 2 cubic feet of steam room. Diameter of tubes 1-30th of their length.

The number of square feet of heating or flue surface required to evaporate a cubic foot of water per hour, which is equivalent to an actual horse power, is in different boilers as follows: *Cornish Boilers*, 70 square feet; *Land and Marine Boilers*, 8 to 11 square feet; *Locomotive Boilers*, 5 to 6 square feet.

Rule to find the Weight necessary to put on a Lever when the area of Valve, Lever, &c. are known.—Multiply the area of valve by the pressure in pounds per square inch; multiply this product by the distance of the lever from the fulcrum ; multiply the weight of lever by one-half its length (or its centre of gravity); then multiply the weight of valve and stem by their distance from the fulcrum ; add these last two products together, and subtract their sum from the first product, and divide the remainder by the length of lever ; the quotient will be the weight of the ball.—*Roper.*

Example:

Area of valve 7 sq. in. .	60 lbs.	9 lbs.	6 lbs.
Pressure . . 60 lbs. .	7 in.	12 in.	3 in.
	420 lbs.	108 lbs.	18 lbs.
Fulcrum 3 in.	3 in.	18 lbs.	
	1260	126 lbs.	
Length of lever 24 in. .	126 lbs.		
	24) 1134 lbs.		
Weight of lever 9 lbs.			
	47.25 lbs. weight of ball.		
Weight of valve and stem 6 lbs.			



Marine Engines.—*Duties to machinery when in Harbor before getting under Steam, by a Practical Engineer.* When an engineer takes charge of the machinery of a boat his first attention ought to be directed to his boilers; for, being the source of power, they may become the source of great danger if not properly looked after. In inspecting the boilers, three things require special attention. 1. The thickness of the plates above the fires and other places of importance. 2. The state of the stays. 3. The position of the gauges, viz.: the water gauge, cocks, and glass water gauges. Respecting the first, a general plan is to drill a small hole through the plate, and thus find its real thickness, for it is often the case that a boiler plate may be far thicker at the seams than in the middle. At the seams the proper thickness cannot always be correctly ascertained on account of the way in which they are caulked, by which a plate may appear considerably thicker than it really is. After the hole has served its purpose, it is tapped and plugged tightly up again.

As regards the stays, they require a great amount of attention; for they are very apt to get eaten through, near the plates by oxidation. The gauge cocks are often placed just above the highest row of tubes. Now this is a very dangerous practice, for it is possible for an engineer to lose his water, let him be ever so careful, when great danger follows; while if the cocks were placed a little higher, the loss of water would not be attended by so much danger.

Duties to Machinery when Steam is getting up. The water in the boiler when the fires are lighted ought to be just above the bottom of the glass. In a large or even moderate sized boiler, the water will expand, and there is also not so much water to heat at first; and we know, by reason of conduction and radiation, that small bodies of water are heated comparatively more rapidly than larger. On first lighting the fires they should not be kept too large, but just sufficient to cover the bars. A large thin surface of fire is found to be the most effective in getting under way. When the fires are lighted, and the steamer is going on a long voyage, it is the practice to rub the polished parts of the engine over with a composition of tallow and white lead. This prevents any rust forming on the rods, etc., from water dropping on them which may have been used for keeping the bearings cool.

The discharge valve is also opened now, or else on starting the engine something will give way. Several accidents have occurred by neglecting to do this.

The safety valves are now to be inspected to find whether they are fast or corroded to their seatings. If so, they must be freed and made ready to act before starting.

It is a good plan and one much practised, to give the engines a good blowing through whilst the steam is getting up. This warms the cylinder and tries any joints that may have been made since the engines were worked last. It also saves the steam, for if not done now (when the engine is starting) a great amount of steam is wasted in heating the cylinder, instead of imparting its elastic force to the piston.

Starting the Engines.—All steamships are now fitted with the double eccentrics or "Stephenson's Link Motion," by which the engines are started, or rather by this the slide valves are under the control of the engineer, and can be worked back or forward as command is given, by either a bar, lever, or generally, in large engines, by a wheel.

The handles, by which steam is turned on and off, with the injection cock handles, are placed beside the wheel, so that one man can now generally start the engine.

Some large ships have a steam piston so fitted that it rises and falls by steam admitted above or below, thus raising or lowering the link in its motion. This is what is called steam starting gear, and is very handy when the link is of great weight. There is always hand gear fitted as well, which can be used in cases of emergency. In giving injection to a common condenser, it should be opened just after the steam is turned on to the cylinders, or else if going slowly the condenser may become too full of water, and the air pump not able to perform its work properly.

In starting an engine that is fitted with surface condensers, the only thing requiring attention before going on, is to open both valves communicating with the sea above or below the condenser, viz.: suction to the circulating pumps and delivery from them.

Duties when under Steam.—Always keep looking at the water level. This is sometimes a source of great anxiety, for some boilers require the water to be kept at a certain fixed level. If water be too high they will not keep steam, and if too low the steam will generate too fast. Some boilers require a high water level: nothing but practice can determine it. A safe rule is to keep the glass gauge about two thirds full. Blowing out marine boilers should be practised every two or three hours. Practice has proved this to be a good rule, on account of not so much water being required to be blown out at a time, and therefore the steam pressure is not reduced to a very great extent.

In steamers fitted with surface condensers, a little sea water is supplied to the boiler to make up for the loss in the steam pipes, jackets, caps, in the condensers, etc. This in time may injure the boiler if not counterbalanced some way or other. The general rule is to blow out about two or three inches every twelve hours. The water in these boilers is never allowed to reach more than 2-30 of saltness.

The fires require much consideration. A furnace is best worked with a heavy fire, but not too heavy, thicker towards the back than front. The fresh fuel should be placed in front, and then pushed back after being thoroughly heated. Every four hours (at the least) the fires should be cleaned out, as large clinkers or refuse of the coals adhere to the fire bars and prevent the draught, making the fires burn dead, especially towards the back of the furnace. Sometimes the slag will stick fast to a furnace bar, and cannot be removed from it. This causes a great amount of trouble, as in trying to remove it, the fire bars are occasionally pulled out of their places, and the greater part of the fire falls through causing much waste and often danger.

The principal thing to pay attention to when the engines are under steam, is to keep the bearings cool and the glands steam tight. Oil is generally used for keeping bearings cool, but when larger ones are working hard, a jet of water is kept playing on them. This is found to answer very well when the water is turned on before they have had time to heat. It should not be used after they have been allowed to get heated, for it may crack them by too sudden contraction. A good stream of water should be kept running on the thrust block from the time of starting, this with the tallow, which is always put into it before starting, keeps this all important bearing cool. The cap of the thrust block requires great care in adjusting. If screwed on too tightly it is almost sure to heat, or fire as it is termed, and if not screwed down sufficiently tight the unpleasant jumping shake so often experienced in our screw ships is sure to follow. The packing of the gland at the stern tube should be well looked after, and kept quite tight and well tallowed.

In paddle-wheel steamers there is frequently not sufficient care taken about the outer bearings of the shafts. In very few ships are proper means provided for lubricating these important parts. At the commencement of a voyage, the outer bearings are well tallowed, and often put down, screwed up, and left to look after themselves as best they may. Very few ships, indeed, being provided with tubes leading down from the paddle boxes to the oil holes of the blocks, or in which means are provided for their lubrication.

The coals in the bunkers must be carefully watched, to prevent spontaneous combustion. The stoppers over the holes should be kept open as much as possible, and care taken not to keep damp coals longer in the bunkers than can be avoided; for it is only damp coal that is liable to spontaneous combustion.

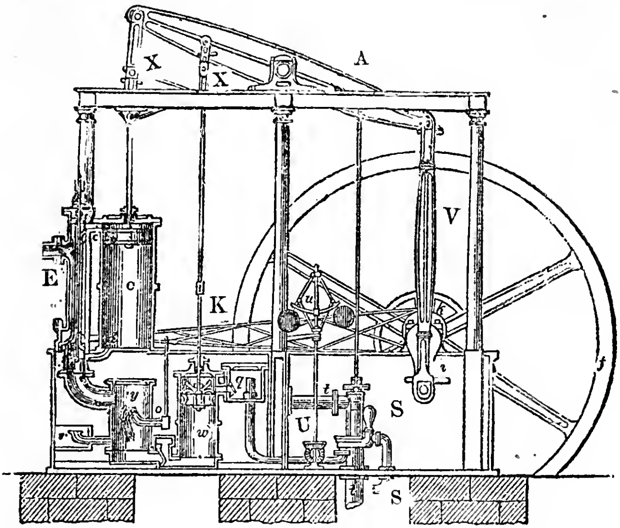
In new fast running engines, castor oil is a very good thing to use on first starting. When new brasses have been fitted into the bearings, till they form a good bearing for themselves, the same should be used. It appears to have a much finer body in it to lubricate than other oils have. The difference in the cost of the oil is not very much, coarse castor oil being very little dearer than good machine oil.

Duties to Machinery when the Ship has arrived in Port.—The white lead and tallow should be rubbed off with a piece of oily waste, and then the bright work of the engines will give no trouble by rusting. The engines should have a good blowing through to drive out all water in the condensers, then the Kingston's valves communicating with the sea, should be shut, next open the condenser drain cocks, which let out all water left in them. This is allowed to run into the bilges, which can be pumped out by the donkey pump, or the hand pump if no steam is left in the boilers.

Some engineers always blow out their boilers after steaming, others do not, the latter only let the fires out and shut the valves in the steam pipes; both plans have their advantages and disadvantages. Perhaps the majority keeps the water in the boilers, only blowing out when repairs or an examination of the boiler is required. An engineer should always examine for himself, whether all the fires are properly out, and not take the word of the stokers for it. A great amount of damage may be done by the fire not being properly put out in the ash pits. A frequent practice is to get a heap of hot ashes together and dash some water over it. This makes it black outside and leaves it burning inside. The ashes should rather be spread out evenly, and the water thrown over gradually and gently, to put out the fire effectually, and to create as little dirt and dust as possible.

To find the amount of Lap on the Slide Valves (before setting the slides). Take a batten of wood, and place it on the cylinder slide face at right angles to and over the ports. Mark off on it the edges of the steam and exhaust ports with a square and scriber. By placing this on the face of the slide valve, the amount of lap can at once be found.

To Set the Slides.—Put the piston at the top or bottom of its stroke. If the eccentric is rightly fixed on the shaft, simply fasten the slide valve on the spindle with the required amount of lead. Then turn the engine to the other end of its stroke, and see if the lead is the same; or in some engines more lead is given at the bottom than at the top (as in vertical engines). If the engine is fitted with the link motion, the reversing eccentric is then connected and the valve tested in like manner. Also with the link motion, the slide rod is placed in the centre of the link; and although the position of the eccentrics on the shaft ought to destroy any motion of the valve, yet there is a little with a short link. This is tested to see that the steam ports are always closed and thus the engines can be stopped, even if the full pressure of steam be admitted to the back of the slide by the stop or throttle valves.



PORTABLE CONDENSING STEAM ENGINE.

The above cut represents a portable condensing steam engine of a pattern quite common in Europe. A, Working-beam; *b*, Steam piston; C, Cylinder; *c*, Upper Steam port; *d*, Lower Steam port; E, Throttle valve; F, Fly-wheel; *i*, Crank; K, *k*, Eccentric and eccentric rod for working the steam valves; *l*, Steam valve and valve casing; *n*, Condenser; *o*, Injection cock; *q*, Hot well; *r*, Shifting valve to cause a vacuum in the condenser previous to starting the engine; S. S, Feed pump; *t*, Cold water pump for supplying the condenser cistern; *u*, Governor; V, Connecting rod; *w*, Air pump; X. X, The parallel motion; *y*, Condenser.

STERRO METAL.—Copper, 55 to 60 parts, zinc, 34 to 44 parts, iron 2 to 4 parts, tin, 2 to 4 parts. Sterro Metal is used for the pumps of hydraulic presses, &c. It is capable of withstanding a pressure of from 43,000 to 85,000 per square inch.

STEAM FIRE ENGINES are or should be constructed with steel boilers and blast tubes, copper tubes and large water spaces, together with a good fit out of gauges, safety valves, injectors, &c., with facility of getting up steam in from 6 to 10 minutes from cold water, and in about 5 minutes from water at 130°. These machines as now constructed are of great elegance and power, some of them having projected a continuous, solid stream of water over 300 feet, through 100 feet of hose, fitted with $1\frac{1}{2}$ inch nozzle. Steam pressure about 80 lbs. per square inch. The principle is that of a steam pump, being fitted with the usual air chamber to induce a continual steam. See diagram of fire engine with horses attached.

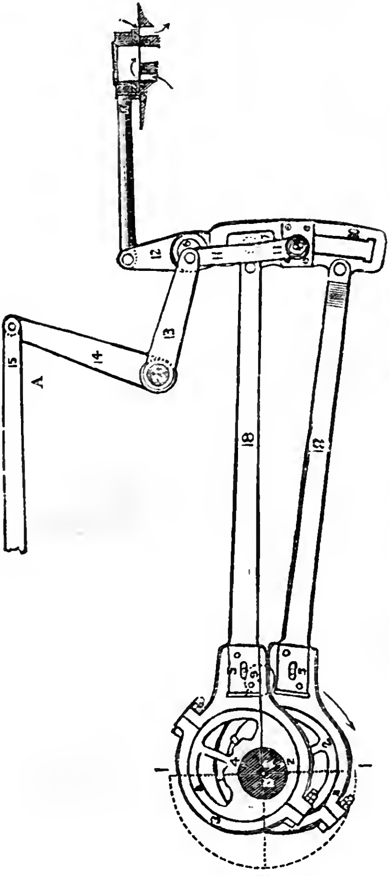
PORTABLE ENGINES are constructed as light as possible, consistent with proper strength of parts, in order to render them available for easy transportation. Sometimes they are mounted on wheels, and are in quite extensive use for driving light saw-mills, threshing, brick-making, pumping, chaff-cutting, &c.

CORNISH ENGINES.–Are usually single acting beam engines which use the steam at a very early "cut off," and only on one side of the piston, making great use of its expansive property, and are used entirely for pumping water in mines and cities. Steam is used in effecting the downward movement of the piston, being the stroke which lifts the water, the upward movement is caused by the weight of the plungers, rods &c., at the pump end of the beam. Cornish engines are usually very massive and powerful, but the first cost is enormous, and there is quite an outcry against them in some places.

In the line of pumping machinery, possibly the largest engines in the world are those doing duty at Haarlem Lake, Holland. The engines, three in number, drain a surface of 45.230 acres, an average lift of the water, depending on the state of the tides, being 16 feet. Each engine lifts 66 tons of water per stroke to a height of 10 feet; when pressed, each lifts 109 tons to that height. Running economically, each lifts 75,000,000 lbs. of water 1 foot high for 94 lbs. of Welsh coal. *Diameter of cylinders* (annular in form), 12 feet, with inner cylinders 7 ft. diameter.

INSTRUCTIONS TO ENGINEERS AND FIREMEN ON LOCOMOTIVES.—Keep the fire evenly and uniformly spread over the grate without elevations or depressions. Fire from large coal, as it leaves wider openings between the lumps for the admission of air, may be deeper than when the coal is small and lies close together. Remove all incombustible material and clinkers from the furnace as soon as possible, they prevent the draught from producing proper results. The bulk of fuel on the grate should always be in proportion to the quantity of fuel consumed. The dampers in the front and rear of the ash-pan regulate the draught admitted to the furnace, and require very careful attention, as the stream of air issues with a velocity of 72 ft. per second when the dampers are open and train under full headway. At a speed of 60 miles per hour the pressure of the current of air amounts to 9 lbs. on every square foot. One ton of bituminous coal requires 300,000 cubic feet of air for its combustion, of which 100,000 is required to consume the gases evolved from it. Anthracite coal requires 310.480 cubic feet of air per ton for its combustion. It burns without smoke, requires a good supply of oxygen and intense heat to burn it, but makes a very fierce fire. Good practice requires complete combustion of the carbon and hydrogen available in the fuel; insufficent air causes a dense black smoke to issue from the chimney, and the loss of heating effect, and too much air, lowers the temperature of the flame and dissipates the heat. Of good coal, 62.2 per cent. go to form steam, and 1 lb. will in good practice evaporate 7½ lbs. of water. In practice the greatest evaporative power of 1 lb. of coke is 9½ lbs. of water, in common practice it is 8½ lbs. and 78 per cent. of its products go to form steam, 22 per cent. being lost by products of combustion, ashes, etc. The heating power of coke as compared with that of coal is in the proportion of about 14 : 12. The temperature produced by the combustion of coke in the hottest part of the fire box, may be estimated at 1666° Centigrade. The temperature produced by wood is usually less than 1111° Centigrade, (100° Centigrade is equivalent to 212° Fahr). The proper combustion of coal requires the admission of air both through and above the grate, the right proportion depending upon the percentage of the gaseous components in the coal: In the combustion of coke the air may be admitted through the grate only, 1 lb. of coke requiring about 200 cubic feet of air. For receiving the best effects from the fuel, the emission of the gases from the furnace should be retarded, in order to promote complete combustion under high temperature, for this reason the grate surface should be as large as possible to induce a slower current, and the weight of the steam exhausted and the air inhaled should be in every case, the same. For the prevention of smoke, engineers usually rely on the damper, the ash pan and the fire door, with careful stoking. They endeavor to prevent the formation of smoke by controlling the admission of air through the grate, adjusting it exactly to the demands of the fuel, also by the fire door for the admission of air above the fuel, by firing with large pieces of coal, and deep fires for heavy duty, and smaller coals with shallow fires for lighter duty, by firing more frequently to lighten the duty, and at all times by keeping the bars covered with fuel to prevent excessive local draughts through the grate. Fresh coal should be thrown on under the fire door directly inside, and, when partly burned, pushed forward towards the tubes; but when the grates are inclined, it will work downwards by gravitation. Never fill a *hot boiler* with *cold water*, and always allow it to cool off before running the water out; never blow out a boiler while hot, under any circumstances, as the heated plates will be sure to bake the deposits of mud into a compact scale of great tenacity ; if allowed to cool, these deposits will settle down in a soft mass easily swept out with a hose and water. Frequent duty should be made of washing out all deposits of foreign matter from the barrel of the boiler, the tubes, and from the crown sheets between the crown bars, especially while using bad water, and after heavy rains ; and screw-plugs, made of hard brass, should be fitted to every boiler near the sides of the fire box, to permit the use of a hose with water for this purpose.

To avert danger from intense heat, to save fuel, and keep up a free circulation, engineers should adjust the injector so that the boiler will lose a little water while running between stations, if the injector is kept at work during stoppages, this loss will be compensated, and a full supply always kept up, absorbing the surplus heat and preventing explosion. Incessant watchfulness is necessary to look out for impending danger in every possible direction, and no engine driver, while on duty, should relax his energy, care, caution, watchfulness, decision, and presence of mind for a single moment. If vigilance and endurance were ever necessary in any business or calling, most certainly they are of paramount importance in this above all others. See that the safety valves are properly acting, and that



The Double Eccentric, Link, and Valve Motion.

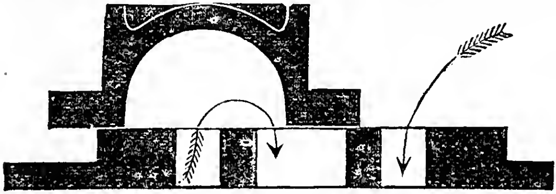
PARTS NEXT DRIVING AXLE, OR CRANK SHAFT, (D S) 1 1 1 shows the positions of the Crank at full and half stroke. 2 2 Eccentrics. 3 3 Eccentric straps. 4 2 Angular Advance. 5 5 Stub ends of eccentric rods. 9 Crank pin. 18 18 Eccentrics. PARTS NEXT LINK.—6 Rocker shaft. 7 Link block. 8 Saddle or Link pin. 10 Link. 11 11 Lifting link. 12 Outside rocker. 13 Lifting arm. 14 Reverse arm. 15 Lever or reach-rod connected with the quadrant or sector in the Cab. 17 Rod working slide valve. 18 18 Eccentric rods. 20 Reverse shaft. If the reverse-arm, 14, is drawn towards A, by the lever or reach-rod controlled by the engineer, the link will be elevated to the block, which will change the position of the valve, and reverse the engine.

the indications of the steam gauge are correct. In experiments made with a locomotive boiler, the fire being kept regular, and the engine at rest, in 9 minutes the pressure increased from 32 lbs. to $74\frac{3}{4}$ lbs. per square inch, being much more than double, a most surprising increase, and one which will enable us to account for many explosions which have happened while engines were at rest.

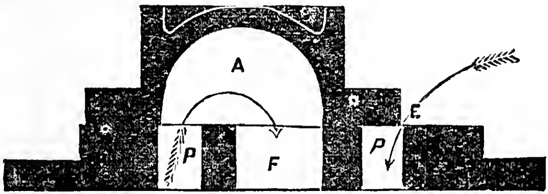
Pay the closest attention to the cylinder and piston rod packing, and exercise judgment and care in selecting the best kinds and also in applying them when selected. Use due precaution against making mistakes either in packing too tight or too loose, as each extreme in its degree is productive of much mischief, waste, and loss of power. It requires the exercise of considerable intelligence and care to make the best possible adjustment of either spring or steam packing.

Equal vigilance is necessary in guarding against incrustation and scale in boilers. In order to raise steam to a pressure of 120 lbs. to the square inch, a very common pressure in locomotive boilers, the water must be heated to a temperature of 345°. This involves a high temperature in the furnace plates and other parts of the boiler, imposing a very severe duty at any time, but doubly destructive in the event of the existence of incrustation or scale.

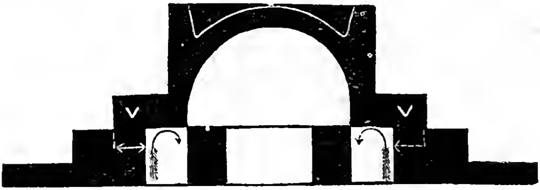
The annexed figures are inserted with a view to render assistance in adjusting the valves of locomotives. The first diagram represents the



position of the valve as it should be when at half stroke, The second figure indicates the proper position of the valve when at the end of its stroke with the crank at the dead centre. A represents exhaust cavity



in valve. F ditto in valve seat. P P steam ports. E lead. The third cut represents the position of the valve when the link is exactly under the saddle-pin and the reverse latch in the outer notch in the quadrant or sector. V V shows the lap. *Full steam* is the position of the valve when fully open, and the engine in motion. *Cut-off* is the position of the valve when it has just closed the port against the admission of steam. *Angular Advance* is the angular measurement of the arc described by the centre of the eccentric while passing from the place it occupies when the valve is at half stroke, to that which it occupies at the commencement of the stroke of the piston. *Linear Advance* is the distance which the valve moves while the centre of the eccentric in describing the above angle. See diagram of *Eccentric, Link and valve motion*

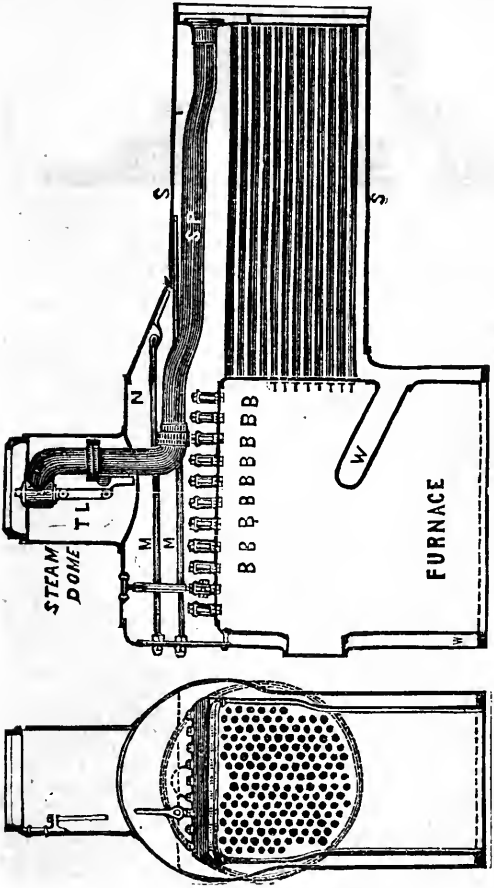


A majority of railways allow for the *travel of valves*, on *Express Passenger Engines*, 5 inches, for outside lap, $\frac{7}{8}$ inches, for inside lap, $\frac{1}{8}$ inch. for lead in full gear 1-10 inch. *On Express Accommodation Engines*, for travel of value, 5 inches, for outside lap, $\frac{3}{4}$ inch, for inside lap, $\frac{1}{8}$ inch, for lead in full gear, 1-10 inch. *On Heavy Freight Engines*, for travel of valve, 5 inches, for outside lap, $\frac{3}{8}$ inch, for inside lap 1-16 inch, for lead in full gear 1-16 inch.

Power of Engines.—Horse-power in steam engines is calculated as the power which would raise 33,000 lbs. a foot high in a minute, or 90 lbs. at the rate of 4 miles an hour. One-horse power is equal to the lifting, by a pump, of 250 hogsheads of water ten feet in an hour. Or it would drive 100 spindles of cotton yarn twist, or 500 spindles of No. 48 mule yarn, or 1000 of No. 110, or 12 power looms. One horse power is produced by 19 lbs. of Newcastle coals, 50 lbs. of wood, or 34 lbs. of culm. Coals 1, wood 3, and culm 2, give equal heats in the production of steam.

Sixteen lbs. of Newcastle coal converts 100 lbs. of water into steam. A bushel of coal per hour raises steam to 15 lbs. the square inch, whose velocity is 1350 feet per second, and 2 bushels raise it to 120 lbs., or velocity of 3800 feet per second. A horse-power requires from 5 to 7 gallons of water per minute for condensation of steam. A steam engine whose cylinder is 31 inches, with 17 double strokes per minute, performs the constant work of 40 horses with 5 tons of coal per day. One of 19 inches and 25 strokes, of 12 horses, with $1\frac{1}{2}$ tons per day. They raise 20,000 cubic feet of water 24 feet for every hundred weight of coals. One bushel of good coals raised from 24 to 32,000,000 lbs. one foot per minute. Four bushels of coal per hour with cylinder of $31\frac{1}{2}$ inches and $17\frac{1}{2}$ strokes of 7 feet per minute, is a force equal to 40 horses constantly. A rotative double engine, with a cylinder of 23.75 inches, making 21.5 strokes of 5 feet per minute, is a 20 horse-power ; and a cylinder of 17.5, making 25 strokes of 4 feet, is a 10 horse-power ; the consumption of coals being proportional.

Proportion of Locomotive Boilers, &c.—Boiler sheets, best cold blast charcoal iron $\frac{3}{8}$ in. thick, or best cast steel 5-16 in., double rivets along horizontal seams and junction of fire box to be double riveted. *Waist* formed of 2 sheets rolled in the direction of the fibre of the iron or steel. One longitudinal seam in each, above the water line to be double riveted. All iron sheets $\frac{3}{8}$ in. thick, riveted with $\frac{3}{4}$ inch rivets placed 2 inches from centre to centre. Steel plates 5-16 in. thick riveted with $\frac{5}{8}$ inch rivets, placed $1\frac{7}{8}$ inch. from centre to centre. Extra welt pieces, riveted to side of side sheets, giving double thick-



Wagon Top Locomotive Boiler.

B B Crown-bars. T T T Tubes. S P Steam pipe. W W Water. S Shell. T L Throttle lever. M Braces. N Steam space. End view of boiler is shown at left side.

ness of metal for stud bolts and expansion braces. *Furnace Plates*, if of iron, 5-16 inch, if of copper ½ in., if of steel, crown sheets, ⅜ in., side and back sheets (steel) 5-16 in., flue sheets (steel) ½ in., water space 3 ins., sides and back, 4 ins. front. *Stay Bolts*, ⅞ in. diam. screwed and riveted to sheets, 4½ in. from centre to centre. *Crown Bars*, made of 2 pieces of wrought iron 4½ in. by ⅝ in. set 1½ in. from centre to centre, and secured by bolts fitted to taper holes in crown-sheets, with head on under side of bolt and nut on top, bearing on crown bar. *Crown Sheets* braced to dome, and outside shell. *Furnace Door* opening formed by hanging and riveting together the outer and inner sheets. *Tubes*, 11 feet long, and 2 in. diam. set in vertical rows ⅞ of an inch apart, give the best results. *Grate Bars*, for burning wood or soft coal, should have ½ in. openings. *Smoke Stack* for wood burning engines should have the "bonnet stack," from 5 to 5½ ft. diam. at top, with wire netting; for engines burning soft coal, a much smaller area of cone is required; but for engines burning anthracite coal, use a plain open stack without cone or netting. *Safety Valves*. Every locomotive should be provided with two safety valves fitted to brass seats, and secured by springs of sufficient elasticity to allow a lift of the valve adequate to permit the emission of all the steam the boiler will generate after it exceeds the maximum pressure. The bearing or mitre on the valve face should not exceed ⅜ in. *Mud Plugs* should be provided on the side of the shell on a level with the crown sheet. To avoid weakening the boiler, rivet a welt on the inside of the shell in the line of the holes. *Steam Room*, 6 to 7 cubic feet per square ft. of growth surface. Good work has been obtained from boilers possessing 1 cubic foot of steam room to 1 square foot of water surface, and a water surface 1-13 that of heating surface.

AVERAGE PROPORTION OF THE VARIOUS PARTS OF LOCOMOTIVES.—*Cylinders* of locomotives vary in size, ranging all the way from 8 in. up to 20 in. diam. *Crank Pin* should be ¼ the diam. of cylinder. *Valve Stems* should be 1-10 the diam. of cylinder. *Piston Rods* should be ⅙ the diam. of cylinder. *Pump Plunger* should be 1-9 the diam. of cylinder. *Main Steam Pipe*. Area should be from ¼ to ⅓ the diam. of cylinder. *Steam Ports*. Area should be 1-12 the area of cylinder. *Exhaust Port*. Area should be equal to ⅓ the area of cylinder. The *width of bridges* for different sized cylinders of locomotives vary from ⅝ to 1¼ inches. *Chimney*. Height should not exceed 14 ft., diameter a little less than the diam. of cylinder. *Diam. of Boilers* vary from 3 ft. to 4 ft. 3 in. *Tubes* vary in number from 100 to 220, top row should be 8 inches under water. *Heating surface*. Total should be from 1000 to 1500 square ft. *Fire Grate Surface* ranges from 12 to 30 sq. ft., usual rule 15 sq. ft., with about 90 sq. ft. of heating surface in fire box. *Evaporative Power* should range from 100 to 200 cubic ft. of water per hour. *Proportion of heating surface to each sq. foot of grate*, should be from 68 to 80 feet. *Petticoat Pipe* should be ¾ the diam. of the inside pipe of the stack. *Ash Pans*, should be 9 inches below bottom of grate for wood burning engines, 10 in. for soft coal, and 12 to 14 in. for anthracite coal burners, and should be as nearly air tight as possible when dampers are shut. *Dampers*, should when shut stand at an angle of 35° from perpendicular. *Smoke Box*, diam. should equal diam. of boiler, length from flue sheet to inside of front door 1¼ times the length of the stroke of the engine. *Tires*, when new $2\frac{1}{2}$ to $2\frac{5}{8}$ in. thick, must not be worn down to less than $1\frac{1}{4}$ to $1\frac{1}{2}$ in. Wrought iron tires wear about 1-12 of an inch per annum. (*For further details see page* 413.)

RULE TO FIND THE HORSE-POWER OF A LOCOMOTIVE.—Multiply the area of the piston by the pressure per square inch, which should be taken as $\frac{2}{3}$ of the boiler pressure; multiply this product by the number of revolutions per minute. Multiply this by twice the length of the stroke in feet or inches; if in inches they must be divided by 12), multiply this product by 2 and divide by 33,000; the result will be the power of the locomotive.—*Roper.*

EXAMPLE:

Cylinder	19 inches
Stroke	24 ,,
Diameter of Drivers . . .	54 ,,

Running Speed, 20 miles per hour.
Area of piston, 283.5 square inches.
Boiler pressure, 130 lbs. per square inch.
Maximum pressure in cylinders, 80 lbs.

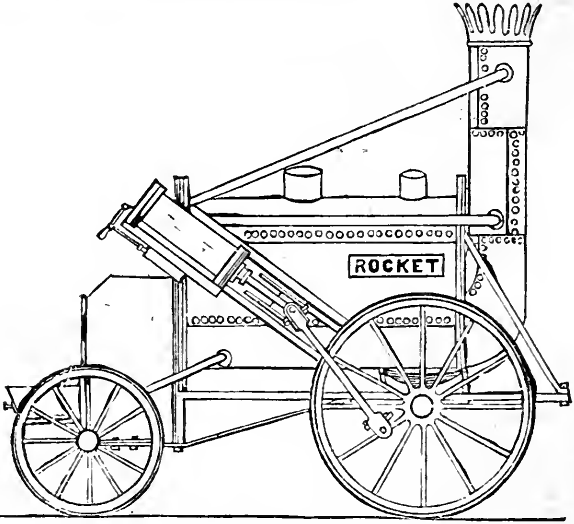
$$\frac{283.5 \times 80 \times 4 \times 124 \times 2}{33,000} = 681.6 \text{ horse-power.}$$

STEPHENSON'S "ROCKET."—The annexed figure represents the "Rocket" as it appeared when it ran in the memorable Rainhill competition, in 1829, and gained the prize of £500 offered by the directors of the Liverpool and Manchester Railway. The stipulations were: (1.) That the engine should consume its own smoke; (2.) If the engine weigh 6 tons, it must draw after it 20 tons, 10 miles an hour; the pressure on the gauge not to exceed 50 lbs.; (3.) There must be 2 safety valves, the engine and boiler must be supported on springs and rest on 6 wheels, the height of the whole not to exceed 15 ft. to the top of the chimney; (4.) It must not weigh more than 6 tons, less weight preferred, which may draw a less weight behind it, then it may have 4 wheels; (5.) The price not to exceed £550.

Dimensions—Boiler. Cylindrical in form, length, 6 ft., diam. 3 ft. 4 in. *Cylinders*, two, diam. 8 in., stroke $16\frac{1}{2}$ in. *Weight of Engine*, 4 tons, 5 cwt. with water in the boiler, with loaded tender 7 tons, 9 cwt. *Chimney*, diam. 12 in. *Heating surface*, $117\frac{3}{4}$ square ft. The boiler contained 25 copper tubes, 3 inches in diameter; the use of those tubes with coke for fuel, gained Stephenson his victory, and established his fame. The cylinders were set inclining to the rails at an angle of 45°, this proved a poor arrangement, as the jolting motion slightly lifted the boiler up and down on the springs. *Driving Wheels*, diam. 4 ft. 8 in. *Highest Speed during trial*, 24 miles per hour, for a distance of $1\frac{1}{2}$ miles. The "Rocket" with all its defects, was a great improvement on Stephenson's first engine constructed at Killingworth, in 1814, and used to "lead coals" from the pit, the motion being transmitted to the wheels by the intervention of cranks and toothed gearing.

There is a vast contrast between the "Rocket" and locomotives of recent construction. Some freight engines are now in use, which weigh 66 tons, having 4 cylinders and 12 coupled driving wheels. Some have cylinders 20 in. diam., with 26 inches stroke, others have driving wheels 9 ft. diam., cylinders 18 in. diam., and 24 inches stroke.

English express engines have attained a speed of 73 miles per hour, between Holyhead and London,

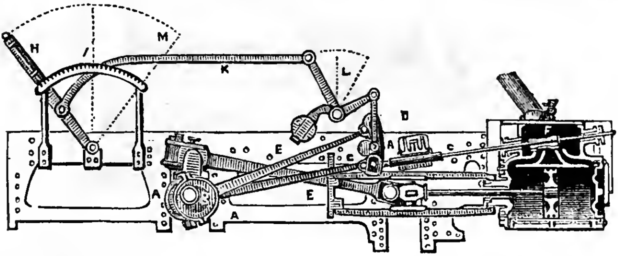


The illustrious Stephenson is well deserving of double honor as the worthy champion of the loftiest description of mechanical progress, at a time when it might truly be said that he was opposed by almost the entire nation. In interference with the old state of affairs nearly every one, high and low, seemed to see visions of bankrupt coach companies, deserted hotels, ruined landlords, roads overgrown with grass, buildings and mansions burned to the ground by flying sparks from the engine, commerce ruined, and man and beast everywhere run over and crushed under the car wheels. During Stephenson's memorable examination before the committee of the House of Commons, one of the questions put to him was—"Would it not be an awkward thing for an engine to run over a cow?" The honest Northumbrian's reply is well known, "Yes, it would be awkward for the coo."

FIRE CEMENT.—Fire clay, wet, 100 parts, white lead, 3 parts, powdered asbestos, ½ part, mix all together and use as mortar.

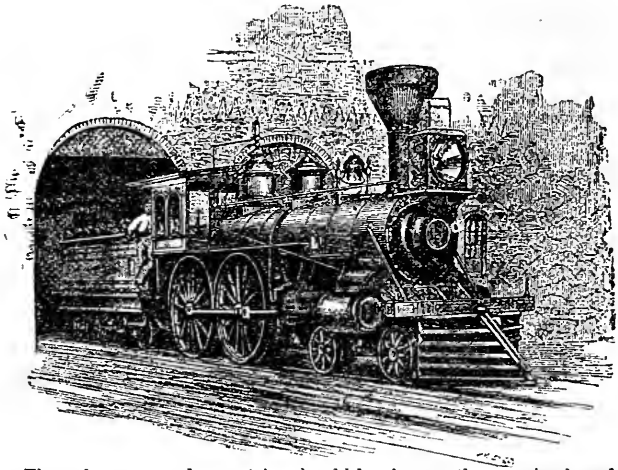
RAILWAY TRAIN SPEED TABLE.—A train going 1 mile an hour travels one and seven-fifteenths—say one and a half foot per second. To form a table of speed from these data is a mere matter of multiplication. Example:—A train going 70 miles an hour travels per second 1 and 7-15 ft. multiplied by 70=102 and two thirds feet

THE STEPHENSON LINK AND VALVE GEAR OF 1833, shown in the cut, differs but little from the arrangement of the present day, as exhibited on page 402. In the sketch, A A represents the eccentrics keyed on the driving-shaft B, C is the link, and D the "strap-link" connected with the eccentrics by the rods E E, as shown in cut, F is the valve and G the valve-rod working slide-valve and connected with link-block. The elevation or depression of the link, necessary to induce a backward or forward movement of the engine, was effected by a lever handle H, fitted with a catch which could be dropped into a series of notches in the sector I; this lever-handle operating by means of the reaching-rod K, and the counter-weighted bell-crank L, had



the effect of bringing the pin on the link-block connecting with the valve-stem into operation with either eccentric as the forward or reverse movement of the engine might require. The lever as shown at H, shows the link in full gear for reversing; at I (mid-gear) steam would be shut off, as the valve would cover both steam-ports; at M the lever would be in full-gear for running forward, and in intermediate positions between mid-gear and full-gear the effect would be more or less expansion of the steam, but never the full power.

The locomotive, with its entire connections and surroundings, should, while on the road, be the object of a care and vigilance which knows no weariness. Before starting from a station, the engine should be closely inspected to be sure that all is right; the boiler should be well replenished with water, and a good surplus stored in the tank. The injector should be closed before starting, and while ascending grades, but should be opened to admit feed water during stoppage, or while descending a down grade if required, and fuel may be added at the same time. In descending down grades, the steam should be either partially or entirely shut off, and the engineer should, like a trusty sentinel, be always at his post, with his hand on the lever, and with all the faculties of his body and mind on the alert, ready to act in response to signals, or on the first intimation of danger in any of its varied forms. Modern improvements have rendered it an easy matter to stop an engine at very short notice, although it sometimes happens, on critical occasions, that some of the most powerful patent brakes have proved inoperative, owing to complicated or imperfect mechanical adjustment. Broken rails, more especially during winter, in cold climates, like that of Canada and Russia, are a fertile cause of numerous disasters, severe loss, and much solicitude and anxiety to the engineer. The frequency of these breakages always increases in proportion with the rigor of the climate.



The valve gear and eccentrics should be frequently examined, and if found defective in any way, no time should be lost in adjusting them by following the directions given elsewhere. Use clean water; by so doing much trouble and danger will be averted. Keep the tubes well swept, and if one should burst, plug both ends of it with as little delay as possible; if impeded by the emission of steam or water, an ample supply of cold feed water will decrease the pressure and permit work. If the leak is very serious, it would be the best plan to quench the fire in order to secure proper access to repair the defective tube. Every engineer should make a point of having on hand all those appliances which experience has shown to be necessary for use during possible emergencies, such as plugs for the tubes, screw jack, wrecking tools, wrenches, hammers, signals, wedges, files, rope, buckets, chisels, waste, oil, tallow, &c.

RAILWAY SIGNALS.—A red flag by day, or red light by night, is a signal of danger. Hoisted at a station it is a signal for a train "to stop." Hoisted by the road side, it is a signal of danger on the train ahead. Carried unfurled on an engine, it is a warning that another engine or train is on its way. One short sound of the whistle is the signal to apply brakes; two, to let them go; three, to back up; four, to call in the flagmen; five, for road crossings.

A sweeping parting of the hands on a level with the eye is a signal to go ahead. A downward motion of one hand, with extended arm, to stop. A beckoning motion of one hand, to back.

A lantern raised and lowered vertically, is a signal for starting; when swung at right angles, or across the track, to stop; when swung in a circle, to back the train.

One stroke of the alarm-bell signifies stop; two, to go ahead; three, to back.

SPEED OF PASSENGER TRAINS.—In the United States, the Newspaper Express train, between New York and Philadelphia makes the daily trip of 93 miles in 1¾ hours, inclusive of four stoppages.

The most remarkable feat of railway travel on record, was accomplished June 4, 1876, by a fast special train, which made the journey from New York to San Francisco, a distance of 2900 miles in 26 minutes less than 84 hours, being at the rate of 40 miles per hour.

Regarding English railways, the following table embraces an enumeration of trains which run over 60 miles without stopping, shows the distance run, and the average speed per hour. It will be seen that the London and Northwestern run the longest distance without stopping, as their engines suck up water on the way while running at full speed. The fastest is the 11.45 A. M from Paddington over the Great Western, which runs from London to Exeter, 194 miles in 4¼ hours on the "broad gauge." The Great Northern, though running on the "narrow gauge," maintains an average speed of more than 50 miles per hour, and the 10 A. M. Express from London to Edinburgh, called by some of the country people the "Flying Scotchman," travels 188½ miles in 4½ hours, from London to York. The Great Northern R., with their new engines, having 8 ft. driving wheels, sometimes attains 51 miles per hour.

		Distance.	Average speed per hour.
London to Swindon (Broad Gauge Express)	G. W.	77¼	53¼
London to Peterborough..................	G. N.	76¼	50¾
York to Newcastle........................	N. E.	87	49¾
Grantham to York........................	G. N.	83	47½
Newcastle to Berwick.....................	N. E.	66¾	47
New Cross to Canterbury..................	S. E.	77	46¾
Carstairs to Carlisle......................	Caledonian	74¾	45⅓
Oxford to London.........................	G. W.	63½	44¾
London to Dover	S. E.	78	44⅓
Rugby to Crewe...........................	L. & N. W.	75¼	44
London to Rugby..........................	L. & N. W.	82¾	43¾
Kentish Tn. to Wellingboro'...............	M.	62	43¾
Holyhead to Chester......................	L & N. W.	85	40¾
Wigston to Luton.....	M.	61½	40⅓
Carlisle to Preston........................	L. & N. W.	89	38⅔

Besides the above, there are well attested cases of passenger trains running 78 miles per hour with 16 coaches attached, and even as high as 84 miles per hour have been attained.

THE FOLLOWING TABLE EXHIBITS THE EFFECTIVE ADHESION OF LOCOMOTIVES PER TON DURING DIFFERENT WEATHERS, ON THE RAILS:

	Lbs.		Lbs.
During frost or snow.......	200	During damp weather..........	400
During misty weather......	350	During fine dry weather.......	760
During wet rainy weather..	600		

The adhesion of a locomotive with 4 wheels, compared with one having 6 wheels, is in the proportion of 5 to 8.

Experiments have demonstrated that trains (properly fitted with good brakes), moving at the rate of 33 miles per hour, can be stopped within a distance of 57 yards, and within 273 yards if moving at the rate of 60 miles an hour, the resisting power of brakes being about 129 lbs. per ton of train. Resistance caused by defects of roads vary from 5 to 40 per cent., and strong side winds resist to the extent of 20 per cent. Resistance increases with the speed in about the following ratios :—

Speed of Trains in miles per hour....	10	15	20	30	40	50
Resistance on level railway in lbs. per ton........................	8¾	9½	10½	13¼	17½	22¾
Resistance on irregular or curved road and high winds....................	13¼	14¼	15¾	20¼	26¼	34¼

EFFECTIVE PRESSURE OF STEAM ON PISTON, with different degrees of expansion, boiler pressure being assumed at 100 lbs. per square inch.

Steam cut off at ¾ of stroke = 90 effective pressure.
" " " ⅔ " " = 80 " "
" " " ½ " " = 69 " "
" " " ⅓ " " = 50 " "
" " " ¼ " " = 40 " "

In experiments with Locomotive No. 47, North London Railway, it was found that in two 17 inch cylinders, 24 ins. stroke, lap of valve, ⅞ in., lead, ½ in., position of gear, 4th notch from middle gear, drivers, 5 ft. 6 ins. diam., with boiler pressure 160 lbs. per square inch, the actual horse-power of both cylinders was............... 840.552
That the friction of both valves was.................. 54.952
" " " eccentrics.................. 74.326

Total friction of valves and eccentrics.......... 129.251
or 15 per cent. of the power of the engine required to move them.

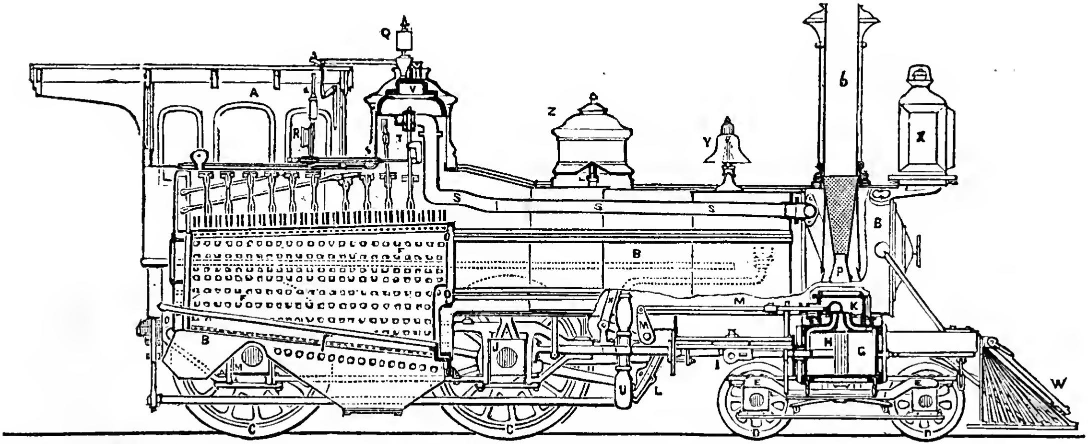
REVOLUTIONS OF DRIVING WHEELS PER MILE.

Diam. in ins.	Rev. per mile.	Diam. in ins.	Rev. per mile.	Diam. in ins.	Rev. per mile.
42	480.4	54	373.5	66	306
43	469	55	367	72	280
46	439	60	336	78	258.6
48	420	62	325.4	81	249
50	403.5	63	320	84	240

The average life of a car wheel under a load of 3½ tons, is 45,000 miles. The weight of iron rails per mile varies from 78 tons, 11 cwt., 48 lbs., to 157 tons, 3 cwt., 84 lbs., according as the rails range from 50 lbs. to 100 lbs. weight to the yard.

No. of 15 ft. rails per mile,	704	No. of 18 ft. rails per mile,	587
" 16 ft. " "	660	" 20 ft. " "	528

A rise of 60° in the temperature of a 25 ft. rail lengthens it to 25 ft. ⅛ in. The last table refers to No. of rails required for single track.

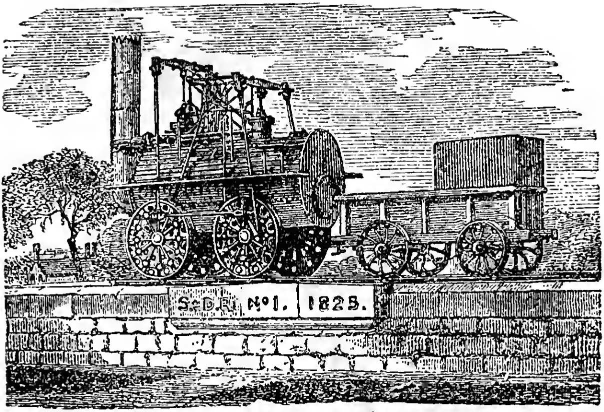


BALDWIN STANDARD PASSENGER ENGINE, SECTIONAL VIEW.—Weight of Engine 63,100 lbs. In the sketch, A represents engineer's cab; B B B the boiler; shell of boiler is 49¼ ins. diam. and 20 ft. 2½ ins. long; C C Driving wheels 4 in number, diam. 5½ ft.; weight on do. 39,000 lbs. D D Truck or bogie wheels, 4 in number, weight on do. 24,100 lbs, E E Carrying truck. F F Fire-box or furnace, showing tubes O O: the grate surface is 15½ sq. ft.: heating surface 1,058 sq. ft., the fire-box (of steel plates) is 6 ft. 2 ins. long outside, 3½ ft. wide, and 5 ft. 4 ins. high; the tubes (of iron) are 142 in number, 2½ ins. diam. and 11 ft. 7 ins. long, extending from the furnace through the boiler to smoke chamber. G Steam Cylinder, (the cylinder on left side is not shown) 17 ins. diam. and 2 ft. stroke of piston. H Piston, I Cross-head, connecting piston to crank shaft J by means of connecting rod. K Valve chest containing valves: the valves are 16½ ins. wide by 8½ins. long; travel of valve, 5 ins.: outside laps of valves, ¾ in., inside, 1-64 in.: the steam ports are 15 15-16 ins. wide and 1¼ins. long, the exhaust post 15 15-16 by 2½ ins. Throw of eccentries 4 1-8 ins. L Link, which with the valve gear M M operates the valves in valve-chest. *X* Lever or reaching-rod, operated by engineer in cab, for raising or depressing link L. P Cone-shaped exhaust-pipe for intensifying the draught. Q Whistle, R Steam gauge, S S S Steam pipe conveying steam from steam-dome T to operate valves in valve-chest K. T Steam-dome for supplying dry steam: outside diam. 30 ins. U Pump, 2½ ins. diam.; stroke 2 ft., is used with a No. 8 Gifford injector, for supplying feed water to engine. V Safety-valve, W. Cow catcher. X Head-light, Y Sand-box, Z Engine bell, *a* Spring balance for adjusting pressure of steam. *b* Smoke-stack, outside diam. 14½ ins. A first class passenger and express engine, exerts the ability to draw a train weighing 150 tons at a speed of 60 miles per hour: nominal power, 800 horse, closely approximating to 1200 actual horse-power.

A STANDARD FREIGHT ENGINE weight 68,500 lbs.; has 6 driving wheels 54⅛ ins. diam. which carry 48,000 lbs. of the load, leaving 20,500 on the truck. *Steam Cylinders* are 18 ins. in diam. with 22 in. stroke of piston. *Boiler* is about the same size as the last noted, and contains 119 tubes, 12 ft. 9 9-16 ins. long, and 2¼ ins. diam., stroke, 22 ins. For details as to proportion of locomotive engines, see Table on page 391.

GEORGE STEPHENSON,
THE FIRST LOCOMOTIVE ENGINEER,
Born June 9, 1781. Died August 12, 1848.

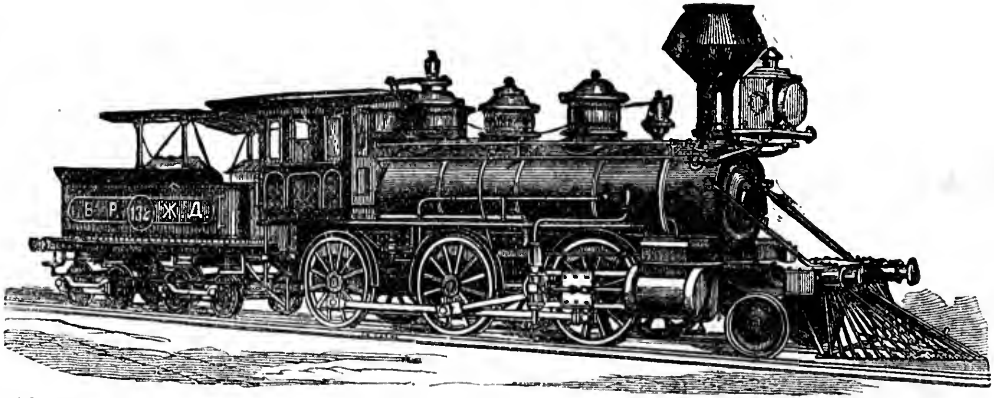
The iron energy, indomitable perseverance, sterling integrity, and thorough practical sagacity for which this Father of Railways was noted, have indelibly enrolled his honored name among the benefactors of the race. Of the first railway, that between Stockton and Darlington, George Stephenson was both surveyor and contractor, laying out every foot of the road, and taking the sights through the spirit level with his own hands and eyes. On his persistent recommendations, the intended plan of a wooden tramway was set aside and iron rails substituted, and reluctant permission given him to place upon the road, which had been intended only for horse-draught, a steam locomotive. The trial day was fixed for the 27th of September, 1825, which may be regarded as the natal day of railway travel. A great throng of people was present to witness the new-fangled and much ridiculed affair, the multitude being ready to applaud the suc-



ENGINE NO. 1.—STOCKTON & DARLINGTON R. R.—1825.

cess or deride the failure of the man whom they were equally ready to canonize as the wisest, or condemn as the craziest man in England. The veteran was fully prepared to withstand the ordeal. A long procession of vehicles was formed, consisting of 6 wagons, loaded with flour ; a covered coach, containing directors and passengers ; 21 coal wagons, fitted up for and crowded with passengers. Locomotive engine No. 1, represented in the cut, driven by our hero, headed the procession, which was preceded by a precursor on horseback, who rode before to herald the coming of the train, the velocity of which was not expected to exceed 4 or 5 miles an hour. But different results followed. An immense multitude of people, both on horseback and on foot, accompanied the train, but not long ; they were soon distanced, the man on horseback who heralded was compelled to leave the track, and the first train that ever carried passengers finished its journey at the rate of 12 to 15 miles an hour. The load carried amounted to 90 tons, including 450 passengers. The railway passenger coach which formed part of the procession was totally unlike anything now in use, and was drawn by horse power. It was several years before passengers were drawn over the road by steam (the traffic being confined to freight only), as the terror inspired by the locomotive was such that the Liverpool & Manchester R. R. Committee pledged themselves not to require any clause empowering its use, and as late as 1829 the Newcastle and Carlisle Act was conceded on the express condition that it should not be worked by locomotives, but by horses only.

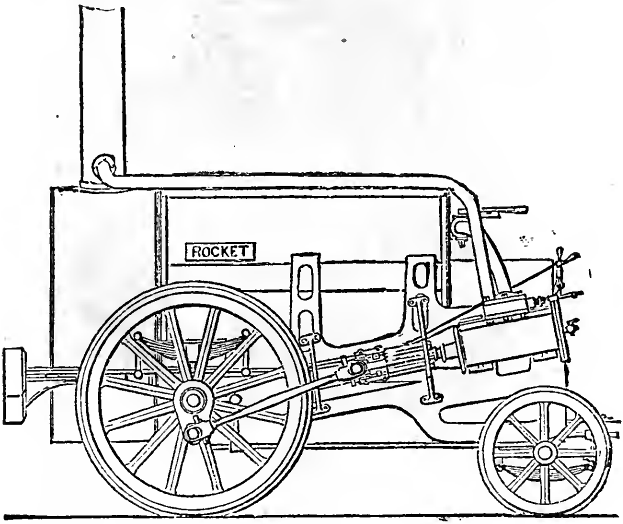
The plans of the Liverpool & Manchester R. R. were fought through Parliament by the indefatigable Stephenson in the face of difficulties which would have appalled any common man ; and when at last the charter was obtained, and the work begun, he personally



The reader is invited to contrast the "Rocket," as displayed on opposite page, with the above representation of a magnificent Freight Engine, built by the Baldwin Locomotive Works for the Russian Government. *Diam. of Cylinder*, 19 ins. *Diam. of Driving Wheels*, 54 ins. *Revolutions per minute*, 124. *Pressure per square inch on piston*, 80 lbs. *Horse-power*, 681.

The Locomotive, since first it was placed on the railway by the immortal Stephenson, has done more to promote the intercourse of nations and affiliate humanity, than any other invention. In its entire design, enormous power, and wonderful performances, it is the most resplendent manifestation of human skill connected with modern engineering.

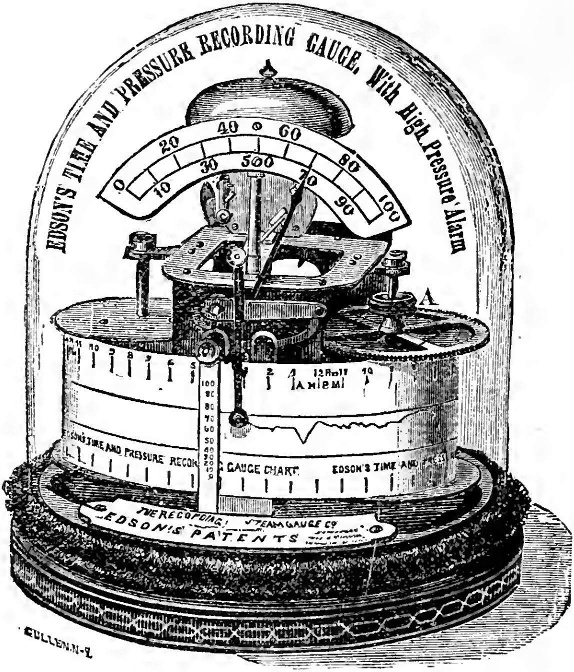
supervised it from beginning to end, getting his breakfast of oatmeal with his own hands, living on horseback, personally inspecting the progress of the work, supervising the pay-rolls of the men, and perfecting with his own hands the working drawings. In 1829, we find Robert, the younger Stephenson, at a later day engineer of the famous Victoria Bridge, Montreal, treading in his father's footsteps, and coming off the victor at the noted contest at Rainhill, when the Rocket, as shown on a previous page, eclipsed the performance of the Novelty, Sanspareil, and Perseverance. Soon the Liverpool & Manchester R. R. was opened with the Rocket, altered and improved, as locomotive, running at the rate of 30 miles an hour. The illustration exhibits the Rocket, as remodelled after the trial and as now to be seen in the South Kensington Museum.



SPARKS FROM THE LOCOMOTIVE.—(*Ill. Cent. R.*) *Fuel, etc.*, Average number of miles run to 1 cord of wood, 43.98. Ditto to 1 ton of coal, 39.87. Ditto, to 1 pint of oil, 13.83. *Cost of Repairs*, Mechanics' wages, 62 per cent. Materials—iron, steel, brass, etc., 31 per cent. Superintendence, paints, tools, etc., 7 per cent. Average cost per mile, in cents, for passenger engines, 20.10, for freight, do, 35.42.

French Locomotives.—Average actual power exerted, 450 horses; speed of passenger trains with 15 vehicles, is 24 miles per hour; freight trains, 18 miles, mixed engines, 20 to 30 miles per hour.

American Locomotive.—A 10 wheeled engine, 18 x 22 cylinder, total weight, 30 tons 9 cwt.; weight on drivers, 22 tons, on Reading



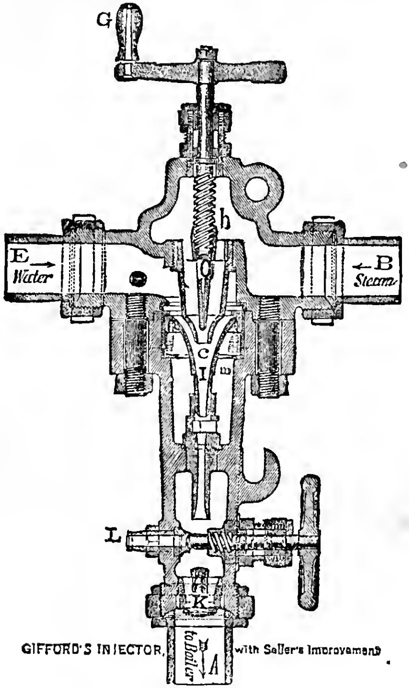
EDSON'S TIME, PRESSURE, SPEED RECORDING, AND ALARM GAUGE.

M. B. EDSON, 91 LIBERTY ST., NEW YORK, INVENTOR AND PATENTEE, ACCORDED EXCLUSIVE MENTION AT THE CENTENNIAL EXHIBITION OF 1876.

RR.; will haul 130 loaded cars; weight of coal, 676 tons; of cars, 380 tons; total load, 1,085 tons; on a down grade, maximum, 13·5 ft. per mile; minimum, 0.65 per mile. Same Engine will haul 70 loaded cars, or 561 tons, over an ascending grade 35.3 ft. per mile.

NEW YORK CITY STREET DUMMY ENGINES.—Cylinders, 6 ins. by 10 ins. stroke; can haul 2 cars, containing 100 passengers each, up a grade 100 ft. per mile, at 5 miles per hour; on a level and low grade, at 10 miles per hour, runs 125 miles per day, burns 1,200 lbs. of coal; steam pressure, 130 lbs.

A Crampton locomotive, drawing 12 carriages, consumes 35 lbs. of coke per mile in summer, and 37 lbs. in winter; the weight with tender is 90,000 lbs.; the cost of running a trip per mile, all items included, is 33 cents (gold). An engine is generally worn out when it has travelled 186,000 miles, although some have run more than twice that distance; the usual performance is from 15,600 to 25,000 miles per annum. The lifetime of an engine may be taken at 10 years; the cost, in England, $9,600 (gold), tender, $2,200, and the annual earnings about $25,000.



GIFFARD'S INJECTOR.

A, steam-pipe connecting with boiler. B, tube or cylinder, through which steam passes into the space *b*. C, screwed rod for regulating the passage of steam through circular conical space *c*, and worked by the handle shown above. E, water supply pipe connecting the reservoir or hot-well with the small chamber *m*. C, I, circular conical opening or discharge pipe, the dimensions of which is adjusted by the movement of the tube or cylinder C. G, hand wheel for operating the cylinder C. H, opening, in connection with the atmosphere, intervening between discharge pipe and the receiving pipe through which the water is forced. I, tube through which the water is passed to the boiler. K, valve for preventing the return of the water from boiler when the injector is closed. L, overflow or waste-pipe.

METHOD OF OPERATION.—Turn the wheel so as to allow a little water to flow into the injector. Open the tap connecting the instrument with the boiler; the admission of the steam will create a partial vacuum, into which the water will flow with rapidity. The steam condenses as it mingles with the water, and as it rushes forward it carries the water along in its course, driving it into the boiler with great force. The quantity may be increased or diminished by means of taps fitted to the steam and water supply-pipes, and any surplus water will escape at the overflow or waste-pipe. This invention effects great economy in the transmission of hot water to the boiler, for not the slightest particle of heat is lost.

Samuel Rue's injector, a most valuable invention, is well adapted to operate as a boiler feeder on land or water; but may be considered as indispensable on marine boilers, as from its peculiar construction, with steam of from 40 to 50 lbs. pressure, it is capable of forcing water against a pressure of over 200 lbs. per square inch.

In 40 years the miles of railway in the United States have increased from 3 miles to 60,000 miles.

RAILWAY	CROSS	TIES,	No. per mile,	2 ft.	centre to	centre,	2.641
"	"	"	"	$2\frac{1}{4}$	"	"	2.348
"	"	"	"	$2\frac{1}{2}$	"	"	2.113
"	"	"	"	$2\frac{3}{4}$	"	"	1.921
"	"	"	"	3	"	"	1.761

The usual dimensions of railway ties are 9 feet long, 10 ins. wide × 5 ins., average life time, 7 years; best material, seasoned white oak. If ties are preserved by Burnettizing they will last 15 years.

The test for new steel car axles, is 5 blows of a ram, weighing 1,650 lbs., falling 30 ft. on axle placed on supports 3 ft. apart. The test for new iron axles, is 5 blows of a ram, weighing 1,650 lbs., falling 20 ft., on axle placed on supports 3 ft. apart.

NON-CONDUCTOR FOR STEAM PIPES AND CYLINDERS.—Good clay, 50 lbs., finely sifted coal ashes 50 lbs., hair for a bind 12 ozs., mix all thoroughly with water to the consistence of mortar, and allow it to rest for a few hours, but just previous to use, add 50 lbs. plaster of Paris, working it in well. Now apply it to the pipes, &c., while warm, in a thin coat, and when dry, add another, continuing until the proper thickness is secured, whitewashing or painting over all.

EVAPORATIVE POWERS OF FUEL, ETC.—

1 lb. of coal evaporates 9 lbs of water.
1 " coke " $7\frac{1}{2}$ to 9 "
1 " wood " $4\frac{1}{2}$ "
1 " turf (peat) " 6 ".

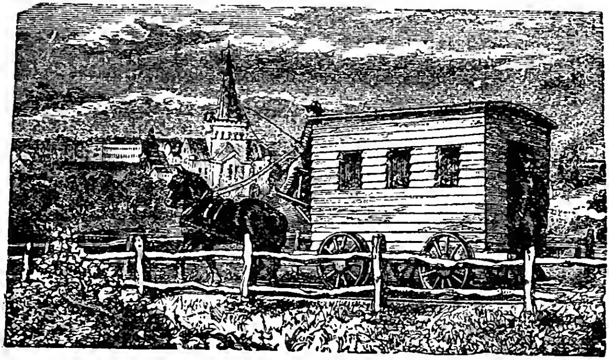
Stationary engines use from 3 to 7 lbs. of coal per horse power per hour.

Locomotive passenger engines 25 to 30 lbs. coal per mile.
" freight " 45 to 55 " "
Wood-burning " 1 cord of wood to 42 miles.

Bulk of coal is 6 times less than its equivalent in wood.

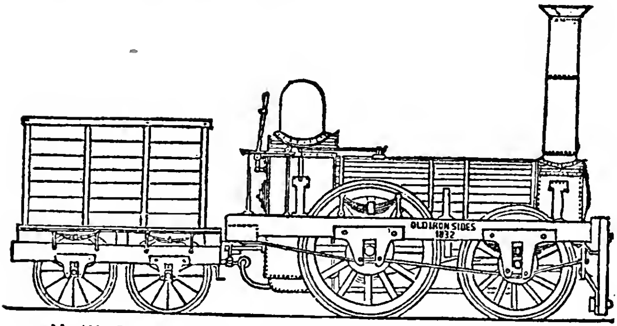
60 bush. Newcastle coal will make 92 bush. of coke.

1 bush. anthracite coal weighs 86 lbs; bituminous coal = 80 lbs.; charcoal (hardwood) = 32 lbs.; coke = 32 lbs.



THE FIRST RAILWAY PASSENGER COACH.

The magnificent caravan represented by the cut conveys a good idea of railway passenger travel and accommodations previous to the use of steam power for that purpose.



M. W. BALDWIN'S LOCOMOTIVE "IRONSIDES"—1832.

M. W. BALDWIN'S LOCOMOTIVE "IRONSIDES"—1852.

The engine represented above, constructed by M. W. Baldwin, founder of the Baldwin Locomotive Works, Philadelphia, Pa., U. S. A., was first run on the Philadelphia & Norristown R. R., in 1832, and proved to be the pioneer of successful railway locomotion in the United States.

The average life of an iron rail is 15,000,000 of tons, or equal to 100,000 trains of 150 tons each. On the Great Northern Railway at Barnet, the life of an iron rail was 5 years, with 13,484,661 tons of fast trains, and 38,303,028 tons of slow traffic. Steel rails were only half worn out with 95,577,240 tons traffic.

LATENT HEAT OF STEAM.—Take 2 small vessels connected at their tops by a tube. Let one contain 1 lb. of water at 32° Fahr., the other 5½ lbs. at the same temperature. Apply a spirit lamp below the vessel containing the 1 lb. of water until it is all boiled away and its vapor condensed by passing through the tube and mingling with the 5½ lbs. of water in the other vessel. At this point the heat absorbed by the 5½ lbs of water will raise the temperature to 212° Fahr. or boiling heat, and the combined weight will be 6½ lbs. instead of 5½ lbs., as placed in the vessel at first. The whole of this heat has been transferred from the 1 lb. of water held over the spirit lamp, although at no time has its heat exceeded 212°. Inasmuch as this heat cannot be measured by any known instrument, it is called latent heat. The 1 lb. of water made the 5½ lbs. to boil, and from this we know by calculation that the combined latent and sensible heat of steam is about 1200°.

The pressure of steam is measured by atmospheres. Steam of 15 lbs. pressure is steam of one atmosphere, of 30 lbs. pressure, of 2 atmospheres, &c. It is frequently used as high as 6 or 7 atmospheres. Steam below 2 atmospheres is called *low pressure* steam, and all pressure above, *high pressure* steam. Heat, by expanding water, imparts motion to the gulf stream, when transformed into steam it evolves sufficient power to drive the rolling mill, cotton and other mills, the machine shop, the locomotive, and impel the steamship over the trackless ocean. As the temperature of water falls below 100° Centigrade (212°.) the boiling point, it will contract or occupy a smaller space until it descends to 3°. 8 Centrigrade, when it will contract no more, as its greatest density is then reached. From 5°. 8, as the water becomes colder, *it expands*, till it reaches the freezing point 0°. Centigrade, so that is specifically lighter than water, and floats on the surface, being about 10 per cent. lighter. Were it not for the interposition of this merciful law, and were ice to sink in water, many of the lakes, rivers and streams within the temperate zones would be rendered incapable of navigation during the greater part of the year by reason of the ice at the bottom.

APPLICATION FOR BURNS AND SCALDS. The following has been tested in the severest cases of burning and scalding from railway and steamboat accidents. Glycerine, 5 ozs.; white of egg, 4 ozs.; tinct, of arnica 3 ozs.; mix the glycerine and white of egg thoroughly in a mortar and gradually add the arnica. Apply freely on linen rags night and morning, previously washing with warm castile soap suds. In urgent cases, if nothing better can be had, clap on a mud poultice, a favorite and very effectual remedy with school boys who are stung while making war on hornets' nests.

CEMENT TO MEND LEAKY BOILERS.—Powdered litharge, 2 parts, very fine sand, 2 parts, slaked quick lime, 1 part. Mix all together. To use, mix the proper quantity with boiled linseed oil and apply quick. It gets hard very soon.

STRONG CEMENT FOR STEAM JOINTS.—White lead ground in oil, 10 parts, black oxide of manganese, 3 parts, litharge, 1 part. Reduce to the proper consistency with boiled linseed oil and apply.

CEMENT FOR HOLES OR CRACKS.—Red lead ground in oil, 6 parts, white lead, 3 parts, oxide of manganese, 2 parts, silicate of soda, 1 part, litharge, ½ part. all mixed and used as putty.

RUST JOINT, QUICK SETTING—Sal ammoniac pulverized, 1 lb., flour of sulphur, 2 lbs.; iron borings, 80 lbs.; mix to a paste with water in quantities as required for immediate use.

QUICK SETTING JOINT BETTER THAN THE LAST, BUT REQUIRES MORE TIME TO SET.—Sal ammonia, 2 lbs., sulphur 1 lb., iron filings 200 lbs.

AIR AND WATER TIGHT CEMENT FOR CASKS AND CISTERNS.—Melted glue, 8 parts, linseed oil, 4 parts, boiled into a varnish with litharge; hardens in 48 hours.

MARINE GLUE.—India rubber 1 part, coal tar 12 parts, heat gently mix, and add 20 parts of powdered shellac, pour out to cool, when used heat to about 250°.

ANOTHER DITTO.—Glue 12 parts, water sufficient to dissolve, add yellow resin 3 parts; melt then add turpentine 4 parts, mix thoroughly together.

CEMENT FOR EXTERNAL USE.—Ashes 2 parts, clay 3 parts, sand 1 part; mix with a little oil, very durable.

CEMENT TO RESIST RED HEAT AND BOILING WATER.—To 4 or 5 parts of clay, thoroughly dried and pulverized, add 2 parts of fine iron filings free from oxide, 1 part of peroxyde of manganese, 1 part of common salt, and ½ part of borax. Mingle thoroughly, render as fine as possible, then reduce to thick paste with the necessary quantity of water, mixing well; use immediately, and apply heat, gradually increasing almost to a white heat.

CEMENT TO JOIN SECTIONS OF CAST-IRON WHEELS, &C.—Make a paste of pure oxide of lead, litharge, and concentrated glycerine. Unrivalled for fastening stone to stone or iron to iron.

VARNISH FOR BOILERS.—Asphaltum dissolved in turpentine.

SOFT CEMENT FOR STEAM-BOILERS, STEAM-PIPES, &C.—Red or white lead, in oil, 4 parts; iron borings, 2 to 3 parts.

HARD CEMENT.—Iron borings and salt water, and a small quantity of sal-ammoniac, with fresh water.

GASFITTERS' CEMENT.—Mix together resin, 4½ parts; wax, 1 part; and Venetian red, 3 parts.

PLUMBERS' CEMENT.—Black resin, 1 part; brick dust, 2 parts, well incorporated by a melting heat.

COPPERSMITHS' CEMENT.—Boiled linseed oil and red lead mixed together into a putty, are often used by coppersmiths and engineers to secure joints; the washers of leather or cloth are smeared with this mixture in a pasty state.

COMPOSITIONS TO FILL HOLES IN CASTINGS.—Mix 1 part of borax in solution with 4 parts dry clay.—*Another:* Pulverized binoxide of manganese, mixed with a strong solution of silicate of soda (water clay) to form a thick paste.

CAST IRON CEMENT.—Clean borings, or turnings of cast iron, 16 parts; sal-ammoniac, 2 parts; flour of sulphur, 1 part; mix them well together in a mortar, and keep them dry. When required for use, take of the mixture, 1 part; clean borings, 20 parts; mix thoroughly, and add a sufficient quantity of water. A little grind-stone dust added improves the cement.

CEMENT FOR STEAM-PIPE JOINTS, ETC., WITH FACED FLANGES.—White lead, mixed, 2 parts; red lead, dry, 1 part; grind, or otherwise mix them to a consistence of thin putty; apply interposed layers with 1 or 2 thicknesses of canvas, or gauze wire, as the necessity of the case may be.

CEMENT FOR JOINTS OF IRON PIPES OR HOLES IN CASTINGS.—Take of iron borings, coarsely powdered, 5 lbs.; of powdered sal-ammoniac, 2 oz.; of sulphur, 1 oz.; and water sufficient to moisten it. This composition hardens rapidly, but, if time can be allowed it sets more firmly without the sulphur. Use as soon as mixed, and ram tightly into the joints or holes.

BEST CEMENT FOR AQUARIA.—One part, by measure, say a gill of litharge; 1 gill of plaster of Paris; 1 gill of dry, white sand; $\frac{1}{3}$ a gill of finely powdered resin. Sift, and keep corked tight until required for use, when it is to be made into a putty by mixing in boiled oil (linseed) with a little patent drier added. Never use it after it has been mixed (that is, with the oil) over fifteen hours. This cement can be used for marine as well as fresh water aquaria, as it resists the action of salt water. The tank can be used immediately, but it is best to give it three or four hours to dry.

ANOTHER.—Mix equal quantities of any white lead and red lead to a paste with mastic varnish and use as soon as mixed.

CEMENT FOR BELTING. *Waterproof.*—Dissolve gutta percha in bisulphide of carbon to the consistence of molasses, slice down and thin the ends to be united, warm the parts, and apply the cement, then hammer lightly on a smooth anvil, or submit the parts to heavy pressure.

TO REPAIR LEAKAGES IN FIRE ENGINE HOSE.—Pass a round bar of iron into the hose under the leak, then rivet on a patch of leather, previously coated with marine glue.

TO REPAIR RUBBER HOSE.—Cut the hose apart where it is defective; obtain from any gasfitter a piece of iron pipe 2 or 3 inches long, twist the hose over it until the ends meet, wrap with strong twine, well waxed, and it will last a long time.

PORTABLE GLUE FOR DRAUGHTSMEN.—Glue 5 ozs.; sugar 2 ozs.; water 8 ozs.; melt in a water bath, cast it in molds. For use dissolve in warm water.

CEMENTING EMERY TO WOOD.—Melt together equal parts of shellac, white resin and carbolic acid in crystals; add the last after the others are melted.

TO COAT IRON WITH EMERY.—Give the iron a good coat of oil and white lead, when this gets hard and dry, apply a mixture of glue and emery.

TO CLEAN COTTON WASTE.—Pack the waste in a tin cylinder with a perforated false bottom and tube with stop-cock at bottom. Pour on the waste bisulphide of carbon sufficient to cover, and allow to soak a few minutes, then add more bisulphide, and so on for a time or two, and then squeeze out. By simple distillation the whole of the bisulphide, or nearly all, can easily be recovered and so be used over again. This will free the cotton completely from grease.

FRENCH PUTTY.—Seven pounds linseed oil and 4 lbs. brown umber are boiled for two hours, and 62 grammes wax stirred in. After removal from the fire $5\frac{1}{2}$ lbs. fine chalk and 11 lbs. white lead are added and thoroughly incorporated; said to be very hard and permanent.

To Mend Cracked Cast-Iron Vessels.—Drill a hole at each extreme end of the crack, to prevent its further extension, plug rivet the holes with copper, and, with fine iron filings saturated with urine, caulk the crack. Four parts of pulverized clay and one part of iron filings made into a paste with boiling linseed oil and applied hot is a good cement for the same purpose.

To Prevent Iron Rusting.—Give it a coat of linseed oil and whiting, mixed together in the form of a paste. It is easily removed and will preserve iron from rusting for years.

Glue for Labelling on Metals.—Boiling water, 1 qt.; pulverized borax, 2 ozs.; gum shellac, 4 ozs. Boil till dissolved. Used for attaching labels to metals, or it will do to write inscriptions with, and dust or dab on a little bronze powder over it, varnishing over the bronze.

Cement for Petroleum Lamps.—Boil 3 parts of resin with 1 part of caustic soda and 5 of water. The composition is then mixed with half its weight of plaster of Paris, and sets firmly in ½ to ¾ of an hour. It is of great adhesive power, not permeable to petroleum, a low conductor of heat, and but superficially attacked by hot water.

For Lute, or cement for closing joints of apparatus, mix Paris plaster with water to a soft paste, and apply it at once. It bears nearly a red heat. To render it impervious, rub it over with wax and oil.

Roman Cement.—Slaked lime, 1 bush., green copperas, 3½ lbs., fine gravel sand, ½ bush. Dissolve the copperas in hot water, and mix all together to the proper consistency for use; use the day it is mixed and keep stirring it with a stick while in use.

Vicat's Hydraulic Cement is prepared by stirring into water a mixture of 4 parts chalk and 1 part clay; mix with a vertical wheel in a circular trough, letting it run out in a large receiver. A deposit soon takes place which is formed into small bricks, which after being dried in the sun, are moderately calcined. It enlarges about ⅜ when mixed with water.

Glue to Resist Moisture.—Glue, 5 parts, resin, 4 parts, red ochre, 2 parts, mix with the smallest possible quantity of water.

Cement to Fasten Leather on Top Rollers.—Gum arabic, 2¾ ozs., isinglass 2¾ ozs., dissolve each separately in water and mix.

Parchment Glue.—Parchment shavings, 1 lb., water, 6 qts. Boil till dissolved, strain and envaporate to right consistence.

To attach Glass or Metal Letters to Plate Glass.—Copal varnish, 15 parts; drying oil, 5 parts; turpentine, 3 parts; oil of turpentine, 2 parts; liquefied glue, 5 parts. Melt in a water bath and add 10 parts of slaked lime.

Turners' Cement.—Beeswax, 1 oz.; resin, ½ oz.; pitch, ½ oz.; melt, and stir in fine brick dust.

Bank Note Glue.—Dissolve 1 lb. of fine glue or gelatine in water; evaporate it till most of the water is expelled; add ½ lb. of brown sugar, and pour it into moulds.

Cement for Electrical Machines and Galvanic Troughs.—Melt together 5 lbs. of resin and 1 lb. of beeswax, and stir in 1 lb. of red ochre (highly dried and still warm) and 4 oz. of plaster of Paris, continuing the heat a little above 212°, and stirring constantly till all frothing ceases, or (for troughs) rosin, 6 lbs.; dried red ochre, 1 lb., calcined plaster of Paris, ½ lb.; linseed oil, ¼ lb.

ARCHITECTURAL CEMENT—1. Reduce paper to a smooth paste by boiling it in water; then add an equal weight of sifted whiting and good size; boil to a proper consistence. 2. Paper paste and size, equal parts; finely powdered plaster of Paris to make it of a proper consistence. Use it as soon as mixed. Can be used in making architectural busts, statues, columns, &c. It is light, receives a good polish, but will not stand water.

ALABASTER CEMENT.—1. Finely powdered plaster of Paris, made into a paste with water. 2. Melt yellow rosin, or equal parts yellow rosin and beeswax, then stir in half as much finely powdered plaster of Paris. The first is used to join and fit together pieces of alabaster or marble, or to mend broken plaster figures. The second is to join alabaster, marble, and other similar substances that will bear being heated.

FRENCH CEMENT FOR ROOMS.—A coat of oxide of zinc, mixed with size, made up like a wash, is first laid on the wall, ceiling, or wainscot, and over that a coat of chloride of zinc applied, prepared in the same way as the first wash. The oxide and chloride effect an immediate combination, and form a kind of cement, smooth and polished as glass, and said to be superior to plaster of Paris for coating the walls of rooms.

CEMENT FOR CLOTH OR LEATHER.—Take ale, 1 pt.; best Russia isinglass, 2 ozs.; put them into a common glue kettle and boil until the isinglass is dissolved; then add 4 ozs. of the best common glue, and dissolve it with the other; then slowly add 1½ ozs. of boiled linseed oil, stirring all the time while adding, and until well mixed. When cold it appears like India rubber. To use, dissolve what you need in a suitable quantity of ale to have the consistence of thick glue. It is applicable for earthenware, china, glass, or leather; for harness, belts for machinery, cloth belts for cracker machines for bakers, &c. If for leather, shave off as if for sewing, apply the cement with a brush while hot, laying a weight to keep the joint firmly pressed for 6 to 10 hours, or over night.

CUTLERS' CEMENT.—Black rosin, 4 lbs.; beeswax, 1 lb.; melt together and add 1 lb. finely powdered and dried brick-dust. Used for fastening knives and forks in their handles when they become loosened by use.

CEMENT FOR FASTENING FIBROUS MATERIALS TO METALS.—This can be effected by dissolving glue in vinegar by heat and adding one-third of its volume of white pine pitch, also hot.

GOOD PASTE THAT WILL KEEP A YEAR.—Dissolve a teaspoonful of alum in a quart of warm water. When cold, stir in as much flour as will bring it to the consistence of cream, being particular to break up all the lumps; next, place it on the fire and allow it to cook gently for a few minutes, stirring well meanwhile; add 2 teaspoonfuls of corrosive sublimate, a few drops of carbolic acid, and a teaspoonful of oil of rosemary, or cloves, or lavender, or any other essential oil, stirring in well. This paste will keep for any length of time in prime condition.

MUCILAGE.—Put 3 ozs. of gum arabic in an earthen-ware vessel containing ½ pt. of cold water. If the liquid is occasionally stirred, the gum in 24 hours will be dissolved and ready for use.

CEMENT TO FASTEN RUBBER TO WOOD OR METAL.—Soak pulverized gum shellac in 10 times its weight of ammonia; in 3 or 4 weeks a slimy mass is obtained which will become liquid without the use of hot water; this softens the rubber, and becomes, after volatilization of the ammonia, hard and impermeable to gases and fluids whenever it is used on rubber connected to wood or metal, as in steam, or other apparatus.

IMPERISHABLE PUTTY.—Linseed oil, 7 lbs.; brown umber, 4 lbs.; boil together two hours; stir in 2 oz. beeswax, remove from the fire, and mix in 5½ lbs chalk and 11 lbs. white lead, mixing thoroughly.

CHEAP GOLD VARNISH FOR ORNAMENTAL TIN-WARE.—Turpentine varnish, 2 gals.; turpentine, 1 gal.; asphaltum, 1 gill; umber, 8 oz.; yellow aniline, 4 oz.; gamboge, 1 lb. Boil and mix for 10 hours.

Temporary Repairs in Locomotive Break-downs on the Road.

That the locomotive, in its long and rapid trips, with continual oscillation, jars, and heavy shocks, over uneven rails, passing around curves and sinuosities, twisting first one way and then another, should meet with frequent break-downs, is a matter of small wonder. The real wonder is that they do not occur more frequently. Much of this immunity from accident is doubtless owing to the watchful care of the men to whom they are intrusted, whose perceptions and intuitions are quickened to a wonderful degree of activity by the peculiar dangers which beset them in their calling. Among the emergencies in which the locomotive engineer may be called to act, the following may be noted :

1. *Bursting of the Tubes or Flues.*—The temporary remedy for this is to drive a tapering plug of pine wood into the ruptured tube by ramming it with the end of an iron bar. When a simple leak exists, the plug should be driven into the tube so as to cover the fractured part, where the action of the steam will swell the plug, causing it to fit tight and correct the trouble. The timber used should be well seasoned, and the plugs formed a trifle too small for the tube ; the expansion due to the moisture will do the rest. With bursted tubes the wooden plugs should be followed up by tapering iron plugs driven tight into the flues. To do this comfortably it will be necessary to repress the heat in the furnace by covering the fire with fresh fuel from the tender.

2. *Throwing off a Driving Wheel.*—When the break occurs, as is frequently the case, just outside the driving-axle box, remove the driving-box and substitute in its place a substantial piece of timber fitted to use as a journal bearing for the axle. Adjust this timber on the pedestal cap so as to sustain the axle in the centre of the pedestal. By cautious management, disconnecting the valve gearing, securing the piston, and opening the cylinder cocks as before, the engine may be run slowly towards its destination.

3. *Where a Wheel Tire is Thrown Off*, the best way is to elevate the dismantled wheel from the track by fitting a block of timber into the oil cistern of the driving-box; when this is done connect with another engine and tow the disabled machine to the repair shop without allowing the tireless wheel to touch the rails.

4. *Heated Axle-Boxes.*—This trouble is frequently detected by the odor of burning oil. In this case the speed should, if possible, be reduced, and the box freely lubricated; but if this proves of no avail, a brisk jet of cold water from the tank should be directed on the hot box by means of a small rubber hose, which should always be kept on hand for such emergencies. To avert all danger from the fused lining metal of the brasses becoming brazed to the journal of the axle the engine should be kept moving *very slowly*, and not allowed to come to a full stop until the trouble is past.

5. *When the Piston-Rod becomes Heated*, the remedy is to loosen the gland sufficiently to permit the free emission of steam from the engine cylinder through the packing. Lubricate freely and apply water with the hose as above noted, while running slowly.

6. *Broken Crank Pin.*—Where only one crank-pin is broken remove the parallel or coupling rods on *both sides* of the engine, and if the broken crank-pin belongs to the driving-wheels, remove the connecting rod at the same time, open the cylinder waste-water cocks, and securely block the cross-head. If the parallel rods on both sides of the engine are not removed, there is imminent danger, while running, of breaking the remaining crank-pins on the opposite side.

7. *Driving out the Front Cylinder-head.*—Remove the connecting-rod on the disabled side of the engine, and detach the valve motion, either by taking down the eccentric rod straps or at the rock-shaft arm. Next, set the valve in the centre of its travel, so as to overlap and cover both of the cylinder steam ports, but with the exhaust port open. Then crowd the back towards the tender as far as it will go and proceed with the sound cylinder.

8. *Breaking of the Piston-rod.*—The provisional remedy for this, where the cylinder-head is not driven out, is to proceed as directed in the last noted emergency. Open the waste-water cocks of the disabled cylinder to check any leakage of steam past the slide valve from gaining admission to the cylinder and forcing the piston against the cylinder-head and driving it out. Block the piston securely by means of pieces of timber fitted between the guide-bars, so as to extend between the guide-yoke and cross-head.

9. *Broken Spring or Spring-Hanger.*—Apply the jacks and raise the engine until the axle-box of the driving-wheel is nearly in the centre of the pedestal, then place a suitable piece of iron crosswise of the upper part of the driving-axle box, but between it and the engine frame, so as to rest the weight of the engine on the frame and relieve the spring. To prevent the movement of the equalizing bar, and to permit the operation of the spring at the other end of the said bar without moving it, a piece of iron should be placed between the bar and the top of the engine frame.

10. *Breaking of Piston-Rod from the Cross-Head.*—In this case the piston may be removed from the cylinder, or immovably braced against the front cylinder-head, as may be most convenient. It matters not if it does leak a little steam.

11. *Breaking a Lifting Link or the Saddle Pin Connecting the Reverse Shaft to the Slot-Link.*—The temporary remedy for this accident is to fit a piece of wood and fasten it with stout twine on the top of the die or link-block. It should be of sufficient length to keep the link in proper position for duty in running the train. Next, secure another piece of wood (by the same means as the last noted) in the link-slot below the die or sliding-block, to fasten that block in the right position to allow the engine to run. As the engine cannot be reversed on the disabled side, the driver must exercise double caution in stopping.

12. *Slipping of the Eccentrics.*—The provisional remedy for this accident is as follows: Place the reverse lever in the end notch of the sector forward and place the driving crank-pin or engine-crank as nearly on a dead centre as possible, opening the waste-water cocks at both ends of the cylinder. Now detach the rocker-arm from the slide-valve spindle, and move the latter until the opening of the cylinder steam-port, corresponding to the end of the cylinder at which the piston stands, will be shown by the emission of steam through the waste-water cock at that end of the cylinder; the throttle-valve being slightly opened to admit a small quantity of steam to the cylinder and steam-chest, for if a large supply entered it would be liable to pass through leaks in the piston and thence through both of the waste-water cylinder-cocks. The position of the valve being now ascertained, the eccentric is next moved upon the driving-axle, and adjusted so that the valve-spindle will connect with the rocker-arm without being moved, or moving the valve at all. Still another temporary remedy is this: Set the reverse lever in the forward notch, place the crank on its forward dead centre, and slacken the set-screw of the eccentric which connects to the upper end of the link; the forward eccentric. This eccentric must now be moved round upon the axle until the slide-valve causes the steam-port at the front end of the cylinder to open sufficiently to afford the required amount of

valve lead. To accomplish the desired results, the eccentric must be moved as it operates when the engine is going ahead. The eccentric being thus properly adjusted in position, it should be firmly secured by means of its set-screw. If the rear eccentric becomes loose, place the reverse lever in the backward notch, and elevate the link so that the eccentric connected to the lower end of the link may be properly adjusted, moving it around on the axle as it operates when the engine is running backwards, until the rear cylinder-cock is open to the required amount of valve lead, when it must be secured as above noted.

HOW TO SHAPE A SAILING VESSEL OR STEAMER.—The model of a vessel is in every case determined by the nature of the traffic for which she is destined, the motive power by which she will be impelled, and the character of the waters she is intended to navigate. For shallow ports and rivers, she must be flat-bottomed and of light draught. If she is to navigate northern seas, she must be constructed to encounter and outride the fearful gales and tremendous storms of frequent occurrence. If she is to visit tropical climates and follow the great marine highways of commerce in deep water from ocean to ocean, she must be equally adapted for conflict with the tropical hurricane and the freezing gales of the north. It is a fact that the first-class iron steamers which ply between New York and the various European ports have proved themselves abundantly capable, where no serious derangement is sustained by the machinery, of coming safely into port through the worst possible kind of weather. Even contrary winds have the beneficial effect of quickening the draught of the furnaces, and thus increasing the speed of the vessel. This wonderful endurance and nice adaptation to duty is no chance work; it is the result of design—the careful adjustment of forces, and the closest calculation on the part of the designer.

If a vessel is to be impelled by the wind, she will have one shape; if by steam, and with paddles, quite another; and still another if a propeller. There is a vast discrepancy between the graceful curves and swelling lines of a first-class excursion steamer and the unwieldy, cumbrous form of the collier, yet each vessel is specially designed for its particular vocation.

The character, cost, length, width, depth, and capacity of the vessel being determined, the first step is to make the model. To do this a number of pieces of well-seasoned, select pieces of wood, of a uniform thickness, are chosen. The size may be from 4 to 7 ins. wide, and from 18 ins. to 3 ft. in length. An equal number of pieces of veneer, of a corresponding size, are next selected, of a color contrasting with that of the boards previously chosen. The boards are now carefully adjusted over each other, with a veneer between each, and the whole are glued together, and submitted to pressure, so as to make a solid, compact block of the whole. From this block the designer forms the model of one side of the hull of the projected vessel, for as both sides will be exactly alike, there is no use for representing more than one-half of the hull. The greatest care and the nicest calculation must be used in order to render the form of the block an exact counterpart of the hull of the future ship, as in building the latter every part must be constructed to conform, in the minutest particulars, to the model. It will be seen from this that every thing relating to the ship's capacity, speed, draught, safety, &c., depends upon the ability, forethought, and prescience of the designer in calculating every possible contingency relating to the displacement of water, draught, buoyancy, the force of the wind and waves, &c. If the future vessel be intended for a steamer, the designer must be able to calculate the proper degree of immersion for the paddles or submersion for the propeller, as either of the two may be used for propulsion, with numerous other minor details.

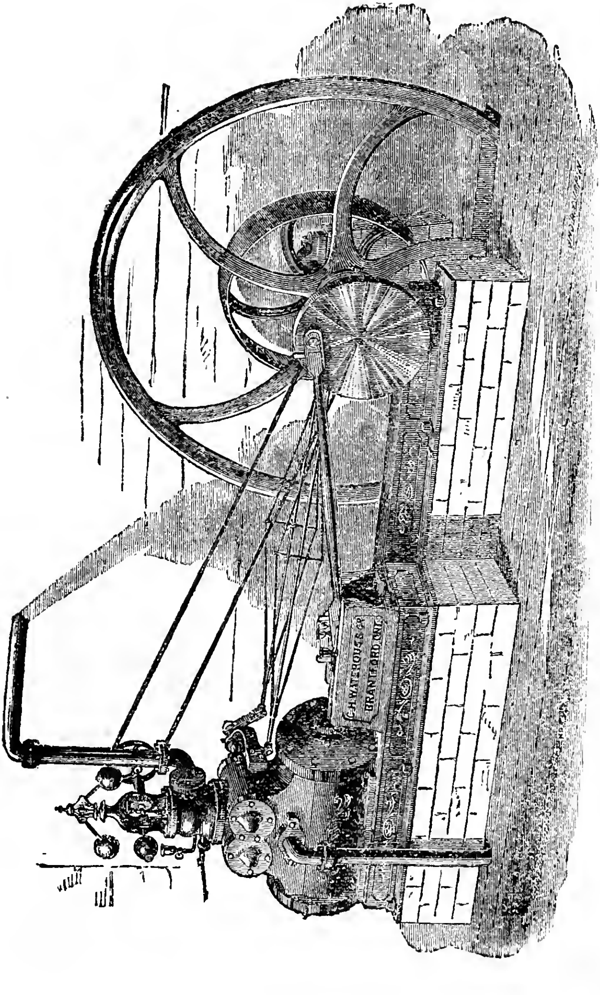
JAMES WATT.

Among the benefactors of humanity, whose labors have conduced to render the latent forces of nature subservient to the uses of mankind, the name of James Watt holds preëminent rank. The following epitaph is inscribed on the pedestal of Chantry's statue of Watt in Westminster Abbey:

NOT TO PERPETUATE A NAME, WHICH MUST ENDURE WHILE THE PEACEFUL ARTS FLOURISH, BUT TO SHOW THAT MANKIND HAVE LEARNT TO HONOR THOSE WHO BEST DESERVE THEIR GRATITUDE, THE KING, HIS MINISTERS, AND MANY OF THE NOBLES AND COMMONERS OF THE REALM, RAISED THIS MONUMENT TO JAMES WATT, WHO DIRECTING THE FORCE OF AN ORIGINAL GENIUS, EARLY EXERCISED IN PHILOSOPHIC RESEARCH, TO THE IMPROVEMENT OF THE STEAM ENGINE, ENLARGED THE RESOURCES OF HIS COUNTRY, INCREASED THE POWER OF MAN, AND ROSE TO AN EMINENT PLACE AMONG THE ILLUSTRIOUS FOLLOWERS OF SCIENCE AND THE REAL BENEFACTORS OF THE WORLD. BORN AT GREENOCK, 1736. DIED AT HEATHFIELD, IN STAFFORDSHIRE, 1819.

In 1764, Watt constructed the first steam engine of real practical value ever made in England, and in 1786 he patented and introduced the first non-condensing engine. This improvement consisted in his discovery of the power of cold water to condense steam, and he applied this means in a separate vessel. Four ounces of water will, in a second, condense 200 feet of steam, and reduce their expansive force to one-fifth.

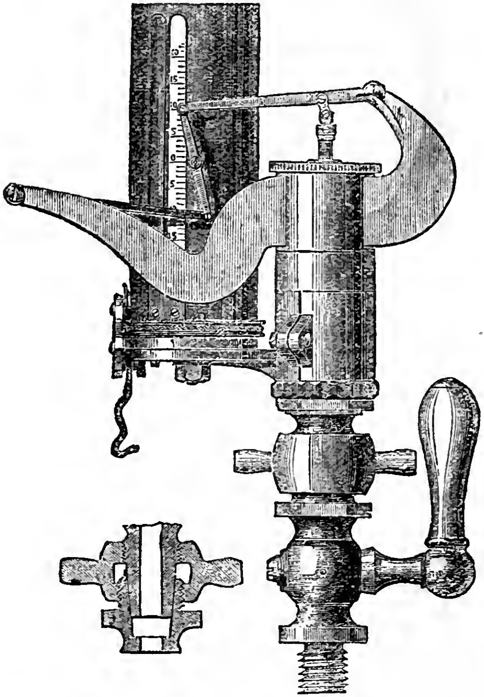
THE WATEROUS ENGINE WORKS CO.'S HIGH PRESSURE ENGINE, represented in the cut, is in very extensive use in Canada, and is credited with first-class performances. The improved Governor used on this engine is superior to most of the best kinds now manufactured in its controlling and regulating action, combined with easy adjustment. Outer bearings are added to the valve spindles, and brass glands to the stuffing boxes, which are held to place with a cap screwed on, thus obviating any liability to get out of line. The piston



THE WATEROUS ENGINE WORK CO.'S. 40-HORSE POWER HIGH PRESSURE ENGINE.

rods and crank-pins are of steel, and all valve spindles and engine bolts are made of Lowmoor iron.

The above noted engine must not be confounded with the 20 and 25-horse power direct action portable engines manufactured by the same company, so well known and so extensively used in driving saw mills, and performing work connected with ship building in the Maratime Provinces, and other parts of the Dominion of Canada. These engines and mills are considered by many who use them as marvels of perfection, several parties having sent in attestations of having performed nearly double the work guaranteed by the company.

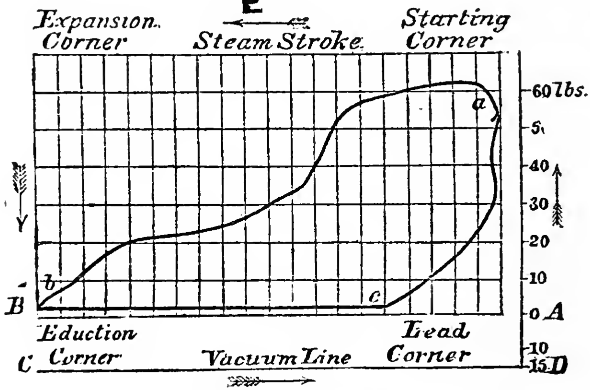


RICHARD'S INDICATOR, BY ELLIOT BROTHERS, LONDON.

The above cut represents a Richards Steam Engine Indicator, consisting of a cylinder containing an accurately adjusted piston, the upper side of which is always exposed to the downward pressure of the atmosphere, and fitted with a stiff spiral spring of known strength to resist the upward movement of the steam when it operates from beneath. The indications of the instrument are exhibited by means of a pencil connected with the piston and operated by the fluctuating pressure of the steam, whereby the pencil is compelled to move up or down in a vertical direction, and describe a line on a piece of paper placed on the card barrel or drum shown in the cut, with the graduated scale, the drum in the meantime being compelled to move hither and thither on its axis by means of a cord connecting it with a suitable part of the engine operating to draw it one way against the tension of a spring during the forward stroke of the engine, the backward movement of the drum towards its original position being effected by the operation of the spring while the cord is relaxed during the return stroke of the engine. The piston to which the pencil is attached, is very light, has very little friction, small momentum, and very limited motion, the spring on the upper part being quite stiff and rigid, and so graduated in strength that a variation in the pressure of 1 lb. to the square inch will force the pencil up or down a definite part of an inch. The indicator is intended to exhibit the pressure of steam in the cylinder at every part of the piston's travel, and thus show the actual or indicated horse-power. In applying the indicator to horizontal cylinders, the proper place for insertion is on the upper side, near the ends, but averted as much as possible from the steam ports, as the rushing steam has a tendency to derange the indications. Vertical cylinders should be tapped at the upper end, and the indicator cock screwed in, or the aperture in which the oil cup is inserted may be used for that purpose; for the lower end, drill through the side of the cylinder, and insert a tube with the end bent upwards for the reception of the indicator cock. The indicator being in position, a cord (fine wire is preferable), from the paper barrel is attached to a "reducing wheel," which is secured to some part of the engine frame; another cord connects the reducing wheel with the piston head ; the intervention of this wheel is necessary in order to diminish or reduce the long movement of the piston to a sufficient extent to conform to the small size of the instrument used. The connection being complete, and the engine in motion, the paper barrel will commence to revolve with the forward movement of the piston, in antagonism to the tension of the coiled spring above noted, when the cord is relaxed by the return stroke of the piston, the paper barrel, operated by the spring, will resume its original position, and this motion will continue as long as may be desirable. The pencil, if now allowed to press upon the moving paper, will describe a straight horizontal line, called the atmospheric line. On the admission of steam by turning the tap of the indicator, this horizontal motion will suddenly change into an upward or downward movement, just as the piston in the indicator is driven upwards by the steam or downwards by the atmosphere, as either gains the ascendancy; and the pencil will describe, on the moving paper, a space or outline, compounded of the two motions, called an indicator diagram, each point in the course of which will determine, by its elevation or depression above the atmospheric line, the exact amount of pressure in that part of the cylinder during each part of the forward and return stroke. Many prefer to trace the indicator diagram previous to tracing the atmospheric line.

In diagram E, the atmospheric line A B, described by the pencil without steam, is equivalent to the stroke of the piston, which may be divided into as many aliquot parts as there are inches in the stroke of the piston. Perpendiculars raised on this line will cut the diagram at points indicating the corresponding pressure. The curved line A B, traced by the pencil, exhibits the varying pressure of the steam during the steam stroke, in the direction A B, and during the return stroke B A; the continuation B C A represents similarly the back pressure due to incomplete exhaust. The curve is thus arranged to begin and end in itself, and it plainly represents the pressure of the steam on one side of the piston during a double stroke. Divide the base line into inches of stroke, say 20, and at each division draw vertical lines; similarly draw lines parallel to the atmospheric line at equal distances, of say 10 lbs. pressure by the indicator scale ; the force of steam at all points of the stroke will be obvious.

E



Return Stroke.

To Compute the Power of the Diagram—Set down the length of the spaces formed by the vertical lines from the base, in measurements of a scale accompanying the indicator, and on which a 10th of an inch usually represents a pound of pressure; add up the total length of all the spaces, and divide by the number of spaces, which will give the mean length, or the mean pressure upon the piston in pounds per square inch; multiply the area of the piston in square inches by the pressure in pounds per square inch, and by the speed of the piston, in feet, per minute, and divide by 33,000, which gives the actual number of horses' power.

At such times a register should be used to count the number of revolutions per minute. Note the size of the ports, the form and kind of engine, the lap and lead of the valve, the exhaust lead, the pressure of steam in the boiler, diameter of cylinder, number of strokes per minute, the diameter and length of steam pipe, the point of cut-off, the height of the barometer and temperature of the engine room; and the vacuum by gauge, the temperature of the hot-well, and that of the injection water, if the operation has been performed on a condensing engine. To take a diagram with absolute truth it is necessary to operate at each end of the cylinder.

POWER REQUIRED FOR VARIOUS PURPOSES.—

To drive a	20 to 30	inch circular saw,	4 to 6	horse power.		
"	32 to 40	"	"	12	"	"
"	48 to 50	"	"	15	"	"
"	50 to 62	"	"	25	"	"

POWER NECESSARY TO GRIND GRAIN WITH PORTABLE MILLS.

Horse Power.	Size of Stones.	Revolutions per Minute.	Bushels Corn Ground per Hour.	Bushels of Wheat Ground per Hour.
2 to 4	12-inch.	800 to 900	1 to 4	1 to 3
4 to 6	20 "	650 to 700	5 to 8	4 to 6
6 to 8	30 "	550 to 600	10 to 15	7 to 10
8 to 12	36 "	450 to 500	18 to 25	12 to 15
12 to 15	48 "	350 to 400	25 to 35	15 to 18

SAW MACHINE FOR STONES.—*Soft Sand Stone:* Breadth of saw-cut, $\frac{1}{4}$ inch; time required to saw 10 square feet, 5 minutes 25 seconds; power expended, 4.54 horses, *Hard Sand Stone*: breadth of cut, $\frac{1}{4}$ inch; time employed to cut 10 square feet, 1 hour 37 minutes; power required, 2 horses. In sawing stone the labor on calcareous stones is as 45 to 50; on granite, as 500 to 700; on porphyry 1,200. A marble saw requires half a horse power.

WATER WORKS.—(*Molesworth.*)—1 gal. of water = 0.16 cubic ft. approximately; 1 cubic foot of water = 6¼ gallons approximately.

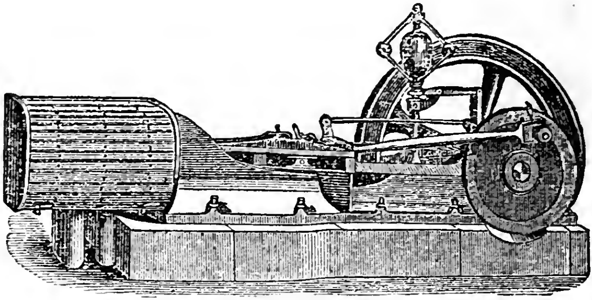
Consumption of water in towns.—16 gallons per head per day in non-manufacturing towns; 20 gallons per day in manufacturing towns. The main should be large enough for double the usual quantity. Impounding reservoirs to contain about 120 days' supply in the less rainy districts in England. Service reservoirs to contain 3 days' supply. On the average, about 6-10ths. of the rainfall is available for storage. Loss from overflow of storm-water, about 10 per cent. Evaporation is 50 per cent. less on flat country than on an undulating rocky country.

Infiltration, in England,	in winter	33	per cent.
" "	in spring	35	" "
" "	in summer	2	" "
" "	in autumn	48	" "
Average of the year		42	" "

FILTERS FOR WATER WORKS.—1 square yard of filter for every 700 gallons in 24 hours; formed of 2 ft. 6 ins. of fine sand, 6 in. of common sand, 6 ins. of shells, 2 ft. 6 ins. of gravel.

Perforated pipes to be laid in the lowest stratum.

TO UNITE WATER PIPES.—An excellent material for uniting water pipes is prepared by combining 4 parts of Portland cement and 1 part of unslacked lime, mixed together in small portions in a stout mortar, adding enough water to permit it to be reduced to a soft paste.



THE ALLEN HIGH PRESSURE CUT-OFF ENGINE.

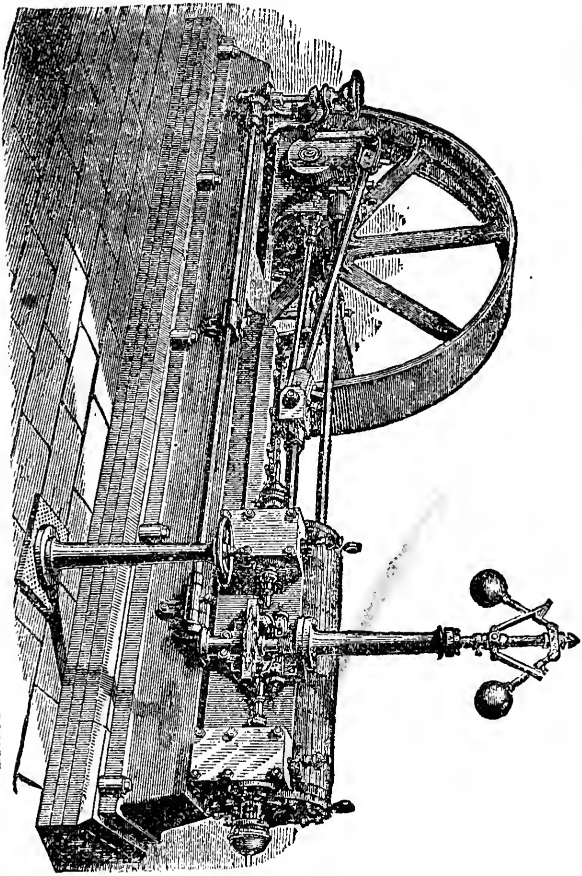
The engine represented above is constructed in the best manner, and valuable improvements have been introduced with a view to attain a very high speed and thus ensure immense power in a limited space. The travel of the piston is from 600 to 800 ft. per minute, and the engine is constructed of the best material, and is of excellent design throughout.

HAMPSON AND WHITEHILL'S HIGH PRESSURE ENGINE.—This massive and powerful engine (see cut) is in quite extensive use, and is noted for its substantial construction, its excellent valve arrangement, powerful governor, economical expansion gear, and many other valuable points.

THE FOLLOWING TABLE SHOWS THE DIMENSIONS, POWER, WEIGHT, &C., OF DIFFERENT KINDS OF PORTABLE STEAM ENGINES AND BOILERS.—*Haswell.*

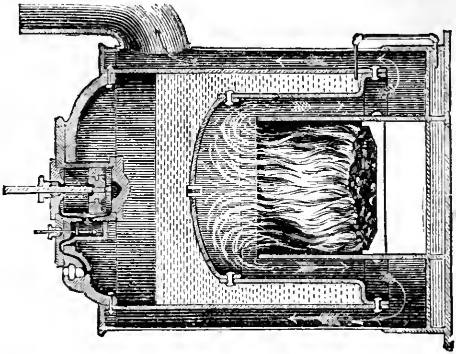
Power.		Cylinder.	Driving or Fly Wheels.		Weight of Engine and Boiler.
Nominal.	Actual.*	Diam. Stroke.	Diam. Fan.	Revolutions.	
			ins.		lbs.
4	4.7	4 × 10	2½× 6	175	2,800
5	7.3	5 × 10	3 × 7	175	3,200
7	10.5	6 × 10	3½× 7	175	4,200
8	14.3	7 × 10	3⅔× 8	175	4,900
12	19.2	8 × 12	4 × 8	150	6,100
15	24.3	9 × 12	5 × 9	150	6,900
20	30.9	10 × 16	6 × 10	116	11,200
25	36.3	11 × 18	6 × 10	100	12,300
30	43.2	12 × 18	6 × 12	100	13,800
40	58.8	14 × 18	7 × 14	100	16,700

* Computed at 60 lbs. pressure. All the Portable Engines have two fly wheels, or Driving pulleys.

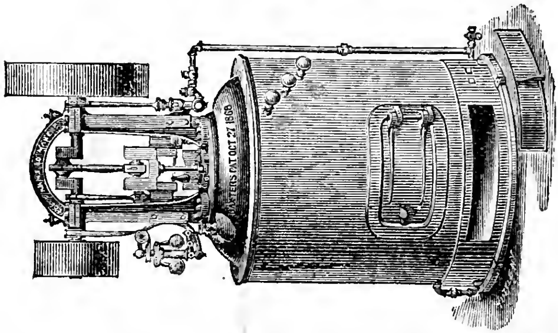


HAMPSON AND WHITEHILL'S HIGH PRESSURE CUT-OFF ENGINE.

THE BAXTER PORTABLE STEAM ENGINE, as manufactured by the Colt Arms Co. of Hartford, Conn., is made of five sizes, embracing two, four, six, eight, and ten-horse power, respectively, is certainly one of the most complete, unique, simple, and economical portable engines ever constructed. It is too well known to require a detailed descri on; but two illustrations are presented herewith, the first showi g a front view of the exterior part, and the other exhibiting a sectional view of the plain boiler for the two-horse power engine.



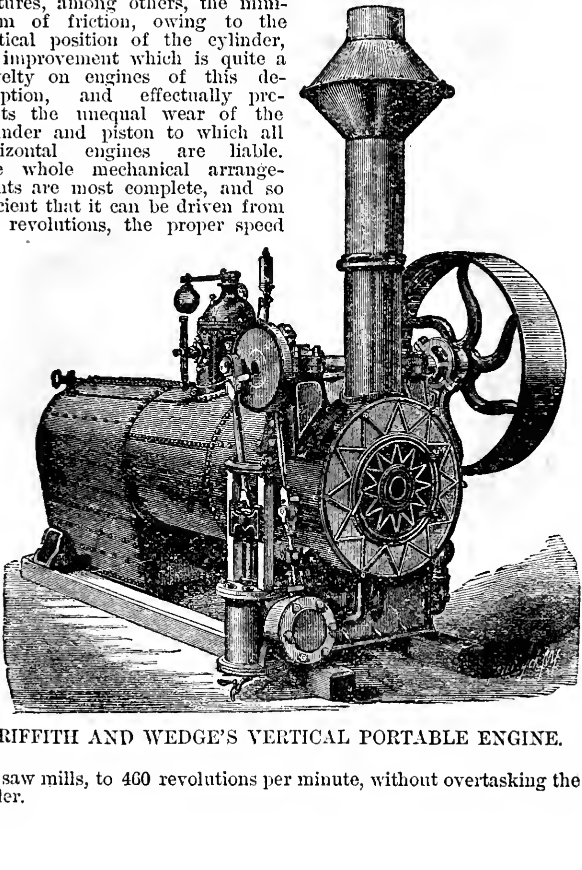
Sectional view of Plain Boiler, Two-Horse power Pattern.



Baxter Engine, Front view.

The largest size has a bursting strength corresponding to 500 lbs. to the square inch, whereas the working pressure is about 70 lbs.; the smallest size a bursting strength of 1000 lbs., and a working pressure of about 90 lbs. All the heating surfaces are below the water line, which ensures safety to the boiler. The circulation of the water within the boiler is perfect, thus holding the sediment in suspension, so that it may be expelled by blowing out. The cylinder and its parts are kept hot by immersion in the steam, so that no caloric is lost, and the piston has a vertical movement, so that there is but little wear and tear resulting from friction. It is hardly possible to explode the boiler in any contingency, and 100 lbs. of coal will run a four-horse engine for 10 hours. The whole machine is composed of about 130 component parts, all interchangeable, so that each article can be furnished by the manufacturer, as it may be required to effect repairs rendered necessary by wear or breakage. The engine has a piston speed of about 200 feet per minute, the diameter of the piston is about the same as the length of the stroke, and the valve arrangement is most complete.

Griffith and Wedge's Vertical Portable Engine.—The engine represented below presents a combination of many valuable features, among others, the minimum of friction, owing to the vertical position of the cylinder, an improvement which is quite a novelty on engines of this description, and effectually prevents the unequal wear of the cylinder and piston to which all horizontal engines are liable. The whole mechanical arrangements are most complete, and so efficient that it can be driven from 275 revolutions, the proper speed



GRIFFITH AND WEDGE'S VERTICAL PORTABLE ENGINE.

for saw mills, to 460 revolutions per minute, without overtasking the boiler.

ROBERT FULTON,

THE PIONEER OF STEAM NAVIGATION IN AMERICA.

While Robert Fulton was in England, converting a speculation into a reality, he was on friendly intercourse with Sir R. Phillips, to whom he wrote a triumphant letter on the evening of his first voyage on the Hudson. This letter was shown to Earl Stanhope and four or five eminent engineers, but treated with scorn as descriptive of an impossibility. Sir R. Phillips then advertised for a company to repeat on the Thames what had been done on the Hudson, but he obtained only two ten-pound conditional subscribers, after expending some pounds in advertising! He then printed, with commendation, FULTON's letter in the *Monthly Magazine* and his credulity was generally reprobated. Then, for several years, the American accounts were treated as falsehoods, till a man ruined himself by launching a vessel on the Clyde. Three Scotchmen afterwards made experiments. It was, however, a mere speculation until taken up by Fulton in 1806–7, and introduced on the American rivers. Thence Bell introduced it to the Clyde. At first every one derided the inventor as well as the invention, being afraid to trust themselves on the boat. The ignoble treatment accorded by America to the memory of her noble son, the generous FULTON, is a blot most foul upon her banner. Hundreds of thousands now avail themselves of the great invention which his genius brought to light, on the waters and wharves where 70 years ago, during his life time, the name of the poor unrequited inventor was a laughing stock and a bye-word. It is but a few days ago that a relation appeared in the *New York Sun*, giving an account of the accidental discovery of his bones in a vault, where, as we now learn, they had been granted a temporary resting place by the favor of the owner, and finally forgotten.

SUGAR MILL FOR CANES.—A 3-cylinder mill, with rollers 5½ ft. long, 30 ins. diam., and making 2¼ turns per minute, driven by an engine of 25 to 30 horse power, will express the juice out of 100 tons of canes in 12 to 15 hours. An acre of land produces from 10 to 20 tons of canes, according to the age and locality of the canes. The juice stands from 8 to 12 of the sacchrometer, according to the locality. The product in sugar varies from 6 to 10 per cent. of the weight of the canes, according to the locality and mode of manufacture. Well constructed mills give in juice from 60 to 70 per cent. of the weight of the canes, and one main condition of efficiency is, that the rollers shall travel slowly, as with too great a speed the juice has not time to separate itself from the woody refuse of the cane, and much of it is reabsorbed. To defecate 330 gals. of juice, 6 boiling pans or cauldrons are required, 4 scum presses, and 10 filters, and to granulate the sugar, 2 vacuum pans, 6½ feet diam., are required, with two condensers, and it is better also to have two air pumps. The steam for boiling the liquor in the vacuum pans is generated in 3 cylindrical boilers, each 6 ft. in diam. To whiten the sugar, there are 10 centrifugal machines, driven by a 12 h. p. engine, which also drives a pair of crushing rollers.—*Bourne.*

OIL MILL.—Weight of edge runners, 6,000 lbs.; number of turns of the vertical spindle per minute, 6; weight of seed introduced every 10 minutes, 55 lbs.; weight of seed crushed daily, 3,300 lbs.; product in oil in 12 hours, 1,320 lbs.; power expended, 2·72 horses.

HYDROSTATIC PRESS.—30 *bales of cotton per hour. Engine (high pressure cylinder)*, 10 ins. diam.; stroke of piston, 3 ft.; *Pressure of steam*, 50 lbs. per square inch; full stroke; *Revolutions*, 45 to 60 per minute; *Presses*, 2, with 12-inch rams; stroke, 4·5 ft.; *Pumps*, 2; diam., 2 ins.; stroke, 6 ins.—*Haswell.*

FULLING MILL.—In fulling the cloth called "Beauchamps," each piece being 220 yds. long and .66 wide, and weighing from 121.to 127 lbs., the fuller makes 100 to 120 strokes per minute; each piece requires 2 hours to full it, and the expenditure of 2 horse power during that time.—*Bourne.*

INDELIBLE RED INK FOR COTTON AND WOOLLEN MILLS.—Use equal parts of copperas and cinnabar, both in fine powder, sift, and rub up with linseed oil with a muller; then squeeze through cloth. Used for writing or stamping on cotton or woollen goods, it cannot be bleached out.

WIND MILLS.—The length of an arm (whip) is divided into seven parts, the sails extending over six parts. The force of wind at 10 miles an hour, is half a pound per square foot; at 14 miles is a pound; at 20 miles 2 lbs.; at 25 miles 3 lbs.; at 35 miles 6 lbs.; at 45 miles 10 lbs.; at 60 miles $17\frac{3}{4}$ lbs.; and at 100 miles is nearly 50 lbs. The driving shaft of a wind mill should be set at an elevated angle with the horizon when set in low localities, and at a depressed angle when set on elevations. These angles may range from 3° to 35°. To give the fullest effect to the force of the wind, the sails are inclined to the axis from 72° to 75°. The tips of the sails often move 30 miles per hour, or 44 feet per second. From tip to tip is about 70 feet, and the breadth from 5 to 6 feet. The performance of such a mill is equivalent to the power of 34 men.

Experiments prove, 1st, That in a vertical wind mill employed to grind corn, the mill stone usually makes 5 revolutions to 1 of the sail. 2nd, When the wind is 19 feet per second, the sails will make from 11 to 12 revolutions per minute, and the mill will grind 880 to 990 lbs. in an hour, or about 22,000 lbs. in 24 hours. 3d, With the wind at 30 feet per second, a mill will carry all sail, and make 22 revolutions per minute, grinding 1984 lbs. of flour in an hour, or 47,690 lbs. in 24 hours.

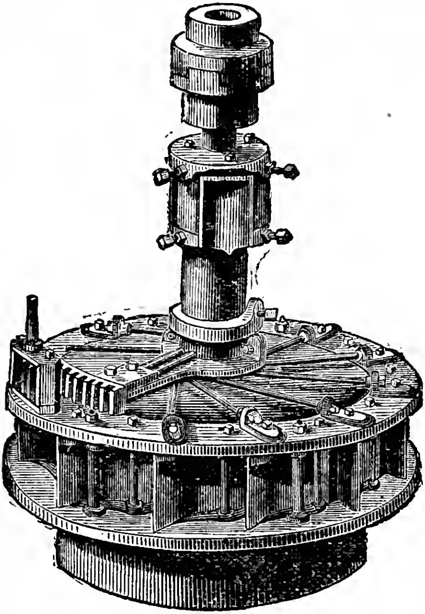
From the experiments of Smeaton, it appears that the following positions are the best. Suppose the radius to be divided into 6 equal parts, and call the first part, beginning with the centre, 1, the second 2, and so on, the extreme part being 6:—

NO.	ANGLE WITH AXIS	ANGLE WITH THE PLANE OF MOTION.
1	72 deg.	18 deg.
2	71 "	19 "
3	72 "	18 "
4	74 "	16 "
5	$77\frac{1}{2}$ "	$12\frac{1}{2}$ "
6	83 "	7 "

FRENCH FLOUR MILL.—Diameter of millstones, 70 inches; number of revolutions per minute, 70; quantity of corn ground and sifted per hour, 260.7 lbs.; power consumed, 3.34 horses, as tested by the dynamometer.

ENGLISH FLOUR MILL.—Diameter of millstones 51.18 inches; revolutions per minute, 110; corn ground per hour by each revolving millstone, 220 lbs.; power required for two revolving stones, 5.64 horses. Power consumed by one winnowing machine and two bolting machines, with brushes sifting 1,650 lbs. of flour per hour was $6\frac{1}{2}$ horses. In another mill the number of turns of the millstone was 486 per minute, the quantity of corn ground by each horse power was 120 lbs., of which 72.7 per cent. was flour, 7.8 per cent. was meal, and 19.5 per cent. was bran. In a portable flour mill, with machinery for cleaning and sifting, the total weight was 1000 lbs.—*Bourne.*

ENGLISH FLOUR MILL NEAR METZ.—Diameter of stones, 51.18 inches; number of revolutions per minute, 110; weight of millstone, 1 ton; corn ground per hour by each pair, 220 lbs. with two pairs of millstones acting, 1 bolting and 1 winnowing machine: the power consumed was $8\frac{1}{2}$ horse power.—*Bourne.* 5 bushels of Northern, and $4\frac{1}{2}$ bushels of Southern wheat, are required to make 1 barrel of flour; 2 lbs. of wheat make about 3 lbs of bread.



THE LEFFEL IMPROVED DOUBLE TURBINE WATER WHEEL.—This celebrated wheel (see cut), manufactured by Jas. Leffel & Co., of Springfield, Ohio, and New Haven, Conn., of which there are now about 8,000 in use, combines two independent sets and kinds of buckets, one a vertical, and the other a central discharge, differing entirely from each other in the principle of action upon the water. The two sets of buckets are so combined as to make really but one wheel, and by their arrangement admit the greatest possible quantity of water consistent with economical use to any given wheel of whatever size, and at the same time the greatest area for the escape of the water is secured. Thus, the surface of the wheel is reduced to a minimum, as compared with the quantity of water used, and a very great loss of power by friction is avoided. In connection with these wheels the Globe cast-iron casing is coming to be almost universally used, especially for the smaller wheels. Many of them are placed under heads of water, varying from 80 to 240 feet, and the tremendous pressure is withstood in the most admirable manner. The severest test, that of taking the place of an over-shot wheel under a very high fall, and with an extremely limited supply of water, is repeatedly applied, and in every instance with the most complete success. For over 12 years this wheel has stood the severest practical tests, developing the utmost power from a given quantity of water, in all places and under all circumstances, from the magnificent cotton mill down to the humble frontier saw and grist mill.

TABLE OF SPOUTING VELOCITY AND DISCHARGE OF WATER FOR GATE ORIFICES.

B	E	F	B	E	F	B	E	F	B	E	F
1	17.64	0.62	11	58.51	2.03	21	80.84	2.81	31	98.22	3.41
2	24.95	0.86	12	61.11	2.12	22	82.75	2.87	32	99.80	3.46
3	30.55	1.16	13	63.61	2.21	23	84.61	2.93	33	101.34	3.52
4	35.28	1.22	14	66.01	2.29	24	86.43	3.00	34	102.87	3.57
5	39.45	1.37	15	68.33	2.37	25	88.21	3.06	35	104.37	3.63
6	43.21	1.50	16	70.57	2.45	26	89.96	3.12	36	105.85	3.67
7	46.68	1.62	17	72.74	2.53	27	91.67	3.18	37	107.31	3.72
8	49.90	1.73	18	74.85	2.60	28	93.35	3.24	38	108.75	3.77
9	52.92	1.84	19	76.90	2.67	29	95.00	3.30	39	110.17	3.82
10	55.79	1.94	20	78.90	2.75	30	96.63	3.55	40	111.58	3.87

The above table gives depth in inches from 1 to 40, as noted under columns B. Columns E represent the velocity per second, in inches and decimals of an inch. Columns F represent the number of cubic feet per minute for each square inch of orifice.

ILLUSTRATION.—Suppose the opening under a forebay gate, required to pass the water of a stream, is 48 inches wide and 3 inches deep, with a head of water (B) in forebay of 28 ins.; to find the water discharged, run down the columns marked B until you come to 28 ins. (head given in this example); then run across to column F, and you will find 3.24, the number of cubic feet of water discharged by an orifice 1 in. square, under 28 ins. head. The area of the opening given, 48 ins. by 3 ins. is 144 square inches; this multiplied by 3.24 gives 466.56 cubic feet that the above opening will discharge per minute. This table gives the actual and not the theoretical discharge.

In the measurement of large open streams, first ascertain the mean velocity in feet per minute, and also the area of cross section of the stream in square feet, when the product of these two quantities will give the required quantity of water afforded by the stream. The velocity of such stream can be estimated by throwing floating bodies on the surface of near the specific gravity of the water, and rating the time accurately required in passing a given distance. It is generally best to ascertain the velocity at the centre, and from this ascertain the mean velocity, which has been found by accurate and reliable experiments to be 83 per cent., or about four-fifths of the velocity of the surface of the stream. The cross section may be estimated by measuring the depth of the stream at a number of points, at equal distances apart (these points being in a line across the stream), adding the depths together, and multiplying their sum by the distance apart in feet of any two points. This will give the result required in square feet of cross section, when the product of mean velocity in feet per minute and cross section in square feet, obtains the quantity of water that the stream affords in cubic feet per minute. *Leffell's Wheel Book.*

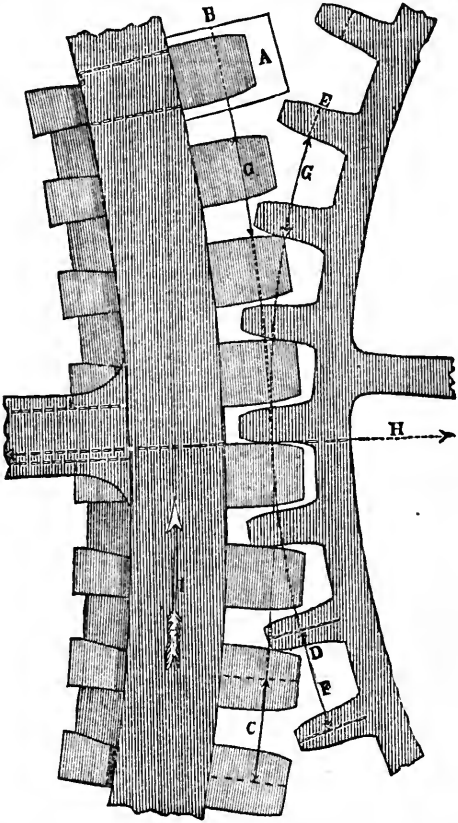
SAW AND GRIST MILL.—A Waterous 40-horse-power engine will drive a 60 inch circular saw, capable of cutting 20,000 feet of ship plank in 12 hours, edger, trimmer, shingle machines, lath machine, and bolter, and 2 run of stones in grist mill.

PITCH OF WHEELS, BEING A TABLE OF RADII OF WHEELS IN INCHES, HAVING FROM 7 TO 226 TEETH, THE PITCH BEING 2 INCHES, SHOWING HOW TO COMPUTE THE PITCH FOR A DESIGNATED DIAMETER, OR THE DIAMETER FOR A DESIGNATED PITCH.

Teeth.	Radius.	Teeth.	Radius.	Teeth.	Radius.	Teeth.	Radius.	Teeth.	Radius
7	2.29	51	16.24	95	30.24	139	44.25	183	58.25
8	2.61	52	16.56	96	30.56	140	44.57	184	58.57
9	2.93	53	16.88	97	30.88	141	44.88	185	58.89
10	3.24	54	17.20	98	31.20	142	45.20	186	59 21
11	3.55	55	17.52	99	31.52	143	45.52	187	59.53
12	3.86	56	17.83	100	31.84	144	45.84	188	59.84
13	4.18	57	18.15	101	32.15	145	46.16	189	60.16
14	4.49	58	18.47	102	32.47	146	46.48	190	60.48
15	4.81	59	18.79	103	32.79	147	46.79	191	60.80
16	5.12	60	19.11	104	33.11	148	47.11	192	61.13
17	5.44	61	19.42	105	33.43	149	47.43	193	61.44
18	5.76	62	19.74	106	33.74	150	47.75	194	61.76
19	6.39	63	20.06	107	34.06	151	48.07	195	62.07
20	6.71	64	20.38	108	34.38	152	48.39	196	62.39
21	7.71	65	20.70	109	34.70	153	48.70	197	62.71
22	7.03	66	21.02	110	35.02	154	49.02	198	63.03
23	7.34	67	21.33	111	35.34	155	49.34	199	63.34
24	7.66	68	21.65	112	35.65	156	49.66	200	63.66
25	7.98	69	21.97	113	35.97	157	49.98	201	63·98
26	8.30	70	22.29	114	36.29	158	50.30	202	64.30
27	8.61	71	22.61	115	36.61	159	50.61	203	64.62
28	8.93	72	22.92	116	36.93	160	50.93	204	64.94
29	9.25	73	23.24	117	37.25	161	51.25	205	65.26
30	9.57	74	23.56	118	37.56	162	51.57	206	65.57
31	9.88	75	23.88	119	37.88	163	51.89	207	65.89
32	10.20	76	24.20	120	38.20	164	52.21	208	66.21
33	10.52	77	24.52	121	38.52	165	52.52	209	66.53
34	10.84	78	24.83	122	38.84	166	52.84	210	66.85
35	11.16	79	25.15	123	39.16	167	53.16	211	67.17
36	11.47	80	25.47	124	39.47	168	53.48	212	67.48
37	11.79	81	25.79	125	39.79	169	53.80	213	67.80
38	12.11	82	26.11	126	40.11	170	54.12	214	68.12
39	12.43	83	26.43	127	40.43	171	54.43	215	68.44
40	12.74	84	26.74	128	40.75	172	54.75	216	68.76
41	13.06	85	27.06	129	41.07	173	55.07	217	69.07
42	13.38	86	27.38	130	41.38	174	55.39	218	69.39
43	13.70	87	27.70	131	41.70	175	55.71	219	69.71
44	14.02	88	28.02	132	42.02	176	56.02	220	70.03
45	14.33	89	28.34	133	42.34	177	56 34	221	70.35
46	14.65	90	28.65	134	42.66	178	56.66	222	70.67
47	14.97	91	28.97	135	42.98	179	56.98	223	70.68
48	15.29	92	29.30	136	43.29	180	57.23	224	71.30
49	15.61	93	29.61	137	43 61	181	57.62	225	71.66
50	15.93	94	29·93	138	43.93	182	58.93	226	71.94

To find the Radius for any given Pitch other than two inches, the rule is, as two inches is to the given pitch, so is the radius of the Table to the radius required, or, to determine the number of Teeth in a wheel for a designated pitch and diameter, divide the diameter by the pitch, and opposite to the quotient, in the Table will be found the proper number of teeth.

WHEEL GEARING, CONSTRUCTION OF TEETH.—The cut represents a section of a pair of gears whose teeth act on each other on the same plane; they are known as *spur gear*. The largest is a *spur mortice* *wheel*, fitted with wooden cogs. A shows the square wooden cogs, generally driven into mortice wheels previous to being laid off with the dividers and dressed down to the exact pitch and outline, as shown



in the shaded part representing the finished tooth. The teeth of the small wheel (called the *driven*, the large one with the cogs being known as the *driver*) are iron, being cast with the wheel, and are sufficiently strong if but half the size of cogs.

The *pitch line* (see dotted lines extending from B to C, and from D to E) is a circle of sufficient dimensions to permit the requisite number of teeth and spaces to be laid out on it.

The *length* of a tooth should be .7 of the pitch, .4 of it being below the pitch line, and .3 above, as shown in cut. As a general thing, the greater the *breadth* of a tooth across the surface the longer it will wear.

By the *pitch* is understood the space between the middle or centres of two adjoining teeth, as shown by the arrows at F F, or the breadth of a tooth and a space, as shown by the arrows at G G. The semi-diameter running to the pitch line is called the pitch radius.

The *true* or *chordial pitch* is a straight line drawn between the centres of two adjoining teeth, and is that by which the dimensions of the teeth and speed of wheel are computed.

The radius is the space between the centre of the wheel and the periphery of a tooth, or half the diameter of the wheel.

The line of centres, shown at H, passes through the centres of two wheels, and on this line the pitch circles of the wheels should merge into each other (as shown in cut) when they are properly regulated for operation.

PROPORTION OF TEETH OF WHEELS—.

From pitch line to top of tooth	= Pitch × 0·33
Total depth of tooth	= Pitch × 0·75
Thickness of tooth on pitch line	= Pitch × 0·45
Space between teeth on pitch line	= Pitch × 0·55
Thickness of rim of wheel	= Pitch × 0·45
Thickness of arms in flat	= Pitch × 2·50
Thickness round centre	= Pitch × 1·30

Mortice wheels to be wider than iron wheels by twice the thickness of the rim; rim to be double the thickness of iron wheels.

PITCHES OF EQUIVALENT STRENGTH FOR THE TEETH OF WHEELS IN DIFFERENT MATERIALS.—

Pitch for cast iron	= 1·00
" brass	= 1·00
" hardwood	= 1·20
" " according to other authorities	= 1·26

The number of arms in wheels should be as follows :—

1·5 to 3.26 feet in diameter,	4	8.5 to 16 feet in diameter,	8
3·25 to 5 " "	5	16 to 24 " "	10
5 to 8.5 " "	6		

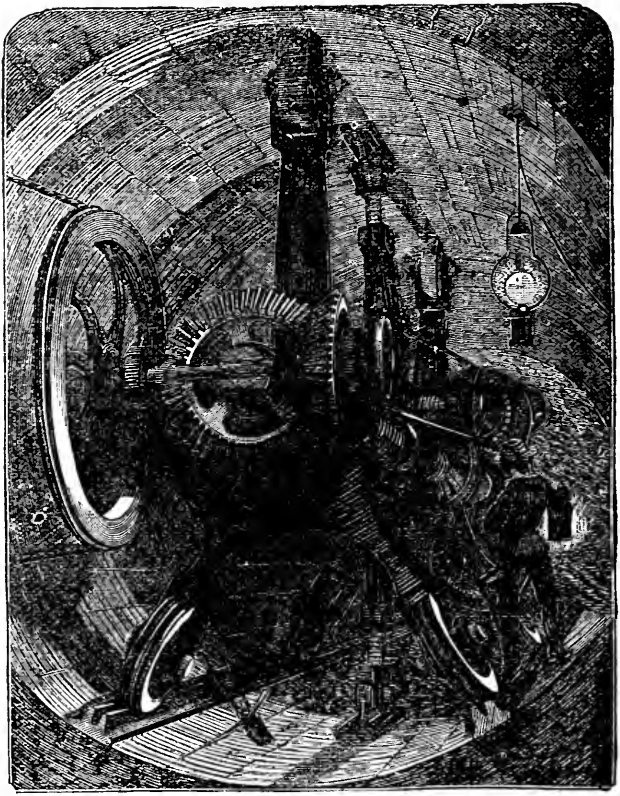
FLY WHEELS.—Weight of rim should be 85 to 95 lbs. per horse power, momentum of wheel being 4½ times that of the piston; *diameter* 3 to 4 times that of the stroke of the engine. Single-acting engines, fly-wheel to be 5 times heavier than in double acting engines.

To Compute Weight of Rim—Multiply the mean effective pressure upon the piston, in pounds, by its stroke, in feet, and divide the product by the product of the square of the number of revolutions, the diameter of the wheel, and ·00023. For a light wheel multiply by ·0003; for a heavy one by ·00016.

To Compute Dimensions of Rim—Multiply the weight, in pounds, by ·1, and divide the product by the mean diameter of the rim, in feet ; the quotient will give the sectional area of the rim in square inches of cast iron.

Ginning Cotton—4 horse power will drive a gin of from 40 to 60 saws, and for every additional 20 saws add 1 horse power.

Threshing Grain—4 horse power should thresh 50 bushels per hour ; 6 to 8 horse power will drive the ordinary 10 to 12 horse thresher and separator.



BORING MACHINE FOR SUBMARINE TUNNELS.

The above engraving represents a back view of the tunnelling or boring machine intended to be used in perforating the proposed tunnel under the English Channel, between France and England. Operations have already been commenced on the French coast, and fervent hopes are entertained that no insurmountable obstacles will be encountered. The chalk formation through which it is proposed to drive the tunnel, is 400 feet thick on the English coast and 300 feet on the French ; and, as the Straits of Dover are in no part deeper than 186 feet, it is confidently anticipated that the proposed enterprise will be successful. It is intended that the machine will at once bore out the tunnel to the proper size, 16 or 18 feet in diameter; and, as the soil to be penetrated consists only of soft chalk beds, it is thought that all the operations can be conducted without resorting to the use of steel drills or blasting operations, as simple boring tools will be all that will be requisite. The power will be transmitted from a steam engine placed at the mouth of the shaft or entrance to the tunnel, by means of a wire rope connecting with the first wheel or pulley, as shown in the cut, which then, by means of intermediate gearing, &c., communicates motion to a series of cutters and borers in front of the machine. Should this arrangement prove too complicated, it is most probable that compressed air will be used as a substitute for steam power. The machine, as represented above, is immovably braced by means of two uprights, fitted with stout rollers, extended against the arch above, and four projecting wheels with triple flanges, fitted into temporary rails below, the whole being further secured by two heavy jack-screws, one above the machine and another below, pressing on proper bearings against the contrivance from the top and bottom of the tunnel. It is estimated that the tunnel, if driven through the lower chalk formation, will be about 23 miles long; but in the event of serious obstacles arising from overwhelming quantities of water breaking in, it is not improbable that the advice of Professor Prestwick may be followed: to drive a tunnel through the Paleozoic rocks (the lowest fossiliferous strata), which are supposed to be about 600 feet below the surface at Dover, in which event the length would somewhat exceed the above estimate. The only question in connection with the prosecution of this enormous enterprise, is merely one of money, as the scientific appliances of the present day put the practicability of the work beyond a doubt. That a vast amount of money will be required, may be manifest from the following table, compiled by Major McClellan, U. S. A., showing the cost of tunnels in various localities prior to 1855:—

Location.	Per Cubic Yard.	Location.	Per Cubic Yard.
Black Rock, U.S., grey wacke slate..	$6 60	England, freestone, marble, clay, &c., lined..	$3 46
Blaisley, France, lined	3 18	Lehigh, U.S., hard granite.	4 36
Blisworth, Eng., blue clay, lined..........	1 55	Schuylkill, U. S., slate..	2 00
Blue Ridge, U. S.....	4 00	Union, U. S.. slate......	2 08

Railway Tunnels in *soft sandstone*, in the United States, cost, without lining, per lineal yard, $88. In loose ground, thick lining, per lineal yard, $7.10. Ordinary brick lining, including centering, per cubic yard, $8.50.

Shafts.—*Blaisley Tunnel*, clay, chalk, and loose earth, cost, per yard in depth, $139.11. Deepest, 646 ft. *Black Rock*, 7 ft. in diam. and 139 in depth, hard slate, cost, per yard in depth, $79.50, or per cubic yard, $18.72. The time required to drive the heading of the Black Rock Tunnel for 1782-5 feet, was 23,387 turns of 12 hours each.

The Ingersoll Rock Drill, represented in the cuts, is a most powerful and effective mechanical appliance in the varied requirements of tunnelling, mining, submarine blasting, &c. It works on the percussion principle, and is operated either by steam power, as illustrated in the cut, or by compressed air, acting on a piston within a cylinder, secured by clamps to a vertical or horizontal column or tripod. It can be adjusted to perforate the rock at any desired angle, and, on open quarry work, the large drill (they are made of different sizes), is an equivalent to the work of 25 men, and has often done the work of 40 men for successive days. In railway tunnels and other subterranean places presenting impediments to active work, of course the progress is considerably less. The average boring done in hard rock, per day, of ten hours, is from 70 to 80 feet. In underground work, where foul air exists, the employment of compressed air becomes a necessity, as it not only dissipates all danger from explosive gases, but drives the drill equal to steam power, cools the atmosphere, and dispenses fresh air to the workmen. Considered in all its bearings, it is a most wonderful machine.

VIEW OF THE DRILL ATTACHED TO COLUMN, AS USED WITH COMPRESSED AIR OR STEAM, WHEN PRACTICABLE.

VIEW OF DRILL ATTACHED TO COLUMN, AS ARRANGED FOR USE IN SHAFTS.

Gold Assay by Smelting Process.—Take 600 grains of the gold-bearing quartz, finely pulverized, and free from sulphurets; mix with 600 grs. litharge and 7 grs. of charcoal; melt all in a crucible of ample size, and set off to cool. Break the crucible when cold, and the gold will be found in a small button under the refuse matter at the bottom. To ascertain the *amount of gold in a metallic substance*, select a small sample, weigh it, and melt in a small cupel, composed of calcined bone ashes. This absorbs the common metal, leaving the gold and silver exposed to view. The resultant button is melted once more in the proportion of gold, 1 part, silver, 3 parts, and then rolled into a thin band and boiled in nitric acid, which dissolves out the silver, and leaves the gold pure at the bottom. The gold can be removed, and the silver subsequently precipitated with salt.

Gold Assay with a Horn Spoon.—Take an ox horn and remove half of it, so as to leave an open part 7 or 8 ins. long and about 3 ins. wide; pulverize the rock to be tested very fine, and using it instead of a pan, wash out a few ounces, and if some particles of gold are detected, or a "color" perceived, as a rule it will pay to work it.

In the Assay of Rock Containing Pyrites, it must be roasted until it ceases to evolve sulphurous fumes, then mix 600 grs. of the powder with 300 grs. carbonate of soda, 300 grs. charcoal, 300 grs. litharge, 300 grs. dried borax, and 15 grs. charcoal; melt all in a crucible, and treat as directed above.

Silver Assay by Smelting.—If no lead is present, mix 600 grs. of the pulverized ore with 300 grs. carbonate of soda, 600 grs. of litharge, and 12 grs. of charcoal in a crucible, add a slight coat of borax over all, put on the furnace, melt, take off, give it a few taps to settle the metal, let it cool, and remove the button.

To Assay Argentiferous Galena, or lead bearing silver ore.—Mix 300 grs. of the pulverized ore with 900 grs. carbonate of soda and 30 grs. charçoal; melt in a crucible on a furnace, and treat as described above, and remelt the button in a porous cupel made of bone dust, which absorbs the lead, leaving the silver pure.

Test for Iron or Copper Pyrites.—Place a sample of the mineral rock on an anvil; if it becomes flat under a blow of the hammer it is gold, but if it scatters into fragments it is pyrites; or place some of the doubtful material, pulverized, in a cup with nitric acid over a flame until it evolves dark red vapors: the acid will become stained or tinged if pyrites are present.

Silver Assay with Testing Tube.—Place in the tube enough of the powdered mineral to fill one inch of space, and on this pour nitric acid in quantity to occupy 2 ins. more, and hold the mixture over a flame until the acid boils. The acid will dissolve whatever silver may be present, and must be passed through filtering paper to remove extraneous matter, and returned to the tube. Next add a few drops of water saturated with salt; any silver or lead that may be present will be precipitated in a cloudy form to the bottom. Drain off the acid, place the precipitate in the sunlight, and in a few minutes, if it contains silver, it will turn to a purple color, and may be again liquified by the addition of spirits of ammonia. The testing tube is formed of thin glass, about 5 ins. long, and less than 1 in. diam.; bottom and sides of equal thickness. Where the tube is lacking, a cup may be used instead.

PROSPECTING FOR QUARTZ.—The first step to be taken is to ascertain the direction of the strata of the bed-rock and quartz veins imbedded therein. Then take a common pick, shovel, and good iron pan, and prospect the surface dirt along, and just under the break of the veins every few yards, then following the vein as far as it shows itself, either by its outcrop or loose fragments; and if gold is found in the surface along the vein, it is a good presumptive evidence that the vein is gold bearing. Then ascertain the point on the vein that gives the best "prospect," and make a cut across it deep enough to show the vein as it is inclosed in the bed or wall rock; then make a carefnl examination of every part of the vein, so as to determine what part of it is gold bearing. The casing of the vein where it joins the wall rock should be carefully tested also; it frequently occurs that the casing is richer than the vein itself. The best mode of testing the rock is to pound it up finely in a hand mortar, and wash it out in a pan or horn spoon. If a satisfactory result is obtained, then sink a shaft so as to cut the vein at the point where the prospect is obtained, and follow it down, say 40 or 50 feet. The character of the "wall rock" should be closely observed, to ascertain the "line of its texture." The smooth faces that separate the vein from the wall rock should be carefully examined; the smooth faces have numerous small ridges upon them, that show "the line of its projection," or the direction from which the vein was forced up between the walls enclosing it. The ridges and fine grooves on the faces of the veins will, in most cases, be found to have the same direction of the texture of the wall rock; and the rich section of the vein will most generally continue rich in the "line of its projection." It is frequently the case that a vein will have a section of a few feet that will be rich, and all the balance of it be poor; therefore, it is very important to learn the "line of its projection," for the rich sections always follow the course indicated by the "line of projection," and the "line of texture" of the wall rock.—*J. E. Clayton.*

TO PROSPECT A RIVER BAR.—The prospector should, during the season of low water, select the bend of a stream below where it emerges from a deep gorge, and, noting the spot where the eddy usually exists during high water on the inward bend of the stream, he will proceed to dig to a depth of 2 or 3 ft., as near the water's edge as possible, but distant enough to keep the hole dry on reaching the rock. Now fill the pan nearly full with the bottom dirt from the rock, take it to the stream, immerse it in the water and agitate the mass, breaking up the lumps of clay, &c., if any exist. Keep the pan under water, with the side next the operator slightly elevated; shake from side to side; the muddy water will flow out, as the clear water flows in, carrying away the dirt; the pan is now raised from the water, and the shaking continued, with the lower side still more depressed in order to allow the light sand to pass over the further edge; the stones are removed by hand, and the operation continued until but a few dregs are left; the particles of gold, if any existed in the sample, will be found in the pan, and a search for them will decide the question of value.

TO PROSPECT IN A GULLY.—Select a spot soon after a rain, when water is abundant, and if possible let it be a level place over a vein of slate with vertical, or nearly vertical strata, presenting its ragged edges towards the adjacent acclivities in such position as to intercept the gold in its downward progress. Fill the pan with dirt from the slaty bed, make a dam across the stream and pan out in standing water.

IN PROSPECTING FLATS, examine the surface for the indications of old channels, and the beds of ancient streams or brooks, and explore the most promising spots by digging down to the bed rock, and test by panning out a portion of the dirt. In mining districts, the high elevations containing gravel and clay should be well tested by the panning out of numerous samples, as they frequently contain vast stores of golden wealth.

TO PROSPECT WITH A KNIFE.—Select a suitable spot in a ravine in an auriferous district, remove the earth to the vicinity of the rock, making a hole large enough to afford room to admit the prospector to overhaul the dirt with the point of a knife. The particles of gold are carefully picked as they are discovered, and the rest is rejected; the seams and crevices in the rock should be thoroughly scraped out and the contents closely examined, as these places often contain the most precious deposits.

PLACER MINING, BOARD SLUICE PROCESS.—The board sluice is a trough from 50, to 1400 or 1500 ft. long (composed of 1½ in. boards, length of boards from 12 to 14 feet,) constructed in sections or boxes of the same length as the boards. The sections composing the trough are made to fit into each other, and usually rest on trestles elevated from the ground, but with an inclination of from 12 to 18 ins. in every 12 feet of length. The box may be from 12 to 50 ins. wide, and half as deep as it is broad, more or less as desired. By placing division boards edgeways along the centre it may be divided into two parts, thus adopting it for the use of two parties, or for keeping up constant work in the washing department on the one side, while cleaning is going on in the other. The bottom of the sluice is fitted with longitudinal riffle bars from 3 to 7 ins. high, and from 2 to 4 ins. wide, well secured from 1 inch to 1½ ins. apart, by means of wedges, two sets of riffle bars being fitted into each box.

The labor of from 5 to 18 or 20 men is required to fill the dirt into the sluice, and a stream of water, say from 15 to 40 inches or more, is admitted at the upper end and emerges at the lower, carrying along the mud, gravel, stones, &c., in its course. A vessel containing quicksilver is placed at the head of the sluice, and, about 2 hours after the washing commences, the liquid particles are allowed to trickle through an aperture in the side of the vessel into the stream, which hurries them onwards and downwards through the sluice, where they mingle with the gold particles and lodge together against the riffle bars. The precious metals being heavy, alway trend towards the bottom, and lodge against these interposed obstacles, the riffle bars. The same effects may be seen on our streets and roads any day after a shower, the dirt is washed away, and the heavy articles, as nails, buttons, horseshoes, &c., remain. This furious torrent "or run" of water, gravel, stones, mud, &c., is continued through the sluice for 6 or 8 days, by which time the riffle bars are usually worn out, and the cleaning up process is commenced by raising 6 or 7 sets of the riffle bars towards the head of the sluice, and the auriferous matter found lodged against them is removed with scoop and pan. Another lot of riffle bars is then raised and the same operation is repeated until they are all cleaned out. An amalgam plate, inserted in the last box of the sluice, is very effective in arresting the fine gold on its downward course. To prepare the plate, place a sheet of copper, say 3 feet or more, in length, and the same width as the box, very even and flat on the bottom. Make a tight, close fit on the upper edge, and secure each side by nailing down narrow strips of board. Next, take nitric acid, 1 lb., add to this, water, 1 lb., and apply the mixture to the copper plate with a rag on the end of a stick; drop on some quicksilver, and wipe it all over the plate until it is completely silvered. This is the amalgam plate. Now get a sheet of stout plate iron, equal in dimensions to the copper plate, and perforate with numerous slits ½ inch long and 1-16 inch wide, crosswise of the plate, not in regular rows, but as it were with broken joints, like bricks in a wall, ranged with their ends out of line on every half inch, in order to permit the easy entrance of fluid material at all points. The perforated iron plate, being now ready, is laid in the box immediately over the amalgamated plate, and resting on the narrow boards, which hold the latter in place, and is firmly secured in this position, but so as to be easily detached when required. The sluice box is now adjusted or placed at the same grade as the others, but so that the iron plate will be on a level with the bottom of the box above. It will be found that while the gravel, stones, and gross material will easily pass over the iron plate, part of the fluid portion, with the fine atoms of gold, will fall through the crevices on the amalgamated plate below, when the latter will be arrested at once. Each day, for the first week or less, the iron plate should be removed, the copper cleaned from a green substance which adheres, and more quicksilver added. A riffle bar should be placed below the plate to secure the surplus quicksilver. The gold may be removed at proper intervals as it accumulates. The value of the catch will be enhanced by admitting a small quantity of water into the sluice just above the plate.

The water used by miners is generally sold by water companies at a certain rate per inch; it is delivered from an orifice in the side of a flume, which in many cases conveys the water from distant mountains over hills, ravines, plains, and along excavations on the sides of precipitous mountains, &c. An inch of water is estimated to be the quantity emitted through an aperture an inch square under a head of 6 or 7 inches, and the price per inch varies from 12 cents up to 40 cents per day, according to the locality, demand, &c.

Hydraulic Mining.—The operative power in hydraulic mining is derived from a reservoir of water placed at a high elevation above the point of action, from whence the water is conveyed through a hose, and projected with terrific force under a pressure of from 80 to 200 feet, against the dirt above the bed rock. The effect is equal to the combined labor of several hundred men; the force exerted being literally equivalent to the removal of mountains, as the superincumbent masses of earth and rock frequently comes tumbling down in quantities of hundreds of tons at a time. The dirt thus loosened is conveyed into and washed down the sluice. To fortify the hose to withstand the fearful pressure of the water, it should be stoutly banded with strong galvanized iron rings about 2 ins. broad, secured around the hose at intervals of about 2 ins. apart. The quantity of water required by a hydraulic claim varies from 50 to 300 ins.

The Long Tom, at one time in quite extensive use by miners in California, is a trough ranging from 8 to 14 ft. in length, generally 10 ins. wide at the upper end where the dirt is deposited, 30 ins. wide at the lower extremity, and about 8 ins. deep. The bottom, at the wide end is composed of a sieve or riddle of perforated sheet iron, with a small riffle box, or trough with riffle bars placed underneath. The water entering in at the upper end, flows through the entire length of the tom, washing the dirt in its passage, but is prevented from forcing it over the lower end by an upward erection at the lower end of the riddle. The gravel, sand, and small stones escape through the perforated iron, while the large stones are tossed out with the shovel, and the gold is caught in the riffle box below, quicksilver being used occasionally to assist in securing the finer particles.

QUARTZ CRUSHING BY STAMPS.—The rotary stamp is very highly commended as the most efficient stamp in use for the crushing of quartz rock. The square stamp is vertical, with the main part or shaft about 8 ft. long, and from 5 to 8 ins. square, shod with massive iron weighing from 100 to 1000 lbs. They are elevated by cams projecting from a horizontal shaft, which effect a lift of from 6 to 18 ins. at each revolution, when the stamp falls with all its force into the battery or the quartz below. The quartz, previously broken to pieces the size of a hen's egg or less, may be crushed in a dry state, or in a wet condition, with a small stream of water constantly flowing through the battery, which is enclosed by a wire cloth or perforated plate of sheet of iron, to permit the egress of the quartz when sufficiently triturated. The separation of the gold from the quartz is effected by washing, etc., as in placer mining; much of it is caught by the use of coarse blankets laid in troughs, through which the quartz is washed as in a sluice, and many use the amalgam plate, made as described above, to secure the gold.

In amalgamating in the battery, 2 ozs. of quicksilver to 1 oz. of gold is the best proportion for use, and produces the most effective results in securing the gold.

MINING MACHINERY (MOLESWORTH).

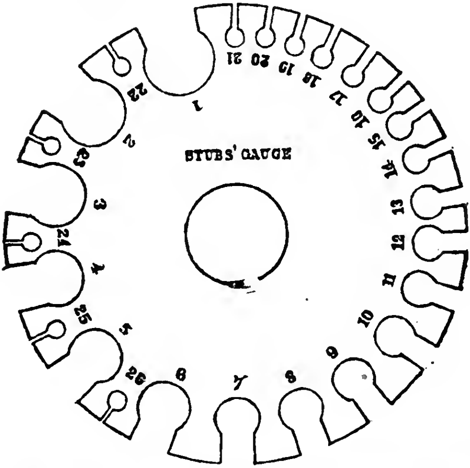
Speed of crushing rolls at periphery	60 ft. per minute.
Diameter of " " "	24 to 30 ins.
Breadth of " " "	12 to 15 ins.
Roller shaft	6 ins. square.
Tumbling shaft	$4\frac{1}{2}$ "
Sifting screen shaft	$1\frac{3}{4}$ ins. diameter.
Rolls crushed together with a force of	60 tons.
Weight of stamper heads, from	$1\frac{1}{2}$ to 5 cwt.
Lift of ditto	9 to 12 ins.
Number of lifts per minute	45 to 60.
Exposed area of cast gratings about	9 × 10 ins.
Number of holes to the inch for tin	140.
Area of stamper bottom, generally	6 × 10 ins.
Pumps for deep mines, usually	8 to 10 ft. stroke.
Each lift	from 150 to 200 ft.

Horse power of pumping engines :—

$Q =$ quantity of water raised per minute, cubic feet.
$H =$ height in feet.
Actual horse power $= \cdot 0021\ H\ Q.$

IN SMELTING SILVER, fifty per cent. of lead is added to silver ore, or lead ore containing that proportion of lead, will do as well. Add 10 per cent. of iron, and melt all together; the silver is then permitted to escape through an orifice in the lower part of the furnace. The silver is once more put in a furnace and boiled until all impurities are driven off.

In the Salt Solution Process, five per cent. of salt is added to the silver ore, and the mixture is roasted until the salt is converted into a chloride. When in this state, and still red hot, it is thrown into a very strong solution of boiling brine, to dissolve the chloride of silver. The brine is filtered at a temperature of 212° and the silver is precipitated by adding small pieces of copper, together with a small quantity of muriatic acid.



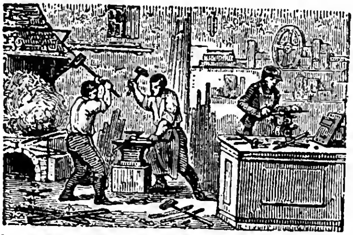
Birmingham Wire Gauge Compared with Inches.

B. W. G.	= Ins.	B. W. G.	= Ins.	B. W. G.	= Ins.	B. W. G.	= Ins.
No. 1 =	.31	No. 10 =	.137	No. 10 =	.042	No. 28 =	.014
2	.28	11	.125	20	.035	29	.015
3	.26	12	.109	21	.032	30	.012
4	.24	13	.095	22	.028	31	.01
5	.22	14	.083	23	.025	32	.009
6	.2	15	.072	24	.022	33	.008
7	.187	16	.065	25	.02	34	.007
8	.166	17	.056	26	.018	35	.005
9	.158	18	.049	27	.016	36	.004

No. 1 W. G. = ...	$\frac{5}{16}$ in.	No. 11 W. G. = ..	$\frac{1}{8}$ in.
4 " ..	$\frac{1}{4}$ in.	16 " ..	$\frac{1}{16}$ in.
7 " ..	$\frac{3}{16}$ in.	22 " ..	$\frac{1}{32}$ in.

Artificial Meerschaum is made with very fine sifted plaster of Paris, baked for a few hours and thrown while warm into melted wax or linseed oil; the resemblance may be increased by a coloring solution of gamboge and dragon's blood.

N.B.—In addition to the following inestimable Receipts and processes, the blacksmith will find Iron Tables, and Tables of Circumferences, Areas and Diameters of Circles, for measurement of hoops, rings, &c., at the end of the mechanical department.



TEMPERING LIQUIDS.—1. Water, 3 gals; soda, 2 ozs.; saltpetre, 2 ozs.; prussic acid, 1 oz., or oil of vitrol, 2 ozs. 2. Water, 6 gals.; saltpetre, sal-ammoniac and alum, of each 4 ozs., and draw no temper. 3. Water, 4 gals.; saltpetre and alum, of each, 4 ozs.; sal-ammoniac, pulverized, 1 oz.; salt, 3 lbs. Heat to a cherry red and plunge in, drawing no temper. 4. Water, 4 gals.; saltpetre, 1 oz.; pulverized borax, 1 oz.; pulverized sal-ammoniac, 1 oz.; white vitriol, 2 ozs.; salt, 3 pts. Do not hammer too cold, nor heat too high. 5. Water, 4 gals.; salt, 2 teacupfuls; saltpetre, 2 ozs.; pulverized alum, 4 teaspoonfuls; never heat over a cherry red, nor draw any temper. 6. Water, 2 gals.; add corrosive sublimate, 1½ oz.; common salt, 2 handfuls; when dissolved it is ready for use. The first gives toughness to the steel, while the latter gives the hardness, causing the water to adhere to the steel, which otherwise would be repelled by the heat. 7. *Tempering Liquid for Mill Picks.*—Water, 3 gals.; spts. of nitre, 3 ozs.; hartshorn, 3 ozs; white vitriol, 3 ozs.; alum, 3 ozs.; sal-ammoniac, 3 ozs.; salt, 6 ozs., with 2 handfuls of the parings of horses' hoof. The steel is to be heated to a cherry red. A large jug of this preparation should be kept corked tight, in order to retain its strength. Use soft water in all these tempering liquids.

TEMPERING MILL PICKS.—Get double refined cast steel made expressly for mill picks. In drawing out the pick, use an anvil and hammer with smooth faces, and be careful not to heat the steel higher than a dark cherry red. Do not strike the pick on the edge when finishing it, but hammer it on the flat side, striking light and often, until the steel is quite dark, letting the blows fall so as to close the pores of the steel. When a dozen picks are ready to temper, get 2 gals. of rain water from which the chill should be taken, if in winter, by dipping a hot iron into it; add 2 lbs. salt, and it is ready for use. Heat your pick gradually from the centre; let the heat run to the point, and when it is a dark cherry red, dip the point vertically into the bath and hold it still. When the heat has left the part immersed, take it out, and cool the balance of the pick in ordinary water. Be sure to heat and hammer well.

TO TEMPER A DRILL VERY HARD.—Heat your drill to a cherry red and quench it in mercury. This will drill hardened steel.

COMPOSITION FOR TEMPERING.—Rosin, 7½ parts; whale oil, 1½ parts; pulverized charcoal, ½ part; tallow, ½ part. *Directions.*—Very small tools should be dipped in this mixture the same as in water, then polish and draw the temper as usual. Large tools should be dipped, then heated up again and temper as usual. This composition will also restore burnt steel as good as new. If small tools, dip once. If large, dip two or three times; no hammering is required.

TO MAKE IRON TAKE A BRIGHT POLISH LIKE STEEL.—Pulverize and dissolve the following articles in 1 qt. hot water; blue vitriol, 1 oz.; borax, 1 oz.; prussiate of potash, 1 oz.; charcoal, 1 oz.; salt, ½ pt.; then add 1 gal. linseed oil, mix well, bring your iron or steel to the proper heat and cool in the solution. It is said the manufacturers of the Judson governor paid $100 for this receipt, the object being to case harden iron so that it would take a bright polish like steel.

DIPPING TOOLS WHEN HARDENING.—To harden a pen-knife blade, lancet, razor, chisel, gouge-bit, plane, spoke-shave, iron shaving knife, three or four square files, and round and flat files, dip them endwise or perpendicularly. This keeps them straight, which would not be the case were they dipped in the water obliquely.

SUBSTITUTE FOR BORAX.—Alum, 2 ozs.; dilute with water and mix with 2 ozs. potash, boil in a pot half an hour over a gentle fire, take it out of the water, add 2 ozs. gem salt in powder, as much of alkaline salt, 3 lbs. honey, and one of cow's milk, mix all together, set it in the sun for 3 days and the borax is ready for use. This will go twice as far in a blacksmith's shop as common borax.

WELDING CAST STEEL.—Silver sand 2 lbs., plaster of Paris, 1 lb.; mix thoroughly. Heat your article and dust it with the above, place it in the fire again until you get a red heat and it will weld.

RESPIRATOR.—An excellent respirator may be made of a thick sheet of carded cotton wool placed between two pieces of muslin. Unequalled for arresting dust, steel particles, &c.

ANNEALING STEEL.—For small pieces of steel, take a piece of gas pipe 2 or 3 inches in diameter, and put the pieces in it, first heating one end of the pipe, and drawing it together, leaving the other end open to look into. When the pieces are of a cherry red, cover the fire with saw dust, use a charcoal fire, and leave the steel in over night.

TO DRILL HARDENED STEEL.—Cover your steel with melted beeswax, when coated and cold, make a hole in the wax with a fine pointed needle or other article the size of hole you require, put a drop of strong nitric acid upon it, after an hour rinse off, and apply again, it will gradually eat through.

TO HARDEN METALS.—Iron, 60 parts; chrome, 40 parts; form a composition as hard as the diamond. A high degree of hardness may also be imparted to iron or steel by adding ¼ part of silver. Copper may be externally hardened by the fumes of zinc and tin. The specula of Lord Ross's telescope is 1 part tin and 1 part copper, this is as hard as steel, and takes a very high polish; if more than this be added it will scarcely cohere.

WELDING CAST STEEL.—Rock saltpetre, ¼ lb.; dissolve in ¼ lb. oil vitriol; and add it to 1 gal. water. After scarfing the steel, get it hot; and quench in the preparation. Then weld the same as a piece of iron, hammer it very quick with light blows. It answers the purpose much better than borax; cork it in a bottle, and it will keep for years. *Another.*—Borax, 15 parts; sal-ammoniac, 2 parts; cyanide of potassium, 2 parts; dissolve all in water, and evaporate the water at a low temperature.

GERMAN WELDING POWDER.—Iron turnings, 4 parts; borax, 3 parts, borate of iron, 2 parts; water, 1 part.

TEMPERING SWORDS AND CUTLASSES.—N. B. Ames, late of Chicopee, Mass., after many costly experiments, found that the best means of tempering swords and cutlasses that would stand the U. S. Government test, was by heating in a charcoal fire, hardening in pure spring water, and drawing the temper in charcoal flame.

BELGIAN WELDING POWDER.—Iron filings, 1000 parts; borax, 500 parts; balsam of copaiba, or other resinous oil, 50 parts; sal-ammoniac, 75 parts. Mix all well together, heat, and pulverize completely. The surfaces to be welded are powdered with the composition, and then brought to a cherry red heat, at which the powder melts, when the portions to be united are taken from the fire and joined. If the pieces to be welded are too large to be both introduced into the forge, one can be first heated with the welding powder to a cherry red heat, and the other afterwards to a white heat, after which the welding may be effected.

COMPOSITION USED IN WELDING CAST STEEL.—Borax, 10 parts; sal-ammoniac, 1 part; grind or pound them roughly together; then fuse them in a metal pot over a clear fire, taking care to continue the heat until all spume has disappeared from the surface. When the liquid appears clear, the composition is ready to be poured out to cool and concrete; afterwards being ground to a fine powder, it is ready for use. To use this composition, the steel to be welded is raised to a heat which may be expressed by "bright yellow;" it is then dipped among the welding powder, and again placed in the fire until it attains the same degree of heat as before: it is then ready to be placed under the hammer.

TO RESTORE BURNT STEEL AND IMPROVE POOR STEEL.—Borax, 3 ozs.; sal-ammoniac, 8 ozs.; prussiate of potash, 3 ozs.; blue clay, 2 ozs.; resin, ¼ lb.; water, 1 gill; alcohol, 1 gill. Put all on the fire, and simmer till it dries to a powder. The steel is to be heated, dipped in this powder, and afterwards hammered.

TO RESTORE BURNT CAST STEEL.—Borax 1½ lbs.; sal-ammoniac ½ lb.; prussiate of potash ¼ lb.; rosin, 1 oz. Pound the above fine, add a gill each of water and alcohol, and boil all to a stiff paste in an iron kettle. Do not boil too long, or it will become hard when cool. The burnt steel is dipped while quite hot in the composition and slightly hammered.

RESTORING BURNT STEEL.—It is not generally known that burnt steel may be almost instantaneously restored by plunging it while hot in cold water, and hammering it with light strokes on the anvil, turning it so as to hammer all over it, again dipping in the cold water, and repeating the hammering process as before Try it; if you don't succeed the first time, you will soon do so.

COMPOSITION TO RESTORE BURNT STEEL.—Two parts horn filings; 10 parts tallow; 1 part sal-ammoniac, 1 part pulverized charcoal; 1 part soda; pulverize the hard ingredients separately, mix all thoroughly with the tallow. Bring your burnt steel to a cherry red and dip it in the mixture; when it gets cold it may be hardened in the usual manner.

COMPOSITION TO TOUGHEN STEEL.—Resin, 2 lbs.; tallow, 2 lbs.; black pitch, 1 lb.; melt together, and dip in the steel when hot.

BURGLAR AND DRILL-PROOF DIAMOND CHILL.—Take 1 gal. urine, and add to it 1 oz. borax and 1 oz. salt.

TO RE-SHARPEN OLD FILES.—Remove the grease and dirt from your files by washing them in warm potash water, then wash them in warm water, and dry with artificial heat; next, place 1 pt. warm water in a wooden vessel, and put in your files, add 2 ozs. of blue vitriol, finely pulverized, 2 ozs. borax, well mixed, taking care to turn the files over, so that each one may come in contact with the mixture. Now add 7 ozs. sulphuric acid and ½ oz. cider vinegar to the above mixture. Remove the files after a short time, dry, sponge them with olive oil, wrap them up in porous paper, and put aside for use Coarse files require to be immersed longer than fine.

SUBSTITUTE FOR BORAX.—Copperas, 2 ozs.; saltpetre, 1 oz.; common salt, 6 ozs.; black oxide of manganese, 1 oz; prussiate of potash, 1 oz.; all pulverized and mixed with 3 lbs. nice welding sand, and use the same as you would sand. High-tempered steel can be welded with this at a lower heat than is required for borax.

TO SOFTEN IRON OR STEEL.—Either of the following methods will make iron or steel very soft:—1. Anoint it all over with tallow, temper it in a gentle charcoal fire, and let it cool of itself. 2. Take a little clay, cover your iron with it, temper in a charcoal fire. 3. When the iron or steel is red hot, strew hellebore on it. 4. Quench the iron or steel in the juice or water of common beans.

TEMPERING STEEL SPRINGS.—The steel used should be that called "spring" for the large work; for small work, "double shear." After hardening in the usual way, in water, or, as some prefer, in oil, dry the spring over the fire to get rid of its moisture, then smear it over with tallow or oil, hold it over the flame of the smith's forge, passing it to and fro, so that the whole of it will be equally heated, holding it there until the oil or tallow takes fire. Take the article out of the fire and let it burn a short time, then blow it out. The process may be repeated two or three times if the operator fancies that any portion of the spring has not been reduced to the proper temperature, or rather raised to it.

TEMPERING SAWS.—A late improvement consists in tempering and straightening the saws at one operation. This is done by heating the saws to the proper degree, and then pressing them with a sudden and powerful stroke between two surfaces of cold iron. A drop press is employed for the purpose. The mechanism is quite simple and inexpensive. Its use effects an important economy in the manufacture of nearly all kinds of saws, and also improves their quality.

TEMPERING SPIRAL SPRINGS.—Place a piece of round iron inside the spring, large enough to fill it; then make the spring and iron red hot, and, when hot place them quickly into cold water, and stir them about till cold; afterwards rub them with oil or grease, and move them about in a flame till the grease takes fire; the spring will then be reduced to its proper temper.

To Temper Small Springs,—*In Large Quantities.*—First, harden them in the usual manner of hardening steel; then place as many as convenient in a vessel containing oil. Heat the oil containing the springs until it takes fire from the top, then set off the vessel and let it cool. The springs will then be found to possess the required temper.

Tempering.—The article after being completed, is hardened by being heated gradually to a bright red, and then plunged into cold water: it is then tempered by being warmed gradually and equably, either over a fire, or on a piece of heated metal, till of the color corresponding to the purpose for which it is required, as per table below, when it is again plunged into water.

Corresponding Temperature.

A very pale straw	430	Lancets	
Straw	450	Razors	
Darker Straw	470	Penknives	All kinds of wood tools.
Yellow	490	Scissors	Screw taps.
Brown yellow	500	Hatchets, Chipping Chisels,	
Slightly tinged purple	520	Saws.	
Purple	530	All kinds of percussive tools.	
Dark purple	550	Springs.	
Blue	570		
Dark blue	600	Soft for saws.	

Tempering Razors, Cutlery, Saws, &c.—Razors and penknives are too frequently hardened without the removal of the scale arising from the foregoing : *this practice, which is never done with the best works, cannot be too much deprecated.* The blades are heated in a coke or charcoal fire, and dipped in the water obliquely. In tempering razors, they are laid on their backs upon a clean fire, about half-a-dozen together, and they are removed one at a time, when the edges, which are as yet thick, come down to a pale straw color. Should the backs accidentally get heated beyond the straw-color, the blades are cooled in water, but not otherwise. Pen-blades are tempered a dozen or two at a time, on a plate of iron or copper, about 12 inches long, 3 or 4 inches wide, and about $\frac{1}{3}$ of an inch thick. The blades are arranged close together on their back and lean at an angle against each other. As they come down to the temper, they are picked out with small pliers and thrown into water if necessary; other blades are then thrust forward from the cooler parts of the plate to take their place. Axes, adzes, cold chisels, and other edge tools, in which the total bulk is considerable compared with the part to be hardened, are only partially dipped; they are afterwards let down by the heat of the remainder of the tool; and, when the color indicative of the temper is attained, they are entirely quenched. With the view of removing the loose scales, or the oxidation acquired in the fire, some workmen rub the objects hastily in dry salt before plunging them in the water, in order to give them a cleaner and brighter face.

Oil, or resinous mixtures of oil, tallow, wax, and resin, are used for many thin and elastic articles, such as needles, fish hooks, steel pens and springs, which require a milder degree of hardness than is given by water. Gun lock-springs are sometimes *fried in oil* for a considerable time over a fire, in an iron tray; the thick parts are then sure to be sufficiently reduced, and the thin parts do not become the more softened from the continuance of the blazing heat. Saws and springs are generally hardened in various compositions of oil, suet, wax, &c. The saws are heated in long furnaces, and then immersed horizontally and edgeways into a long trough containing the composition. Part of the composition is wiped off the saws with a piece of leather, when they are removed from the trough, and heated one by one, until the grease inflames. This is called "*blazing off.*" The composition used by a large saw manufacturer is 2 lbs. suet and ¼ lb. of beeswax, to every gallon of whale oil; the seare boiled together, and will serve for thin works and most kinds of steel. The addition of black resin, about 1 lb. to each gallon, makes it serve for thicker pieces, and for those it refused to harden before; but resin should be added with judgment, or the works will become too hard and brittle.

To Improve Poor Iron.—Black oxide of manganese, 1 part; copperas and common salt, 4 parts each; dissolve in soft water, and boil till dry; when cool, pulverize, and mix quite freely with nice welding sand. When you have poor iron which you cannot afford to throw away, heat it, and roll it in this mixture; working for a time, reheating, &c., will soon free it from all impurities, which is the cause of its rottenness. By this process you can make good horse nails out of common iron.

Case-Hardening for Iron.—Cast iron may be case-hardened by heating to a red heat, and then rolling it in a composition composed of equal parts of prussiate of potash, sal-ammoniac, and saltpetre, all pulverized and thoroughly mixed. This must be got to every part of the surface; then plunged, while yet hot, into a bath containing 2 ozs. prussiate of potash, and 4 ozs. sal-ammoniac to each gallon of cold water.

Moxon's Case-Hardening Process.—Cow's horns or hoofs are to be baked, dried and pulverized in order that more may be got into the box with the articles, or bone dust answers very well. To this add an equal quantity of bay salt; mix them with stale chamber ley, or white wine vinegar; cover the iron with this mixture, and bed it in the same in loam, or enclose it in an iron box, lay it on the hearth of the forge to dry and harden; then put it into the fire, and blow till the lump has a blood red heat, and no higher, lest the iron mixture be burnt too much. Take the iron out and throw it into cold water.

For Malleable Iron.—Put the articles in an iron box, and stratify them among animal carbon, that is, pieces of horns, hoofs, skins, or leather, just sufficiently burned to be reduced to powder. Lute the box with equal parts of sand and clay; then place it in the fire, and keep at a light red heat for a length of time proportioned to the depth of steel required, when the contents of the box are emptied into water.

Another for Wrought Iron.—Take prussiate of potash, finely pulverized, and roll the article in it, if its shape admits of it; if not, sprinkle the powder upon it freely, while the iron is hot.

To Temper Springs.—For tempering cast-steel trap springs, all that is necessary is to heat them in the *dark*, just so that you can see that they are red; then cool them in luke-warm water. You can observe a much lower degree of heat in the dark than by daylight, and the low heat and warm water give the desired temper.

CASE-HARDENING COMPOUND.—Prussiate of potash, 3 lbs.; sal-ammoniac, 2 lbs.; bone dust, 2 lbs.

COMPOSITION FOR WELDING CAST STEEL.—Pulverized borax any quantity, and slightly color it with dragon's blood. Heat the steel red hot, shake the borax over it; place it again in the fire till the borax smokes on the steel, which will be much below the ordinary welding heat, and then hammer it.

TO WELD CAST IRON.—The best way of welding cast iron is to take it at a very intense heat, closely approaching the melting point. In this state it will be found sufficiently malleable to stand welding by the hammer. There are other methods, but most of them are attended by almost insurmountable difficulties.

TO TEMPER TAPS OR REAMERS without springing, select your steel for the job, and forge the tap with a little more than the usual allowance, being careful not to heat too hot nor hammer too cold; after the tap or reamer is forged, heat it and hold it on one end on the anvil. If a large one, hit it with the sledge; if a small one, the hammer will do. This will cause the tap to bend slightly. Do not straighten it with the hammer, but on finishing and hardening the tap, it will become straight of its own accord.

TO HARDEN AND TEMPER CAST STEEL.—For saws and springs in general the following is an excellent liquid; Spermaceti oil, 20 gals.; beef suet *rendered*, 20 lbs.; neat's-foot oil, 1 gal.; pitch, 1 lb.; black resin, 3 lbs. The last two articles must be previously melted together, and then added to the other ingredients, when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until all moisture is evaporated, and the composition will take fire on a flaming body being presented to its surface.

WATER ANNEALING.—Heat the steel to a red heat, and let it lie a few minutes, until nearly black hot; then throw it into soap-suds; steel in this way may be annealed softer than by putting it into the ashes of the forge.

TO SOFTEN MALLEABLE IRON.—When your furnace is charged with fuel and metal, get the fire up to a dull red heat, then pour fluoric acid all over the coke; use ½ pt. to 1 pt. or even 1 qt. adding a handful of fluor spar; it will make the metal much softer.

WORKING STEEL FOR TOOLS.—In working steel for tools, great care should be taken to hammer all sides alike, for if one side is hammered more than another it will cause it to spring in hardening. Again, steel, when being hammered, should be heated as hot as it will stand, until finishing, and should then be hammered until almost black hot, for the reason that it sets the grain finer, and gives the tool a better edge. The reason for heating the steel so hot while hammering is simply because it makes the steel tougher when hardened, and softer when annealed, while if it were worked at a low red heat, the continued percussive shocks of the hammer would so harden it as to make it almost impossible to anneal it, and at the same time render it brittle when hardened.

TO MAKE, HARDEN, AND TEMPER TOOLS.—Experience has proved that all steel cutting tools should be hardened at a low red heat, or the lowest degree of heat compatible to yield efficient results, not forgetting that large tools require more heat than small ones, for the reason that they retain the heat much longer in the cooling process. Very small tools such as some surgical, and dental instruments, all springs, centre drills, needles, etc., should be hardened in oil, as cold water is apt, by cooling them too rapidly, to render them brittle and worthless. Too much heat imparts a coarse grain like cast iron, to the steel, and makes it liable to break when in use. A heat sufficient to raise scales should never be taken unless with an implement too large to temper without it, for it is sure to result in injury to the steel, even though the temper is drawn to a straw color. Tools such as *cutters* and *reamers* which require to be hardened without springing, should be accurately turned to within $\frac{1}{4}$ inch of their finished size, and then annealed previous to finishing. In *annealing steel*, it should be heated very slowly to a red heat, being careful to keep it under the scaling degree, then allow it two days or more to cool in. In *making taps*, you should have immediately under the square head, a place accurate size of the outside of the thread, so that you will have no trouble in getting dimensions of the thread wherever an odd number of flutes exist. Every tap should be the accurate size of the bottom of the thread to within about $\frac{1}{2}$ an inch of the square head, shaping it this way, when a strain comes in the work it will twist instead of breaking. The threads on V taps ought to be cut with a tool exactly three square, (unless the thread is rounded on the top), and then finished with a sharp tool without polishing, as this produces a glaze on the metal while being tapped. In making a tap for common machine screws or for bolts, measure with callipers, the lower part of the thread of one of the screws, and proceed to cut your tap at the bottom of the thread the exact size of the measurement. Strong taps for *square thread screws* ought to be cut $\frac{1}{2}$ the depth of their pitch, so if the thread is five to the inch, cut one-tenth of an inch deep. The threads being 5 to the inch, leaves a space between the threads of one tenth of an inch, and the thread being one tenth in depth and one-tenth wide, would make the thread square. In square threads required for wear, the cut should be $\frac{3}{4}$ the depth of their pitch.

In *hardening* a tap, use a clear, bright fire; a fire of charcoal is the best; heat to a cherry red, and holding it by the upper end immerse the entire thread-part first, keeping it stationary until the smooth part attains a dark red color; then gradually dip the whole tool, holding it stationary until cold. Brighten the fluted parts and proceed to *temper* the tool by heating a piece of an iron pipe to a bright red; remove it from the fire, place it in a vertical position, and insert the tap in the centre of the tube (but not touching any part of it) with the threaded part outside. The interior of the tube should be twice the diameter of the tool, and the length but half. Revolve the tap in the hot pipe until the smooth part is warm enough to slightly pain the hand, keeping it in motion endways, back and forth through the pipe and turning it until the thread is tinted to a deep brown, and the rest of the tool to a brown purple, modify any irregularity in the color by holding the light colored parts longer in the tube, or if any parts color too deep, cool off with a little oil. The squares of taps should be tempered to a deep blue color.

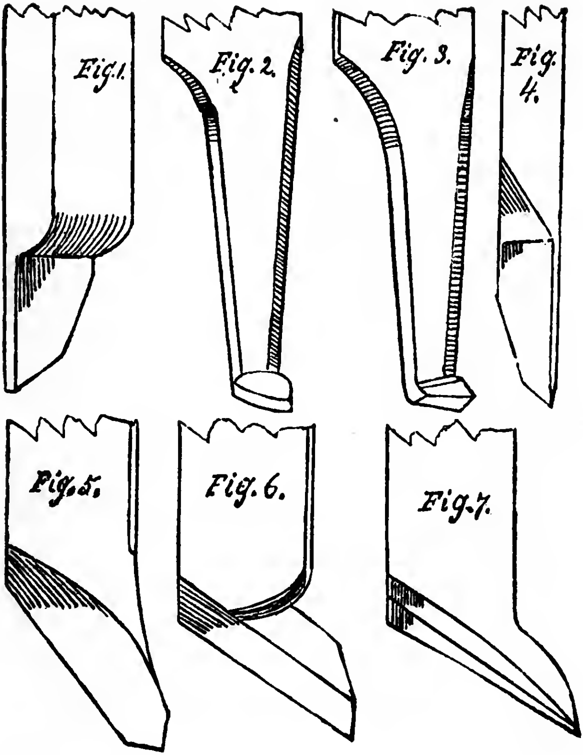


Fig. 1. Tool for cutting square thread screws, &c.
Fig. 2. Lathe tool for boring.
Fig. 3. Tool for cutting interior screws.
Fig. 4. Left hand side tool, top view.
Fig. 5. Tool for cutting V thread screws.
Fig. 6. Diamond-point tool, to turn small shafting, &c.
Fig. 7. Round-ended tool, to turn heavy shafting, &c.

To Dip or Temper Half-round Files or Reamers.—On account of the unequal surface presented to the water by half round tools, it is necessary, in order to keep them straight, or nearly so. while tempering, that they should be inserted with the *semi-circular side 20° leaning towards the water. To dip a fluted reamer*, insert it ½ an inch beyond the fluting, dipping and withdrawing it several times in succession. This ensures a reliable temper in the tool and will assist greatly in preventing fracture, and breakage.

To Set a Lathe to Turn Tapering.—Calculate a certain amount of taper to the foot or the extension of the piece to be turned, for instance with a shaft one foot long with a thickness of 1 inch at one end larger than the other, set the puppet-head over ½ inch, and you will obtain the desired taper of 1 inch per foot. With a shaft 20 ins. long, you will obtain a taper of 2 ins. over its whole length, by setting your lathe over 1 inch.

To Set a Lathe to Turn Shafting.—Find out if your centres are true, and adjust them correctly if they are not, using a square end tool, keeping them true to a three-square gauge, otherwise you will be apt to ruin your work. Now set your puppet-head so that it will turn the shaft true and straight, and if without a straight mark upon it, turn one end of the shaft for about an inch, next, without stirring your tools, take the shaft from the lathe, run the carriage down to the main head, and if the tool comes in contact with the spot you have turned, the machine is straight, if not, screw over the puppet head, and keep adjusting it until the tool touches the place turned at both ends of the lathe.

On Keys, Planing Key Ways, &c.—To ensure an easy entrance, apply oil to the key way and enter the key, marking where it binds, avoiding extreme tightness at the sides, and securing the lock by a proper taper at the rate of about ⅛ of an inch to the foot of length. *To ease hardened key ways and slots*, use a strip of copper as a file on the surface of the metal, together with emery and oil. *To plane a key way in a shaft*, drill a hole the size of the way the depth you wish to plane; then plane the key way slightly narrower than the intended size ; this is done with a square point tool, afterwards finish with a tool of the desired size ; this method ensures a much neater finish, than the use of one tool only. *To ensure true cutting* in adjusting a tool for cutting a key way, test each side of it by a square set on the planer bed, to see that it is perpendicular. *To plane a* T *shaped slot or way*, plane to the desired depth with a square point tool, then plane the upper part of the way to the proper width. Now plane the bottom part of the way with two tools, each being bent to a different angle, one to the right and the other to the left. *Shallow ways* may be cut out, the upper width and proper depth, then finished with one tool shaped the desired form of the way. Powerful tools should be used in planing large ways in order to avoid breaking, and should cut easily on each of the three sides. Use a sheet iron gauge and plane the way to conform to it. *To plane a gibe rest or slide*, plane it all over, omitting the slide, on both sides; then set the planer head at an angle of 30°, and finish the slide with a taper point tool. *In planing thin cast iron surfaces*, the outside being harder than the inside, it is necessary in order to prevent springing owing to the expansion of the scale, to plane over a cut on each side previous to finishing either.

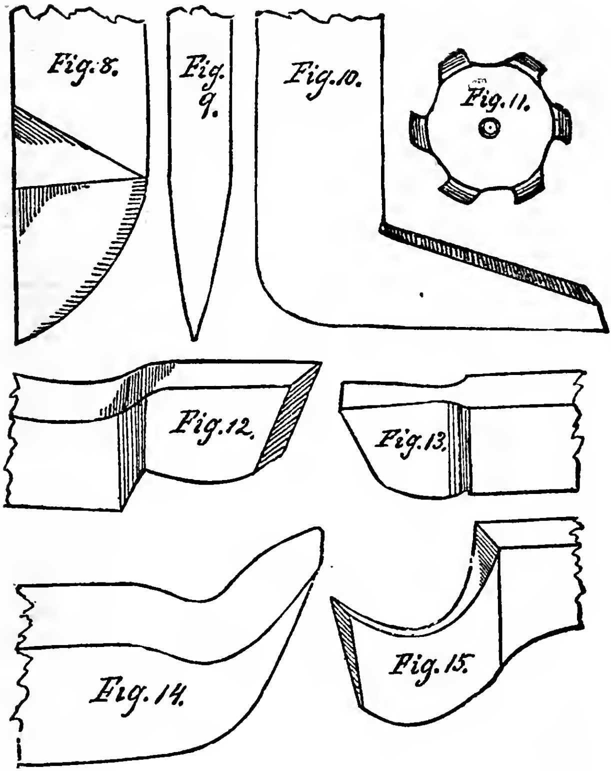


Fig. 8. Side view of right-hand side tool.
Fig. 9. Tool for cutting V threads, side view.
Fig. 10. Tool for planing a key-way.
Fig. 11. End view of a fluted tap or reamer.
Fig. 12. Side tool for squaring the ends of wrought iron work.
Fig. 13. Tool for parting or cutting brass apart.
Fig. 14. Side tool for cast iron, wrought iron or steel, left hand form.
Fig. 15. Parting tool for iron or steel work.

CARE OF LATHES, PLANERS, DRILLS, &c.—In order to utilize your lathes, &c., for nice fine work, and keep your ways, arbors, and centres in order, it is necessary to keep them clean by brushing away the rubbish from the ways, feed gears, and other working parts; clean well by frequent rubbing with cotton waste, and keep them in easy working order by regular oiling.

TOOLS FOR TURNING.—1. For *turning balance wheels, or squaring up large surfaces*, use a round end tool constructed well tapering to cut from the side. 2. The best tool for *turning small shafting* is a diamond point tool; for heavy shafting use a round end tool, shaped to stand high like a diamond point and to cut full and free from the side. 3. For *cutting off a shaft*, use a tool shaped thin and having the tapering down the reverse of turning tools. 4. For cutting a V thread screw use a V thread tool, with the points ground to lean down when finished, so as to prevent running and destroying both the tool and the work. 5. For *cutting a square thread screw*, the best way is to use a square point tool about ¾ of the thickness of the thread you intend to cut, and finish with another the exact size of the thread. In cutting a thread within a hole apply the same method. 6. For boring out a hole use a lathe boring tool with the end turned on a right angle to the left, and the point turned up hooking.

The side tool shown in Fig. 12, should, for light work, be hardened right out; temper to a straw color for heavy work. For heavy work on a slotting machine, temper to a brownish purple, and grind so that the cutting edge first strikes the cut near the body of the tool, and not at the point ends; use at a speed of about 10 feet per minute.

The *parting tool for brass*, Fig. 13, should be made to conform to the shape as represented and hardened right out.

The *side tool for iron*, Fig. 14, cannot be made too hard; and should be used at a speed ranging from 20 to 30 feet per minute, with feed from 20 to 30 revolutions for each inch cut, varying as the dimensions of the work ranges from 1 inch up to 12 inches in diameter, the speed decreasing as the size of the work increases.

The *parting tool for iron*, Fig. 15, should be tempered in accordance with the size of the tool and the nature of the work to be done; it may be hardened right out, or hardened to a dark straw, or, for a weak tool, to a purple color.

The *roughing tool for wrought iron*, Fig. 16, when used on large work, should be tempered to a light straw, but for work of 5 inch diameter or less, it should be made as hard as possible and not tempered at all. The cutting speed varies from 15 to 35 feet per minute as the size of the work varies from 1 inch to 20 inches or more in diameter; feed &c., ranging about as follows:—

Diameter of Work in Inches.	Cutting Speed Feet per Minute;	Feed per Inch Cut.
1 or less.	35	25
1 to 2	24	19
2 " 5	20	19
5 " 10	17	14
10" 20	16	12
20 and upwards	15	12.

In hardening and tempering the *boring tools* represented by Figs. 17, 19, 20, 21. 22 and 26 proceed, according to the directions given elsewhere; making them very hard.

The *side tool for brass*, Fig. 18, should be hardened as much as fire

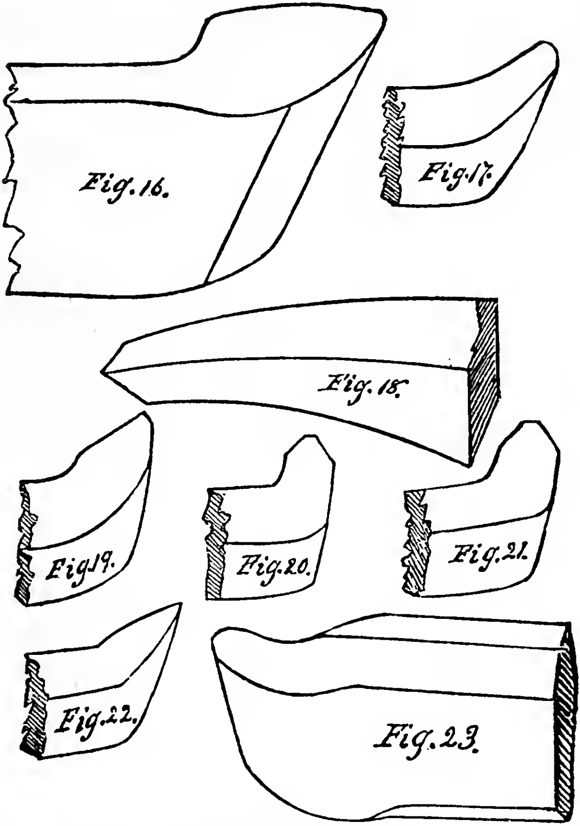


Fig. 16. Tool for roughing out wrought iron work.
Fig. 17. Boring tool for heavy work on wrought iron.
Fig. 18. Side tool for brass work.
Fig. 19. Boring tool for heavy cutting on wrought iron.
Fig. 20. For boring on cast iron where tool is liable to vibrate or tremble.
Fig. 21. Stout finishing tool on cast iron. The back part of the tool is formed for scraping only, the front corner doing the cutting.
Fig. 22. Tool to cut out a straight corner at the bottom of a hole in wrought iron. Fig. 23. Boring tool for wrought iron or steel.

and water will permit, and may be used at a cutting speed of from 150 to 350 feet per minute on work ranging from 1 inch up to 20 inches in diameter, with a feed of 30 and 25 revolutions to each inch turned.

The *boring tool for wrought iron, etc.*, Fig. 23, should, if slight, be tempered to a light straw color; otherwise, harden it right out, and when in use lubricate well with a mixture of soft soap 1 lb; boiling water, 1 gal.

The *finishing tool for cast iron*, Fig. 24, should be hardened right out; the cutting speed on the lathe is about 25 to 30 feet per minute on small work, and 18 feet on large work, with a coarse feed of say, 8 revolutions of the lathe per inch of travel.

To make a *counter boring tool*, (Fig. 25), adjust the handle to a proper collet and turn the governor, which ought not to be over a ¼ of inch in length; next turn a spot for the lips about ⅜ of an inch, on small tools and about ¾ inch on large ones. Above this spot, turn it about ⅓ larger than the governor and straight up to the handle, by leaving the place for the lips short, thus saving filing. Next file 4 spiral lips in them, resembling a drill; afterwards dress off the back back side of the lips on the end to an edge with a file, and harden.

Milling tools or cutters, (Fig. 27.) ought to be chucked to fit loosely on the arbor, so that they may not prove to be too small after hardening. Now turn them to within a 32nd. of an inch of the required thickness, and again heat previous to finishing. This second heating renders them less apt to spring when heated for the final hardening.

The *front tool for brass*, Fig. 29, should be hardened right out, and the speed and feed should be about the following :—

Diameter of Work in Inches.	Cutting Speed ft. per minute.	Amount of Feed
1 or less,	345	25
2 to 5,	245	25
5 to 10,	195	25
10 to 20,	150	30

The tool for *cutting square threads*, Fig. 30, should be made quite hard, and formed as shown in cut. The same remark applies to the *tool for hard metal*, shown at Fig. 31.

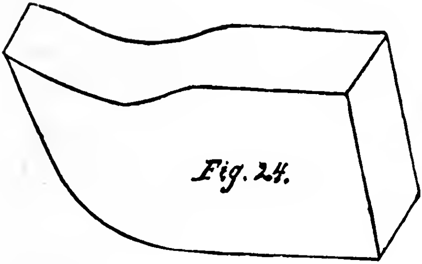
The *boring tool for brass*, Fig. 32, should be made as hard as fire and water will make it, and used with a quick speed and lightfeed.

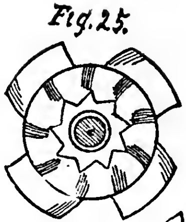
The *finishing tool for wrought iron, &c.*, Fig. 33, should be hardened right out, and used at a cutting speed of from 18 to 38 revolutions per minute, as the size of the work varies from 18 inches, or more, down to 1 inch in diameter, with a feed from 14 to 30 revolutions for each inch cut, as follows :—

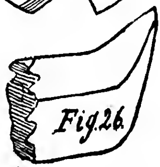
Diameter of Work in Inches.	Cutting Speed ft. per minute.	Amount of Feed.
1 or less,	38	30
1 to 2,	29	24
2 to 4,	24	19
4 to 10,	22	19
10 to 18,	19	16
18 and upwards,	18	14

In addition to these instructions, each tool requires to be ground in such a way as will best adapt it for the performance of the various kinds of work that may be in hand.

SPIRAL DRILLS, Fig. 35. should be annealed and turned to 1-50th of an inch larger than the finished size ; then heated again, and an-







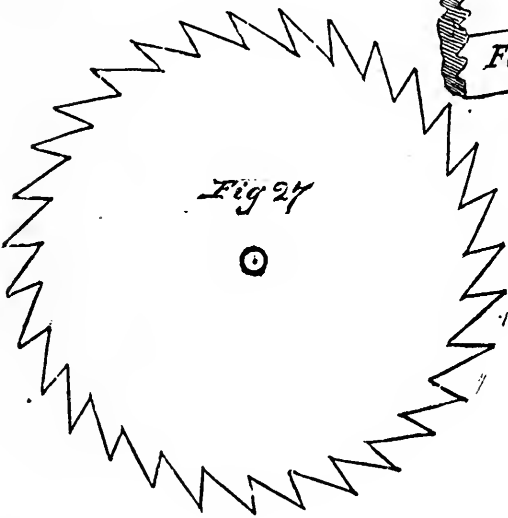


Fig. 24. Finishing tool for cast iron.

Fig. 25. Counter boring tool, end view.

Fig. 26. To be used on wrought iron when the tool is liable to spring on account of distance from the tool post.

Fig. 27. Fluted milling tool or cutter.

nealed in a vertical position, among lime, ashes, or soap-suds; the shank is then turned to fit a proper collet socket, and afterwards the point may be turned to the desired dimensions and shaped. Next measure from the point and finish the turning, by making it tapering to the extent of 100th of an inch smaller for every 2 inches of the length of the drill. The spiral grooves are cut on a machine constructed for the purpose, containing a spindle, which imparts the double movement of sliding and revolving slowly while the spirals are being cut. The spindle contains a screw, on which a chuck to hold the drill is adjusted. The drill being inserted in the chuck, proceed to elevate the sliding block beneath the drill, so that it will touch it, adjusting it so as not to raise it too high; then insert a cutter, which should be one-half the diameter of drill, and groove your drills, which should, for a drill 1 inch in diameter, be cut 1 to the inch, and down to within a 32nd of the centre; for $\frac{1}{2}$-inch drills, cut the grooves $1\frac{1}{2}$ to the inch, down to within a 64th of the centre; for $\frac{1}{8}$-inch drills, cut the grooves 2 to the inch, down to within 100th of the centre, computing as you would in cutting a screw in a lathe, the index plate giving you the two starting points at which to commence the work.

Fluted Reamers, Fig. 36, should be carefully turned to a 32nd of an inch of the finished size, then heated and allowed to cool in a perpendicular position, previous to finishing. The treatment removes the strains and the occasional hardness made by the hammering, so that they will not spring in the operation of heating for tempering. The lips of a reamer should be made uneven; otherwise, when it chatters, it leaps from one lip to the other. In reamers from 1 inch to $1\frac{1}{4}$ inches in diameter, the flutes or channels should be 9 in number, and 11 in reamers of from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in diameter. Reamers from $\frac{1}{4}$ to $\frac{5}{8}$ of an inch in diameter, should have 5 flutes, and reamers from $\frac{5}{8}$ to 1 inch should have 7. After cooling, as above noted, turn the part intended for the lips 100th of an inch larger than the finished size; afterwards turn a spot in the middle of it $\frac{5}{8}$ long, and 1-12th of the size of the reamer smaller than the reamer. After hardening, this is the place to pene it straight. When the turning of all but the upper part is finished, put it on the centres, and prepare to flute it, deferring the turning of the upper part until after hardening and straightening. Place it on the centres; if on a planer, flute with a round end tool, 1-10th of an inch thick, and plane down to the face of each lip, to the bottom of the spot intended for the pening, and plane them so that the space between every other of the two lips will be shorter than that of the two just before them. The next step is to plane off the back side of the lips with a square end tool to within a 32nd of an inch from the face. The faces of the lips should be planed even with the centre, the lips dressed smooth with the file, hardened again, and then pened straight. Finish by turning the upper part to the desired size, and polish it off; grind the lips to a sharp edge and to the proper size, and it is all right.

To *flute taps*, Fig. 38, adjust the work on the centres, and plane the faces of all the teeth with a cutter or planing tool, made circular at the end, the thickness at the end being $\frac{1}{4}$ the diameter of the tap. Taps should be fluted with the teeth slightly hooking on the face. Dress the faces of all the teeth with the planer one-half the depth of he thread deeper than the bottom of the thread; this done, plane

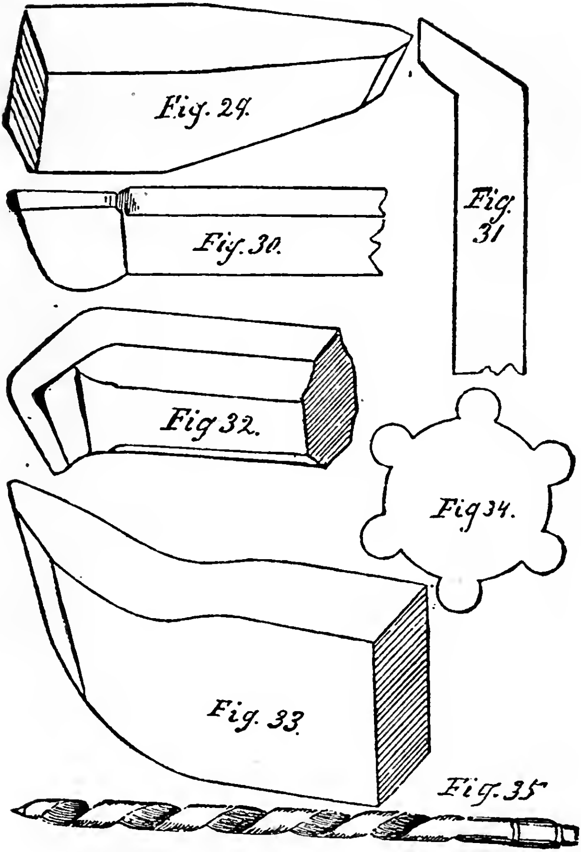


Fig. 29. Front tool for brass work.
Fig. 30. Tool for cutting square threads.
Fig. 31. Tool for cutting hard metal.
Fig. 32. Boring tool for brass.
Fig. 33. Tool for finishing cast iron, wrought iron and steel.
Fig. 34. Die for screw-cutting, face view.
Fig. 35. Spiral drill.

off the back parts of the teeth, giving them 1½ the breadth of their pitch, leaving them, if the pitch is 10, a 10th and a 20th, which leaves them quite strong enough for efficient service and easy work. Trim the back parts of the teeth with a planing tool equal in thicknes to the size of the tap. Two taps should be used for each thread; with hte first, remove two-thirds of the thread, and finish off with the other. No taer is prequired on taps for 5 threads ; if they are fabricated by this plan, they are not liable to break, and work easy. Extra large mongrel-thread taps should invariably be of two or more sizes, owing to the coarse thread and the mass of metal to be removed by them, which otherwise would be crushed and torn.

Cold Chisels should be shaped thin at the cutting end, and with the edge slightly rounded outwards, instead of being square across or hollowed inwards, as is frequently the case. This shape imparts more endurance to the tool, and makes it cut easier than when it is even across or rounded inwards, as we see it in many eases. In hardening, heat the tool to a dark red heat to a depth equivalent to its width, and dip it half that length into the tempering liquid, holding it stationary about 4 seconds ; then plunge it a little deeper and withdraw ; brighten one side by rubbing on an emery or sand board, remove the bad color with a piece of waste or rag, and bring out a clear blue color by immersion in the water. In many cases it is rather difficult to temper a piece of steel uniformly, and molten metallic mixtures are used, being chiefly made up of tin and lead ; the bright hardened steel is kept in these molten mixtures until it has assumed the temperature of the bath. The following tabulated form exhibits the composition of the metallic baths which experience has proved to be the best for the manufacturing of cutlery :—

	Composition of Metallic Mixture. Lead.	Tin.	Melting Point.	Temperature.
Lancets	7	4	220°	Hardly pale yellow.
Razors	8	4	228°	Pale yellow to straw yellow
Pen-knives	8½	4	232°	Straw yellow.
Pairs of Scissors	14	4	254°	Brown.
Clasp-knives, Joiners' and Carpenters' Tools	19	4	265°	Purplish Colored.
Swords, Cutlasses, and Watch Springs	48	4	288°	Bright blue.
Stilettos, Boring Tools, and Fine Saws	50	2	292°	Deep blue.
Ordinary saws	in boiling linseed oil.		316°	Blackish blue.

Such tools as are required to work iron and other metals, and hard stones, are heated to a bright yellow ; razors, coining dies, engravers' tools, and wire-drawing plates follow next to straw yellow ; carpenters' tools to purplish red, while such tools and objects as are required to be elastic are heated to the violet or deep blue tint. The less steel is heated the harder it remains, but also the more brittle.

Fig. 36 Fig. 37. Fig. 38. Fig. 39. Fig. 40.

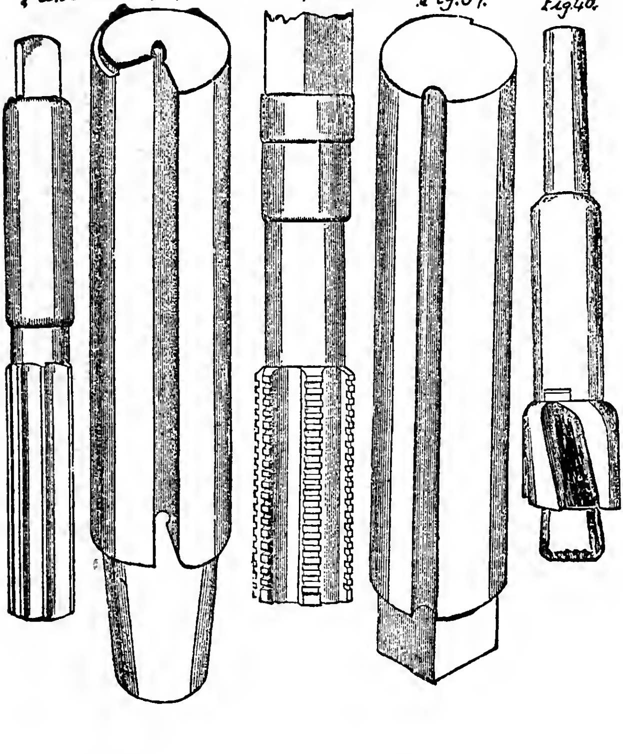


Fig. 36. Fluted reamer, side view.

Fig. 37. Single lipped drill, to drill very true.

Fig. 38. Square thread tap, side view.

Fig. 39. Single lipped reamer.

Fig. 40. Counter boring tool, side view.

Single-lipped Reamers, Fig. 39, should be fabricated from a piece of steel, with the head forged square to adept it to a proper wrench; turn it tapering and exactly round, and, after placing it on the centres, plane a groove through its entire length, one side of which groove will form the lips of the reamer. From this groove dress off the 64th of an inch half the distance round. Finish by filing up the face of the lips on a line through the middle on the end: next harden and temper. *Rose reamers* should be made with square ends, with the corners removed, lips cut about 9 to the inch on the end, and a little hooking, with a temper like other roamers.

TO CHUCK PULLEYS.—This means to adjust or secure the work in such position as to ensure truthful drilling or planing; the term chuck is also used to denote the instrument employed to secure the work, being merely a circular piece of iron with an aperture on one side of it, fitted with a screw arrangement used to secure it to the spindle of a lathe. The other side contains a number of jaws, generally three or four, which screw together for the purpose of securing the work while it is being drilled or otherwise operated upon. To chuck a pulley, first secure it by screwing it in the jaws of the chuck as near the right position as possible, next screw a tool into the post, with one end of it near the face of the pulley; then turn and true the pulley by means of the screws, so that the tool touches it all around, and true the edges the same way; repeat, trying the face again to see if it has moved. Pulleys should be chucked either on a mandril or else chucked by the arms, since chucking them by the rims springs them out of true.

TO SET THE CHUCK REST.—To set the rest, place it into the tool post with the centres of the slats through which the drills passes just as high, and no more, as the centres of the lathe, (otherwise it will fail to bore true) and drill your wheel, using two drills, to ensure true work, or three, if the holes are cored badly to one side; the last tool should remove no more than the $\frac{1}{16}$ of an inch, which will leave the hole exactly right.

TO SCRAPE CAST-IRON SMOOTH.—Place a rest close to the surface to be operated on, and, using a thin wide scraper, rest it on one edge and scrape, twisting it, and upholding it while cutting, in your hand. Don't bear on very hard, but remove as thin a chip as possible, and you will easily succeed.

Work should be fitted as exact and true as possible before being scraped with the flat scraper, which should be used on flat surfaces only. The half round scraper is the best form for curves, hollow work, etc., the three-cornered scraper being the least useful. Old files which have never been re-cut make very good scrapers.

TO MAKE DRILL SOCKETS OR COLLETS.—The best collets for correct work on drill lathes are those formed to screw on to the spindle, and constructed with a tapering hole for the retention of the drill, and a key-way to secure the end of the drill from turning. Sockets for ordinary job form, should be shaped with a set-screw to retain the drills, and the aperture for the drills should be drilled circular, adapted for the reception of round drill steel about $\frac{7}{16}$ of an in. in diameter. For collets to screw on the drill lathe, bore out the end and shape the screw to conform well to the spindle, and attach it by screwing it on to the lathe where it is required for use. Next, bore a hole for the drill shank 1¼ ins. deep, exactly straight and true, ream it tapering, and cut a key-way through the metal, below the lower part of, and running into the aperture bored for the shank. This key-way is intended to secure the drill and ought to be ½ an inch long and ¼ wide. A collet for upright drills should be made by drilling the centres and turning up the ends to be drilled for the shank so as to adapt it for running in a back rest; then insert the end to be drilled into the back rest and the other end on the lathe centre and proceed to drill out the hole for the shank; then remove it from the back rest, and, making use of the hole for a centre, turn it to fit the drill, insert a set screw in it, and all is finished.

SCREW THREADS.—THE ENGLISH PROPORTIONS, THE WHITWORTH THREAD.

Diam. in inches	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Threads per inch	21	20	18	16	14	12	11	10	9	8	7	7	6	6

Diam. in inches	1 5/8	1 3/4	1 7/8	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2
Threads per inch	5	5	4 1/2	4 1/2	4	4	3 1/2	3 1/2	3 1/4	3 1/4	3	3	2 7/8	2 7/8

Diam. in inches	4 3/4	5	5 1/4	5 1/2	5 3/4	6
Threads per inch	2 3/4	2 3/4	2 5/8	2 5/8	2 1/2	2 1/2

Angle of threads = 55°. Depth of threads = pitch of screws. One-6th of the depth is rounded off at top and bottom. Number of threads to the inch in square threads = ½ number of those in angular threads.

SCREW THREADS.—STANDARD AMERICAN PROPORTIONS.

Diam. in inches	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
No. of threads	20	18	16	14	13	11	10	9	8	7	7	6

Diam. in inches	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2
No. of threads	6	6	5	5	4 1/2	4 1/2	4	4	3 1/2	3 1/2	3 1/4

Diam. in inches	3 3/4	4	4 1/4	4 1/2	4 3/4	5	5 1/4	5 1/2	5 3/4	6
No. of threads	3	3	2 7/8	2 3/4	2 5/8	2 1/2	2 1/2	2 3/8	3 3/8	2 1/4

Angle of threads = 60°. Flat surface at top and bottom = ⅛ of the pitch. For rough bolts, the distance between the parallel sides of bolt-head and nut = 1½ diameters of bolt + ⅛ of an inch. Thickness of head = ½ distance of between parallel sides. Thickness of nut = diam. of bolt. In finished bolts, thickness of head equals thickness of nut. Distance between parallel sides of a bolt-head and nut and thickness of nut is 1/16 of an inch less for finished work than for rough.

SPEED OF EMERY WHEELS.—A 12-inch wheel should make 1,200 revolutions per minute; an 8-inch, 18,00; and a 6-inch, 2,400.

TO TRUE CORUNDUM WHEELS.—Adjust the wheel in the lathe and start it at a high speed, holding a piece of corundum stone against the uneven surface. The stone will soon melt and unite itself to the defective places in the wheel.

TO CLEAN GREASY COTTON WASTE.—Boil it in a strong solution of common soda in water, and use the resultant emulsion as a lubricant for drills, reamers, &c.

TEMPERING TOOLS.—Drawing the temper of tools is usually done in a charcoal flame, and to draw the temper of a tool properly it should be held in the thickest part, or the part not requiring any temper, towards the fire, and in the meantime, should be often wiped with a piece of waste or rag, dipped in oil. The oil keeps the temper even, and prevents it drawing more to one place than another. And in drawing the temper of any tool it should be drawn very slowly, otherwise it will run too far ere you are aware of it. Lancet blades and razors should be drawn to a straw color. Knife blades and chisels should be drawn to a copper or almost red color. Plane irons, shaving knives and shoemakers knives the same temper; cold chisels and stone drills, should be drawn to a dark blue. Fluted reamers should only be drawn to a straw color, on the end, as they never break elsewhere, and keep their size longer by leaving the lips hard. Half round or tapering reamers, also taps, dies, and drills, should be drawn to a straw color. Jijues and gauges, also common lathe tools, need no drawing, being tempered enough when merely hardened.

HARDENING AND FILLING FOR FIRE-PROOF SAFES.—Experience has shown that the fire and burglar-proof diamond chill for iron or steel, described in another part of this work, has no superior as a hardening for security in the construction of safes; and, as a non-conductor of heat, we would recommend a filling of plaster of Paris or alum. It is claimed by some that a mixture of both of these articles forms the best known filling for safes, as an external application of intense heat is certain to liberate a large quantity of water, which is transformed into steam, thus ensuring entire safety to the contents of the safe. Other manufacturers employ a concrete filling for safes, and extol it very highly. Mr. Moffat, gas and steamfitter, Boston, has informed me that he has applied for protection in the matter of a discovery by which he claims that he can fully protect a safe against a double blast furnace heat, by means of an outside lining of bricks composed of asbestos and kaolin, a very small portion of the latter material being used. From the well known incombustible nature of these materials, there can be no reasonable doubt but that the claim in question is a just one.

METALLIC BATH FOR TEMPERING.—Use a black lead or cast iron crucible (of the requisite depth), and place the same, filled with lead, on a fire made of coal or charcoal, and surrounded on all sides by a metallic or brick wall, level, or nearly so, with the top of the crucible; but at a sufficient distance (say 5 or 6 inches) from it, to receive the fuel necessary to maintain the fire, in order to keep the lead in a melted state. Let the crucible rest on iron bars, and leave apertures to admit air to the fire. The articles, slightly greased to prevent the adherence of oxide, are immersed in the melted lead (which is kept at a red heat) by means of tongs, two or three pairs being generally used, in order that one or two pieces may be heated while the other is undergoing manipulation by the hardening process. Keep the lead covered with charcoal dust or cinders. This plan is used by many cutlers and file manufacturers for giving the proper degree of heat in the tempering of their wares. The process is highly valued by those who use it. See file manufacture.

CONCERNING SAWS, RAILWAY SPRINGS, &C.—When the saws are wanted to be rather hard, but little of the oil tempering composition is burned off; when milder, a large portion; and for a spring temper the whole is allowed to burn away. Saws as well as springs appear to lose their elasticity, after hardening and tempering, from the reduction they undergo in grinding and polishing. Towards the conclusion of the manufacture, the elasticity of the saw is restored principally by hammering, and partly over a clear coke fire to a straw color; the tint is removed by very diluted muriatic acid, after which the saws are well washed in plain water and dried. Spring manufacture includes the heaviest specimens of hardened steel works uncombined with iron; for example, bow-springs for all kinds of vehicles, some intended for railway use, measure 3½ feet long, and weigh 50 lbs. each piece; two of these are used in combination; other single springs are 6 feet long, and weigh 70 lbs. The principle of these bow-springs will be immediately seen by conceiving the common archery bow fixed horizontally with its cord upwards; the body of the carriage being attached to the cord sways both perpendicularly and sideways with perfect freedom. In hardening them they are heated by being drawn backwards and forwards through an ordinary fire built hollow, and they are immersed in a trough of plain water. In tempering them they are heated until the black red is just visible at night; by daylight the heat is denoted by its making a piece of wood sparkle when rubbed on the spring, which is then allowed to cool in the air. The metal is nine-sixteenths of an inch thick, and some consider five-eighths the limits to which steel will hard enproperly, that is sufficiently alike to serve as a spring. Their elasticity is tested far beyond their intended range.

TEMPERING LOCOMOTIVE TIRES.—This is quite ponderous work, as the tires of the eight foot wheels weigh about 10 cwt. and consist of about one-third steel. The materials for the tires are first swaged separately, and then welded together under the heavy hammer at the steel works, after which they are bent to the circle, welded, and turned to certain gauges. The tire is now heated to redness in a circular furnace ; during the time it is getting hot, the iron wheel, previously turned to the right diameter, is bolted down upon a face-plate, the tire expands with the heat, and when at a cherry red, it is dropped over the wheel, for which it was previously too small, and is also hastily bolted down to the surface plate. The whole load is quickly immersed by a swing crane into a tank of water about five feet deep, and hauled up and down until nearly cold ; the steel tires are not afterwards tempered. The spokes are forged out of flat-bars with T formed heads, these are arranged radially in the founder's mould whilst the cast-iron centre is poured around them, the ends of the T heads are then welded together to constitute the periphery of the wheel or inner tire, and little wedge-form pieces are inserted where there is any deficiency of iron. The wheel is then chucked on a lathe, bored and turned on the edge, not cylindrically, but like the meeting of two cones, and about one quarter of an inch higher in the middle than the two edges. The compound tire is turned to the corresponding form, and consequently, larger within or under cut so that the shrinking secures the tire without the possibility of obliquity or derangement, and no rivets are required. It sometimes happens, that the tire breaks in shrinking, when by mismanagement the diameter of the wheel is in excess.

MAKING ANCHORS.—The anchor smith's forge consists of a hearth of brickwork, raised about 9 inches above the ground, and generally about 7 feet square. In the centre of this is a cavity containing the fire. A vertical brick wall is built on one side of the hearth, which supports the dome, and a low chimney to carry off the smoke. Behind this wall are placed the bellows, with which the fire is urged; the bellows being so placed that they blow to the centre of the fire. The anvil and the crane by which the heavy masses of metal are moved from and to the fire are adjusted near the hearth. The *Hercules*, a kind of stamping machine, or the steam hammer, need not be described in this place. To make the anchor, bars of good iron are brought together to be fagoted; the number varying with the size of the anchor. The fagot is kept together by hoops of iron, and the whole is placed upon the properly arranged hearth, and covered up by small coals, which are thrown upon a kind of oven made of cinders. Great care and good management are required to keep this temporary oven sound during the combustion; a smith strictly attends to this. When all is arranged, the bellows are set to work, and a blast urged on the fire; this is continued for about an hour, when a good welding heat is obtained. The mass is now brought from the fire to the anvil, and the iron welded by the hammers. One portion having been welded, the iron is returned to to the fire, and the operation is repeated until the whole is welded in one mass. The different parts of the anchor being made, the arms are united to the end of the shank. This must be done with great care, as the goodness of the anchor depends entirely upon this process being effectively performed. The arms being welded on, the ring has to be formed and welded. The ring consists of several bars welded together, drawn out into a round rod passed through a hole in the shank, bent into a circle, and the ends welded together. When all the parts are adjusted, the whole anchor is brought to a red heat, and hammered with lighter hammers than those used for welding, the object being to give a finish and evenness to the surface. The toughest iron that can be procured should be used in anchors. Good "Welsh mine iron" is suitable; also "scrap iron." An anchor of the ordinary or Admiralty pattern, the Trotman, or Porter's improved (pivot fluke), the Honiball, Porter's, Aylin's, Rodger's, Mitcheson's and Lennox's, each weighing, inclusive of stock, 27000 lbs., withstood without injury a proof strain of 45000 lbs. In *dry ground*, Rodger's dragged the Admiralty anchor at both long and short stay; at short stay, Rodger's and Aylin's gave equal resistance; Mitcheson's dragged Aylin's at both long and short stay; and Aylin's dragged the Admiralty at short stay, they giving equal resistance at long stay. In *ground under water*, Trotman's dragged Aylin's, Honiball's, Mitcheson's, and Lennox's: Aylin's dragged Rodger's; Mitcheson's dragged Rodger's, and Lennox's dragged the Admiralty's. The breaking weights between a Porter and Admiralty anchor, as tested at the Woolwich Dockyard, were as 43 to 15.

MANUFACTURING AND REPAIRING ANVILS.—The common anvil is usually made of seven pieces: 1, the core, or body; 2, 3, 4, 5, the four corner pieces, which serve to enlarge its base; 6, the projecting end, which has a square hole for the reception of the tail or shank of a chisel on which iron bars may be cut through, and 7, the beak, or horizontal cone round which rods or slips of metal may be turned in a circular form, as in making rings. These six pieces are welded separately to the first or core, and then hammered into a uniform body. In manufacturing large anvils two hearths are needed, in order to bring each of the two pieces to be welded to a proper heat by itself, and several men are employed in working them together briskly in the welding state, by heavy swing hammers. The steel facing is applied by welding in the same manner, powdered borax with sal-ammoniac (1 part to 10 parts of borax) being used as a flux. The anvil is then heated to a cherry red, and plunged into cold water, a running stream being better than a pool or cistern, the rapid formation of steam at the sides of the metal preventing the free access of the water for the removal of the heat with the required expedition. In some cases a stream of water is contrived to descend from a cistern above on the part to be chilled, which is sure to render it very hard. The facing should not be too thick a plate, for when such, it is apt to crack in the hardening. It is somewhat dangerous to stand near such works at the time, as when the anvil face is not perfectly welded, it sometimes, in part, flies off with great violence and a loud report. In the case of broken anvils the repairs will have to be made in accordance with the above description. In finishing off the face, it is smoothed upon a grindstone, and, for fine work, polished with emery and crocus.

Manufacturing Chains.—For this purpose the iron is cut off with a plain chamfer, as from the annular form of the links their extremities cannot slide asunder when struck. Every succeeding link is bent, introduced, and finally welded. In some of these welded chains the links are not more than ½ an inch long, and the iron wire ⅛ inch diameter. These are made with great dexterity by a man and a boy, at a small fire. The curbed chains are welded in the ordinary way and twisted afterwards, a few links being made red-hot at a time for the purpose. The massive cable chains are made much in the same manner, although partly by aid of machinery. The bar of iron, now one, one and a half, or even two inches in diameter, is heated and the scarf is made as a plain chamfer, by a cutting machine; the link is then formed by inserting the edge of the heated bar within a loop in the edge of an oval disc, which may be compared to a chuck fixed on the end of a lathe mandril. The disc is put in gear by the steam engine; it makes exactly one revolution and throws itself out of motion. This bends the heated extremity of the iron into an oval figure. Afterwards it is detached from the rod with a chamfered cut by the cutting machine, which, at one stroke, makes the second scarf of the detached link, and the first of that next to be curled up. The link is now threaded to the extremity of the chain, closed together and transferred to the fire, the loose end being carried by a traverse crane. When the link is at the proper heat, it is returned to the anvil welded, and dressed off between the top and bottom tools, after which the cast iron transverse stay is inserted, and the link having been closed upon the stay, the routine is recommenced. The work commonly requires three men, and the scarf is placed at the side of the oval link, and flat way through the same. In similar chains made by hand, it is, perhaps, more customary to weld the link at the *crown*, or small end.

VULCANITE EMERY WHEELS.—Use a compound of India rubber, and Wellington mills emery, as little of the former as will suffice to hold the particles of emery together. The materials must be thoroughly incorporated together, then rolled into sheets, cut into wheels of the desired size and pattern, pressed into the iron moulds, and vulcanized or cured by being subjected to a high degree of steam heat for several hours, making it almost as hard as cast iron.

TO BRAZE A BAND SAW.—*Whitney's method.*—The tools required are a small portable forge, brazing clamps, &c. and a straight edge, 3 or 4 feet long, also some brass wire and powdered borax. Take the saw and cut it to the proper length, scarf the ends from one-half to three-fourths of an inch, then put the saw in the clamps. I would say that I use a very small and simple clamp in the shape of a double vise. Keep the back of the saw out of the jaws of the vise, or clamps, and apply the straight edge to the back, as it is very necessary to braze it straight; make the fire in as small a compass as possible; place the clamps directly over the centre of the fire, and then put on three pieces of brass wire, bent in the form of the letter U, so that they will pinch the laps together; put as much borax as will lie on the saw, cover the whole with a piece of charcoal: melt the brass so that it will flow over the saw before taking it off the fire, and cool very slow so as not to make the braze brittle. File off what remains on the saw and it is ready for use.

TO REMOVE RUST.—If you immerse the articles in kerosene oil and let them remain for some time, the rust will become so much loosened as to come off very easy.

DAMASCUS STEEL.—It is said that this steel consists of a highly carburetted metal which, by undergoing careful cooling and annealing, separates into two compounds of iron and carbon, giving it the peculiar appearance known as "Damasceening." The wonderful strength of this steel is no doubt owing to careful manipulation.

GEARING A LATHE FOR SCREW CUTTING.—Every screw-cutting lathe contains a long screw called the lead screw, which feeds the carriage of the lathe, while cutting screws; upon the end of this screw is placed a gear to which is transmitted motion from another gear placed on the end of the spindle, these gears each contain a different number of teeth, for the purpose of cutting different threads, and the threads are cut a certain number to the inch varying from 1 to 50. Therefore to find the proper gears to cut a certain number of threads to the inch, you will first:—multiply the number of threads you desire to cut to the inch, by any small number, four for instance, and this will give you the proper gear to put on the lead screw. Then with the same number, four, multiply the number of threads to the inch in the lead screw, and this will give you the proper gear to put on the spindle. For example, if you want to cut 12 to the inch, multiply 12 by 4, and it will give you 48. Put this gear on the lead screw, then with the same number, 4, multiply the number of threads to the inch in the lead screw. If it is five, for instance, it will give you twenty, put this on the spindle and your lathe is geared. If the lead screw is 4, 5, 6, 7, or 8, the same rule holds good. Always multiply the number of threads to be cut, first. Some, indeed most small lathes, are now made with a stud geared into the spindle, which stud only runs half as fast as the spindle, and in finding the gears for these lathes, you will first multiply the number of threads to be cut, as before, and then multiply the number of threads on the lead screw, as double the number it is. For instance, if you want to cut 10 to the inch, multiply by 4, and you get 40, put this on the lead screw, then if your lead screw is five to the inch, you call it 10; and multiply by 4 and it will give you 40. Again put this on your stud and your lathe is geared ready to commence cutting.

CUTTING A SCREW IN AN ENGINE LATHE.—In cutting V thread-screws, it is only necessary for you to practice operating the shipper and slide-screw handle of your lathe, before cutting. After having done this, until you get the motions, you may set the point of the tool as high as the centre, and if you keep the tool sharp, you will find no difficulty in cutting screws. You must, however, cut very light chips, mere scrapings in finishing and must take it out of the lathe often, and look at it from both sides, very carefully, to see that the threads, do not lean like fish scales. After cutting, polish with an emery stick, and some emery.

CUTTING SQUARE THREAD-SCREWS.—In cutting square thread-screws, it is always necessary to get the depth required, with a tool somewhat thinner than one-half the pitch of the thread. After doing this, make another tool exactly one-half the pitch of the thread, and use it to finish with, cutting a slight chip on each side of the groove. After doing this, polish with a pine stick, and some emery. Square threads for strength should be cut one-half the depth of their pitch, while square threads, for wear, may, and should be cut three-fourths the depth of their pitch.

MONGREL THREADS.—Mongrel, or half V, half-square threads are usually made for great wear, and should be cut the depth of their pitch and for extraordinary wear they may even be cut 1½ the depth of the pitch. The point and the bottom of the grooves should be in width ¾ the depth of their pitch. What is meant here by the point of the thread, is the outside surface. And the bottom of the groove is the groove between the threads. In cutting these threads it is necessary to use a tool about the shape of the thread, and in thickness about one-fifth less than the thread is when finished. As it is impossible to cut the whole surface at once, you will cut it in depth about one-sixteenth at a time, then a chip off the sides of the thread and continue in this way alternately till you have arrived at the depth required. Make a gauge of the size required between the threads and finish by scraping with water. It is usually best to leave such screws as these a little large until after they are cut, and then turn off a light chip, to size them, this leaves them true and nice.

PLANING METALS.—The first operation about planing, is to oil your planer and find out if the bed is smooth. If it is not, file off the rough places; then change the dogs to see if they will work well, and find out the movements of the planer. After doing this, bolt your work on the bed, and if it is a long, thin piece, plane off a chip, then turn it over and finish the other side, taking two chips, the last of which should be very light. Great care should be taken, in bolting it to the bed, not to spring it. After finishing this side turn it to the other side, and take off a light cut to finish it.

PLANING PERPENDICULARLY.—In planing perpendicularly, it is necessary to swivel the bottom of the small head around, so it will stand about three-fourths of an inch inside of square, towards the piece you are to plane. This prevents breaking the tool when the bed runs back.

GEAR CUTTING.—In cutting gears, they are reckoned a certain number of teeth to the inch, measuring across the diameter to a certain line which is marked on the face or sides of the gear with a tool. This line is one-half the depth of the teeth from the outer diameter. That is, if the teeth of the gear are two-tenths of an inch deep, this line would be one-tenth of an inch from the edge and is called the pitch line.

DEPTH OF TEETH.—Every gear cut with a different number of teeth to the inch, should be cut of a depth to the pitch line, to correspond with the number of teeth to the inch. This is called proportion. Therefore, if you cut a gear eight to the inch, the depth to the pitch line should be one-eight of an inch, and the whole depth of the tooth would be two-eighths. Again, if you cut a gear twelve to the inch, the depth to pitch line should be one-twelfth of an inch, and the whole depth of tooth two-twelfths. And again, if you cut a gear twenty to the inch, the depth to pitch line should be one-twentieth of an inch, while the whole depth should be two-twentieths, and so on *ad infinitum.*

MEASURING TO FIND THE NUMBER OF TEETH.—To find the size a certain gear should be, for a certain number of teeth, is an easy matter, if you study carefully these rules. If you want a gear with thirty-two teeth and eight to the inch, it should be four inches measuring across the diameter to the pitch line, and the two-eighths outside of the pitch line would make it four inches and two-eighhts. Again, if you want a gear with forty teeth, and ten to the inch, it should measure across the diameter to pitch line four inches, and the two-tenths outside the pitch line would make the whole diameter four inches and two-tenths. And again, if you want a gear with eighty teeth, and twenty to the inch, it should measure to the pitch line, across the diameter, four inches, and the two-twentieths, outside the pitch line, would make it four inches and two-twentieths, and these examples will form a rule for the measurement of all except bevel gears.

BEVEL GEARS.—These are turned a certain bevel to correspond with each other, according to the angle upon which the shafts driven by them are set. For instance, if two shafts are set upon an angle of ninety degrees, the surfaces of the faces of these gears will stand at an angle of forty-five degrees. To get the surface of these gears, in turning them, put a straight edge across the face. Then set your level on an angle of forty-five degrees, and try the face of the teeth by placing the level on the straight edge. After turning the face of the teeth, square the outer diameter by the face of the teeth; and to get the size to which you wish to cut, measuro from the centre of the face of the teeth. Thus, if a bevel gear is six inches in diameter, and the face of the teeth is one inch, you will measure from the centre of the face, and find it is five inches. On this line you calculate the number of teeth to the inch, and if you want a gear with twenty teeth, and ten to the inch, it should measure two inches across the face to the centre of the surface of the teeth; and if the face of the teeth were one inch in length, the diameter of the gear would be three inches, and the inside of the teeth would measure only one inch. Again, if you want to cut a gear with forty teeth, and ten to the inch, it would measure four inches to the centre of the teeth on the surface. And if the surface of the teeth were one inch long, the diameter of the gear would be five inches, while it would only measure three inches inside the teeth. These examples will form a rule for all bevel gears.

Draw-filing and Finishing.—To draw-file a piece of work smoothly and quickly, it is best to first draw-file it with a medium fine file, and finish with a superfine file. After doing this, polish the work with dry emery paper and then with emery paper and oil.

Lining Boxes with Babbitt Metal.—To line boxes properly, so as to insure their filling every time, it is necessary to heat the box nearly red hot, or at least hot enough to melt the metal. Then smoke the shaft where the metal is to be poured upon it. This insures its coming out of the box easily, after it is cold. After smoking the shaft, put it into the box or boxes, and draw some putty around the ends of them, for the purpose of stopping them, taking care not to press upon it, for if you do it will go into the box and fill a place that ought to be filled with metal; and, in the meantime, your metal ought to be heated, and after you have poured it, let the box stand till it is nearly cold; drive out your shaft, and it is done.

Turning and Boring.—For *turning*, the proper speed for the circumference is about fifteen feet per minute. The best speed for boring cast iron is about 7½ feet per minute. For *drilling*, about 10 o 11 feet per minute is a good speed for the circumference of the tool. For a 1 inch drill, 40 revolutions = 11 feet per minute, other sizes in proportion.

How to fit Keys into Locks.—When it is not convenient to take locks apart in the event of keys being lost, stolen, or missing, when you wish to fit a new key, take a lighted match or candle and smoke the new key in the flame, introduce it carefully into the keyhole, press it firmly against the opposing wards of the lock, withdraw it; and the indentations in the smoked part of the key will show you exactly where to file.

Putting Machines Together.—In putting machines together no part should be finished except where it is necessary to make a fit, as it is sometimes the case that machinery is miscalculated, and by finishing it would be spoiled, while if it were not, it might be saved by slight alterations in design. And again, in finishing certain parts before you get a machine together, you are unknowingly finishing parts not necessary to be finished, and making them of a shape anything but desirable. This rule, however, is not intended to apply to machinery being made to detail drawings.

To Drill a Hole where you have no Reamer.—It is sometimes necessary to drill a hole of an exact size to fit a certain shaft, and at the same time have it smooth without reaming it. This may be done, by first drilling a hole, one-hundredth of an inch smaller than the size desired, and then making a drill the exact size and running it through to finish with. This last drill should have the corners of its lips rounded, like a reamer, and the hole should be finished without holding the drill with a rest.

SQUARING, OR FACING UP CAST IRON SURFACES.—A round-end tool is best for this. A rough chip should first be taken off, over the entire surface to be faced. Then speed your lathe up and taking a light chip, merely enough to take out the first tool mark, run over the entire surface again. In turning up surfaces it is always best to begin at the centre and feed out, as the tool cuts freer and will wear twice as long.

BORING A HOLE WITH A BORING TOOL.—In boring a hole with a boring tool, it is usually necessary to drill the hole first, and too much care cannot be taken in finishing. An iron gauge should be made first; it is usually made of a piece of sheet iron or wire. The hole should then be drilled smaller than the size desired, and then bored to the required size, and it is impossible to bore a hole perfect without taking two or three light chips, mere scrapings with which to finish. Holes, in this way, may be bored as nicely as they can be reamed.

BORING HOLES WITH BORING ARBOR.—A boring arbor is a shaft with a set in it, for the purpose of boring holes of great length, and is designed to be used in a lathe. In doing this properly, you must first see if your lathe is set straight; if not, adjust it. Having done this, put the piece of work to be bored in the carriage of your lathe, pass your arbor through the hole to be bored, and put it on the centres of your lathe. Having done this, adjust your work true to the position desired by measuring from the point of the tool, continually turning round the arbor from side to side of the piece to be bored, while you are bolting it to the carriage, and measure until it is perfectly true. Having done this, bore the hole, and take for the last chip only a hundredth of an inch. This makes a true and smooth hole. It is impossible to make a hole true with any kind of a tool when you are cutting a large chip, for the tool springs so that no dependence can be placed upon it.

TO MAKE A BORING ARBOR AND TOOL THAT WILL NOT CHATTER.—Boring tools, when used in small arbors, are always liable to chatter and make a rough hole. To prevent this, the tool should be turned in a lathe, while in its position in the arbor, upon the circle of the size of the hole to be bored, and the bearing lengthwise of the arbor, should be only as wide as the feed of the lathe; for if the bearing of a tool is on the face, the more it will chatter.

TO STRAIGHTEN SHAFTING.—This should be done by centreing, then put it into a lathe, and square the ends up with what is called a side tool. After doing this, take a piece of chalk and try it in several places, to find out where the worst crooks are: then, if you have not a machine for springing shafting, spring it with a lever where the most crook is, and continue this operation till the shaft is straight.

TURNING SHAFTING.—To do this properly, two chips should always be run over the shaft, for the reason that it saves filing, and leaves the shaft truer and more round, and on shafts thus turned, the time saved in filing more than compensates for the time lost in turning. Before you commence you will put your feed belts or gear on a coarse feed; turn off one a sixty-fourth of an inch larger than the size required; having turned off this chip, commence the finishing chip, and turn it small enough to have the pully wring on about an inch without filing. This will leave it large enough to file and finish. If there are couplings to go on a shaft, with holes smaller than the holes in the pulleys, the ends of the shaft, where they fit on, should be turned down to a sixty-fourth of an inch of the size required before any part of the shaft is finished; that is, every part of a shaft should be turned to within a sixty-fourth of an inch of the size required before any part if it has the finish-chip taken off. The reason for that is that it leaves every part of the shaft perfectly true, which would not be the case were it done otherwise. Having done this, you will file the shaft so that the pulleys will slide on, and the couplings so that they will drive on; polish the shaft with a pair of polishing-clamps and some emery and it is done.

TO FORGE A TWIST DRILL.—It is necessary to forge a flat blade similar to a flat drill, and then twist this blade into the resemblance required, then, with a light hammer, and careful blows, hammer the twisted edges so that they will be thicker than the central line of the tool. This will give greater strength and a better drill, and, to cut well, the central line or cutting point must be made quite thin. Be careful to get the *same twist* at the point of the drill as upon the body of the drill. The inexperienced often leave the point straight like a flat drill.

TO COMPUTE THE NUMBER OF TEETH REQUIRED IN A TRAIN OF WHEELS TO PRODUCE A GIVEN VELOCITY. *Rule.*—Multiply the number of teeth in the driver by its number of revolutions, and divide the product by the number of revolutions of each pinion, for each driver and pinion. *For speed of Wheel, Pulleys, &c., see page* 267.

Example.—If a driver in a train of three wheels has 90 teeth, and makes 2 revolutions, and the velocities required are 2, 10, and 18, what are the number of teeth in each of the other two.

10: 90: : 2: 18=*teeth in 2nd wheel.*
18: 90: : 2: 10=*teeth in 3rd wheel.*

TO COMPUTE THE DIAMETER OF A WHEEL. *Rule.*—Multiply the number of teeth by the pitch, and divide the product by 3, 1416.

Example.—The number of teeth in the wheel is 75, and the pitch 1, 675 ins: what is the diameter of it?

$$\frac{75 \times 1.6755}{3.1416} = 10 \textit{ ins.}$$

TO COMPUTE THE TRUE OR CHORDIAL PITCH. *Rule.*—Divide 180 by the number of teeth, ascertain the sine of the quotient, and multiply it by the diameter of the wheel.

Example.—The number of teeth is 75, and the diameter 40 inches; what is the true pitch?

$$\frac{180}{75} = 2°24, \text{ and } \textit{sin.} \text{ of } 2°24, = \ 04188, \text{ which} \times 40 = 1.6752 \text{ ins.}$$

PAPER FRICTION PULLEYS.—These superior mechanical contrivances are made by cutting pieces of pasteboard into a circular form, and of the desired diameter of the pulley, and placing them in layers one on the top of another, cementing properly with a good coat of glue between each layer, pounding or pressing them together as close as possible, and leaving a perforation in the centre of each, for the shaft. When you have got enough of these layers together to give you the proper breadth of pulley, allow the glue to harden, then turn it off to a smooth finish in a lathe. Secure each side of the pulley with a good stout iron flange large enough to cover the entire diameter, or nearly so, and with proper usage it will last a long time.

ON BELTING AND FRICTION.—Leather belts will last double the usual time if treated with castor oil, they will be rat proof, they will always remain flexible and will not crack. A belt 4 inches wide will be equal to one 6 inches wide without it. It requires about 24 hours to penetrate the leather, if used sooner the greasiness will cause it to slip. A leather belt should have a speed of 1300 ft. per minute, and not more than 1800 ft. or it will not last long. Leather belts, with grain side to pulley will drive 35 per cent. more than the flesh side, because it is less porous, thus admitting less air between the surfaces. Pulleys covered with leather with evolve full 50 per cent. more power than the naked pulley. To increase the power of rubber belting, use red lead, French yellow and litharge, equal parts; mix with boiled linseed oil and japan sufficient to make it dry quick. This will produce a highly polished surface. Experiments without lubricants resulted in showing the following co-efficients. Oak upon oak, 62; wrought iron on oak, 49 to 62; cast iron on oak, 65; wrought iron on cast, 19; cast iron on cast, 16; cast iron axles on lignum-vitæ bearings, 18; copper on oak, 62; iron on elm, 25; pear tree on cast iron, 44; iron axles on lignumvitæ bearings (with oil), 11; iron axles with brass bearings (with oil), .07. A belt 5 in. wide, velocity 1000 ft. per minute, on leather covered pulleys, will yield 5-horse power; double the speed and it will evolve double the power.

METHYLATED SPIRIT.—Methylated spirit, so very useful in the arts, is an inferior kind of alcohol, mixed with one-ninth of its volume of pyroxylic spirit, or wood naphtha.

ENGINEERS' BELL SIGNALS IN USE ON STEAMERS.—*Go ahead*, 1 stroke, *Back*, 2 strokes, *Stop*, 1 stroke, *Slowly*, 2 short strokes, *Full speed*, 3 short strokes, *Go ahead Slowly*, 1 long and 2 short strokes, *Back Slowly*, 2 long and 2 short strokes, *Go ahead Full Speed*, 1 long and 3 short strokes, *Back Fast*, 2 long and 3 short strokes, *Hurry*, 3 short strokes repeated.

TO DYE METALS.—Metals can be dyed any color by dissolving any of the aniline dyes in methylated spirit and adding shellac. This solution must be painted on until the desired shade is obtained. If the iron has been previously painted white so much the better.

NEW SELF-LUBRICATING ANTI-FRICTION FOR BEARINGS.—Take equal parts of asbestos and plumbago, mix them thoroughly and carefully together, then add sufficient liquid silicate of soda or potash to reduce the whole to a half dry paste. This paste must then be submitted to the action of a hydraulic or other press, till it is converted into a solid mass, which is afterwards dried, either in a furnace or by exposure to the air, until all moisture has disappeared. The bearings may either be turned out of the block or moulded from the composition while in the moist state. When the bearing is finished it is steeped in hot melted paraffine or other mineral oil, until all the pores of the composition are filled up.

BURGLAR ALARM.—During the present time, when tramps, sneak thieves, audacious burglars and desperadoes are prowling around and infesting society, it may not be amiss to quote the following description of a home made burglar alarm by a correspondent of the *English Mechanic* :—" Just inside my shop door, and directly opposite to it, I have cut a trap in the floor, 3ft. by 2ft., and made it to work upon hinges, at the back or door side (same as a box-lid). I have placed under the front edge of the trap two common spiral bed springs, blocked up from the ground sufficently to throw front edge of trap, which rests upon them, about 1 in. above the level of the flooring. The springs of course, are placed about 6 in. from each front corner, along front edge, so as to equalize the strain as much as possible. The following is easy. In the place where "New Subscriber" would fix his electric bell, let him fix or have fixed an ordinary bell or gong, with the wire carried from it, in the way best suited to the house, under flooring of passage to the trap, beneath the front or raised edge of which there must be a crank that the springing of the trap shall work and ring the bell, which, if well hung at a good ringing pitch, will awaken the soundest sleeper in the event of a thief or any intruder entering the house at improper times, or for improper purposes. To avoid annoyance in the day time, a button at each end of trap would fix it down firmly, and at night, upon going to bed or when locking up, it could be released. The door-mat would cover the entire thing, and no one but those concerned need ever know of its existence. I do not hesitate to say that not one in fifty people, or even a hundred, that enter my shop know of anything or notice anything different to any other place they may go into, yet it has been in use for seven years. I fitted it myself, though not a bell-hanger, and it has never once got out of condition, but the bell will often give fifteen and twenty beats with one person treading on the mat."

BLACK VARNISH FOR IRON WORK.—Asphaltum, 1 lb.; lampblack, ¼ lb.; resin, ½lb.; spirits turpentine, 1 quart; linseed oil, just sufficient to rub up the lampblack with before mixing it with the others. Apply with a camel's hair brush.

TO FILE A HOLE SQUARE.—To file a hole square, it is necessary to reverse the work very often; a square file should first be used, and the holes finished with either a diamond-shaped file or a half round. This leaves the corners square, as they properly should be.

TO TURN CHILLED IRON.—At Lister's Works, Darlington, England, some articles required turning in the lathe, and cast steel could not be made hard enough to cut them. One man proposed cast metal tools. He was laughed at, of course, but his plan had to be tried. Well, cast metal tools were tried, with points chilled, and they cut when cast steel tools were of no use. The article was turned up with metal tools.

DRILLING HOLES IN CAST IRON.—By means of carbolic acid a hole ¼ of an inch in diameter has been drilled through ½ inch thickness of cast iron, with a common carpenter's brace; judge, then, what can be done by using the acid and pressure drill.

HARDENING WOOD FOR PULLEYS.—After a wooden pulley is turned and rubbed smooth, boil it for about eight minutes in olive oil; then allow it to dry, and it will become almost as hard as copper.

TO SOLDER FERRULES FOR TOOL HANDLES.—Take your ferrule, lap round the jointing a small piece of brass wire, then just wet the ferrule, scatter on the joining ground borax, put it on the end of a wire, and hold it in the fire till the brass fuses. It will fill up the joining, and form a perfect solder. It may afterwards be turned in the lathe.

MAKING DIES FOR SCREW-CUTTING.—In making dies for screw-cutting, they should, whenever practicable, be lapped with a taper tap, as they cut more easily and wear longer than those which are cut straight, and then tapered off to make the screw "take."

Very fine threaded screws, however, cut well with straight dies. Small dies, or dies below one-fourth of an inch in size, should only have three lips in them. Dies from one-fourth to one-half should have four lips in them. Dies from three-fourths to one inch should have six lips in them; and dies from one inch to one-and-a-half should have seven lips in them. The cuts through dies should be only twice the depth of the thread, which is sufficient to make them free themselves from chips, for when cut too deep they are liable to break on the face. Harden and draw to a straw color.

TO DIP A FLUTED REAMER PROPERLY.—Dip it perpendicularly to a short distance beyond the fluting—that is to say, about half an inch and withdraw and return it several times. This hardens all the lips, and prevents it cracking off at the water's edge, which is the case when a piece of steel is dipped in to a certain depth, and allowed to cool without moving.

ANTI-FRICTION METAL.—Copper, 4 lbs.; regulus of antimony, 8 lbs.; Banca tin, 96 lbs. 2. Grain zinc, 7½ lbs.; purified zinc, 7¼ lbs.; antimony, 1 lb. 3. Zinc, 17 parts; copper, 1 part; antimony, 1½ parts. This possesses unsurpassible anti-friction qualities, and does not require the protection of outer casings of a harder metal. 4. Block tin, 8 lbs.; antimony, 2 lbs.; copper, 1 lb. If the metal be too hard, it may be softened by adding some lead. 5. The best alloy for journal boxes is composed of copper, 24 lbs.; tin, 24 lbs.; and antimony, 8 lbs. Melt the copper first, then add the tin, and lastly the antimony. It should be first run into ingots, then melted, and cast in the form required for the boxes. 6. Melt in a crucible 1½ lbs. of copper, and, while the copper is melting, melt in a ladle 25 lbs. of tin and 3 of antimony, nearly red hot, pour the two together, and stir until nearly cool. This makes the finest kind of lining metal. 7. *Very cheap.* Lead, 100 lbs.; antimony, 15 lbs. This costs about 10 cents per lb. 8. *For Bearings to sustain great weights.*—Copper, 1 lb.; zinc, ½ oz.; tin, 2½ oz. 9. *Hard Bearings for machinery.*—Copper, 1 lb.; tin, 2 ozs. 10. *Very Hard ditto.*—Copper, 1 lb.; tin, 2½ ozs. 11. *Lining Metal for Boxes of Railway Cars.*—Mix tin, 24 lbs.; copper 4 lbs.; antimony, 8 lbs.; (for a hardening) then add tin 72 lbs. 12. *Lining Metal for Locomotives' Axle trees.*—Copper, 86.03.; tin, 13.97.13. *Another, French.*—Copper, 82 parts, tin, 10 parts, zinc, 8 parts. 14. *Another, (Stephenson's).*—Copper, 79 parts; tin, 8 parts, zinc, 5, parts, lead 8 parts. 15. *Another (Belgian).*—Copper, 89.02. parts, tin, 2.44 parts, zinc, 7.76 parts iron, 0.78. 16. *Another (English).*—Copper, 73.96 parts, tin, 9.49 parts, zinc, 9.03 parts, lead, 7.09 parts, iron, 0.43 parts. 17. *Another.*—Copper, 90.06 parts, tin, 3.56 parts, zinc. 6.38. of *Nickel Anti-friction Metal.*—A late improvement in the manufacture of anti-friction metal is the introduction of a small percentage of nickel into either of the above, or any other anti-friction composition.

COMPOSITION FOR CRUCIBLES.—1. Stourbridge crucible clay 4 parts, plumbago 3 parts, hard coke 2 parts, cement, consisting of old pots ground and sifted, 1 part. If old pots are not to be had, the foregoing must be burnt hard, ground and sifted. The carbon chippings from the interior of gas retorts are superior to the best ordinary coke. Pulverize the whole and sift through a ⅛ inch mesh sieve, temper and mix with plenty of clean cold water, tread with the bare foot to the consistency of stiff dough, allow it to stand for three or four days covered with a damp cloth to permit sweating and thorough maturity, then block by a machine or by hand. When completely dry, place in the kiln and anneal, but do not burn hard. 2. *Another.*—The Birmingham soft, tough pot consists of 2 parts of the best Stourbridge crucible clay, 3 parts plumbago, and 1 part cement consisting of old crucibles pulverized and sifted, &c., as above described. 3, *Another.*—Stourbridge crucible clay 2 parts, cement 3 parts, sift through a ⅛ inch mesh sieve, temper as above, and when dry place in the kiln and burn hard. 4. *Another.*—Stourbridge best crucible clay, 3 parts by measure; cement, composed of old worn out fire brick, 2 parts; hard coke, 1 part; sift, temper and manipulate as above.

CAST IRON PATTERNS should be made very smooth, then slightly warmed, and waxed all over with the best beeswax.

FACINGS, SANDS, &C., FOR CASTINGS.—As a facing for loam castings use fire sand 3 parts, Whitehead sand 1 part; mix. For pipes and small cylinders use No. 1, or fine sand, facing with plumbago. Albany or Waterford sand is excellent for fine castings, or use 1 part of sea coal to 8 or 10 of Albany sand; 1 part to 5 will do for heavy castings. To ensure very *smooth* castings, mix with the green foundry sand about 1-20 part of tar.

TO PREVENT HOLES IN CASTINGS.—In casting iron on iron or steel spindles, the moulds are cast endwise; let the cast metal spindle be an inch longer on the uppermost side than is necessary when the job is finished; thus the air holes, if any, will form in the extra inch of length, and may be cut off in the lathe.

TO CAST CHILLED IRON TOOLS FOR CUTTING CHILLED IRON.—After making a tool of the required form out of wrought iron, cast the chilled part, using charcoal iron No. 5.

DYSIOT.—The new alloy, called dysiot, brought into the market by Rompel & Co., of Homburgh, has been analyzed by Von Uhlenhuth, and found to consist of copper, 62.30 parts; lead, 17.75; tin, 10.42; zinc, 9.20, with traces of iron. It can be prepared by melting together 62 parts of copper, 18 of lead, 10 of tin, and 10 of zinc.

EXCELLENT ANTI-FRICTION.—Tin 50 parts, antimony 5, copper 1.

CHEAP BRASS.—Copper 1 lb., zinc 12 ozs.

BRAZING METAL.—Copper 1 lb., spelter 8 ozs., with a little lead.

TOUGH TYPE METAL.—Lead 100 lbs., antimony 40, tin 20.

PLATINUM BRONZE, *Rust-Proof.*—Nickel 100 parts, tin 10, platinum 1.

MALLEABLE OR ALUMINUM BRONZE.—Copper 90, tin 10.

ALUMINUM SILVER, OF FINE LUSTER AND POLISH.—Copper 70 parts, nickel 23, aluminum 7.

YELLOW BRASS FOR STEAM ENGINES.—Add 4½ to 9 ozs. zinc to each lb. of copper.

GOOD BRASS FOR MACHINERY.—1. Copper, 2 lbs., tin $2\frac{1}{2}$ ozs., zinc $\frac{1}{2}$ oz. 2. *Tough Brass.*—Copper, 10 ozs., tin, $1\frac{1}{2}$ ozs., zinc $1\frac{1}{2}$ ozs. 3. *Wheels and Valves.*—Copper, 90 lbs., tin, 10 lbs. 4. *Brass, very tenacious.*—Copper, 88.9 parts, tin, 8.3 parts, zinc, 2.8 parts. 5. *Lathe Bushes.*—Copper, 80 parts, tin 20 parts. 6. *Machinery Bearings.*—Copper, 88 parts, tin, 12 parts. 7. *Boxes for Engines Running at High Speed.*—Copper, 7 lbs., tin, 1 lb.; add spelter 1 lb. to every 40 lbs. of the mixture. Use steel piston rods for high speed and lignum vitæ or apple-tree wood for *shoes* or *gibbs* on the cross-heads. Iron for cylinders and guides, if made from pig iron should be melted at least 8 or 9 times previous to use.

BRONZE.—1. Copper, 83 parts; zinc, 11 parts; tin, 4 parts; lead, 2 parts; mix. 2. Copper, 14 parts; melt and add zinc, 6 parts; tin, 4 parts; mix. 3. *Ancient Bronze.*—Copper, 100 parts; lead and tin, of each 7 parts; mix. 4. *Alloy for Bronze Ornaments.*—Copper, 82 parts; zinc, 18 parts; tin, 3 parts; lead, 3 parts; mix. 5. *Statuary Bronze.*—Copper, 88 parts; tin, 9 parts; zinc, 2 parts; lead, 1 part. 6. *Another.*—Copper, $82\frac{1}{2}$ parts; tin, 5 parts; zinc, $10\frac{1}{2}$ parts; lead, 2 parts. 7. *Another.*—Copper, 90 parts; tin, 9 parts; lead, 1 part. 8. *Bronze for Medals.*—Copper, 89 parts; tin 8 parts; zinc, 3 parts. 9. *Bronze.*—Copper, 7 lbs.; zinc. 3 lbs.; tin, 2 lbs. 10. *Another.*—Copper, 1 lb.; zinc, 12 lbs.; tin, 8 lbs.

SUPERIOR BELL METAL.—1. Copper, 100 lbs.; tin, 23 lbs. 2. Copper, 25 parts; tin, 5 parts. 3. Copper, 79 parts; tin, 26 parts; mix. 4. Copper, 78 parts; tin, 22 parts; mix. 5. *Parisian Bell Metal.*—Copper, 72 parts; tin, $26\frac{1}{2}$ parts; iron, $1\frac{1}{2}$ parts. Used for the bells of small ornamental clocks. 6. *Clock Bell Metal.*—Copper, 75.19 parts; tin, 24.81 parts. 7. *Bell Metal for Large Bells.*—Copper, 100 lbs.; tin, from 20 to 25 lbs. 8. *Bell Metal for Small Bells.*—Copper, 3 lbs.; tin, 1 lb. 9. *White Metal for Table Bells.*—Copper, 2.06 parts; tin, 97.31 parts; bismuth, 0.63 parts.

YELLOW BRASS (*for casting*).—1. Copper, 61.6 parts; zinc, 35.3 parts; lead, 2.9 parts; tin, 0.2 parts. 2. *Brass of Jemappes.*—Copper, 64.6 parts; zinc, 33.7 parts; lead, 1.4 parts. tin, 0.2 parts. 3. *Sheet of Stolberg, near Aix la Chapelle.*—Copper, 64.8 parts; zinc, 32.8 parts; lead, 2.0 parts; tin, 0.4 parts. 4. *D'Arcets Brass for Gilding.*—Copper, 63.70 parts; zinc, 33.55 parts; lead, 0.25 parts; tin, 2.50 parts. 5. *Another.*—Copper, 64.45 parts; zinc, 32.44 parts; lead, 2.86 parts; tin, 0.25 parts. 6. *Sheet Brass of Romilly.*—Copper, 70.1 parts; zinc, 29.9 parts. 7. *English Brass Wire.*—Copper, 70.29 parts; zinc, 29.26 parts; lead, 0.28 parts; tin, 0.17 parts. 8. *Angsburg Brass Wire.*—Copper, 71.89 parts; zinc, 27.63 parts; tin, 0.85 parts.

RED BRASS, FOR GILT ARTICLES.—1. Copper, 82.0 parts; zinc, 18.0 parts; lead, 1.5 parts; tin, 3.0 parts. 2. *Another.*—Copper, 82 parts; zinc, 18 parts; lead, 3 parts; tin, 1 part. 3 *Another.* Copper, 82.3 parts; zinc, 17.5 parts; tin, 0.2 parts. 4. *French Tombac for Sword Handles.*—Copper, 80 parts; zinc, 17 parts; tin, 3 ports. 5 *For Parisian Ornaments.*—Copper, 85 parts; zinc, 15 parts; tin, a trace 6. *Used for German Ornaments.*—Copper, 85 3 prrts; zinc, 14.7 parts. 7. *Chrysochalk.*—Copper, 90.0 parts; zinc, 7.9 parts; lead, 1.6 parts. 8. *Red Tombac from Paris.*—Copper, 92 parts; zinc, 8 parts.

BRASS.—1. *Yellow Brass for Turning.* (common article.)—Copper, 20 lbs. zinc, 10 lbs. lead, 4 ozs. 2. *Another Brass for Turning.*—Copper, 32 lbs. zinc, 10 lbs. lead, 1 lb. 3. *Red Brass free, for Turning.*—Copper, 160 lbs. zinc, 50 lbs. lead, 10 lbs. antimony, 44 ozs. 4. *Best Red Brass for fine Castings.*—Copper, 24 lbs. zinc, 5 lbs. bismuth, 1 oz. 5. *Red Tombac.*—Copper, 10 lbs. zinc, 1 lb. 6. *Tombac.*—Copper, 16 lbs. tin, 1 lb. zinc, 1 lb. 7. *Brass for Heavy Castings.*—Copper, 6 to 7 parts; tin, 1 part; zinc, 1 part. 8. *Malleable Brass.*—Copper, 70.10 parts; zinc, 29.90 parts. 9. *Superior Malleable Brass.*—Copper, 60 parts; zinc, 40 parts. 10. *Brass.*—Copper, 73 parts; zinc, 27 parts. 11. Copper, 65 parts; zinc, 35 parts. 12. Copper, 70 parts; zinc, 30 parts. 13. *German Brass.*—Copper, 1 lb. zinc, 1 lb. 14. *Watchmakers' Brass.*—Copper, 1 part; zinc, 2 parts. 15. *Brass for Wire.*—Copper, 34 parts; calamine, 56 parts. 16. *Brass, for Tubes.*—Copper, 2 parts; zinc, 1 part. 17. *Brass for Heavy Work.*—Copper, 100 parts: tin, 15 parts; zinc, 15 parts. 18. *Another.*—Copper, 112 parts; tin, 13 parts; zinc, 1 part. 19. *Tombac or Red Brass.*—Copper, 8 parts; zinc, 1 part. 20. *Brass.*—Copper, 3 parts; melt, then add zinc, 1 part. 21. *Buttonmakers' Fine Brass.* Brass, 8 parts; zinc, 5 parts. 22. *Buttonmakers' Common Brass.*—Button brass, 6 parts; tin, 1 part; lead, 1 part; mix. 23. *Mallet's Brass.*—Copper, 25.4; zinc, 74.6; used to preserve iron from oxydizing. 24. *Best Brass for Clocks.*—Rose copper, 85 parts; zinc, 14 parts; lead, 1 part.

To Cast Brass solid.—The metal should not be run any hotter than is necessary to insure sharp castings. The most probable cause of the honey combings of castings is that the air cannot get out of the way; and there ought to be proper vents made for it from the highest parts of the mould; the metal should be run in near or at the bottom of the mold. If about 1 lb. of lead be added to every 16 lbs. of old brass, when just at the melting point, solid good brasses will be the result. In melting old brass, the zinc, or lead, contained in it (when fluid) oxydizes freely, consequently the proportions of the metal are altered, and require an addition similar to the above. If the brass has not been re-cast a little less lead will do, but if re-cast several times it may take the full quantity.

New and Beautiful Alloys.—Copper, 69.8 parts; nickel, 19.8 parts; zinc, 5.5 parts; cadminum, 4.7 parts; used for spoons, forks, &c. *Another.*—Copper, 89.3 parts; aluminum, 10.5 parts. *Oreide resembling Gold.* Copper, 79.7 parts; zinc, 83.05 parts; nickel, 6.09 parts, with a trace of iron and tin.

Good Britannia Metal.—1. Tin, 150 lbs.; copper 3 lbs.; antimony, 10lbs. 2. *Britannia.* 2d *Quality.*—Tin, 140 lbs.; Copper, 3 lbs.; antimony 9 lbs. 3. *Britannia Metal, for Casting.*—Tin, 210 lbs.; copper, 4 lbs.; antimony, 12 lbs. 4. *Britannia Metal for spinning.*—Tin, 100 lbs.; Britannia hardening, 4 lbs.; antimony, 4 lbs. 5. *Britannia Metal for Registers.*—Tin, 140 lbs.; hardening 8 lbs.; antimony 8 lbs. 6. *Best Britannia for spouts.*—Tin 140 lbs.; copper, 3 lbs.; antimony, 6 lbs. 7. *Best Britannia for spoons.*—Tin, 100 lbs.; hardening 5 lbs.; antimony, 10 lbs. 8. *Best Britannia for Handles.*—Tin, 140 lbs.; copper 2 lbs.; antimony 5 lbs. 9. *Best Britannia for Lamps, Pillars, and Spouts.*—Tin, 300 lbs.; copper, 4 lbs.; antimony 15 lbs. 10. *For Casting.*—Tin, 100 lbs.; hardening 5 lbs.; antimony, 5 lbs. 11. Tin, 82 parts; lead, 18 parts; brass 5 parts; antimony, 5 parts; mix. 12. *Another Britannia.*—Tin, 20 parts; antimony, 4 parts; brass, 1 part; mix. 13 *Hardening for Britannia.*—Brass, 4 parts; tin, 4 parts; when fused, add bismuth, 4, and antimony, 4 parts. *Another Hardening.*—Antimony, tin, bismuth, and plate brass of each equal parts. Add this mixture to melted tin until it acquires the proper color and hardness. 15. *Britannia.*—Tin, 89.70 parts, antimony 9.70 parts, copper 0.30 parts, zinc, 0.30 parts, 16. Tin, 81.64 parts, antimony, 16.51 parts, copper, 1.85 parts. 17. Tin, 89.97 parts, antimony 9.12 parts, copper, 0.91 parts. 18. Tin, 90.00 parts, antimony, 10 parts. 19. Tin 89.30 parts, antimony, 7.14 parts, copper, 1.78 parts, bismuth, 1.78 parts.

GERMAN SILVER, FIRST QUALITY FOR CASTING.—1. Copper 50 lbs. zinc, 25 lbs. nickel, 25 lbs. 2. *Second Quality, for Casting.*—Copper, 50 lbs. zinc, 20 lbs. best pulverized nickel, 10 lbs. 3. *German Silver for Rolling.*—Copper, 60 lbs. zinc, 20 lbs. nickel, 25 lbs. 4. *German Silver for Bells, and other Castings.*—Copper 60 lbs. zinc, 20 lbs. nickel, 20 lbs. lead, 3 lbs. iron, that of tin plate is the best, 2 lbs. 5. *German Silver for Castings.*—Lead, 3 parts, nickel, 20 parts, zinc, 20 parts, copper 60 parts, mix. 6. *German Silver for Rolling.*—Nickel, 5 parts, zinc, 4 parts, copper 12 parts, mix. 7. Copper, 40. 62 parts, zinc, 43. 76 parts, nickel, 15. 62 parts. 8. Copper 41.47 parts, zinc 26. 08 parts, nickel, 32. 35 parts. 9. Copper 55. 55 parts, zinc, 5. 55 parts, nickel 38. 90 parts. 10. Copper, 53. 40 parts, zinc 29. 10 parts, nickel 17. 50 parts. 11. *Alfenide.*—Contain a trace of iron, copper, 59. 60 parts, zinc, 30. 30 parts, nickel, 10. 10 parts. 12. *Fine Silver Colored Metal.*—Tin 100 lbs. antimony, 8 lbs. copper, 4 lbs. bismuth, 1 lb. 13. *Fine White German Silver.*—Iron 1 part: nickel, 10 parts, zinc, 10 parts, copper, 20 parts: melt. 14. *Genuine German Silver.*—Iron 2½ parts, nickel 31½ parts, zinc 25½ parts, copper, 40½ parts: melt. 15. *Bidery.*—Copper, 48.48 parts; tin, 6.60 parts, zinc, 33.80 parts, lead, 12.12 parts.

SUNDRY COMPOSITIONS.—1. *Organ Pipe Metal* consists of lead alloyed with about half its quantity of tin to harden it. Lead, 100; tin, 33 parts; and lead, 100; tin, 20 parts, answer very well. The mottled or crystalline appearance so much admired shows an abundance of tin. 2. *Cannon Metal.*—Tin, 10 parts; copper, 90 parts; melt. 3. *Alloy for Cymbals.*—Copper, 80 parts; tin, 20 parts. 4. *Chinese Gong Metal.*—Copper, 78 parts; tin, 22 parts. 5. *Cock Metal.*—Copper, 20 lbs.; lead, 8 lbs.; litharge, 1 oz.; antimony, 3 ozs. 6. *Metal for taking Impressions.*—Lead, 3 lbs.; tin, 2 lbs.; bismuth, 5 lbs. 7. *Alloy for Gun Mountings.*—Copper, 80 parts; tin, 3 parts. zinc, 17 parts. 8. *Pinchbeck.*—Copper, 5 lbs.; zinc, 1 lb. 9. *Spanish Tutania.*—Iron or steel, 8 ozs.; antimony, 16 ozs.; nitre, 3 ozs. Melt and harden 8 ozs. of tin with 1 oz. of the above compound. 10. *Rivet Metal.*—Copper, 32 ozs.; tin, 2 ozs.; zinc. 1 oz. 11. *Chinese White Copper.*—Copper, 40.4; nickel, 31.6; zinc, 25.4; and iron, 2.6 parts. 12. *Bath Metal.*—Brass, 32 parts; zinc, 9 parts. 13. *Speculum Metal.*—Copper, 6; tin, 2; arsenic, 1 part. Or copper, 7; zinc, 3; and tin, 4 parts. 14. *Electrum.*—Copper, 8, nickel, 4, zinc, 3½ parts. This compound is unsurpassed for ease of workmanship and beauty of appearance. 15. *Common Pewter.*—Tin, 4; lead, 1 part. 16. *Best Pewter.*—Tin, 100, antimony, 17 parts. 17 *Queen's Metal.*—Tin, 9; antimony, 1; bismuth, 1; lead, 1 part. 18. *Chantry's Hard Alloy.*—Copper, 1 lb.; zinc, 2½ ozs.; tin, 2½ ozs. Razors as hard as tempered steel have been made from this alloy. 19. *Alloy for Mechanical Instruments.*—Copper, 1 lb.; tin, 1 oz. 20. *Rivet Metal for Hose.*—

Tin, 46 lbs.; copper, 1 lb. 21. *Hard White Metal.*—Sheet brass, 32 ozs.; lead, 2 ozs.; tin, 2 ozs.; zinc, 1 oz. 22. *Fusible Alloy, melts in Boiling water.*—Bismuth, 8 ozs.; tin 3 ozs.; lead, 5 ozs. 23. *Fusible Alloy for Silvering Glass.*—Tin, 6 ozs.; lead, 10 ozs.; bismuth, 21 ozs.; mercury, a small quantity. 24. *Hard White Metal for Buttons.*—Brass, 1 lb.; zinc, 2 ozs.; tin, 1 oz. 25. *Button Maker's Metal.*—Copper, 43 parts; zinc, 67 parts. 26. *Another.*—Copper, 52.22 parts, tin. 2.78 parts, zinc, 35 parts. 27. *Another.*—Copper, 58.94 parts; tin, 5.28 parts; zinc, 35.78 parts. 28. *Metal that expands in cooling.*—Lead, 9; antimony, 2; bismuth, 1 part. This metal is very useful in filling small defects in iron castings, &c. 29. *Albata Metal.*—Nickel, 3 to 4 parts; copper, 20 parts; zinc, 16 parts. Used for plated goods. 30. *Birmingham Platin.*—Copper, 8 parts, zinc, 5 parts. 31. *Imitation Platinum.*—Melt together, 8 parts brass, 5 parts of zinc. This alloy closely resembles platinum. 32. *Chinese Silver.*—Silver, 2.5; copper, 65.24; zinc 19.52; cobalt or iron, 0.12; nickel, 13. 33. *Tutenag.*—Copper, 8; zinc, 5; nickel, 8 parts. 34. *Prince's Metal.*—Copper, 3 parts; zinc, 1 part. 35. *Another.*—Brass, 8 parts, zinc, 1 part. 36. *Another.*—Zinc and copper equal parts. Mix. 37. *Queen's Metal.*—Lead, 1 part; bismuth 1 part; antimony, 1 part; tin, 9 parts.—Mix. 38. *Another.*—Tin, 9 parts; bismuth 1 part; lead, 2 parts; antimony 1 part; mix. 39. *Imitation Gold.*—Platina, 8 parts; silver, 4 parts; copper, 12 parts, melt. 40. *Imitation Silver.*-Block tin, 100 parts; antimony, 8 parts; bismuth, 1 part; copper, 4 parts; melt. 41. *Spurious Silver Leaf.*—Tin, 90.09; zinc, 9.91 parts; melt. 42. *Mirrors of Reflecting Telescope.*—Copper 100, tin, 50 parts. 43. *White Argentan*—Copper, 8 parts; nickel, 3 parts, zinc, 35 parts. This beautiful composition is in imitation of silver. 44. *Yellow Dipping Metal.*—Copper, any desired quantity and 6 or 7 ozs. of zinc to every lb. of copper. 45. *Shot Metal.*—Lead, 97.06 parts; arsenic, 2.94 parts. *Another.*—Lead, 99.60 parts; arsenic, 0.40 parts. 46. *White Metal.*—Parts by weight; tin, 82; lead, 18; antimony, 5; zinc, 1; copper, 5. 47. *Hard Pewter.*—Melt together, 12 lbs of tin; regulus of antimony, 1 lb.; copper, 4 ozs. 48. *Common Pewter.*—Melt in a crucible, tin, 7 lbs.; when fused throw in lead, 1 lb.; copper, 6 ozs.; zinc, 2 ozs. 49. *British Plate.*—Nickel, 5 to 6 parts; copper, 20 parts; zinc, 8 to 10 parts. Used for plated goods. 50. *Composition for Strong Pumps, &c.*—Copper, 1 lb.; zinc, ½, and tin, 1½ ozs. 51. *Composition for Toothed Wheels.*—Copper, 1 lb.; brass, 2 ozs.; tin, 2 ozs. 52. *Another.*—Copper, 1 lb.; brass, 2 ozs.; tin 1¾ ozs. 53. *For Turning Work.*—Copper, 1 lb.; brass 2 ozs.; tin, 2 ozs. 54. *For Nuts of coarse Threads and Bearings.*—Copper, 1 lb.; brass, 1½ ozs.; tin, 2¼ ozs. 55. *Pewterers Temper.*—Copper, 1 lb.; tin, 2 lbs. Used to add in small quantities to tin. 56. *Alloy for Cylinders of Locomotives.*—Copper, 88.63 parts; tin, 2.38 parts; zinc, 6.99 parts. 57. *Metal for Sliding Levers of Locomotives.*—Copper, 85.25 parts; tin, 12.75 parts; zinc, 2.00 parts. 58. *Another (Fenton's).*—Copper, 5.50 tin, 14.50; zinc, 80 parts. 59. *Baron Wetterstedt's Patent Sheathing for Ships.*—Consists of lead with from 2 to 8 per cent. of antimony, about 3 per cent. is the usual quantity. The alloy is rolled into sheets. 60. *Muntz Metal for Ships.*—Best selected copper, 60 parts; best zinc, 40 parts. Melt together in the usual manner and roll into sheets of suitable thickness. This composition resists oxidation from exposure to sea water, and prevents the adhesion of barnacles. 61. *Metal for Anatomical Injections.*—Tin, 16.41 parts; lead, 9.27 parts; bismuth, 27.81 parts; mercury, 41.41 parts. 62. *Fusible Metal for casts.*—Bismuth, 8 parts; lead, 5 parts; tin, 3 parts. It will melt at 200° or under boiling water. For male casts use tin only. 63. *Pot Metal.*—Copper, 40 lbs.; lead, 16 lbs.; tin, 1½ lbs. 64. *Metal for Models.*—Tea lead, 6 lbs.; tin, ½ lb.; antimony, ¾ lb. 65. *Imitation of Silver.*—Copper, 1 lb.; tin, 3 ozs. 66 *Von Bibra's Alloy for Medels.*—Bismuth, 27.27 parts; lead, 59.01 parts; tin, 13.46 parts. If the cast objects be bitten with diluted nitric acid, washed with water, and rubbed with a woolen rag, the elevated spots become bright, while the sunken portions are dull and the castings acquire a dark gray appearance with an antique lustre. Without biting the color is light gray. 67. *New Sheathing Metal.*—This alloy is made by melting 2½ parts of copper in one crucible, in another, 9 parts of zinc, 87 of lead, 1 part of mercury, and ½ part of bismuth, then mix the contents of both crucibles, covering the surface with charcoal dust, and stirring well till all are incorporated. The mercury in this alloy protects both the zinc and copper from the action of sea water. The contents of the crucible are run into ingots and rolled into sheets. 68. *Spelter.*—Natural impure zinc, which contains a portion of lead, iron, copper and a little manganese and plumbago.

IRON MANUFACTURE.—Charcoal 138 bushels, limestone 432 lbs., and ore 2612 lbs., will produce 1 ton of pig iron. In England temperature of hot blast is 600°, density of blast and of refining furnace 2½ to 3 lbs. per square inch. Revolutions of puddling rolls 60 per minute; rail rolls, 100; rail saw, 800.

HORSE POWER (INDICATED) REQUIRED FOR DIFFERENT PROCESSES.

Blast Furnace	60	Railway rolling train	250
Refining "	26	Small bar train	60
Puddling Rolls with squeezers and shears	80	Double rail saw	12
		Straightening	7

One pound of Anthracite coal in a cupola furnace will melt from 5 to 10 lbs of cast iron; 8 bushels of bituminous coal will melt 1 ton of cast iron. Small coal produces about ¾ of the effect of large coal of the same kind.

TO REDUCE OXIDES.—The more powerful deoxidizing agent is undoubtedly coal in its several varieties, and the gases deriving therefrom during combustion in the furnace. The oxides of lead, bismuth, antimony, nickel, cobalt, copper, and iron require a strong red heat in the furnace, whilst the oxides of manganese, chromium, tin, and zinc, do not lose their oxygen until heated to whiteness. On a small scale, the reduction of oxides is generally effected by mixing charcoal, together with the oxide to be reduced, in a refractory clay crucible, the charcoal furnishing the carbon necessary to the proper performance of this work. Some use a crucible thickly lined with charcoal, putting in the oxide on the top of the charcoal. It is necessary, however, when using the crucible and charcoal, to use a flux, say a little borax in powder, strewed on the mixture to accelerate the reduction of the oxide. The borax is generally the first to fuse, and, as the metal is eliminated, seems to purify and cleanse it, as it gathers into a button at the bottom of the crucible. It is all the better if you give the crucible a few sharp taps when you take it off the fire.

EFFECTS OF HEAT ON VARIOUS BODIES.

Fine Gold melts	2590°	Heat, cherry red	1500°
" Silver "	1250	" bright "	1860
Copper melts	2548	" red visible by day	1077
Wrought Iron melts	3980	" white	2900
Cast " "	3479	Mercury boils	662
Bright red " in the dark	752	" volatilizes	680
Red hot " in twilight	884	Platinum melts	3080
Glass melts	2377	Zinc melts	740
Common fire	790	Highest natural temperature (Egypt),	117
Brass melts	1900	Greatest natural cold (below zero)	56
Air furnace	3300	" artificial " "	106
Antimony melts	951	Heat of human blood	98
Bismuth "	476	Snow and Salt, equal parts	0
Cadmium	600	Ice melts	32
Steel	2500	Water in *vacuo* boils	98
Lead	504	Furnace under steam boiler	1100
Tin	421		

SHRINKAGE OF CASTINGS.

Iron, small cylind's = 1-16th in. per ft	Ditto, in length ... ⅛ in 16 ins.
" Pipes .... = ⅛ " " ft.	Brass, thin .... = ⅛ in 9 "
" Girders, beams, ect .... = ⅛ in. in 15 ins.	Brass, thick .... = ⅛ in 10 "
" Large cylinders, the contraction of diameter at top. = 1-16th per foot.	Zinc .... = 5-16ths in a foot
Ditto at bottom .. = 1-12th per foot.	Lead .... = 5-16ths " "
	Copper .... = 3-16ths " "
	Bismuth .... = 5-32nds " "

Green sand iron castings are 6 per cent. stronger than dry, and 30 per cent. stronger than chilled, but when the castings are chilled and annealed, a gain of 115 per cent. is attained over those made in green sand. Chilling the under side of cast iron very materially increases its strength.

TO REPAIR CRACKED BELLS.—The discordant tones of a cracked bell being due to the jarring of the rugged uneven edges of the crack against each other, the best remedy that can be applied is to cut a thin slit with a toothless saw driven at a very high velocity, say 3 or 4000 revolutions per minute, in such a manner as to cut away the opposing edges of the fracture whereever they come in contact. This will restore the original tone of the bell.

TO GALVANIZE GREY IRON CASTINGS.—Cleanse the articles in an ordinary chaffing mill, which consists of a barrel revolving on its axis. containing sand ; when the sand is all removed, take them out and heat one by one, plunging, while hot, in a liquid composed as follows: 10 lbs. hydrochloric acid and sufficient sheet zinc to make a saturated solution. In making this solution, when the evolution of gas has ceased, add muriate, or preferably sulphate of ammonia 1 lb., and let it stand till dissolved. The castings should be so hot that when dipped in this solution, and instantly removed, they will immediately dry, leaving the surface crystallized like frost work on a window pane. Next plunge them while hot, but perfectly dry, in a bath of melted zinc, previously skimming the oxide on the surface away, and throwing thereon a small amount of powdered sal ammoniac. If the articles are very small, inclose them in a wrought iron basket on a pole, and lower them into the metal. When this is done, shake off the superfluous metal, and cast them into a vessel of water to prevent them adhering when the zinc solidifies.

TO FIND THE SPEED OF A COUNTER-SHAFT.—If the revolutions of the main shaft and size of pulleys are given: Multiply the revolutions of the main shaft by the diameter in inches of the pulley, and divide by the diameter in inches of the pulley on the counter-shaft, the quotient will be the number of revolutions.

Example.—What will be the speed of a counter-shaft with a 12 in. pulley driven by a 30 in. pulley 180 revolutions per minute: 180+30÷12=450.

TO FIND THE SIZE OF A PULLEY REQUIRED, if the number of revolutions and size of pulley on the main shaft are given: Multiply the diameter in inches of driving pulley by the revolutions of the main shaft, and divide by the speed required; the quotient will be the diameter in inches of the pulley.

Example—What will be the diameter of a pulley to make a counter-shaft turn 450 revolutions per minute driven by a 30 inch pulley 180 revolutions per minute: 180+30÷450=12 in. pulley.

TO FIND THE SIZE OF A PULLEY FOR A MAIN SHAFT, if the speed of shafts and diameter of pulley on the counter-shaft are given: Multiply the diameter in inches of pulley by speed of the counter-shaft, and divide by the revolutions of the main shaft; the quotient will be the diameter of the pulley.

Example.—What will be the diameter of a pulley on a main shaft, making 180 revolutions per minute, to drive a 12 in. 450 revolutions per minute: 450×12÷180=30 inch pulley.

TO WELD STEEL AXLES.—To insure a good weld, prepare the composition described on page 270 for welding cast steel. Use a strong fire, and when the axle is brought to what may be termed a bright red heat, apply a sufficiency of the composition and return it to the fire until the heat is regained once more, then place it under the hammer. Be careful not to put on too much of the composition, otherwise it might waste in the fire, and by its affinity for metal obstruct the tire iron, thereby preventing the fire from receiving the full energy of the blast, and thus retarding if not spoiling the job.

MILDEW ON SAILS can be prevented by soaping the mildewed parts and then rubbing in powdered chalk. The growth of the mildew fungus can be prevented by steeping the canvas in an aqueous solution of corrosive sublimate. *Another way.* Slacked lime 2 bushels, draw off the lime water, and mix it with 120 gals. water, and with blue vitriol ¼ lb.

TO MAKE GUN COTTON.—Take dry saltpetre, ½ oz.; strong oil vitriol, ¾ oz. Mix in a tumbler, add 20 grs. of dry cotton wool, stir with a glass rod 5 minutes, remove the cotton and wash from all traces of the acid in 4 or 5 waters; then carefully dry under 120°. This is gun cotton.

TO KEEP WAGON TIRES ON THE WHEEL.—A practical mechanic suggests a method of so putting tires on wagons that they will not get loose and require resetting. He says he ironed a wagon some years ago for his own use, and, before putting on the tires, he filled the felloes with linseed oil, and the tires have worn out and were never loose. This method is as follows: He used a long cast iron heater made for the purpose; the oil is brought to a boiling heat, the wheel is placed on a stick, so as to hang in the oil, each felloe an hour. The timber should be dry, as green timber will not take oil. Care should be taken that the oil is not made hotter than a boiling heat, or the timber will be burned. Timber filled with oil is not susceptible of injury by water, and is rendered much more durable by this process.

TO CHILL CAST IRON VERY HARD.—Use a liquid made as follows: Soft water, 10 gallons; salt, 1 peck; oil vitriol, ½ pt.; saltpetre, ½ lb.; prussiate of potash, ½ lb.; cyanide of potash, ½ lb. Heat the iron a cherry red and dip as usual, and if wanted harder repeat the process.

ANOTHER TO HARDEN CAST IRON.—Salt, 2 lbs.; saltpetre ½ lb.; roche alum, ½ lb.; ammonia, 4 ozs.; salts of tartar, 4 ozs.; pulverize all together and incorporate thoroughly, use by powdering all over the iron while it is hot, then plunging it in cold water.

FLUX FOR REDUCING LEAD ORE.—Red argol, 6 parts; nitre, 4 parts; fluor spar, 1 part; grind well and mix thoroughly.

VARNISH FOR SMOOTH MOULDING PATTERNS.—Alcohol, 1 gal.; shellac 1 lb.; lamp or ivory black, sufficient to color it.

IRON LUSTRE is obtained by dissolving a piece of zinc with muriatic acid, and mixing the solution with spirit of tar, and applying it to the surface of the iron.

BLACK HAVING A POLISH FOR IRON.—Pulverized gum asphaltum, 2 lbs.; gum benzoin, ½ lb.; spirits of turpentine, 1 gal.; to make quick, keep in a warm place, and shake often; shade to suit with finely ground ivory black. Apply with a brush. And it ought to be used on iron exposed to the weather as well as on inside work desiring a nice appearance or polish.

VARNISH FOR IRON.—Asphaltum, 8 lbs.; melt in an iron kettle, slowly adding boiled linseed oil, 5 gals.; litharge, 1 lb.; and sulphate of zinc, ½ lb.; continuing to boil for 3 hours; then add dark gum amber, 1½ lbs.; and continue to boil 2 hours longer. When cool, reduce to a proper consistence to apply with a brush, with spirits of turpentine

TO SOFTEN CAST IRON FOR TURNING.—Steep it in 1 part of aquafortis to 4 of water, and let it remain in 24 hours.

CAST IRON ORNAMENTS are rendered susceptible of being finished with a scraper, where they cannot be reached with files, after having the following liquid applied to them:

SCALING CAST IRON.—Vitriol, 1 part; water, 2 parts; mix and lay on the diluted vitriol with a cloth in the form of a brush, enough to wet the surface well; after 8 or 10 hours, wash off with water, when the hard, scaly surface will be completely removed.

TO BREAK UP OLD CANNON.—Old cannon and massive castings may be cut in two by a continuous stream of hot molten iron, which wears away the iron as a stream of hot water would eat into a mass of ice. Or the gun may be rolled on a frame to the mouth of a furnace, and the muzzle end shoved in as far as possible among other iron, the opening filled up and luted around the gun, the end of which is melted off. At the next charge shove it in another length, and so on until the breech is disposed of.

Large masses of cast iron may be broken up by drilling a hole in the the most solid part, filling it up with water, fitting a steel plug very accurately into the hole, and letting the drop of a pile driver descend on the plug.

AMALGAM FOR MIRRORS.—1. Tin, 70 parts; mercury, 30 parts; 2. (*For curved mirrors*) Tin, 80 parts; mercury, 20 parts; 3. Tin, 8.33 parts; lead, 8.34 parts; bismuth, 8.33 parts; mercury, 75 parts. 4. (*For spherical Mirrors*) Bismuth, 80 parts; mercury, 26 parts.

REFLECTOR METAL.—1. (*Duppler's*) Zinc, 20 parts; silver, 80 parts; 2. Copper, 66.22 parts; tin, 33.11 parts; arsenic, 0.67 parts. 3. (*Cooper's.*) Copper, 57.86 parts; tin, 27.28 parts; zinc, 3.30 parts; arsenic, 1.65 parts; platinum, 9.91 parts; 4. Copper, 64 parts; tin, 32.00 parts; arsenic, 4.00 parts. 5. Copper, 82.18 parts; lead, 9.22 parts; antimony, 8.60 parts. 6. (*Little's*) Copper, 69.01 parts; tin, 30.82 parts; zinc, 2.44 parts; arsenic, 1.83 parts.

METAL FOR GILT WARES.—1. Copper, 78.47 parts; tin, 2.87 parts; zinc, 17.23 parts; lead, 1.43 parts. 2. Copper, 64.43 parts; tin, 0.25 parts; zinc, 32.44 parts; lead, 2.86 parts. 3. Copper, 72.43 parts; tin, 1.87 parts; zinc, 22.75 parts; lead, 2.96 parts. 4. Copper, 70.90 parts; tin, 2.00 parts; zinc, 24.05 parts; lead, 3.05.

AMALGAM FOR ELECTRICAL MACHINES.—1. Tin, 25 parts; zinc, 25 parts; mercury, 50 parts. 2. Tin, 11.11 parts; zinc, 22.22 parts; mercury, 66.67 parts.

TYPE METAL.—1. *For smallest and most brittle types.*—Lead, 3 parts; antimony, 1 part. 2. *For small, hard, brittle types.*—Lead, 4 parts; antimony, 1 part. 3. *For types of medium size.*—Lead, 5 parts; antimony, 1 part. 4. *For large types.*—Lead, 7 parts; antimony, 1 part. 5. *For largest and softest types.*—Lead, 7 parts; antimony, 1 part. In addition to lead and antimony, type metal also contains 4 to 8 per cent. of tin, and sometimes 1 to 2 per cent. of copper. 6. *Stereotype plates* are made of lead, 20 parts; antimony, 4 parts; tin, 1 part. 7. *Another do.*—Lead, 25 parts; antimony, 4 parts; tin, 1 part. 8. *Type metal.*—Lead, 4 parts; antimony, 2 parts. 9. *Tough type metal.*—Lead, 100 parts; antimony, 32 parts; tin, 8 parts.

DOWLAIS IRON WORKS, (*England.*) *Furnaces.*—Eight, diameter 16 to 18 feet, 1300 Tons Forge Iron per week; discharging 44,000 cubic feet of air per minute. *Engine.* (*noncondensing,*) *Cylinder*, 55 ins. in diam. by 13 feet stroke of piston. *Pressure of steam*, 60 lbs per square inch, cut off at $\frac{1}{3}$ the stroke of the piston. *Valves*, 120 ins. in area. *Boilers.* Eight, (Cylindrical flue, internal furnace,) 7 feet in diam. and 42 feet, in length; one flue, 4 ft. in diam. *Grates*, 288 square feet, *Fly wheel.* Diam. 22 feet, weight, 25 tons. *Blowing Cylinder*, 144 ins. diam. by 12 ft. stroke of piston. *Revolutions*, 20 per minute. *Blast* $3\frac{1}{4}$ lbs. per square inch, *Discharge pipe*, diam. 5 ft. and 420 feet in length. *Valves*, Exhaust, 56 square feet, delivery, 16 square feet.

TO ENAMEL CAST IRON AND HOLLOW WARE.—1. Calcined flints, 6 parts; Cornish stone or *composition*, two parts; litharge, 9 parts; borax, 6 parts; argillaceous earth, 1 part; nitre, 1 part; calx of tin, 6 parts; purified potash, 1 part. 2. Calcined flints, 8 parts; red lead, 8 parts; borax, 6 parts; calx of tin, 5 parts; nitre, 1 part. 3 Potters' composition, 12 parts; borax, 8 parts; white lead, 10 parts; nitre, 2 parts; white marble, calcined 1 part; purified potash, 2 parts; calx of tin, 5 parts. 4. Calcined flints, 4 parts; potters' composition, 1 part; nitre, 2 parts; borax, 8 parts; white marble, calcined, 1 part; argillaceous earth, ½ part; calx of tin, 2 parts. Whichever of the above compositions is taken must be finely powdered, mixed, and fused. The vitreous mass is to be ground when cold, sifted, and levigated with water; it is then made into a pap with water, or gum water. The pap is smeared or brushed over the interior of the vessel, dried, and fused with a proper heat in a muffle. Clean the vessels perfectly before applying.

Russia Sheet Iron.—Russia sheet iron is, in the first instance, a very pure article, rendered exceedingly tough and flexible by refining and annealing. Its bright, glossy surface is partially a silicate, and partially an oxide of iron, and is produced by passing the hot sheet, moistened with a solution of wood-ashes, through polished steel rollers.

Liquid Black Lead Polish.—Black lead pulverized 1 lb.; turpentine, 1 gill; water, 1 gill; sugar 1 oz.

Copperas Dip for Cast Iron.—Dissolve 3 lbs. of sulphate of copper and add 2 fluid ozs. sulphuric acid.

Enamelled Cast Iron.—Clean and brighten the iron before applying. The enamel consists of two coats—the body and the glaze. The body is made by fusing 100 lbs. ground flints, 75 lbs. of borax, and grinding 40 lbs. of this frit with 5 lbs. of potters' clay, in water, till it is brought to the consistence of a pap. A coat of this being applied and dried, but not hard, the glaze-powder is sifted over it. This consists of 100 lbs. Cornish stone in fine powder, 117 lbs. of borax, 35 lbs. of soda ash, 35 lbs. of nitre, 35 lbs. of sifted slacked lime, 13 lbs. of white sand, and 50 pounds of pounded white glass. These are all fused together; the frit obtained is pulverized. Of this powder, 45 lbs. are mixed with 1 lb. soda ash, in hot water, and the mixture being dried in a stove, is the glaze powder. After sifting this over the body-coat, the cast-iron article is put into a stove, kept at a temperature of about 212°, to dry it hard, after which it is set in a muffle-kiln, to fuse it into a glaze. The inside of pipes is enamelled (after being cleaned) by pouring the above body composition through them while the pipe is being turned around to insure an equal coating; after the body has become set, the glaze pap is poured in in like manner. The pipe is finally fired in the kiln.

To Enamel Copper and Other Vessels.—Flint glass, 6 parts. borax, 3 parts; red lead, 1 part; oxide of tin, 1 part. Mix all together, frit, grind into powder, make into a thin paste with water, apply with a brush to the surface of the vessels, after scaling by heat and cleaning them, repeat with a second or even a third coat, afterwards dry, and lastly fuse on by heat of an enamelled kiln.

Emery Wheels for Polishing.—Coarse emery powder is mixed with about half its weight of pulverized Stourbridge loam, and a little water or other liquid to make a thick paste; this is pressed into a metallic mould by means of a screw-press, and, after being thoroughly dried, is baked or burned in a muffle at a temperature above a red, and below a white heat. This forms an artificial emery stone, which cuts very greedily, with very little wear to itself. Unequalled for grinding and polishing glass, metals, enamels, stones, &c.

MOULDING SAND FOR CASTING BRASS OR IRON.—The various kinds of good moulding sand employed in foundries for casting iron or brass, have been found to be almost uniform chemical composition, varying in grain, or the aggregate form only. It contains between 93 and 96 parts silex, or grains of sand, and from 4 to 6 parts clay, and a little oxide of iron, in each 100 parts. Moulding sand which contains lime, magnesia, manganese and other oxides of metal, is not applicable, particular for the casting of iron or brass. Such sand is either too close, will not stand or retain its form, or it will acuse the metal to boil through its closeness.

REFINING FLUXES, FOR METALS.—Deflagrate, and afterwards pulverize, 2 parts of nitre and 1 part of tartar. The following fluxes answer very well, provided the ores be deprived of their sulphur, or if they contain much earthy matter, because, in the latter case, they unite with them, and convert them into a thin glass, but, if any quantity of sulphur remains, their fluxes unite with it, and form a liver of sulphur, which has the power of destroying a portion of all the metals, consequently the assay must be, under such circumstances, very inaccurate. Limestone, fieldspar, fluorspar, quartz, sand-slate, and slags, are all used as fluxes. Iron ores, on account of the argillaceous earth they contain, require calcareous additions; and the copper ores, rather slags, or nitrescent stones, than calcareous earth.

BURNING IRON CASTINGS TOGETHER.—The usual mode is by imbedding the castings in the sand, having a little space left vacant round about the joint where it is to be burned. Two gates must then be provided, one lying on a level with the lower side of this space, and the other raised so that the metal, which must be very hot, is poured in at the higher one; it passes round, fills up the space, and runs off at the lower gate. A constant supply of metal is thus kept up, till the parts of the casting are supposed to be on the eve of melting. The lower gate is then closed, and the supply stopped. When cool, and the superfluous metal chipped off, it forms as strong a joint as if it had been original.

CORNISH REDUCING FLUX.—Tartar 10 ozs., nitre 3 ozs. and 6 drs. borax, 3 oz. and 1 dr. Mix together.

CRUCIBLES.—The best crucibles are made from pure fire-clay, mixed with finely-ground *cement* of old crucibles, and a portion of black-lead or graphite; some pounded coke may be mixed with the plumbago. The clay should be prepared in a similar way as for making pottery-ware; the vessels, after being formed must be slowly dried, and then properly baked in the kiln.

Black-lead crucibles are made of 2 parts graphite, and 1 of fire-clay, mixed with water into a paste, pressed in moulds, and well dried, but not baked hard in the kiln. This compound forms excellent small or portable furnaces.

MALLEABLE CAST IRON.—The great secret of this sort of work is the annealing, which if not done properly the castings are of no use at all. The best mode is to take an iron pan, say one foot square; put in a layer of charcoal, then some of the castings, then another layer. When the pan is full cover it over with some sand, to keep the charcoal from burning away. Put on an old piece of iron for a lid to cover all, put it in the annealing furnace, and get the heat up quite slow and gradually, taking care not to get the heat up too quick. After you have got it to the proper heat, which is this, the castings must be red hot through; keep it at this heat for 5 or 6 hours, then let your fire die gradually out, or, if you want to take some out and put more in, take them to a corner and bury them, pan and all,—let them lie there till properly cooled. Regarding the melting, procure not less than two good sorts of No. 2 pig iron, which you may mix with some good scrap if you choose; the casting, melting, and moulding are conducted in the same manner as common cast-iron, only the metal being hard, when casting, you have to make properly constructed runners and risers, or flow gates, if the article is likely to sink, for you cannot pump it well.

JAPANNING CASTINGS.—Clean them well from the sand, then dip them in or paint them over with good boiled linseed oil; when moderately dry, heat them in an oven to such a temperature as will turn the oil black, without burning. The stove should not be too hot at first, and the heat should be gradually raised to avoid blistering; the slower the change in the oil is effected the better will be the result. The castings, if smooth at first, will receive a fine black and polished surface by this method.

HARDENING AXLETREES AND BOXES.—The method now used in the manufacture of Murphy's axletrees is to use wrought iron and weld two pieces of steel into the lower side, where they rest upon the wheels and sustain the load. The work is heated in an open forge fire, in the ordinary way, and when it is removed, a mixture, principally prussiate of potash, is laid upon the steel; the axletree is then immediately immersed in water, and additional water is allowed to fall upon it from a cistern. The steel is considered to be very materially hardened by the treatment, and the iron around the same is also partially hardened. One very good way to chill *axletree* boxes is to mould from wooden patterns on sand, and cast them upon an iron core which has the effect of making them very hard. To form the annular recess for oil, a ring of sand, made in an appropriate core-box, is slipped upon the iron mandrill, and is left behind when the atter is driven out of the casting.

COMPOSITE IRON RAILINGS.—The process by which this light, elegant and cheap fabric is manufactured, is as follows:—Rods and bars of wrought-iron are cut to the lengths desired for the pattern, and subjected to a process called crimping, by which they are bent to the desired shape. These rods are then laid in the form of the design, and cast-iron moulds are affixed at those points where a connection is desired; the moulds are then filled with melted metal, and immediately you have a complete railing of beautiful design. Casting in iron moulds has this great advantage over the old sand moulding, it does not require any time for cooling, as the metal is no sooner run than the moulds may be removed and used again immediately on another section of the work; and besides, it is so much more easily effected. By the combination of wrought and cast-iron in this process, the most curious and complex designs may be produced with great rapidity and cheapness.

TO GALVANIZE CAST IRON THROUGH.—To 50 lbs. melted iron add 1 lb. pulverized pure zinc. Scatter the zinc powder well over the ladle, then catch the melted iron, stir it up with an iron rod and pour at once.

TO OBTAIN COMMERCIAL ANTIMONY.—Fuse together 100 parts sulphuret of antimony, 40 parts metallic iron, and 10 parts dry crude sulphate of soda. This produces from 60 to 65 parts of antimony, besides the scoriæ or ash which is also valuable. *Metallic Antimony.* Mix 16 parts sulphuret of antimony and 6 parts cream of tartar, both in powder; put the mixture, in small quantities at a time, into a vessel heated to redness; when reaction ceases, fuse the mass and after 15 minutes, pour it out and separate the metal from the slag. The product is nearly pure.

HOLES IN MILLSTONES are filled with melted alum, mixing burr sand with it. If the hole is large, put some pieces of burr mill stones in it first, and pour in melted alum. These pieces of block should be cut exactly to fit. There should be small joints, and fastened with plaster of Paris. These holes should be cut at least 4 inches deep; there is then no danger of their getting loose.

FITTING A NEW BACK ON AN OLD MILLSTONE.—Block your stone up with a block of wood, having its face down until it lies even, solid, and perfectly level; then pick and scrape off all the old plaster down to the face blocks, so that none remains but what is in the joints of the face blocks; then wash these blocks, and keep them soaked with water. Keep a number of pieces of burr blocks, at the same time, soaked with water. Take a pail half filled with clean water, and mixed with 2 tablespoonfuls of glue water, boiled and dissolved; mix in with your hand plaster of Paris until it be thick enough that it will not run; and, breaking all the lumps, pour this on the stone, rubbing it with your hand; the stone being at the same time damped; and place small pieces of stone all over the joints of the face blocks; you then, with more plaster, mixed in the same way but more stiff, with this and pieces of burr stones, build walls round the eye and verge 4 or 5 inches high, leaving the surface uneven and the eye larger, as it will be brought to its proper size by the last operation. It is better to build up the wall of the running stone round the verge for 3 inches without any spalls, so that the holes may be cut in to balance it. If you wish to make your stone heavier, you will take small pieces of iron, perfectly clean and free from grease, and lay them evenly all around the stone in the hollow place between the two walls just built; and, with plaster mixed a little thicker than milk, pour in under and through all the crevices in the iron until the surface is nearly level with the two walls. If the stones do not require additional weight added, instead of iron, use pieces of stone the same way, leaving the surface rough and uneven. Again, as before, build walls round the verge of the stone, and round the eye of the stone, until they are within 2 inches of the thickness you want your stones to be, the wall round the eye being 2 inches higher than that round the verge, and filling the space between the walls with stones; and pouring in plaster again, make it nearly level with the walls, but leaving the surface rough and jagged, to make the next plaster adhere well to it. Let it stand until the back is dry and perfectly set, when you raise the stone upon its edge, and, with a trowel, plaster round the edge of the stone neatly, giving it a taper of half an inch from the face to the back of the stone. When cased round in this way, lay the stone down on the cock-head; it being in the balance ryne, but the driver off, then raise the spindle, and balance the stone as already directed before putting on the remainder of the back. Then have a tin made the size of the eye, and to reach from the balance ryne to the thickness you want the stone to be at the eye. This tin should be exactly fitted to its place, and made fast; then fit a hoop of wood or iron round the verge, having the upper edge of the thickness from the face you want the stone to be at the verge, and equal all round. This hoop should be greased; and, all the cracks round it, and the tin in the eye, being stopped, you pour thin plaster (with more glue water than in previous operations, to prevent it from setting so quickly, and to give time to finish off the back correctly) until it be level with the hoop round the verge, and with a straight edge, one end resting on the hoop, and the other end resting on the tin at the eye; then, by moving it round, and working the plaster with a trowel, make the surface of the back even and smooth between these two points. The hoop is then taken off, and the back and edges planed smooth; then lower the spindle until your runner lies solid, and put your band or hoop on, it being first made nearly red hot, and taking care that it is of sufficient size not to require too much driving; if fitting too tightly, it may loosen the back in driving it to its proper place; it may be cooled gently by pouring water on it; and, when cool, it should fit tight.

BALANCING A MILLSTONE.—First, take off the driver, that the stone may have full play on the cock-head; then raise the spindle so that there may be room between the stone to see the balance. Find the heaviest parts, and near the verge lay on sufficient weight to balance it. Cut a hole in the back of the stone, as deep as you can make it and as near the verge as possible that the binding iron hoop of the stone may keep the lead in its place. This hole should be wider at the bottom than the top in order to retain the lead when the stone is in motion, and into this the melted lead should be poured until it brings the stone completely into balance. When the lead is cold, cover over with mixed plaster, even with the back of the stone.

COMPOSITION TO KEEP MILLSTONES CLEAN.—Hot water, 1 gal; borax, 2 oz; washing soda, ¼ lb. and 3 balls of the size of a hazel nut each, of sal prunel. Mix and apply it to the burrs with a scrubbing brush. When grinding garlic wheat it is not necessary to take up the burrs at all. It is sufficient to drop through the eye of the burr twice per day one of the above described balls of sal prunel, and that will keep the burrs sharp and clean, enabling the miller at all seasons to use the No. 13 bolt, to make finer flour and in greater quantity than usual.

MILL DAMS.—When building a dam, you should select the most suitable place. If you can, place it across the stream near a rocky bluff so that the end of the dam may run into the bluff. This will prevent the water running by at the ends of the dam. Build your dam very strong; if this is not done, they are breaking up often, causing ruinous expense in money and loss of time.

FLOUR MILL MACHINERY.—For each pair of 4 feet stones, with all the necessary dressing machinery, etc., there is required 15 horses' power. *Stones*, 4 ft. diam., 120 to 140 revolutions per minute. *Dressing Machines*, 21 ins. diam., 450 to 500 revolutions per minute.

Elevator, 18 ins. diam., 40 revolutions per minute. *Creepers*, $3\frac{1}{2}$ ins. pitch, 75 revolutions per minute. *Screen*, 16 ins. diam., 300 to 350 revolutions per minute. 788 cubic feet of water, discharged at a velocity of 1 foot per second, are necessary to grind and dress a bushel of wheat per hour=1.40 horses' power per bushel. 2000 feet per minute for the velocity of a stone 4 feet in diam. may be considered a maximum speed.

ROCK DAMS are incomparably the best in use, if there is plenty of material at hand for building, and a rock bottom to the stream; if there is not a rock bottom you should dig a trench in the bottom, deep enough, so that the water cannot undermine it. This should be the same as if you were building the foundation of a large building. The wall to be built should be of a small circular form, so that the back of the circle should be next to the body of water, which may by its pressure tighten it. To secure the water from leaking through at the ends of the dam, dig a ditch deeper than the bottom of the river; then fill this with small pieces of rock, and pour in cement. This cement is made of hydraulic cement, and is made of one part of cement to five parts of pure sand. It will effectually stop all crevices. A rock dam if well built will be perfectly tight. Use as you conveniently can move; building this wall 4 to 6 feet thick, according to the length of the dam, with jam or buttressess every place where they are needed to strengthen it; make true joints to these rocks, especially on the ends so that they may join close together. When you have the outside walls laid in cement for every layer fill the middle up with pieces of small rock, pouring in your grout, so that there may not be a crevice but what is filled. If there is any crevice or hole left open, the water will break through, wearing it larger and larger. If the stream is wide and large, it is necessary to build the dam in two sections, which should be divided by a waste way, necessary for the waste, or surplus water, to run over, to keep the head in its proper place or height. Let each section, next to where the water is to be run over, be abutments, built to strengthen the dam. The last layer of rock, on the top where the waste water runs over, should project 5 or 6 inches over the back of the dam so that the water may not undermine it. This last layer should be of large rocks and jointed true; then laid in hydraulic cement, in proportion of 1 of cement to 3 of sand. When the dam is guilt, the front should be filled up with coarse gravel or clay; this is best done with teams, for the more it is tramped the more durable it becomes.

FRAME-DAMS.—In building a frame dam, commence with a good foundation, laying the first sills in the bottom, of sufficient depth. They should be large square timbers that will last in the water without rotting. Where there is a soft foundation, the bottom should first be made level; then dig trenches for the mudsills, about 7 or 8 feet apart, lengthways of the stream, and 10 or 12 feet long. Into these first sills other sills must be framed, and put crosswise of the stream, 6 or 8 feet apart, to reach as far across the stream as necessary. Then two outside sills should be piled down with 2-inch plank driven down to a depth of 4 or 5 feet. If this can be done conveniently, they are to be jointed as closely as possible. It would be better to line with some stuff 1 inch thick; then with posts their proper length, about 12 or 14 inches square, which should be framed into the uppermost sill, in both sides, and all the way across the dam, from bank to bank, at a distance of 6 feet apart. Then, with braces to each post, to extend two-thirds of the length of the post, where they should be joined together with a lock, instead of a mortise and tenon, with an iron bolt 1 or 1¼ inches in diameter, going through both, and tightened with a screw and nut. When mortises and tenons are used, they often become rotten and useless in a few years. These braces should be set at an angle of 50 or 60° with the other end mortised into the mud sill. These braces require to be about 6 to 8 inches, and as long as you find necessary; being covered with dirt it will not decay for a long time, as the air is excluded. These posts should be capped from one to the other, plate fashion. The posts should be lined with 2 or 2½ inch plank on the inside, pinned to the plank, and should, in the middle, be filled in with dirt.

If the stream is large and wide, the dam should be built in two sections, which should be divided by a waste-way for the surplus water, which should be in the centre of the dam, and sufficient for all the waste-water to run over. Let each section of the dam form an abutment next to the waste-way, placing cells or sills 4 feet apart the length of the waste-way; in each of these sills, posts should be framed with a brace for the sides. These rows of posts, standing across the dam, will form the sectional abutments; the middle one may be constructed by being lengthways of the stream, with short braces, so that they will not be in the way of drift-wood passing down the stream; it being necessary for strong pieces for a bridge. Then cover the sills with an apron of 2-inch plank joined perfectly straight, to extend 30 or 40 feet below the dam, to prevent undermining of the dam. The planks which are used for the purpose of lining the posts which form the abutments of each section of the dam, and the ends of the waste-way, should be truly pointed, so as to prevent any leakage. The dam being built, the dirt should be filled in with teams, as the more it is tramped the better. Clay or coarse gravel is the best. Then place your gates on the upper side of the waste-way, the size that is necessary to a level with low-water mark; which gates are not to be raised except in times of high water, as the proper height of the mill-pond should be regulated by boards placed over the gate for the desired head, as the water should be allowed pass at all times freely over them. To strengthen the dam, if you think necessary, 2-inch plank may be used in lining the front side of the dam, long enough to reach from the bottom of the stream (on an inclined plane, and next to the body of water to the top of the dam, and filled up nearly to the top of the dam with clay or gravel well trampled down.

BRUSH OR LOG DAMS are very often used in small, muddy streams When the bottom of the stream is of a soft nature, take a flat boat where you want to fix your dam, and drive piles the whole length of the stream, about 3 or 4 feet apart, as deep as you can. Take young oak saplings pointed at the end, for the purpose. If you can, construct a regular pile-driver, similar to those in use for making trestle-work on the railways. This weight may be pulled up by horses instead of an engine. When you have finished driving piles, make some boxes or troughs of 2 or 3 inch plank, about 3 feet wide and as long as the plank is. Sink these in the water the length of the dam, close to the piles, by loading them with rock, until they are at the bottom of the stream, filling in the front part of the dam with dirt and brush, nearly to the height you want it. This kind of a dam will last a long time.

Whenever there is a small break in the dam or race, cut up some willows and brush, put them in the break along with some straw and dirt, and ram them down with clay.

In regard to the flume, the greatest care must be taken to insure strength and durability combined with tightness. Every step taken in its construction must be of such a nature as to unite these qualities in the highest possible degree, otherwise the whole is, in a manner, labor lost.

BRONZING COMPOSITIONS, 32 KINDS.—1. *Silver white Bronzing Powder.*—Melt together 1 oz. each, bismuth and tin, then add 1 oz. quicksilver, cool and powder. 2. *Gold colored Bronze Powder.*—Verdigris, 8 ozs.; tutty powder, 4 ozs.; borax and nitre, of each 2 ozs.; bichloride of mercury, ½ oz.; make into a paste with oil and fuse them together. Used in japanning as a gold color. 3. *Beautiful Red Bronze Powder.*—Sulphate of copper, 100 parts; carbonate of soda, 60 parts; apply heat until they unite into a mass. 4. *Acid Bronze.*—Cobalt, 4 lbs.; pulverize; sift through a fine sieve; put in a stone pot; add ½ gal. nitric acid, a little at a time, stirring frequently for 24 hours; then add about, 5 gals. muriatic acid, or until the work comes out a dark brown. 5. *Alkali Bronze.*—Dissolve 5 lbs. nitrate of copper in 3 gals. of water; and 5 lbs. pearlash; add 1 or 2 pts. potash water; then add from 2 to 3 lbs. sal ammoniac or until the work comes out the required color. 6. *Coating Dip.*—Sulphate of zinc, 8 lbs.; oil of vitriol, 5 gals.: aquafortis, ¾ gal. To use, warm up scalding hot. 7. *Quick Bright Dipping Acid, for Brass which has been Ormolued.*—Sulphuric acid, 1 gal.; nitric acid, 1 gal. 8. *Dipping Acid.*—Sulphuric acid, 12 lbs.; nitric acid, 1 pt.; nitre, 4 lbs.; soot, 2 handfuls; brimstone, 2 ozs.; pulverize the brimstone and soak it in water 1 hour, add the nitric acid last. 9. *Good Dipping Acid for cast Brass.*—Sulphuric acid, 1 qt.; nitre, 1 qt.; a little muriatic acid may be added or omitted. 10. *Ormolu Dipping Acid for Sheet Brass.*—Sulphuric acid, 2 gals.; nitric acid, 1 pt.; muriatic acid, 1 pt.; nitre, 12 lbs.; put in the muriatic acid last, a little at a time, and stirring the mixture with a stick. 11. *Dipping Acid.*—Sulphuric acid, 4 gals.; nitric acid, 2 gals.; saturated solution of sulphate of iron 1 pt.; solution of sulphate of copper, 1 qt. 12. *Ormolu Dipping Acid for cast Brass.*—Sulphuric acid, 1 gal.; sal ammoniac, 1 oz.; sulphur (in flour) 1 oz.; blue vitriol, 1 oz.; saturated solution of zinc in nitric acid, 1 gal.; mixed with an equal quantity of sulphuric acid. 13. *Vinegar Bronze for Brass.*—Vinegar, 10 gals.; blue vitriol, 3 lbs.; muriatic acid 3 lbs.; corrosive sublimate, 4 ozs.; sal ammoniac, 2 lbs.; alum, 8 ozs. 14. *Antique Bronze Paint.*—Sal ammoniac, 1 oz.; cream of tartar, 3 ozs.; common salt, 6 ozs.; dissolve in 1 pt. hot water; then add nitrate of copper, 2 ozs.; dissolve in ½ pt. water; mix well and apply it to the article in a damp place with a brush. 15. *Blue Bronze on Copper.*—Clean and polish well, then cover the surface with a fluid obtained by dissolving vermillion in a warm solution of sodium, to which some caustic potash has been added. 16. *Bronze Dip.*—Sal ammoniac 1 oz.; salt of sorrel, (binoxolate of potash) ¼ oz.; dissolved in vinegar. 17. *Parisian Bronze Dip.*—Sal ammoniac, ⅓ oz.; common salt, ½ oz.; spirits of hartshorn, 1 oz.; dissolved in an English qt. of vinegar, a good result will be obtained by adding ½ oz. sal ammoniac instead of spts. of hartshorn; the piece of metal being well cleaned is to be rubbed with one of these solutions, then dried by friction with a fresh brush. 18. *Green Dip.*—Wine vinegar, 2 qts.; verditer green, 2 ozs.; sal ammoniac 1 oz.; salt, 2 ozs.; alum, ½ oz.; French berries, 8 ozs.; boil the ingredients together. 19. *Aquafortis Dip.*—Nitric acid, 8 ozs.; muriatic acid, 1 qt.; sal ammoniac, 2 ozs.; alum, 1 oz.; salt, 2 ozs. 20. *Olive Bronze Dip for Brass.*—Nitric acid, 3 ozs.; muriatic acid, 2 ozs.; add titanium or palladium, when the metal is dissolved add 2 gals. pure soft water to each pt. of the solution. 21. *Brown Bronze Paint for Copper Vessels.*—Tinct. of steel, 4 ozs.; spts. of nitre 4 ozs.; blue vitriol, 1 oz.; water, ½ pt.; mix in a bottle, apply it with a fine brush, the vessel being full of boiling water. Varnish after the application of the bronze. 22. *Bronze for all kinds of Metal.*—Muriate of ammonia, (sal ammoniac) 4 drs.; oxalic acid, 1 dr.; vinegar, 1 pt; dissolve the oxalic acid first; let the work be clean, put on the bronze with a brush, repeating the operation as many times as may be necessary. 23. *Green Bronze.*—Dissolve 2 ozs. nitrate of iron, and 2 ozs. hyposulphate of soda in 1 pt. of water; immerse the article until the required shade is obtained, as almost any shade from brown to red can be obtained according to the time of immersion, then well wash with water, dry and brush. 24. *Pale Deep Olive Green Bronze.*—Perchloride of iron, 1 part; water, 2 parts. Mix and immerse the brass. 25. *Dark Green.*—Saturate nitric acid with copper and immerse the brass. 26. *Dead Black for Brass Work.*—Rub the surface first with tripoli, then wash it with a solution of 1 part, neutral nitrate of tin, with 2 parts, chloride of gold, after 10 minutes wipe it off with a wet cloth. 27. *Best Bronze for Brass.*—Take 1 lb. of nitric acid, and ½ lb. of white arsenic, put them into an earthen vessel and then proceed in the usual manner. 28. *Another Bronze for Brass.*—1 oz. muriate of ammonia, ½ oz. alum, ¼ oz. arsenic, dissolve together in 1 pt. of strong vinegar. 29. *Black Dip for Brass.*—Hydrochloric acid (commonly called smoking salts,) 12 lbs.; sulphate of iron, 1 lb.; and pure white arsenic 1 lb. This dip is used in all the large factories in Birmingham, but the dip used in the London trade is 2 ozs. corrosive sublimate, in 1 pt. of the best vinegar, cork both air tight in a bottle, let it stand 24 hours; then it is fit for use. 30. *Quick Bright Dip for Brass.*—Use strong nitric acid in sufficient quantity, dip your brass in the liquid for an instant, withdraw, and immediately immerse it first in cold water, then in boiling water, for a short time only in each bath, then allow it to dry, repeat the process if necessary. 31. *Application of Bronze Powder.*—The proper way is to varnish the article and then dust the bronze powder over it after the varnish is partly dry. 32. *Black color for Brass Work.*—Make a strong solution of nitrate of silver, in one dish and nitrate of copper, in another. Mix the two together and plunge in the brass. Now heat the brass evenly till the required degree of blackness is acquired. Unrivalled as a beautiful color on optical insruments.

GRAHAM'S QUICK BRONZING LIQUIDS.—*For immediate action on Copper, Brass, or Zinc.*—1. *Brown or Dark Bronze for Copper, Brass, or Zinc.*—Dissolve 5 drachms nitrate of iron in 1 pt. water; or, 5 drs. perchloride of iron in 1 pt. water. A black may also be obtained from 10 ozs. muriate of arsenic in 2 pts. permuriate of iron, and 1 pt. water. 2. *Brown or Red Bronzing for Brass.*—Dissolve 16 drs. nitrate of iron, and 16 drs. hyposulphate of soda, in 1 pt. water, or, 1 dr. nitric acid may be substituted for the nitrate of iron. 3. *Red Brown Bronzing for Brass.*—Dissolve 1 oz. nitrate of copper, and 1 oz. oxalic acid in 1 pt. water, brought to the boil and then cooled. 4. *Dark Brown Bronzing for Brass.*—Mix 1 oz. cyanide of potassium, and 4 drs. nitric acid, with 1 pt. water. 5. *Red Bronzing for Brass.* Mix 30 grs. tersulphate of arsenic, 6 drs. solution of pearlash, and 1 pt. water. 6. *Orange Bronzing on Brass.*—Mix 1 dr. potash solution of sulphur with 1 pt. water. 7. *Olive Green Bronze for Brass.*—Dissolve 1 pt. permuriate of iron in 2 pts. water. 8. *Slate-colored Bronzing for Brass.*—Dissolve 2 drs. sulphocyanide of potassium, and 5 drs. perchloride of iron, in 1 pt. water. 9. *Steel Grey Bronzing for Brass.*—Mix 1 oz. muriate of arsenic with 1 pt. water, and use at a heat not less than 180° Fahr. 10. *Bright Red Bronzing for Copper.* Mix 2 drs. sulphide of antimony, and 1 oz. pearlash in 1 pt. water. 11. *Dark Red Bronze for Copper.*—Dissolve 1 dr. sulphur and 1 oz. pearlash in 1 pt. water. 12. *Copper Colored Bronzing for Zinc.* Agitate the articles in a solution of 8 drs. sulphate of copper, and 8 drs. hyposulphate of soda in 1 pt. water.

COPPER PLATES OR RODS may be covered with a superficial coating of brass by exposing to the *fumes* given off by melted zinc at a light temperature. The coated plates or rods can then be rolled into thin sheets, or drawn into wire.

SOLUTION OF COPPER OR ZINC.—Dissolve 8 ozs. (Troy) cyanide of potassium, and 3 ozs. cyanide of copper or zinc, in 1 gal. of rain water. To be used at about 160° F., with a compound battery of 3 to 12 cells.

BRASS SOLUTION.—Dissolve 1 lb. (Troy) cyanide of potassium, 2 ozs. cyanide of copper, and 1 oz. cyanide of zinc, in 1 gal. of rain-water; then add 2 ozs. of muriate of ammonia. To be used at 160° F., for smooth work, with a compound battery of from 3 to 12 cells.

BRASSING IRON.—Iron ornaments are covered with copper or brass, by properly preparing the surface so as to remove all organic matter which would prevent adhesion, and then plunging them into melted brass. A thin coating is thus spread over the iron, and it admits of being polished or burnished.

ORMOLU COLORING, LACQUERS, &C.—18 KINDS.—*Ormolu Coloring.*—1. Alum, 30 parts; nitrate of potassa, 30 parts; red ochre, 30 parts; sulphate of zinc, 8 parts; common salt, 1 part; sulphate of iron, 1 part. It is applied with a soft brush. The articles are placed over a clear charcoal fire until the salts, melted and dried, assume a brown aspect. They are then suddenly cooled in nitric acid water, containing 3 per cent. of hydrochloric acid, afterwards, washed in abundance of water and dried in sawdust. 2. *To Prepare Brass Work for Ormolu Dipping.*—If the work is oily, boil it in ley, and if it is finished work, filed or turned, dip it in old acid, and it is then ready to be ormolued, but if it is unfinished and free from oil, pickle it in strong sulphuric acid, dip in pure nitric acid, and then in the old acid, after which it will be ready for ormoluing. 3. *To Repair Old Nitric Acid Ormolu Dips.*—If the work after dipping appears coarse and spotted, add vitriol till it answers the purpose: if the work after dipping appears too smooth, add muriatic acid and nitre till it gives the right appearance. The other ormolu dips should be repaired according to the receipts, putting in the proper ingredients to strengthen them. They should not be allowed to settle, but should be stirred often while using. 4. *Directions for making Lacquer.*—Mix the ingredients, and let the vessel containing them stand in the sun, or in a place slightly warmed, 3 or 4 days, shaking it frequently till gum is dissolved, after which let it settle from 24 to 48 hours, when the clear liquor may be poured off for use. Pulverized glass is sometimes used in making lacquer to carry down the impurities. 5. *Lacquer for Dipped Brass.*—Alcohol, (95 per cent.) 2 gals.; seed lac, 1 lb.; gum copal, 1 oz.; English saffron, 1 oz.; annatto, 1 oz. 6. *Lacquer for Bronzed Brass.*—To 1 pt. of the above lacquer add gamboge, 1 oz., and, after mixing it, add an equal quantity of the first lacquer. 7. *Deep Gold Colored Lacquer.*—Best alcohol, 4 ozs.; Spanish annatto, 8 ozs.; turmeric, 2 drs.; shellac, ½ oz.; red sanders, 12 grs.; when dissolved, add spts. of turpentine, 30 drops. 8. *Deep Gold Colored Lacquer for Brass not Dipped.*—Alcohol, 4 gals.; turmeric, 3 lbs.; gamboge, 3 ozs.; gum sandarac, 7 lbs.; shellac, 1½ lbs.; turpentine varnish, 1 pt. 9. *Gold Colored Lacquer, for Dipped Brass.*—Alcohol, 36 ozs.; seed lac, 6 ozs.; amber, 2 ozs.; gum gutta, 2 ozs.; red sandal wood, 24 grs.; dragon's blood, 60 grs.; oriental saffron, 36 grs.; pulverized glass, 4 ozs. 10. *Gold Lacquer, for Brass.*—Seed lac, 6 ozs.; amber or copal, 2 ozs.; best alcohol, 4 gals.; pulverized glass 4 ozs.; dragon's blood, 40 grs.; extract of red sandal wood obtained by water, 30 grs. 11. *Lacquer, for Dipped Brass.*—Alcohol, 12 gals.; seed lac, 8 lbs.; turmeric, 1 lb. to a gal. of the above mixture; Spanish saffron, 4 ozs. The saffron is to be added for bronzed work. 12. *Good Lacquer.*—Alcohol, 8 ozs.; gamboge, 1 oz.; shellac, 3 ozs.; annatto, 1 oz.; solution of 3 ozs. of seed lac in 1 pt. alcohol. When dissolved, add ½ oz. Venice turpentine, ¼ oz. dragon's blood, will make it dark. Keep it in a warm place 4 or 5 days. 13. *Pale Lacquer, for Tin Plate.*—Best alcohol, 8 ozs.; turmeric, 4 drs.; hay saffron, 2 scrs.; dragon's blood, 4 scrs.; red sanders, 1 scr.; shellac, 1 oz.; gum sandarac, 2 drs.; gum mastic, 2 drs., Canada balsam, 2 drs.; when dissolved, add spts. turpentine, 80 drops. 14. *Red Lacquer for Brass.*—Alcohol, 8 gals.; dragon's blood, 4 lbs.; Spanish annatto. 12 lbs.; gum sandarac, 13 lbs.; turpentine, 1 gal. 15. *Pale Lacquer, for Brass.*—Alcohol, 2 gals.; cape aloes, cut small, 3 ozs.; pale shellac, 1 lb.; gamboge, 1 oz. 16. *Best Lacquer, for Brass.*—Alcohol, 4 gals.; shellac, 2 lbs.; amber gum, 1 lb.; copal, 20 ozs.; seed lac, 3 lbs.; saffron to color; pulverized glass, 8 ozs. 17. *Color for Lacquer.*—Alcohol, 1 qt.; annatto, 4 ozs. 18. *Gilder's Pickle.*—Alum and common salt, each, 1 oz.; nitre 2 oz.; dissolved in water, ½ pt. Used to impart a rich yellow color to gold surfaces. It is best largely diluted with water.

TO REDUCE OXIDE OF ZINC.—The oxide may be put in quantities of 500 or 600 lbs. weight into a large pot over the fire; pour a sufficient quantity of muriatic acid over the top, to act as a flux, and the action of the fire will melt the dross, when the pure metal will be found at the bottom of the pot.

TO SEPARATE TIN FROM LEAD.—If the lead and tin are in solution, precipitate the former by sulphuric acid, and the latter with sulphuretted hydrogen gas. In an alloy the lead will dissolve in nitric acid, leaving the tin as an oxide.

TO FROST AND CLOUD SMALL BRASS-WORK.—Scour the brass thoroughly with strong ley, and hold the work against a circular scratch-brush of fine brass wire, secured in a lathe and driven at a high speed, as in frosting watch plates, see page 326; for *clouding* brass work, see page 515.

CEMENT FOR BRASS AND WOOD.—The best cement for this purpose is a glue composed of best gelatine, 1 part; glacial acetic acid, 1 part. Soak the gelatine in cold water until it has swollen up and become quite soft. Throw away the water and dissolve the gelatine in the acetic acid, applying gentle heat if necessary.

YELLOW AND LIGHT RED BRONZE.—1. Copper bronze powder, 1 oz.; mix thoroughly with japanner's gold size, adding turpentine during its use sufficient to keep it at the consistency of cream. Mix with a pallet knife on glass or porcelain; if made too thin it is liable to be removed by the brush as fast as put on. Apply with a soft brush. 2. A *gold bronze color* is obtained by using ½ gold bronze and ½ copper bronze powder, or other beautiful colors may be obtained by varying the mixtures. 3. A *Dark Brown Bronze* is produced by the addition of burnt umber to the above named ingredients. 4. A *Dark Green Bronze* is obtained by mixing green bronze and terra verte with gold size, adding as much ivory black as may be required to impart the depth of tint required. Finish with a coat of fine shellac varnish. 4. For a *Verde Antique* shade, apply the bronze coat as above, varnish with shellac, allow it to get firm and hard; then coat the depressed parts with gold size thinned with turpentine. Previous to drying, dust the article with dry paint, of light yellow or blue color, and gently remove all that can be easily rubbed off with a rag moistened with turpentine. 6. *Brown Bronze for Hardware.*—Muriatic acid, 2 lbs.; iron scales, 2 lbs.; arsenic, 2 oz.; zinc (a solid mass to be kept in only when the solution is in use), 1 lb. 4 oz. Previous to immersion in the bath, cleanse the articles thoroughly in acid pickle. 7. *Green Bronze on Hardware.*—Apply a varnish composed of ground tin or bronze powder mixed up with honey in gum water, then wash with a solution of vinegar, 1 pt; spts. hartshorn, 1 oz.; sal ammoniac, ½ oz.; salt, ½ oz. Place the articles in the sun for a day or two; then give them another coat. 8. *Black Stain on Brass.*—Water, 80 parts; hydrochloric acid, 4 parts; sulphuric acid, 1 part. 9. *Another.*—Hydrochloric acid, 12 parts; arsenic by weight, 4 parts; apply brighten, dry, and lacquer.

MAGIC POLISH FOR BRASS.—Add to sulphuric acid half its bulk of pulverized bichromate of potash; dilute with an equal weight of water, and apply well to the brass, swill it well immediately in water, wipe dry, and polish with pulverized rotten stone.

TO BRONZE POLISHED STEEL.—Methylated spirits, 1 pt.; gum shellac, 4 oz.; gum benzoin, ½ oz. Set the bottle in a warm place, with occasional agitation. When dissolved, decant the clear part for fine work, and strain the dregs through muslin. Now take 4 oz. powdered bronze green, varying the color with yellow ochre, red ochre, and lampblack, as may be desired. Mix the bronze powder with the above varnish in quantities to suit, and apply to the work after previously cleansing and warming the articles, giving them a second coat and touching off with gold powder if required, previous to varnishing.

Dead Black for the Brass Work of Lenses.—The brass work must be made quite clean and the following preparation applied with a camel's-hair pencil: bichlorid of platinum, 4 drams; nitrate of silver, 1 grain; water, 6 oz. When you get the right depth, wash with clean water, dry, and finish with plumbago.

To Solder German Silver.—Dissolve granulated zinc in spirits of salts in an earthen vessel. Cleanse the part to be soldered, and apply the spirits of salts. Next put a piece of pewter solder on the joint and apply the blow-pipe to it. Melt German silver, 1 part, and zinc in thin sheets, 4 parts, then powder it for solder.

Silvery Appearance on Iron Wire.—Suspend a piece of zinc in hydrochloric acid, and immerse the wire in it. Next, place it in contact with a strip of zinc, in a bath of 2 parts of tartaric acid dissolved in 100 parts of water, to which is added 3 parts of tin salts and 3 parts of soda. Let it remain two hours in the bath; then brighten by polishing or drawing through a drawing iron.

Permanent Brassing on Iron Wire.—Place the wire, thoroughly cleaned, in a solution of sulphate of copper, when it immediately becomes covered with a thin film of copper; now cover with a paste of pure oxide of tin, and heat hot enough to fuse the copper.

To Clean Smooth Tarnished Brass.—Use a saturated solution of oxalic acid in water; apply with a stiff roll of clean flannel briskly used; then rinse the object in plenty of water to remove the acid. After drying with a warm cloth, polish up with chamois-skin and prepared chalk or the finest whiting.

To Clean Embossed or Undercut Brass.—Boil the objects in a strong solution of caustic soda or ley, and immerse them in a mixture of hydrochloric acid, 6 parts; water, 2 parts; and nitric acid, 1 part, until they become covered with a dark deposit. Take them from the mixture and remove the black matter with a fine scratch-brush: when thus cleansed, swill in hot water and dry in hot saw dust. A fine orange-yellow tinge may be given to the brass by substituting an equivalent weight of powdered alum for the nitric acid in the solution.

Dead Appearance on Brass.—Immerse the objects in a mixture of nitric acid, 200 parts; sulphuric acid, sp. gr. 1.845, 100 parts; common salt, 1 part; sulphate of zinc, 2 parts. Rinse thoroughly; this imparts the dead appearance styled *mat*, by the French. For large work use nitric acid, 3 parts; sulphuric acid, 1 part; water, 1 part; sulphate of zinc, ½ part. Repeat dipping and rinsing the objects till the proper color is brought out.

To Lacquer Brass.—For *flat* work, cleanse thoroughly by boiling the articles in strong potash water; if you wish to heighten the color of the brass, dip it in hydrochloric acid, rinse well in cold and hot water alternately, using a fine brush to remove any blackness, and dry in hot sawdust, burnishing afterwards if desired. Place the work on an iron plate, kept at a low heat, and pass the lacquer regularly and rapidly over the surface with a good sized fine camel's-hair brush, keeping the iron plate warm until the work is dry *Small circular* work, after being well cleansed, and burnished if need be, and slightly heated in a stove or over a charcoal fire, should have the lacquer thinly and evenly applied while in motion in the lathe, holding a charcoal brazier under the work for a short time, to avoid cooling too soon.

CONTRAST COLORS FOR PAINTING MACHINERY.—1. Deep blue and golden brown; 2, Black and warm brown; 3, Chocolate and light blue; 4, Violet and light rose color; 5, Violet and pale green; 6, Deep red and gray; 7, Claret and buff; 8, Maroon and warm green; 9, chocolate and peagreen; 10, Deep blue and pink; 11, Black and warm green; 13, Maroon and deep blue.

VARNISH FOR LOOM HARNESS.—Linseed oil, 2 gals.; gum shellac, 2¼ lbs.; red lead, 1 lb.; umber, 1½ lbs.; litharge, 2 lbs.; sugar of lead, 1½ lbs. Mix and thoroughly incorporate together.

WATER-PROOFING FOR NETS AND FISHING LINES.—Soak the nets or lines in a mixture of 2 parts boiled linseed oil and 1 part gold size; expose to the air, and dry.

WINTER FISHING ON THE WESTERN LAKES.—A small portable house is erected on large runners, like those of a sled, with a hole cut in the centre of the floor. This house is moved to any desired spot; a hole is cut in the ice, so as to be directly under the aperture in the floor; the lines are dropped through the hole, and the fish are drawn in while the fishermen are seated by a warm stove.

PAINT FOR METALS, PROOF AGAINST HOT WATER.—Prepare the metal by cleaning it with turpentine, ley, or benzine; then apply two thin coats of a mixture of white lead, spts. turpentine and carriage varnish, and follow at once with a thick coat of carriage varnish and white lead.

DRAUGHTMEN'S COLORS FOR MECHANICAL DRAWING.—The following are the names of different materials, together with the pigments used to represent them: 1, *Red brick*, Indian red; 2, *Yellow brick*, Indian yellow or cadmium, tinged with white; 3, *Wrought iron*, Prussian blue or cobalt; 4, *Cast iron*, Paine's gray and a little India ink, or Prussian blue and India ink; 5, *Steel*, a purple color by the admixture of crimson lake and Prussian blue; 6, *Gun metal or brass*, gamboge or yellow cadmium; 7, *Copper*, Indian red mixed with a little lake; 8, *Wood*, burnt umber; 9, *Water*, broken, irregular straight lines, with liquid copperas; 10, *Stone color*, Chinese white and India ink, tinted with yellow.

TRACING PAPER, TO STAND WASHING.—Saturate writing paper with benzine, and follow at once with a slight coat of the following varnish: Boiled bleached linseed oil, 20 oz.; oxide of zinc., 5 ozs.; lead shavings, 1 oz.; Venice turpentine, ½ oz. Boil all for 8 hours, cool, and add gum-copal 5 ozs., gum sandarac ½ part.

TRACING PAPER.—Dissolve castor oil in strong alcohol and apply the mixture to the paper with a sponge. The alcohol will volatilize, leaving the paper dry. Proceed to finish your tracing, and then you may, if you wish to do so, restore the paper to its original state, by immersion in strong alcohol, thereby absorbing the castor oil from the paper.

TO SOLDER WITHOUT HEAT.—Brass filings, 2 oz.; steel filings, 2 oz.; fluoric acid, ¼ oz. Put the filings in the acid, and apply the solution to the parts to be soldered, after thoroughly cleaning the parts in contact; then dress together. Do not keep the fluoric acid in glass bottles, but in lead or earthen vessels.

EASY SOLDERING OF BRASS.—Cut a piece of tin foil the size of the surface to be soldered; then pass over the surface a solution of sal ammoniac for a flux, place the tin foil between the pieces, and apply a hot iron until the foil is melted.

TO TIN COPPER AND BRASS.—Boil 6 lbs. cream of tartar and 4 gals. of water and 8 lbs. of grain tin or tin shavings. After the material has boiled a sufficient time, the articles to be tinned are put therein and the boiling continued, when the tin is precipitated on the goods in metallic form.

MIXTURE FOR SILVERING.—Dissolve 2 ozs. of silver with 3 grs. of corrosive sublimate; add tartaric acid, 4 lbs.; salt, 8 qts.

TO SEPARATE SILVER FROM COPPER.—Mix sulphuric acid, 1 part; nitric acid, 1 part; water, 1 part; boil the metal in the mixture till it is dissolved, throw in a little salt to cause the silver to subside.

TO WRITE IN SILVER.—Mix 1 oz. of the finest pewter or block tin, and 2 ozs. of quicksilver together till both become fluid, then grind it with gum water, and write with it. The writing will then look as if done with silver.

TINNING ACID, FOR BRASS OR ZINC.—Muriatic acid, 1 qt.; zinc, 6 ozs. To a solution of this, add water, 1 qt. ; sal-ammoniac, 2 ozs.

TO CLEAN AND POLISH BRASS.—Wash with alum boiled in strong lye, in the proportion of an ounce to a pint; afterwards rub with strong tripoli. Not to be used on gilt or lacquered work.

BRONZE PAINT, FOR IRON OR BRASS.—Chrome green, 2 lbs.; ivory black, 1 oz.; chrome yellow, 1 oz.; good japan, 1 gill; grind all together, and mix with linseed oil.

TO BRONZE IRON CASTINGS.—Cleanse thoroughly, and afterwards immerse in a solution of sulphate of copper, when the castings will acquire a coat of the latter metal. They must be then washed in water.

REMOVING ZINC AND IRON FROM PLUMBERS' SOLDER.—Digest the metal in grains in diluted sulphuric acid. The acid will dissolve the zinc first, the iron next, and all traces of these metals by subsequent washing.

TINNING CAST IRON.—Pickle your castings in oil of vitriol; then cover or immerse them in muriate of zinc (made by putting a sufficient quantity of zinc in some spirit of salt): after which dip it in a melted bath of tin or solder.

SILVERING BY HEAT.—Dissolve 1 oz. silver in nitric acid; add a small quantity of salt; then wash it and add sal-ammoniac, or 6 ozs. of salt and white vitriol; also ¼ oz. corrosive sublimate; rub them together till they form a paste; rub the piece which is to be silvered with the paste; heat it till the silver runs, after which dip it in a weak vitriol pickle to clean it.

ZINCING.—Copper and brass vessels may be covered with a firmly adherent layer of pure zinc by boiling them in contact with a solution of chloride of zinc, pure zinc turnings being at the same time present in considerable excess.

TO CLOUD METAL WORK.—Metal work may be clouded by putting a piece of fine emery paper under the thumb or finger and working it over a surface of the metal with a spiral motion.

SILVERING POWDER.—Nitrite of silver and common salt, of each 30 grs.; cream tartar, 3½ drs.; pulverize finely and bottle for use Unequalled for polishing copper and plated goods.

TO CLEAN AND POLISH BRASS.—Oil of vitriol, 1 oz.; sweet oil, ½ gill; pulverized rotten stone, 1 gill; rain water, 1½ pts.; mix all and shake as used. Apply with a rag and polish with buckskin or all woolen. Rotten stone, followed by Paris white and rouge is very good also.

PASTE FOR CLEANING METALS.—Take oxalic acid, 1 part; rotten stone, 6 parts; mix with equal parts of train oil and spts. turpentine to a paste.

TO PREVENT IRON OR STEEL FROM RUSTING.—Warm your iron or steel till you cannot bear your hands on it without burning yourself, then rub it with new and clean white wax. Put it again to the fire till it has soaked in the wax. When done rub it over with a piece of serge. This prevents the metal from rusting afterwards.

BRONZING LIQUIDS FOR TIN CASTINGS.—Wash them over, after being well cleansed and wiped, with a solution of 1 part of sulphate of iron, and 1 of sulphate of copper, in 20 parts of water; afterwards, with a solution of 4 parts verdigris in 11 of distilled vinegar; leave for an hour to dry and then polish with a soft brush and colcothar.

FANCY COLORS ON METALS.—1. Dissolve 4 ozs. hypo-sulphite of soda, 1½ pts. of water, and then add a solution of 1 oz. acetate of lead in 1 oz. water. Articles to be colored are placed in the mixture, which is then gradually heated to the boiling point. This will give iron the color of blue steel, zinc becomes bronze, and copper or brass becomes, successively, yellowish. red, scarlet, deep blue, light blue, bluish white, and finally white, with a tinge of rose. 2. By replacing the acetate of lead in the solution by sulphate of copper, brass becomes, first, of a fine rosy tint, then green, and lastly, of an irridescent brown color.

COATING IRON CASTINGS WITH GOLD OR SILVER.—The articles to be gilded are well cleaned and boiled in a porcelain vessel, together with 12 parts of mercury, 1 of zinc, 2 of iron vitriol, 1½ of muriatic acid of 1.2 specific gravity, and 12 parts of water; in a short time a layer of mercury will deposit upon the iron, and upon this the gold amalgam may be uniformly distributed. Iron to be silvered is first provided with a coating of copper, upon which the silver is applied either by means of amalgam or silver leaf.

BRUNSWICK BLACK FOR GRATES, &C.—Asphaltum, 5 lbs.; melt, and add boiled oil, 2 lbs.; spirits of turpentine, 1 gal. Mix.

BRONZE PAINT FOR IRON.—Ivory black, 1 oz ; chrome yellow, 1 oz.; chrome green, 2 lbs.; mix with raw linseed oil, adding a little japan to dry it, and you have a very nice bronze green. If desired, gold bronze may be put on the prominent parts, as on the tips or edges of an iron railing where the paint is not quite dry, using a piece of velvet or plush to rub on the bronze.

TINNING IRON.—Cleanse the metal to be tinned, and rub with a coarse cloth, previously dipped in hydrochloric acid (muriatic acid,) and then rub on French putty with the same cloth. French putty is made by mixing tin filings with mercury.

TINNING.—1. Plates or vessels of brass or copper boiled with a solution of stannate of potassa, mixed with turnings of tin, become, in the course of a few minutes, covered with a firmly attached layer of pure tin. 2. A similar effect is produced by boiling the articles with tin-filings and caustic alkali, or cream of tartar. In the above way, chemical vessels made of copper or brass may be easily and perfectly tinned.

New Tinning Process.—Articles to be tinned are first covered with diluted sulphuric acid, and, when quite clean, are placed in warm water, then dipped in a solution of muriatic acid, copper, and zinc, and then plunged into a tin bath to which a small quantity of zinc has been added. When the tinning is finished, the articles are taken out, and plunged into boiling water. The operation is completed by placing them in a very warm sand-bath. This last process softens the iron.

To Recover the Tin from Old Britannia.—Melt the metal, and while hot sprinkle sulphur over it; and stir it up for a short time, this burns the other metals out of the tin, which may then be used for any purpose desired.

Kustitien's Metal for Tinning.—Malleable iron, 1 lb., heat to whiteness; add 5 ozs. regulus of antimony, and Molucca tin, 24 lbs.

Galvanizing Iron.—The iron plates are first immersed in a cleansing bath of equal parts of sulphuric or muriatic acid and water used warm; they are then scrubbed with emery or sand, to clean them thoroughly and detach all scales if any are left; after which they are immersed in a "preparing bath" of equal parts of saturated solutions of chloride of zinc and chloride of ammonium, from which bath they are directly transferred to the fluid "metallic bath," consisting, by weight of 640 lbs. zinc to 106 lbs. of mercury, to which are added from 5 to 6 ozs. of sodium. As soon as the iron has attained the temperature of this hot fluid bath, which is 680° Fahr., it may be removed, and will then be found thoroughly coated with zinc. A little tallow on the surface of the metallic bath will prevent oxidation.

Preventing of Rust.—Cast iron is best preserved by rubbing it with blacklead. For polished work, varnish with wax dissolved in benzine, or add a little olive oil to copal varnish and thin with spts. turpentine. To remove deep-seated rust, use benzine, and polish off with fine emery, or use tripoli, 2 parts; powdered sulphur, 1 part. Apply with soft leather. Emery and oil is also very good.

To Purify Zinc.—Pure zinc may be obtained by precipitating its sulphate by an alkali, mixing the oxide thus produced with charcoal powdered, and exposing the mixture to a bright red heat in a covered crucible in which the pure metal will be found as a button at the bottom when cold.

Transparent Blue for Iron or Steel.—Demar varnish, ½ gal.; fine ground Prussian blue, ½ oz.; mix thoroughly. Makes a splendid appearance. Excellent for bluing watch-hands.

Lead Shot are cast by letting the metal run through a narrow slit into a species of colander at the top of a lofty tower; the metal escapes in drops, which, for the most part, assume the spherical form before they reach the tank of water into which they fall at the foot of the tower, and this prevents their being bruised. They are afterwards riddled or sifted for size, and afterwards churned in a barrel with black lead.

Black Bronze on Iron or Steel.—The following mixtures are employed: liquid No. 1. A mixture of bichloride of mercury and sal-ammoniac. No. 2. A mixture of perchloride of iron, sulphate of copper, nitric acid, alcohol and water. No. 3. Perchloride and protochloride of mercury mixed with nitric acid, alcohol and water. No. 4. A weak solution of sulphide of potassium. Clean your metal well and apply a slight coat of No. 1 with a sponge; when quite dry, apply another coat. Remove the resulting crust of oxide with a wire brush, rub the metal with a clean rag, and repeat this operation after each application of these liquids. Now apply several coats of No. 2, and also of No. 3, with a full sponge; then, after drying for ten minutes, throw the pieces of metal into water heated near the boiling point; let them remain in the water from 5 to 10 minutes, according to their size. After being cleaned, cover again with several coatings of No. 3, afterwards with a strong coating of No. 4; then again immerse in the bath of hot water. Remove from the bath dry, and wipe the pieces with carded cotton dipped in liquid No. 3, diluted each time with an increased quantity of water; then rub and wipe them with a little olive oil; again immerse in a water bath heated to 140° Fahr., remove them, rub briskly with a woolen rag, and lastly, with oil. Unequalled for producing a beautiful glossy black on gun-barrels, steel, iron, &c.

PAINT FOR SHEET IRON SMOKE PIPE.—Good varnish, ½ gallon; boiled linseed oil ½ gallon; add red lead sufficient to bring to the consistency of common paint. Apply with a brush. Applicable to any kind of iron work exposed to the weather.

TO COPPER THE SURFACE OF IRON, STEEL, OR IRON WIRE.—Have the article perfectly clean, then wash with the following solution, and it presents at once a coppered surface. Rain water, 3 lbs.; sulphate of copper, 1 lb.

TO JOIN BROKEN LEAD PIPES DURING PRESSURE OF WATER.—It frequently happens that lead pipes get cut or damaged when the water is running at a high pressure, causing much trouble to make repairs, especially if the water cannot be easily turned off. In this case plug both ends of the pipe at the break, place a small pile of broken ice and salt around them. In a few minutes the water in the pipe will freeze ; next, withdraw the plugs and insert a new piece of pipe; solder perfectly, thaw the ice, and it will be all right.

TO REPAIR SMALL LEAKS IN LEAD PIPES.—Place the point of a dull nail over the leak, give it a gentle tap with a hammer and the flow will cease.

TO PREVENT CORROSION IN LEAD PIPES.—Pass a strong solution of sulphide of potassium and sodium through the inside of the pipe at a temperature of 212°, and allow it to remain about 10 or 15 minutes. It converts the inside of the pipe into an insoluble sulphide of lead and prevents corrosion.

TO BEND COPPER OR BRASS TUBES.—Run melted lead or resin into your pipe till full, and you may then bend it gradually into any desired shape ; the pipe may then be heated and the lead or resin melted and run out.

TO JOIN LEAD PLATES.—The joints of lead plates for some purposes are made as follows : The edges are brought together, hammered down into a sort of channel cut of wood and secured with a few tacks. The hollow is then scraped clean with a scraper, rubbed over with candle grease, and a stream of hot lead is poured into it, the surface being afterwards smoothed with a red hot plumber's iron.

TO JOIN LEAD PIPES.—Widen out the end of one pipe with a taper wood rift, and scrape it clean inside; scrape the end of the other pipe outside a little tapered, and insert it in the former: then solder it with common lead solder as before described; or, if it requires to be strong, rub a little tallow over, and cover the joint with a ball of melted lead, holding a cloth (2 or 3 plies of greased bedtick) on the under side; and smoothing over with it and the plumber's iron.

TINNING INTERIOR OF LEAD PIPES.—This invention consists in applying a flux of grease or muriate of zinc or any other flux that will protect the lead from oxidation, and insure a perfect coating of tin, when the tin is poured through the pipe or the pipe dipped into the bath of tin; after the lead pipe has been made, place the same in a vertical or nearly vertical position, and pass down through the same a strong cord, to which a weight is attached to draw the cord through the pipe; and at or near the other end of the cord, a sponge or piece of other porous or elastic material, is attached of a size to fill the pipe, and of any desired length, say 6 inches more or less. The sponge or porous wad being saturated with the flux, is drawn through the pipe, and by its length ensures the covering of the entire inside surface of the inside of the pipes with the flux, so that the melted tin, subsequently applied, will adhere to all parts with uniformity and firmness.

TO PREVENT LEAD EXPLODING.—Many mechanics have had their patience sorely tried when pouring melted lead around a damp or wet joint to find it explode, blow out, or scatter from the effects of steam generated by the heat of the lead. The whole trouble may be stopped by putting a piece of resin the size of the end of a man's thumb into the ladle and allowing it to melt before pouring. Simple as the secret is, many have paid $20 for the privilege of knowing it.

TABULAR VIEW OF THE PROCESSES OF SOLDERING.—*Hard soldering.* The hard solders most commonly used are the spelter solders, and silver solders. The general flux is borax, marked A on the table, and the modes of heating are the naked fire, the furnace or muffle, and the blow pipe, marked *a*, *b*, *g*, applicable to nearly all metals less fusible than the solders; the modes of treatment are nearly similar throughout. *Note.*—The examples commence with the solders (the least fusible first) followed by the metals for which they are commonly employed. Fine gold, laminated and cut into shreds, is used as the solder for joining chemical vessels made of platinum. Silver is by many considered as much the best solder for German silver, for silver solders, see Jewellers' alloys Copper cut in shreds, is sometimes similarly used for iron. Gold solders laminated are used for gold alloys, see 333 and 338. Spelter solders, granulated whilst hot, are used for iron, copper, brass, gun metals, German silver, &c., see below. Silver solders laminated, are employed for all silver works and for common gold work, also for German silver, gilding metals, iron, steel, brass, gun metal, &c., when greater neatness is required than is obtained from spelter solder.

White or button solders, granulated, are employed for the white alloys called button metals; they were introduced as cheap substitutes for silver solder. *Hard Soldering.*—Applicable to nearly all the metals; the modes of treatment are very different. The soft solder mostly used is two parts tin and one of lead; sometimes, from motives of economy, much more lead is employed, and 1½ tin to 1 lead is the most fusible of the group, unless bismuth is used. The fluxes B to G, and the modes of heating, *a* to *i*, are all used with the soft solders.

Note.—The examples commence with the metals to be soldered. Thus in the list, zinc, 8, *c*, *f*, implies, that zinc is soldered with No. 8 alloy, by the aid of the muriate or chloride of zinc, and the copper bit. Lead, 4 to 8, F, *d*, *e*, implies that lead is soldered with alloys varying from No. 4 to 8, and that it is fluxed with tallow, the heat being applied by pouring on melted solder, and the subsequent use of the heated iron, not tinned; but in general one only of the modes of heating is selected, according to circumstances. Iron, cast-iron and steel, 8, B, D, if thick, heated by *a*, *b*, or *c*, and also by *g*. Tinned iron 8, G, D, *f*. Gold and silver are soldered with pure tin, or else with 8, E, *a*, *g*, or *h*. Copper and many of its alloys, namely brass, gilding metal, gun metal, &c., 8, B, C, D; when thick, heated by *a*, *b*, *c*, *e*, or *g*, when thin, by *f*, or *g*. Speculum metal, 8, B, C, D, the heat should be cautiously applied; the sand bath is perhaps the best mode. Zinc, 8, C, *f*. Lead and lead pipes, or ordinary plumber's work, 4 to 8 F, *d*, or *e*. Lead and tin pipes, 8, D, and G, mixed, *g*, and also *f*. Britannia metal, C, D, *g*. Pewters, the solders must vary in fusibility according to the fusibility of the metal, generally G, and *i*, are used, sometimes, also G, and *g* or *f*. Lead is united without solder by pouring on red hot lead, and employing a red hot iron, *d*. *e*. Iron and brass are sometimes burned, or united by partial fusion, by pouring very hot metal over or around them.

ALLOYS AND THEIR MELTING HEATS.

No. 1	1	Tin	25	Lead	258	Fahr.
2	1	"	10	"	541	"
3	1	"	5	"	511	"
4	1	"	3	"	482	"
5	1	"	2	"	441	"
6	1	"	1	"	370	"
7	1½	"	1	"	334	"
8	2	"	1	"	340	"
9	3	"	1	"	356	"
10	4	"	1	"	365	"
11	5	"	1	"	378	"
12	6	"	1	"	381	"

13	4	Lead	4	Tin	1	Bismuth	320	Fahr.
14	3	"	3	"	1	"	310	"
15	2	"	2	"	1	"	292	"
16	1	"	1	"	1	"	254	"
17	2	"	1	"	2	"	236	"
18	3	"	5	"	2	"	202	"

FLUXES.

A. Borax.
B. Sal-am. or mur. of amm.
C. Muriate or chlor. of zinc.
D. Common resin.
E. Venice turpentine.
F. Tallow.
G. Gallipoli oil, or common sweet oil.

MODES OF APPLYING HEAT.

a. Naked fire.
b. Hollow furnace or muffle.
c. Immersion in melted solder.
d. Melted solder or metal poured on.
e. Heated iron, not tin'd.
f. Heated copper tool, tinned.
g. Blow Pipe flame.
h. Flame alone, generally alchohol.
i. Stream of heated air.

CHEAP MOSQUITO BAR.—Drop a small quantity of petroleum or kerosene oil on a piece of cotton, squeeze out the excess as much as possible, then rub the cotton over the face, hands, &c., and these pestiferous insects will not alight where the scent has been left.

SOLDERS 32 KINDS.—1. *Plumbers' solder.*—Lead, 2 parts; tin, 1 part. 2. *Tinmen's solder.*—Lead, 1 part; tin, 1 part. *Zinc solder.* —Tin, 1 part; lead, 1 to 2 parts. 4. *Pewter solder.*—Lead, 1 part; bismuth, 1 to 2 parts. 5 *Spelter solder.*—Equal parts copper and zinc. 6. *Pewterers' soft solder.*—Bismuth, 2; lead, 4; tin, 3 parts. 7. *Another.*—Bismuth, 1; lead, 1; tin, 2 parts. 8. *Another pewter solder.* —Tin, 2 parts; lead, 1 part. 9. *Glazier's Solder*—Tin, 3 parts; lead, 1 part. 10. *Solder for Copper.*—Copper, 10 parts; zinc, 9 parts. 11. *Yellow Solder for Brass or Copper.*—Copper, 32 lbs.; zinc, 29 lbs.; tin, 1 lb. 12. *Brass Solder.*—Copper, 61.25 parts; zinc 38.75 parts. 13. *Brass Solder Yellow and easily fusible.*—Copper, 45; zinc, 55 parts. 14. *Brass solder, White.*—Copper, 57.41 parts; tin, 14.60 parts; zinc, 27.99 parts. 15. *Another Solder for Copper.*—Tin, 2 parts; lead, 1 part. When the copper is thick, heat it by a naked fire; if thin, use a tinned copper tool. Use muriate or chloride of zinc, as a flux. The same solder will do for *iron, cast iron,* or *steel;* if the pieces are thick, heat by a naked fire, or immerse in the solder. 16. *Black Solder.*—Copper, 2; zinc, 3; tin, 2 parts. 17. *Another.*—Sheet brass, 20 lbs.; tin, 6 lbs.; zinc, 1 lb. 18. *Cold Brazing without Fire or Lamp.*—Fluoric acid, 1 oz.; oxy muriatic acid, 1 oz.; mix in a lead bottle. Put a chalk mark each side where you want to braze. This mixture will keep about 6 months in one bottle. 19. *Cold Soldering without Fire or Lamp.*—Bismuth, ¼ oz.; quicksilver, ¼ oz.; block tin filings, 1 oz.; spirits salts, 1 oz.; all mixed together. 20. *To Solder Iron to Steel or either to Brass.*—Tin, 3 parts; copper, 39½ parts; zinc, 7½ parts. When applied in a molten state it will firmly unite metals first named to each other. 21. *Plumbers' Solder.*—Bismuth, 1; lead, 5; tin, 3 parts; is a first class composition. 22. *White Solder for raised Britannia Ware.*—Tin, 100 lbs.; hardening, 8 lbs.; antimony, 8 lbs. 23. *Hardening for Britannia.*—(To be mixed separately from the other ingredients). Copper, 2 lbs.; tin, 1 lb. 24. *Best soft solder for cast Britannia Ware.*—Tin, 8 lbs.; lead, 5 lbs. 25. *Bismuth solder.* Tin, 1; lead, 3; bismuth, 3 parts. 26. *Solder for Brass that will stand Hammering.*—Brass, 78.26 parts; zinc, 17.41 parts; silver, 4.33 parts; add a little chloride of potassium to your borax for a flux. 27 *Solder for Steel Joints.*—Silver, 19 parts; copper, 1 part; brass, 2 parts. Melt all together. 28. *Hard Solder.*—Copper, 2 parts; zinc, 1 part. Melt together. 29. *Solder for Brass.*—Copper, 3 parts; zinc, 1 part; with borax. 30. *Solder for Copper.*—Brass, 6 parts; zinc, 1 part; tin, 1 part; melt all together well, and pour out to cool. 31. *Solder for Platina.*—Gold with borax. 32. *Solder for Iron.*—The best solder for iron is good tough brass with a little borax.

N. B. In soldering, the surfaces to be joined are made perfectly clean and smooth, and then covered with sal ammoniac, resin or other flux, the solder is then applied, being melted on and smoothed over by a tinned soldering iron.

SOLDERING FLUID.—Take 2 oz. muriatic acid; add zinc till bubbles cease to rise; add ½ teaspoonful of sal-ammoniac.

BLACK VARNISH FOR COAL BUCKETS.—Asphaltum, 1 lb.; lamp-black, ¼ lb.; resin, ½ lb.; spirits of turpentine, 1 qt. Dissolve the asphaltum and resin in the turpentine, then rub up the lamp-black with linseed oil, only sufficient to form a paste, and mix with the othser. Apply with a brush.

SIZES OF TIN-WARE OF DIFFERENT KINDS.

(*For Diameters. &c. of Circles see Tables.*)

		Diam. of bot.	Diam. of top.	Heig't
		inches	inches	inches
DIPPERS.	$\frac{1}{2}$ gal.	4	$6\frac{1}{3}$	4
"	1 pt.	$3\frac{3}{4}$	$4\frac{1}{4}$	$2\frac{3}{4}$
COFFEE POTS.	1 gal.	7	4	$8\frac{1}{2}$
" "	3 qts.	6	$3\frac{1}{3}$	$8\frac{1}{2}$
PANS.	20 qts.	13	$19\frac{1}{2}$	8
"	16 qts.	$11\frac{1}{4}$	18	$6\frac{1}{4}$
"	14 qts.	$9\frac{1}{4}$	$15\frac{1}{4}$	$6\frac{1}{4}$
"	10 qts.	11	$14\frac{3}{4}$	$4\frac{1}{8}$
"	6 qts.	9	$12\frac{3}{4}$	4
"	2 qts.	6	9	$3\frac{3}{4}$
"	3 pts.	$5\frac{3}{4}$	$8\frac{1}{4}$	$2\frac{3}{4}$
"	1 pt.	4	$6\frac{1}{4}$	$2\frac{3}{4}$
PIE PANS		$7\frac{1}{3}$	9	$1\frac{3}{4}$
LARGE WASH BOWL		$5\frac{3}{4}$	11	5
SMALL WASH BOWL		$5\frac{1}{3}$	$9\frac{1}{3}$	5
MILK STRAINER		$5\frac{1}{2}$	$9\frac{1}{2}$	$3\frac{1}{2}$
PAILS AND DISH KETTLES	14 qts.	9	13	9
" " "	10 qts.	7	$11\frac{1}{3}$	9
" " "	6 qts.	$5\frac{1}{2}$	$9\frac{1}{4}$	$6\frac{1}{2}$
" " "	2 qts.	4	$6\frac{1}{4}$	4
COLANDER.		$5\frac{3}{4}$	11	5
MEASURES for Druggists, Beer, &c.	2 gal.	6	$10\frac{1}{3}$	$8\frac{2}{3}$
	1 gal.	$8\frac{3}{4}$	$3\frac{3}{4}$	$7\frac{1}{2}$
	$\frac{1}{2}$ gal.	$6\frac{2}{3}$	$3\frac{1}{3}$	6
	1 qt.	$5\frac{1}{3}$	$2\frac{1}{2}$	$4\frac{7}{8}$
	1 pt.	4	2	4
	$\frac{1}{2}$ pt.	$3\frac{3}{4}$	$1\frac{3}{4}$	$3\frac{1}{8}$
MEASURES of other forms.	1 gal.	$6\frac{1}{8}$	$5\frac{1}{2}$	$9\frac{1}{4}$
	$\frac{1}{2}$ gal.	$4\frac{7}{8}$	4	8
	1 qt.	4	$3\frac{1}{3}$	$5\frac{3}{4}$
	1 pt.	$3\frac{3}{4}$	$2\frac{1}{3}$	$4\frac{1}{2}$
	$\frac{1}{2}$ pt.	$2\frac{7}{8}$	$2\frac{3}{8}$	$3\frac{1}{8}$

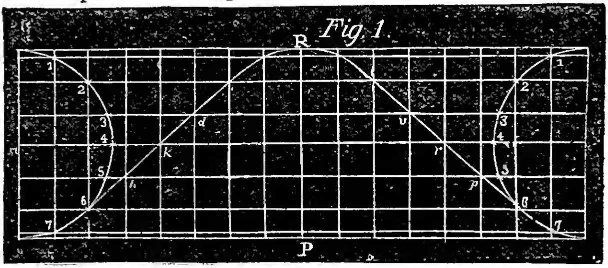
TIN CANS.—SIZE OF SHEET, FOR FROM 1 TO 100 GALLONS.

For 1 gallon,	7 by 20 inches.	For 25 gallons,	30 by 56 inches.
$3\frac{1}{2}$ "	10 by 28 "	40 "	36 by 63 "
5 "	12 by 40 "	50 "	40 by 70 "
6 "	14 by 40 "	75 "	40 by 84 "
10 "	20 by 42 "	100 "	40 by 98 "
15 "	30 by 42 "		

This includes all the laps, seams, &c., which will be found sufficiently correct for all practical purposes.

PATENT LUBRICATING OIL.—Water, 1 gal.; clean tallow, 3 lbs.; palm oil, 10 lbs.; common soda, $\frac{1}{2}$ lb. Heat the mixture to about 210° Fahr.; stir well until it cools down to 70° Fahr., when it is fit for use.

Explanation of Diagrams for Sheet Metal Workers, &c.



RIGHT-ANGLED ELBOW.--*Fig.* 1.—Strike out the length and depth of the elbow as shown in the above diagram, drawing semicircles at the end as exhibited above. Then draw seven horizontal lines as shown extending along the small figures. Divide the circumference or length into 16 equal parts by drawing 15 vertical lines as in diagram. Now draw a line from *h* to *k* and *d*; directly opposite draw another line along the letters *v r p*; for the top sweep set the compasses on the fourth line from the bottom, and sweep two of the spaces; and do the same at the corner. On space for the two remaining sweeps set the compasses so as to intersect in the three corners of the spaces designated by the small cross marks. The drawing does not include seams or laps, these must be added.

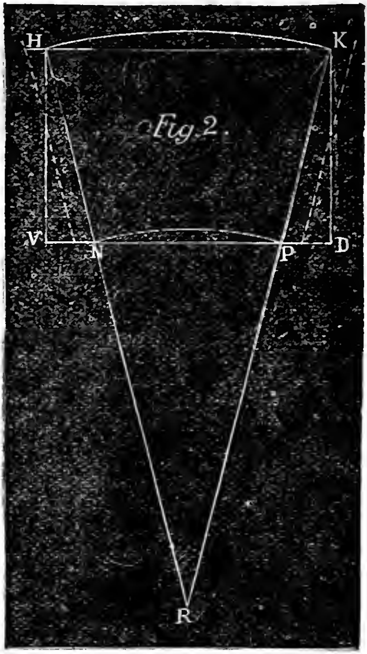
ELBOWS FOR GUTTERS FOR EAVES OF ROOFS.—Eave troughs possess a form resembling the undivided half of a pipe divided lengthways, therefore by describing one half of one end of the elbow of a pipe whose size is equal to the size of the gutter at the top, you have the requisite pattern; extra allowance to be made for bead.

BRONZING GAS FITTINGS.—Boil the work in a strong ley, and scour it free from all grease or old lacquer. Pickle it in dilute nitric acid until quite clean, and then dip it into strong nitric acid to make it bright, swilling it in the water immediately after. Sometimes this latter dipping in strong acid requires to be repeated two or three times, but the work must always be rinsed immediately after dipping. Bind it very loosely round with iron wire, and let it stand for a few minutes in the water you have used for swilling. This will deposit a layer of copper on the work. Again wash well, dry in boxwood dust, and brush over with equal parts of blacklead and Bagnell's red bronze.

TO SEPARATE GOLD FROM SILVER—The alloy is to be melted and poured from a height into a vessel of cold water, to which rotary motion is communicated. By this means the alloy is reduced to a finely granulated condition. The metallic substance is then treated with nitric acid and gently heated. Nitrate of silver is produced, which can be reduced by any of the ordinary methods; while metallic gold remains as a black mud, which must be washed and melted.—*Scientific American.*

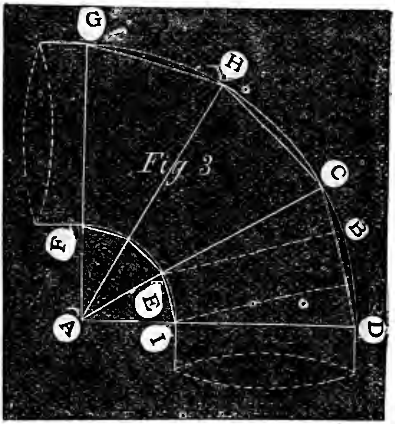
TO TIN COPPER STEW DISHES, &C.—Wash the surface of the article to be tinned with sulphuric acid, and rub the surface well, so as to have it smooth and free of blackness caused by the acid; then sprinkle calcined and finely pulverized sal-ammoniac upon the surface, holding it over a fire, when it will be sufficiently hot to melt a bar of solder which is to be rubbed over the surface. Any copper dish or vessel may be tinned in this way.

PARKER'S COPPER HARDENING process consists in introducing an admixture of a minute quantity of phosphorus into the metal.

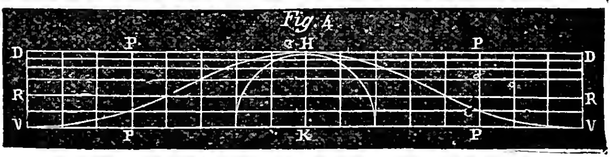


TO STRIKE OUT COMMON FLARING VESSELS, CONES, &c.—*Fig.* 2.—Form a right angled paralellogram H K D V, H K equal to the circumference of the wide end of the diagram, and N P equal to its circumference at the indicated points, K D being the elevation; draw the right lines H N R and K P R; from R as a basis lay out arcs from H to K and N P, calculating proper allowance for backs. TO STRIKE OUT A CONE.—Form a paralellogram as in the diagram; the space from H to K equivalent to the diameter of the cone; K to D equivalent to the elevation; next draw lines from H and K to the centre of the line D V, and from this as a base or centre describe a segment of a circle from H to K.

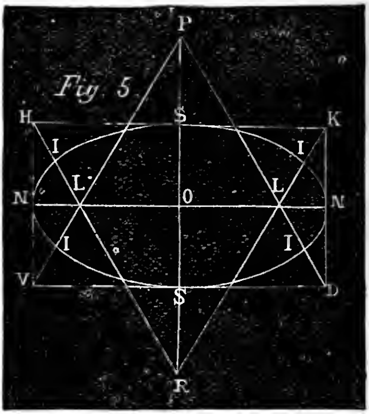
FLUX FOR WELDING COPPER.—Boracic acid, 2 parts; phosphate of soda, 1 part; mix. This welding powder should be strewn over the surface of copper at a red heat; the pieces should then be heated up to a full cherry red, or yellow heat, and brought immediately under the hammer. Heat the copper at a flame, or gas jet, where it will not touch charcoal or solid carbon.



TO STRIKE OUT A CIRCULAR ELBOW.—*Figs.* 3 *and* 4.—Lay out two curved lines F I and G D to suit the desired length of elbow; the space from F to G equivalent to the intended diameter of the pipe; lay off the circles F D, G I into as many divisions as youdesire; construct the paralellogram, Fig. 4, the length equivalent to the diameter of the pipe you are making, the width equal to C B in Fig. 3; lay off a segment of a circle equivalent in diameter to the pipe, touching the point H; divide the segment into any desired number of equal divisions; draw lines across the dots parallel to V V; open the compasses 1¼ times the diameter of the pipe, and describe the line from V to the intersection of the lines P P and R R, draw curvilinear lines to the crossings of the other lines to the point H, this will furnish one side of a section.



TO STRIKE OUT OVALS, OVAL FLARING VESSELS, &c.—*Fig.* 5.—Construct the paralellogram H K D V; H K equivalent to the long and K D to correspond to the short diameter; divide it into four equal parts by drawing the lines P R and N N; mark the point L one-third the distance from N to O; then describe the arcs I S I, I S I, and from the line N N describe the segment I N I. To describe an egg-shaped oval with ends of unequal magnitude, construct the frustrum of a cone that will embrace the oval and proceed as in *Fig.* 5. *To Strike*



out an oval Flaring Vessel in four subdivisions, find the circumference of the arcs I S I and I N I for the bottom of the pieces; form a parallellogram the length of which shall be equal to the circumference of the top of either division, and operate as in Fig. 2. The same allowance must be accorded for flare on the side parts as on the ends, allowing for burrs and locks.

GOLD LACQUER FOR TIN—TRANSPARENT, ALL COLORS.—Alcohol in a flask, 1 pt.; add gum-shellac, 2 ozs.; turmeric, 1 oz.; red sanders, 1½ ozs. Set the flask in a warm place, shake frequently for 12 hours or more, then strain off the liquor, rinse the bottle, and return it, corking tightly for use. When this varnish is used, it must be applied to the work freely and flowing, and the articles should be hot when applied. One or more coats may be laid on, as the color is required more or less light or deep. If any of it should become thick from evaporation, at any time, thin it with alcohol. And by the following modifications, all the various colors are obtained: 1. *Rose Color.* Proceed as above, substituting 1 oz. of finely ground best lake in place of the turmeric. 2. *Blue.* The blue is made by substituting pulverized Prussian blue, 1 oz., in place of the turmeric. 3. *Purple.* Add a little of the blue to the *first*. 4. *Green.* Add a little of the rose to the *first*.

CRACKED STOVES.—Equal parts of wood ashes and salt; mix to a paste with water; with this fill the cracks.

TO DESCRIBE A HEART.—*Fig.* 6.—Draw the straight line H D K equal to the breadth of the heart; lay off the segments H D and D K, then with the dividers extended from H to K, describe the arcs H K and K V.

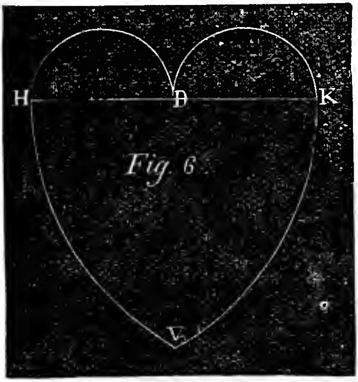


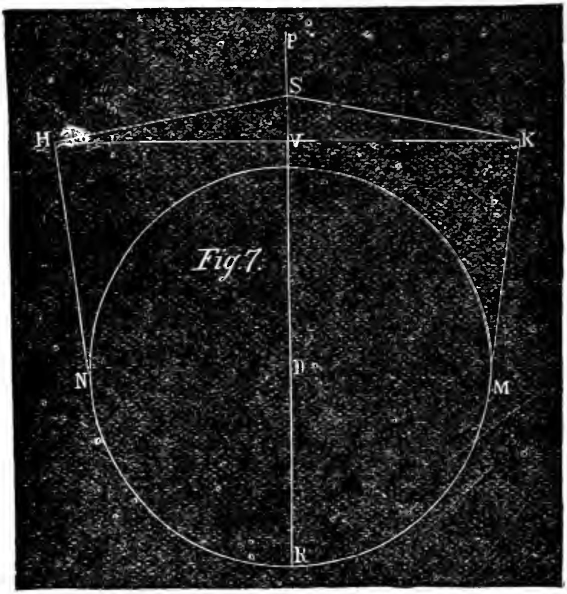
Fig. 6

To find the circumference of a circle, the diameter being known, multiply the diameter by 3.1416, and to find the *diameter* of a circle, the circumference being known, divide the circumference by 3.1416.

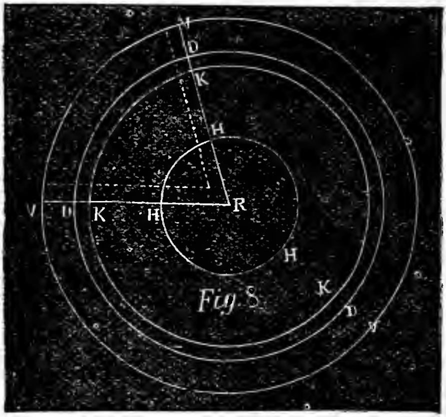
TO STRIKE OUT OVAL WASH BOILER COVERS.—*Fig.* 7.—Describe the line V R equal in extension to half the length of the boiler; from the central point D lay off the circle M R N, equivalent in diameter to the breadth of the boiler outside the wire around the rim; describe the line H K so as to cross the line V R in the manner shown in diagram; make V S three-eighths of an inch high more or less as you desire it for the pitch of the cover; place the corner of the measuring square on the line H K, laying the flat part touching the point S; then describe the lines H N, H S, S K and K M, which, with the proper allowance for locks and edges, completes the cover.

JAPANNERS' GOLD SIZE.—Gum ammoniac, 1 lb.; boiled oil, 8 ozs.; spirits turpentine, 12 ozs. Melt the gum, then add the oil, and lastly spirits turpentine.

JAPANNING.—Nearly 30 formula for varnishes will be found on page 283, among them *Japanners Copal Varnish*, and this, together with oil, alcohol, shellac, or any other transparent varnish, admits of being mixed with coloring matter to produce different shades. 1. *For Scarlet.* Ground vermilion may be used, but being so glaring it is not beautiful unless covered over with rose-pink, or lake, which have a good effect when thus used. 2. *Bright Crimson.* Use saff-flower or Indian lake dissolved in alcohol; in place of this lake carmine may be used, as it is more common. 3. *Yellow.* Turmeric dissolved in spirits of wine, strained through a cloth, and mixed with pure seedlac varnish, makes a good yellow japan; saffron will answer applied in the same way. And chrome yellow is excellent. Dutch pink forms a cheap yellow japan ground. If dragon's blood be added to the yellow japan, a most beautiful and rich salmon-colored varnish is the result, varied according to the quantity of the ingredient used. 4. *Orange.* Use yellow mixed with vermilion or carmine, just as a bright or inferior color is desired. 5. *Purple.* Add to the varnish a mixture of lake and Prussian blue, or carmine, or for an inferior color, vermilion. 6. *Blue.* Use bright Prussian blue; it may be mixed with shellac varnish and brought to a polishing state by 5 or 6 coats of varnish of seedlac; mix with the purest varnish when a *light* blue is desired. 7. *Black.* Prussian blue 1 oz., asphaltum 2 ozs., spirits turpentine 1 pint; melt the asphaltum in the turpentine, rub up the blue with a little of it; mix and strain, then add the whole to 2 pints of the varnish. 8. *Green.* Mix equal parts of the blue and yellow together, then mix with the varnish until the color suits the fancy. 9. *Pink.* Mix a little of the blue to more in quantity of the red and then add to the varnish till it suits. 10. *White.* One white ground is made by the following composition: white flake or lead washed over and ground up with a sixth of its weight of starch, then dried and mixed with the finest gum, ground up in parts of 1 oz. gum to ½ oz. of rectified turpentine mixed and ground well together. This is to be finely laid on the article to be japanned, dried and then varnished with 5 or 6 coats of the following: 2 ozs. of the whitest seed-lac to 3 ozs. of gum-anime reduced to a fine powder and dissolved in 1 qt. alcohol. For a softer varnish than this, a little turpentine should be added and less of the gum.



TO STRIKE OUT CAN TOPS AND BEVEL COVERS FOR VESSELS.—*Fig.* 8.—Describe the circle K K K for the size of the can or cover; allow the space between K K K and D D D for edges to the same, and the distance between V V V and D D D for the flare; span the dividers from R to K and divide the curvilinear line V V V into six equal divisions; cut out the pieces H H H, D D D leaving edges for locks parallel to H V. For the opening in the can head or top, describe the curvilinear line H H H equal in magnitude to the circumference of the opening. To have your can tops one-third pitch, span the dividers two-thirds of the diameter of the can: lay out a circle and use



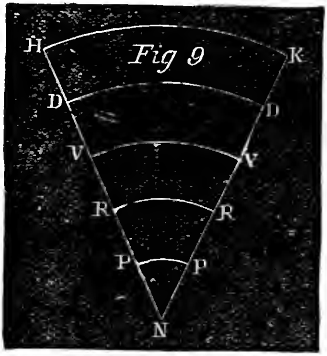
two-thirds of it. For one-quarter pitch, span the dividers three-fourths of the diameter of the can, lay out a circle and use three-quarters of it. For one-half pitch, lay off the circle twice the diameter of the can and use half of it. Remember to grant full allowance for locks only.

Different Styles of Filing.—To file a surface true, it is necessary on commencing, to squeeze the file tightly between the third and fourth fingers and palm of your hand until you become used to it. Your position in filing should be half left face to your work, with the middle of your right foot fifteen inches behind your left heel; and to file your work true or square, it is necessary to reverse your work often, as by this means you are enabled to see the whole surface you are filing, and see while filing whether you are filing true or not. When, however, your work is so heavy that you cannot reverse it you had better file first to the right and then to the left, as by this means you can plainly see the file marks, and this again assists you in filing true.

To Crystallize Tin.—Sulphuric acid, 4 ozs.; soft water, 2 to 3 ozs., according to strength of the acid; salt 1¼ ozs, Mix. Heat the tin hot over a stove, then with a sponge apply the mixture, then wash off directly with clean water. Dry the tin, and varnish with demar varnish

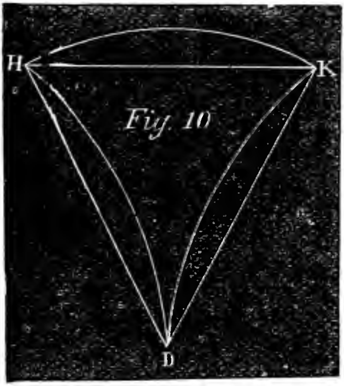
Compression of an India-Rubber Buffer of Three Inches Stroke.—1 ton, 1.3 inches. 1½ tons, 1¾ inches. 2 tons, 2 inches. 3 tons, 2⅔ inches. 5 tons, 2¾ inches. 10 tons, 3 inches.

To Strike a Set of Patterns for the Envelope of a Cone.—*Fig.* 9.—Lay off the lines H N and K N; the space from H to K corresponding to the circumference of the cone at the largest end; H N equal to the sloping height; from N as a basis describe the segments H K, D D, V V, R R, and P P; each of the parts between these segments will compose a section of the covering if allowance be made for the laps. To lay off the frustrum of a cone, see Fig. 2.

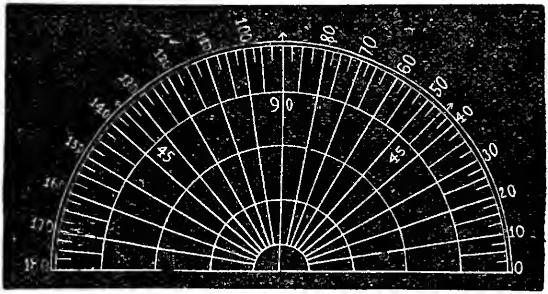


To find the Area of a Circle, multiply the circumference by one-fourth the diameter. *To find the Area of a Section of a Circle*, multiply the length of the arc by half the length of the radius.

To Strike out Strainer Bucket and Coffee Pot Lips (*Eastern Style*).—*Fig.* 10.—Describe the triangle H K D, H K equivalent to the slanting height; from D lay out the section H K; describe sections of circles from K to D and H to D according to the dimensions of the vessel. In coffee pots, the section extending from H to K should be regulated according to the style in which it is to be constructed. In describing Tea-kettle and Tea-pot Spouts, proceed as in Figs. 1 and 4, making the breadth of the parallelogram commensurate or equal to the angle you desire to cut, and the length equivalent to the circumference of the spout.



To Strike out Lips for Measures, &c.—Lay out a circle the dimensions of the top of the vessel; describe a line through the centre of the circle and divide it into four equal sections; span the compasses on the line one quarter the distance from the end, and describe a semi-circle touching the opposite end of the line; pass the compasses the breadth of the lip desired, and lay out an arc until it approaches the semi-circle, which will allow the desired lip. The annexed Sector is appended to enable mechanics to obtain angles when required:



ADJUSTING LOCOMOTIVE VALVES.—A correspondent of the *Scientific American* gives the following method of setting slide valves of locomotives :—Make a steel tram, about $5\frac{1}{2}$ in. long, with two points at the right angles with the straight bar, one point to be $2\frac{3}{4}$ in. in length, and the other $1\frac{1}{2}$ in. Both points are to be sharp. Take a centre punch, and make a centre-mark on the top of the steam-chest packing-box; then take a strip of tin and put it in the steam-port. Draw the valves slowly back until you can just move the tin between the edge of the valves and the edge of the steam-port (which is now closed except as to the thickness of the strips of tin.) Take the tram, place the short point in the centre-mark on the packing-box; then make a scratch on the valve stem, and go through with the same process with the opposite steam-port. Now you have marks on the valve-stem just where the valve begins to open. The valve-stem must next be got into radius (as we term it), which is to show the proper length for the valve-stem. It is done thus: Cover the steam-ports equally with the valve, put the centre of the rock shaft and the rocker pin at a right angle with the bore of the cylinder: and when the valve-stem is adjusted to this, it is of the proper length and should not be altered. To adjust the valves in forward motion, hook the reverse lever in the forward notch, take the dead points for centres, and alter the eccentric rods until the spaces are equal on the valve-stem, which is determined by the use of the tram. Take the forward centres and give 1-10th. lead to the valve, for either passenger or freight engines. By adopting this plan the engine will reverse her action promptly. Hook the reverse lever in the back motion, and repeat as above. If the job is to be done quickly and the eccentrics are in the proper position, it can be done by the travel, in this way : Move the engine slowly forward with steam, take the tram, and trace the movement of the valve on the valve-stem until the stem stops; then trace the return movement until that stops. Take a pair of dividers and measure each distance from the valve mark on the stem to the extreme of the travel line (or where the valve stopped). Alter eccentric rods until the spaces are equal. By these means you do not require to take the steam chest covers off.

FACTS FOR GAS COMPANIES AND CONSUMERS.—The following different volumes of gas have been obtained from various kinds of coal. Cannel coal, 15,000 cubic ft.; Wigan cannel, 15,426; Boghead cannel, 13,334; Cape Breton "Cow Bay," etc., 9,500; Pictou and Sidney, 8000; English, mean, 11,000; Newcastle from 9,500 to 10,000; Pittsburg, 9,520, Scotch, from 10,300 to 15,000; Wallsend, 12,000, Virginia, 8,960; Western, 9,500. Pine wood will evolve 11,000 cubic ft. per ton. Rosin 15,600. Oil and grease 23,000 cubic ft. Each retort should produce about 600 cubic ft. of gas in 5 hours, with a charge of 1½ cwt. of coal, or 2800 cubic feet in 24 hours. One ton of coal should produce about 9000 cubic ft. of gas, 1 chaldron of coke and about 11 gals. of tar, and 9 of ammoniacal liquor. *Dry purifiers* require 1 bush. of lime to 10,000 cubic ft. of gas, and *wet purifiers* an admixture of water, 48 bushels, and lime, 1 bushel for each 10,000 cubic ft. of gas. One per cent. of carbonic acid in gas diminishes its illuminating power one-tenth. Defective burners should be changed without delay, as all smoking, roaring, irregular, ragged, and pronged flames caused a great waste of gas with deficient light; a smoky flame indicates loss of gas as well as loss of light. One good gas light is better economy than a number of small ones. *The standard of gas burning* is a 15 hole Argand lamp, interior diameter ·44 ins., chimney 7 ins. high, consuming 5 cubic ft. per hour, evolving a light from common coal gas of from 10 to 12 sperm candles of 6 to the pound, with cannel coal from 20 to 24 candles, and with Pennsylvania coal from 14 to 16 candles The advantage gained by employing a 30-hole argand instead of the standard is a greater production of light, the increase being from 20 to 30 per cent., for if the standard consumes 5 ft. per hour, and evolves the light of 12 candles, the 30-hole burner, consuming 7 ft. per hour, will give the light of 22 candles. An Argand burner with two chimneys, one within the other, with air space between in which the air becomes heated during its downward movement towards the flame, for an equal amount of light, causes a saving of gas equal to 33 per cent., and for an equal consumption of gas, the gain in light is equal at 62 per cent.

Burners are made so as to produce all shapes of flame, and are of different materials, lava, iron, steel, porcelain, steatite, brass, platinum lined, etc. The bore from which the flame of the gas issues should be arranged, as regards its width, for the quality of the gas consumed, cannel coal gas for instance, being provided with narrower openings than those for common coal gas. We have single jet burners, double jet burners, bat's wing, fishtail, cockspur, and other varieties; also Argand burners of various sizes, bored with 6 to 30 or 48 holes, or as in the Dumas burner, a slit instead of a hole. The best gas burners are made of lava, and the kind known as fishtail burners consume from 4 to 5 ft. of common coal gas per hour; large burners require from 6 to 10 cubic ft. per hour, in proportion to size; sheltered lights consume about 4 cubic ft. per hour, out door lights about 5 cubic ft.; street lamps in cities consume from 3 to 5 cubic ft. per hour, according to size of burner used. A 13 candle-gas, consumed in an Argand burner, evolves an illuminating power of 13 candles; if burnt in a batwing or fish-tail burner the same gas will produce only the illuminating power of 9 candles. The deficiency of light is caused by an admixture of atmospheric air mingling largely with the thin jets of gas, increasing the heat, but dissipating the light, and imparting a blue tinge to the flame. Bat-wing burners are the best adapted for all out-door lights. Whenever economy in gas and good light are main objects, the larger kind of bat-wing burners are preferable; a bat-wing burner consuming $3\frac{1}{2}$ ft. of gas per hour yields only the light of 6 candles, whereas a burner consuming 6 ft. per hour evolves a light equal to $15\frac{1}{2}$ candles, the pressure being 4-10ths of an inch at the point of ignition. Nearly the same results are obtained by the use of the fishtail burner. The *carcel* burner, with a perforated disc at the lower part, and two orifices at the upper, where the flames unite and spread into one, each side of this united flame being supported by two curved levers or arms, is said to be equal if not superior to the Argand or fishtail burners in the power of evolving a soft, steady, mellow light.

LOSS TO THE DIFFUSION OF GAS LIGHT BY GLASS GLOBES.—Clear glass, 12 per cent.; glass globe engraved with ornaments, 24 per cent,; half ground globe, 35 per cent.; globe obscured all over, 40 per cent.; opal globe, 60 per cent.; painted opal globe, 64 per cent. No glasses of any kind are ever used with the bat-wing burner owing to the widely extended flame, but for fish-tail burners they are in common use. Globes as usually made, are of faulty construction and cause needless obscurity and a great loss of light. The Trudeau globe, invented and patented by Mr. Trudeau, of Ottawa, Canada, is constructed on correct scientific principles, with spacious and roomy apertures, which tend to promote a low temperature in the glass, thus preventing fracture from the heat, and the accumulation of smoke and dust. The burner being properly adjusted, the height of the globe being low, and the openings wide, the gas is easily ignited, and burns at an exceedingly low pressure, with a clear, steady flame, without flickering, and diffuses a flood of soft, brilliant light, which for quantity and quality is really surprising to one accustomed to the old fashioned globes. If 1 per cent. of air is mixed with gas, the illuminating power is diminished about 6 per cent.; if one-fifth of air be mixed with four-fifths of gas, no servicable light can be derived from the mixture. The greatest light and least heat is produced when the gas is not exposed to too great a current of outside air, and the most heat and least light is evolved by permeating the gas largely with external air; in every case an insufficiency of air supply will cause smoke and obscurity of light with any kind of burner. Large burners under a low pressure produce a greater amount of light than small burners under a high pressure, each kind consuming equal quantities of gas in a given time, and a greater volume of light is emitted from a large burner than from two small ones consuming the same quantity of gas as the one large. All burners, no matter what the size may be, require a certain quantity of gas to produce the largest amount of light, which is as much lost through the use of too little gas as by the use of a surplus.

EXPLOSION OF GAS.—Seven parts of air and one of gas is considered to be the most dangerous compound, but much depends on the purity, &c., of the gas. Compounds of less than 3 of air to 1 of gas, or above 11 of air to 1 of gas, will not explode. Gas unmixed with oxygen or atmospheric air, extinguishes flame, and while in this state cannot explode. The terrific gas explosion during the summer of 1870 in Cincinnati, was caused by a lighted pipe belonging to a laborer employed on the top of the gas holder; the heat generated by the flash was nearly 2,500°, or about the temperature of melted steel; one party at the distance of half a mile from the explosion compared his experience to the inhalation of a stream of hot air from a furnace; the time occupied by the explosion was about the 3rd part of a second. An explosive mixture of gas, *while under pressure*, will only ignite at the *exterior orifice* of the pipe or holder; but if the *pressure is removed*, the flame penetrates to the interior, and explosion ensues. On perceiving the odor of escaping gas, instant action should be taken to detect and stop the leak, but there is great temerity in applying a light in such cases; the best way is to turn off the gas for 3 or 4 hours, and allow it full time to dissipate into the open air through the doors, windows, &c., before using flame in any form. If a light is required at the open end of a pipe while making a new connection, gas-fitters should in every case turn the outlet tap off, or disconnect the outlet union of the meter, in order to avoid the hazard of exploding the meter.

PRESSURE.—According to Mr. Haswell, "The pressure with which gas is forced through pipes should seldom exceed 2½ inches at the works, or the leakage, will exceed the advantages to be obtained from increased pressure. When pipes are laid at an inclination either above or below the horizon, a correction will have to be made in estimating the supply, by adding or deducting 1-100 of an inch from the initial pressure for every foot of rise or fall in the length of the pipe. By experiment 30,000 cubic feet of gas, sp. gr. ·42 were discharged in an hour through 6 inches in diameter, and 22.5 feet in length, and 852 cubic feet, specific gravity ·398 were discharged under a head of 3 ins. of water, through a main 4 ins. in diam. and 6 miles in length. Loss of volume of discharge by friction, in a pipe 6 ins. diam. and 1 mile in length, is estimated at 95 per cent. In distilling 56 lbs. of coal the volume of gas produced in cubic feet when the distillation was effected in 3 hours was 41.3, in 7 hours 37.5, in 20 hours 33.5, and in 25 hours 31.7." The expiration of the breath from the lungs in the gentlest manner, is about equal to the proper pressure for the most favorable consumption of gas, while a slight blowing force is equal to the highest pressure in the mains of gas companies; the first example is about equivalent to two or three-tenths pressure, and the second to from 3 to 5 ins. pressure.

The orifices of gas burners should be well proportioned, not too small, to require increased pressure to expel the gas, thus seriously curtailing the light, as shown by the following experiments with 4 Argands, all of one size, each having 15 holes, but the orifice of each graduated so that only 5 cubic feet of gas per hour could pass under the respective pressures here intimated:—

Gas issuing with Pressure in tenths of inches.

1-10th	yielded	the light of	12	candles.
5-10ths	"	"	6	"
10-10ths	"	"	2½	"
40-10ths	"	"	1-6	"

On the other hand, if the orifice of an Argand burner is too large, the flame will smoke offensively and thus entail waste and loss. Grade the size of the orifice by the quality of the gas to be consumed; for poor gas the holes may be large; for good gas, smaller holes may be used. In every case be careful to effect a correct adjustment in order to obtain the best results.

VOLUMES OF GAS DISCHARGED PER HOUR UNDER A PRESSURE OF HALF AN INCH OF WATER—SPECIFIC GRAVITY OF GAS ·42.

Diam. of opening.	Volume.	Diam. of op'ning.	Volume.	Diam. of op'ning.	Volume.	Diam. of op'ning.	Volume.
Ins.	Cubic ft.	Ins.	Cubic ft.	Ins.	Cubic ft.	Ins.	Cubic ft.
1/4	80	3/4	723	1 1/8	1625	1 1/2	2885
1/2	321	1.	1287	1 1/4	2010	5.	46,150

DIAMETER AND LENGTH OF GAS PIPES TO TRANSMIT GIVEN VOLUME OF GAS TO BRANCH PIPES.—*Dr. Ure.*

Volume p. hour.	Diameter.	Length.	Volume p. hour.	Diameter.	Length.	Volume p. hour.	Diameter.	Length
Cub. ft.	Ins.	Feet.	Cub. ft.	Ins.	Feet.	Cub. ft.	Ins.	Feet.
50	4.	100	1,000	3.16	1,000	2,000	7.	6,000
250	1.	200	1,500	3.87	1,000	6,000	7.75	1,000
500	1.97	600	2,000	5.32	2,000	6,000	9.21	2,000
700	2.65	1000	2,000	6.33	4,000	8,000	8.95	1,000

TO DETERMINE THE SIZE OF GAS PIPE REQUIRED—LONDON RULE.—For 200 lights, 2 inch tube; 120 lights, 1 1/2 inch; 70 lights, 1 1/4 inch; 50 lights, 1 inch; 25 lights, 3/4 inch; 12 lights, 1/2 inch; 6 lights, 3/8 inch; 2 lights, 1/4 inch.

DIAMETER AND EXTREME LENGTH OF TUBING AND NUMBER OF BURNERS ALLOWED—AMERICAN STANDARD.

Diam. of tube.	Feet in length	No. of burners.	Capacity of met'rs.	No. of burners.	Diam. of tubing.	L'ngth in feet.	No. of burners.	Capacity of met'rs	No. of burners.
1/4	6	1	3 lights.	6	1	70	35	45 li'ts.	90
3/8	20	3	5 "	10	1 1/4	100	60	60 "	120
1/2	30	6	10 "	20	1 1/2	150	100	100 "	200
5/8	40	12	20 "	40	2	290	200	....	...
3/4	50	20	30 "	60	..	...	...	....	...

DIAMETER AND LENGTH OF PIPE FROM THE MAIN, TOGETHER WITH THE NUMBER OF LIGHTS ALLOWED IN THE GAS SERVICE FOR LAMPS.

No. of lamps.	Distance from main in feet.	Diameter of pipe.	No. of lamps.	Distance from main in feet.	Diameter of pipe.	No. of lamps.	Distance from main in ft.	Diameter of pipe.
2	40	3/8	10	100	3/4	25	180	1 3/4
4	40	1/2	15	130	1	30	200	1 1/2
6	60	5/8	20	150	1 1/4	..	...	...

In experiments conducted by Mr. Pattinson, analytical chemist, Newcastle, one burner he tested gave light equivalent to 17 3/4 candles; while, with the same quantity of gas, some burners gave only 3 3/4, others 5 1/2, 6, 8, and 9 1/4 candle light.

As to the *quality of illuminating gas*, the English law enacts that "such gas shall, with respect to its purity, be so far free from ammonia and sulphuretted hydrogen that it shall not discolor either turmeric paper, or paper imbued with acetate or carbonate of lead, when these tests are exposed to a current of gas, issuing for one minute under a pressure of five-tenths of an inch of water, and shall not contain more than 20 grains of sulphur in any form in 100 cubic ft. of gas." The following enumeration shows the illuminating power of the *common* gas used in various cities and towns in Great Britain, as determined by Prof. Frankland, in accordance with the Government standard: London, 12 candles, Liverpool, 22, Manchester, 22, Carlisle, 16, Birmingham, 15, Edinburgh, 28, Glasgow, 28, Hawick, 30, Aberdeen, 35, Inverness, 25, Greenock, 28.5, Paisley, 30.3. In Berlin, it is 15.5, Paris, 12.3, Vienna, 9; and in the United States it varies from 12 to 18 candles, computing by the English standard. Gas manufactured from cannel coal emits a light the standard of which is equal to 20 candles. This gas, in London, is usually supplied to the public buildings and the residences of the wealthy. London has now (1876) 5,000 miles of gas mains, 54,000 street lamps, which burn 3,000,000 cubic feet of gas each night; on the lighting of the lamps and other lights the deoxydation of the atmosphere caused thereby is equivalent to the addition of 500,000 inhabitants to the population.

The illuminating value of gas is enormously enhanced by causing it, after it has passed through the meter, to enter a *Carbonizer* or *Carburetter*, containing gasoline, or other light oil, where it becomes saturated and enriched by the absorption of the carbonaceous fumes and vapors generated from the oil previous to emission into the service pipes of the building. The apparatus ought to be of sufficient size, and should, in its construction and location, combine every available appliance to ensure safety, strength, simplicity, and ease of management, while presenting the largest possible surface for the proper evaporation of its contents. The economy of this carbureted gas is such that a two-foot burner emits the light of five feet of common gas, while the direct saving effected on the consumption of the latter, varies, according to the quality of the gas used, from 33 to 43 per cent. Hydrogen, an essential component of coal gas, is the lightest substance in nature, being 15 times lighter than air, and 12,000 times lighter than water, and requires for perfect combustion, 8 times its weight, or half its volume of oxygen; in its passage through the carbureter above described, it is simply the medium or vehicle to transmit the particles of vaporized carbon from the generator to the burner, where on ignition it attracts to itself a sufficient portion of the surrounding oxygen, etc., to effect illumination. When 12 lights with 5 foot burners are required to furnish the desired light from common gas, 6 lights, with 3 foot burners and carbureted gas, is found to be all sufficient for the same purpose.

Gasoline being almost a pure carbon, may be transmitted in the vaporized form in combination with the coal gas, direct from the gas works to the consumer. The Superintendent of the West Pittsburg, Pa., Gas Works, reports a product of 603,600 cubic feet of 20 candle gas from 70 bbls. benzine, 72 gravity, costing $1.75 per bbl., being a result of 8,622 feet per bbl., at a cost, including material, labor, fuel, etc., of about 32 cents per 1000 cubic feet. Crude petroleum and heavy oil from the refineries, including gasoline, benzine, etc., were all tested and used with the greatest ease, the vaporizing or carbonizing process being produced by means of superheated or other steam passing through a coil of pipe inside a tank or still containing the oil. Proportions used were: 14 candle gas, 50 per cent. oil gas, 30 per cent. air, 15 per cent. It is worthy of note that the unusually large percentage of air did not perceptibly diminish the illuminating power of the compound, used with common coal gas, 15 per cent. of air would have produced great obscurity in the resultant light.

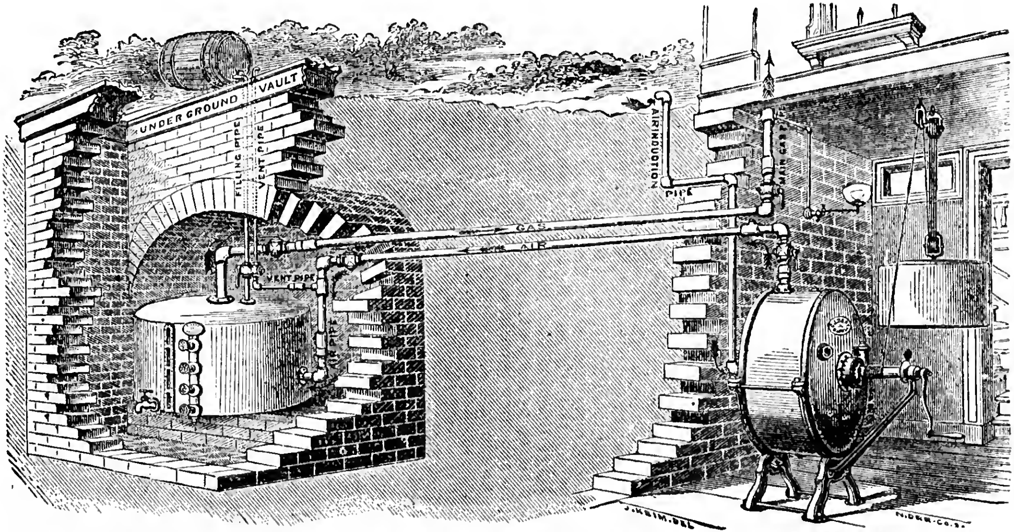
Owing to the cheapness of petroleum and its products, several towns have commenced its exclusive use for the production of illuminating gas, and find it much cheaper and better every way than the gas produced from coal. In Pittsburg, Pa., and elsewhere, several enterprising firms have taken a notable step in utilizing natural gas, which is conveyed in some instances many miles through pipes from the wells, and is used in the manufacture of iron, for illumination, the generation of steam power, etc. The gas, manufactured in nature's alembic, is most probably generated by the action of subterranean heat operating on an ocean of volatile carbonaceous matter at a great depth in the earth, from which it frequently issues with terrific noise and irresistable force on the penetration of the crust by drilling or otherwise.

Gas machines for generating gas from gasoline are now in extensive use for lighting factories, dwellings, offices, etc. A good illustration of a most meritorious invention of this class can be seen on the next page. The gas made by this machine, known as *carburetted air gas*, is obtained by the impulsion of common air, by means of an air-pump, into a carbureter containing gasoline. In this receptacle the air becomes saturated and impregnated with the carbonaceous vapors from the gasoline, and, impelled by the action of the air-pump, it transmits its burden to the burners through the service pipes of the building, yielding a beautiful, rich, bright flame, conceded to be fully equal to that evolved by the best coal gas, being free from sulphurous compounds and other impu ities. Nearly one thousand of these machines are now in successful operation in the United States, Canada, etc., and the saving effected by them is almost incredible. The proprietors of the National Drover's Hotel, cor. 100th Street and 3d Avenue, New York, certify that their gas bill for one year, with a 200 light Gas Machine, was only $550, the light obtained being every way more desirable, and far superior to that formerly supplied by the "city gas" at an annual cost of nearly $1,400.

DIAMETER AND EXTREME LENGTH OF PIPE AND NUMBER OF BURNERS ALLOWED FOR CARBURETTED GAS, SERVED BY GAS MACHINE. (*Gilbert & Barker*).

Greatest number of feet to be run.	Size of pipe.	Greatest number of burners to be supplied.
20 feet	3/8 inch.	2
30 "	1/2 "	4
50 "	3/4 "	15
70 "	1 "	25
100 "	1 1/4 "	40
150 "	1 1/2 "	70
200 "	2 "	140
300 "	2 1/2 "	225
400 "	3 "	300
500 "	4 "	500

As to the *quality* of carburetted air gas it possesses an illuminating power of from 16 to 20 candles, being nearly equal to cannel gas, and is characterized by perfect combustion, ease of lighting, large volume of flame, and perfect combination.



GAS GENERATOR IN VAULT. Distant from house 50 feet or more.

SPRINGFIELD GAS MACHINE.—Manufactured at Springfield, Mass.

AIR PUMP IN CELLAR OF HOUSE.

The above cut shows an Automatic Apparatus for making Gas, (without fire or heat) by impregnating common air with the vapor of gasolene. It consists of an air pump operated by a weight, which forces a current of air through a gas generator filled with gasolene, located in a vault underground and removed from the building lighted. The process is a simple and safe one, and much used in lighting isolated buildings.

CLASSIFICATION OF HYDROCARBONS.—The grade usually accepted by distillers stands as follows: All above 88° of Baumé's hydrometer is styled chimogene, from 88° to 70° gasoline, from 70° to 60° naphtha, from 60° to 50° benzine, from 50° to 35° kerosene, from 35° to 28° lubricating oil.

ON GAS METERS—In distinguishing between dry and wet meters, the construction of the former is briefly as follows: In a gas-light metallic box are placed 2 or 3 bellows like vessels, which instead of being inflated by air, are inflated by the gas entering from the service pipes. When inflated to some extent an arrangement of springs and levers, forces the gas out of the bellows again into the exit-pipe leading to the burners. The cubic capacity of the chambers (as the bellows like arrangements are called), having been accurately adjusted, the movements of their walls is communicated to wheel-work, which being connected with dials, indicate in tens, hundreds and thousands, the consumption of gas in cubic feet.

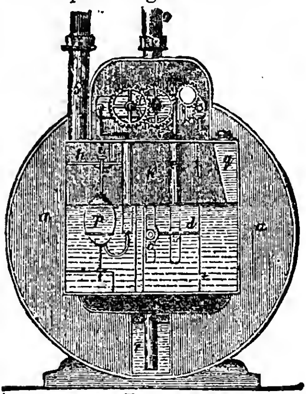


FIG. 1.

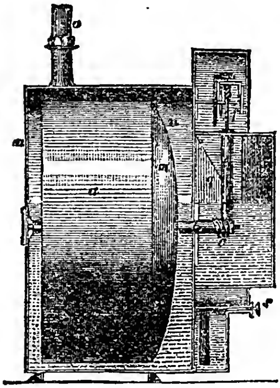


FIG. 1.

Dry meters are preferred on account as well of not being liable to be affected by frost as of not causing the sudden extinguishing of the gas-light for want of water as may occur with wet meters. Wet meters are constructed upon a plan devised in 1817, by Clegg, and improved by Crossley, and others. Figs. 1, 2, 3 and 4, are drawings of this kind of meter, which consists in the first place of an outer cylindrical box of cast iron, closed on all sides. In this box is placed a drum of pure block-tin, divided into 4 compartments, bearing upon a bell-metal axis, and immersed for rather more than half its circumference in water. By the pressure of the gas, and the ensuing depression of the water, the drum revolves, each of its compartments becoming alternately filled with and emptied of gas. On the axis of the drum is an endless screw, which by mechanical means is connected with the wheel-work of the dials. The drum is very accurately adjusted, so that at every complete revolution a certain cubic quantity of gas passes through and is registered. Fig. 1 exhibits the apparatus with the front plate removed; Fig. 2 shows the side of the meter; Fig. 3 is sectional plan; and Fig. 4 is a section through the box; *a* is the box *a* the drum, *b* its axis, *c* the endless screw; bearing in the wheel *d*, and carrying by means of *c* the movement of the drum on to the wheel-work of the dials; *f g* is the inlet pipe for the gas, which flows into the valve box, *h* and passing by the valve, *i* (kept open as long as the meter contains sufficient water for action), flows through the bent tube, *l* into the bulged cover of the drum, or technically antechamber *m*,

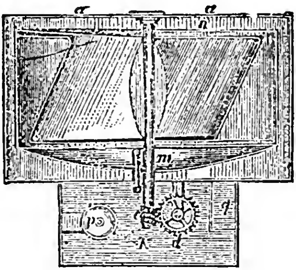


FIG. 3

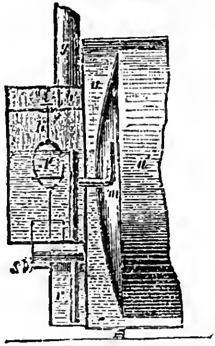


FIG. 4.

and thence into the several compartments of the drum, Hence the gas enters the space *n*, to which is fitted the outlet pipe, *o i* is the valve; *p* the float; *q* the funnel tube for filling the meter with water; *r* the waste water cistern; *s* the plug by which the waste water may be run off. As long as no gas burners are in use, the meter connected with them is inactive; but when the gas is burnt the drum rotates, and by its communication with the wheel-work registers the quantity of gas consumed. Instead of filling wet meters with water, they may be filled with glycerine, which does not freeze nor evaporate, and they should be set perfectly level.

WATER GAS.—The manufacture of water gas essentially consists in forcing steam through iron or fire clay retorts filled with red-hot charcoal or coke. The steam is decomposed, yielding a mixture of hydrogen, carbonic oxide, and carbonic acid gases, with a small quantity of marsh-gas. The purified gas, consisting essentially of carbonic oxide and hydrogen, is, although not luminous when burnt by itself, suitable for illuminating purposes under the following conditions: 1. By placing on the burners small platinum cylinders which, by becoming white-hot, yield a strong light—Gengembre's and Gillard's plan. 2. By impregnating the gas with vapors of hydro-carbons, as above described, the original idea being due to Jobard (1832), of Brussels.

GAS WELLS.—Although these remarkable wells are quite numerous in Pennsylvania, they are by no means confined to that locality. In the neighborhood of Fredonia, New York, a native permanent source of gas exists, which having been accidentally discovered by the pulling down of a mill situated on the banks of the river Canadaway, has been, by boring the bituminous limestone, enlarged, and a gas holder constructed. The native gas now serves the purpose of illuminating the locality. In the Szlatina salt mine, in Hungary, illuminating gas is constantly evolved, at a depth of 90 metres, in great quantities, and subserves the purpose of lighting up the mine. The Rev. Mr. Imbert, who, as a missionary, has travelled through China, states that in the province of Szu Tchhouan, where many bore-holes for rock salt have been made to the depth of about 1500 to 1600 feet, gas is permanently emitted and conveyed in bamboo tubes to places where it is used for lighting and heating purposes, more especially the heating of salt-pans in which the brine is evaporated. In Central Asia, and near the Caspian Sea, there are, at several localities, so-called infernal fires, which are due to the constant evolution of gas from the soil. Similar phenomena exist at Arbela, in Central Asia, at Chitta-Gong, in Bengal, and other places.

About 1786, Earl Dundonald made experiments on gas lighting at Culross Abbey; but it should be observed regarding these experiments that they were made with the view of obtaining tar, the gas evolved by the distillation of the coals being regarded as a curiosity. The real inventor of practical gaslighting is William Murdock, who, in 1792, lit his shops at Redruth, Cornwall, with gas obtained from coals. The first more extensive gas-work was established in 1802, by Murdock, at the Soho Foundry, near Birmingham, the property of the celebrated Boulton & Watt. In 1803 he illuminated two cotton mills in Manchester the same way.

Gas Engines.—In Lenoir's gas engine, now much employed in France, the source of power is the expansion arising from the explosion of gas. Air and gas are admitted to a cylinder in the proportion of 11 to 1; a spark from a galvanic battery is sent through it; the spark explodes the mixture, and the expansion consequent on this explosion drives a piston to the other end of the cylinder. Mechanism does all the rest; opens a slide valve to permit exit to the exploded mixture, drives the piston back by the momentum of a fly-wheel, opens tubes for the admission of new air and gas, establishes connection again with the battery, and prepares for a renewal of the action, and so on continuously. These engines are costly in the first instance, and many precautions are necessary to prevent them being overheated; but they require no fireman, and are rather cheaper to work than steam-engines; consequently they are much employed for 2 to 4 horse-power purposes.

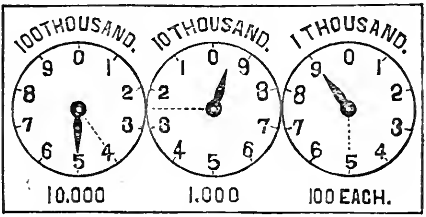
Products of a Cord of Pitch Pine obtained by Distillation.—*Charcoal*, 50 bushels; *Illuminating Gas*, about 1000 cubic feet; *Illuminating Oil and Tar*, 50 gals.; *Rosin* 1½ bbls.; *Pyroligneous Acid*, 100 gals.; *Spirits Turpentine*, 20 gals.; *Tar*, 1 bbl.; *Wood Spirit*, 5 gals.—*Haswell.*

To Mend Iron Retorts.—Fire clay 15 lbs., saleratus, 1 lb., with water sufficient to make a thick paste. Apply to the broken part of the retort while at a good working heat, then cover it with fine coal dust, and charge the retort for working.

To Stop Leaks in Clay Retorts When at Working Heat:—Five parts fire clay, 2 parts white sand, 1 part of borax pressed and ground. Mix the whole together with as much water as may be neessary to bring it to the consistence of putty. Roll it in the hands to a proper length and apply it over the crack, pressing it with a long spatula into the crack.

To Remove Deposit of Carbon from Clay Retorts.—Leave the retort uncharged for 48 hours, or as long as can be spared. Put the lid on the mouth-piece so as to be closed at top, and open two or three inches at the bottom. Take out the stopper from stand pipe, so as to allow a current of air to pass through the retort and oxydize the carbon; use no bar. Put in a charge of coal after the retort has lain idle the number of hours required, and when it is withdrawn the carbon comes with it.

To Prevent Gas Meters From Freezing.—Half a pint of good glycerine is said to prevent the freezing of 1 gal. water, though at least double the proportion is preferable in the country, whatever the temperature in the winter may happen to be.



How To Read The Gas Meter. The figures on the index at the right hand denote even hundreds. When the hand completes the entire circle it denotes ten hundred, and is registered by the hand in the centre circle, pointing to one—each figure in the centre circle being a thousand, this entire circle being ten thousand; and is registered on the index of the left hand circle by the hand, there denoting by each figure, ten thousand.

The quantity of gas which passes through the meter, is ascertained by reading from the index at the time the amount is required to be known, and deducting therefrom the quantity shown by the index at a previous observation.

If the whole is registered by the hands on the three circles above, it indicates..........49.900

Amount at previous observation, as shown by the dotted lines..........42.500

Shows amount which passed through since last taken off.....7.400

The register at all times shows the quantity that has passed through since the meter was first set, by deducting from which the amount that has been paid for (without any regard to the time when,) shows that the difference remains unpaid.

To Purify Gas.—The purifier is to be filled with milk of lime, made by mixing 1 part of slaked lime with 25 parts of water. A very great improvement in the purification of gas has been effected by Mr. Statter, of England, by the employment of hydrated clay along with the lime employed for this purpose. Hydrated clay unites with the ammonia of the gas as with a base, and, at the same time with its sulphuret of carbon as an acid, and thus removes both of these noxious impurities from the gas exposed to its influence. It assists also, in conjunction with the lime, in removing tarry vapor and other impurities from the gas. The illuminating power of the gas is positively increased by the clay purification from 22 to 33⅓ per cent. Latterly, use is made of hydrated sesquioxide of iron for purifying gas.

TO AVOID WASTE OF GAS.—Turn the gas partly off at the meter; much gas is burned to waste by too great pressure in certain localities. In buildings of any size a good regulator will soon pay for itself. *To stop the leakage of gas.* Turn off the gas back of the meter; then take out (a screw driver is all the tool required) the plug. Next light a wax, sperm, or paraffine candle, and drop the melted wax, sperm, or paraffine upon the surface of the plug, till it is covered with a thin layer. Next, screw in the tap, and in nine cases out of ten the leak will be stopped, and remain stopped.

TO REMEDY SCATTERING SHOT GUNS.—The only remedy known to gunsmiths is by choke-boring, that is, boring from the breech of the gun, so as to have a gradual taper towards the muzzle. This method of boring greatly improves the shooting qualities of the gun, as the charge concentrates at the muzzle. Large shot are more apt to scatter than fine, but this depends on the bore of the gun. A large bored gun does not shoot fine shot so well as medium. A small bored gun throws fine shot with greater force than a large bored one. As a general thing, a small bored gun is not adapted to large shot, as it does not chamber them well. The length of gun also depends on the size of bore—28 or 30 inches for a gun of from 10 to 14 gauge; 30 to 34, of guns from 8 to 10; 26 to 28, of guns of 15 to 18 gauge.

BRONZING FLUID FOR GUNS.—Nitric acid, sp. gr. 1.2 parts; nitric ether, alcohol, muriate of iron, each 1 part; mix, then add sulphate of copper, 2 parts, dissolved in water, 10 parts.

BLUING ON REVOLVERS AND GUN BARRELS is performed by simply heating the piece to be blued in powdered charcoal over a fire until the desired color is obtained.

FINE BLUE FINISH FOR GUN BARRELS.—Apply nitric acid and let it eat into the iron a little; then the latter will be covered with a thin film of oxide. Clean the barrel, oil and burnish. A very fine appearance is given to gun barrels by treating them with dilute nitric acid and vinegar, to which has been added sulphate of copper. The metallic copper is deposited irregularly over the iron surface; wash, oil and rub with a hard brush.

BROWNING FOR GUN BARRELS.—Spirits of nitre, 1 lb.; alcohol, 1 lb.; corrosive sublimate. 1 oz.; mix in a bottle, and cork for use. Directions: polish the barrel perfect; then rub it with quick lime with a cloth, which removes grease and dirt; now apply the browning fluid with a clean white cloth, apply one coat, and set it in a warm dark place for from 10 to 20 hours, until a red rust forms on it; then card it down with a gunmaker's card, and rub off with a clean cloth. Repeat the process if you wish a dark shade.

BROWNING FOR TWIST BARRELS.—Spirits of nitre, ¾ oz.; tincture of steel, ¾ oz.; or use the unmedicated tincture of iron if the tincture of steel cannot be obtained; black brimstone, ¼ oz.; blue vitriol, ½ oz.; corrosive sublimate, ¼ oz.; nitric acid, 1 dram; copperas, ¼ oz.; mix with 1½ pints rain water, and bottle for use. This is to be applied the same as the first; it causes the twist of the barrel to be visible after application, a quality which the other liquid does not possess.

BROWNING COMPOSITION FOR GUN BARRELS.—1. Blue vitriol, 4 oz.; tincture of muriate of iron, 2 oz.; water, 1 qt.; dissolve, and add aquafortis and sweet spirits of nitre, of each, 1 oz. 2. Blue vitriol and sweet spirits of nitre, of each 1 oz.; aquafortis, ½ oz.; water, 1 pint. To be used in the same manner as previously described in this work.

VARNISH AND POLISH FOR GUN STOCKS.—Gum shellac, 10 ozs.; gum sandarac, 1 oz.; Venice turpentine, 1 dr.; 98 per cent. alcohol, 1 gal.; shake the jug occasionally for a day or two, and it is ready for use. Apply a few coats of this to your gun stocks, polish by rubbing smooth, and your work is complete.

BORING GUN BARRELS.—Take a piece of rod, cast steel, ⅛ inch smaller than the interior of the barrel, and a few inches longer, beat one end up something larger than the size of the bore, then turn or file it in the shape of an egg, leaving the swell, or centreing part 1-20th of an inch larger than the bore. With a saw file, cut longitudinal cuts, ⅛ inch apart, laying them the same angle as a rose bit countersink, taking care not to injure the periphery of the tool; harden and temper to straw color.

DAMASCUS TWIST AND STUB-TWIST GUN-BARRELS.—The twisted barrels are made out of long ribbands of iron, wound spirally around a mandril, and welded on their edges by jumping them on the ground, or rather on an anvil embedded therein. The plain stub barrels are made in this manner, from iron manufactured from a bundle of stub-nails, welded together, and drawn out into ribbands, to insure the possession of a material most thoroughly and intimately worked. The Damascus barrels are made from a mixture of stub-nails and clippings of steel in given proportions, puddled together, made into a bloom, and subsequently passed through all the stages of the manufacture of iron, in order to obtain an iron that shall be of an unequal quality and hardness, and therefore display different colors and markings when oxidized or browned. Other twisted barrels are made in the like manner, except that the bars to form the ribbands are twisted whilst red hot, like ropes, some to the right, others to the left, and which are sometimes laminated together for greater diversity. They are subsequently again drawn into the ribbands and wound upon the mandril, and frequently two or three differently prepared pieces are placed side by side to form the complex and ornamental figures for the barrels of fowling-pieces, described as *stub-twist*, *wire-twist*, *Damascus-twist*, &c. Sometimes Damascus gun-barrels are formed by arranging twenty-five thin bars of iron and mild steel in alternate layers, welding the whole together, drawing it down small, twisting it like a rope, and again welding three such ropes, for the formation of the ribband, which is then spirally twisted to form a barrel, that exhibits, when finished and acted upon by acids, a diversified, laminated appearance, resembling, when properly managed, an ostrich feather.

DAMASKEENING.—This is the art, now in a great measure lost, of producing a watered or wavy appearance on the steel sword-blades, armour, &c., or of inlaying and encrusting steel with gold and silver, originally practised at Damascus. Various methods of damaskeening were practised. but the most common seem to have been those of welding two different kinds of steel, or steel and iron, together, or of cutting lines on the surface of the steel and filling them with gold or silver, which was either forced into the incised lines and brought to a level with the surface of the steel, or remained in relief above it. When the former method was used, a light pattern, generally in many lines, was produced on a dark ground, or *vice versa*, and the junction of the metals caused the pattern to run through the entire thickness of the blade, so that it could not be obliterated even by grinding.

On Wood Cuts and New Wood Types.—Wood cuts should never be washed with lye or water, benzine or camphene only should be used. Large wood letters when new should be soaked in a mixture of turpentine and thin boiled linseed oil over night, and taken out of the bath in the morning, and then wiped clean. Let them stand awhile to absorb what oil, etc., may not have been removed by wiping, then ink them well. After they stand a few hours wash them with benzine.

Printers' Rollers.—*No.* 1. *Black Composition*, very durable and elastic. Genuine Irish or Buffalo glue 10½ lbs., black sugar cane, or best maple molasses, 1 gal., purified India rubber shavings, 1 lb., Carolina tar, 2 ozs., glycerine, 12 ozs., strong vinegar. 4 ozs. Soak the glue over night and drain in the morning by means of a *covered* colander. Boil molasses and skim for 20 minutes. Add the rubber shavings and stir until it combines with the molasses, add the glue and boil 6 or 7 minutes, and pour. If purified rubber cannot be procured add 1½ lbs. more glue and 4 ozs. more glycerine. No. 1 glue, 2 lbs.; Baeder's glue 2 lbs.; best sugar house molasses, 1 gal.; glycerine, ½ pt. For *Winter* use, reduce each glue ¼ to ⅜ of a lb. Soak the glues wrapped up separately in woolen cloths about three hours. Boil the molasses 45 or 50 minutes, skimming thoroughly. Then add the glues drained of superfluous water. Boil the whole for 15 or 20 minutes, add the glycerine, boil and stir 3 to 5 minutes then pour off. *No.* 3. *Strong Middle Weather Rollers. Temp.* 60° *to* 70° *Fahr.* Coopers best glue, 8½ lbs.; extra syrup, 2 gals.; glycerine, 1 pt.; Venice turpentine, 2 ozs. Steep the glue in rain water until pliant, and drain it well. Then melt it over a moderate fire, but do not "cook it." This will take from 15 to 25 minutes. Next put in the syrup, and boil ¾ of an hour, stirring it occasionally and skimming off impurities arising to the surface. Add the glycerine and turpentine a few minutes before removing from the fire, and pour slowly. Slightly reduce or increase the glue as the weather becomes colder or warmer.

Silvering Solution for Electrotype Plates.—Nitrate of silver 2 drs.; distilled water, 37 drs. Dissolve, and add sal ammoniac, 1 dr.; hydrophosphite of soda, 4 drs.; precipitated chalk, 4 drs. Agitate the preparation occasionally for 12 hours, when it will be ready for use. Apply with a fine sponge.

Printing on Glass.—A Frenchman, named Wilbaux, has taken out a patent to use an elastic type for printing on glass, with fluorspar rendered adhesive by some such material as mucilage or printers' ink; sulphuric acid of suitable temperature is then allowed to act on that portion of the glass. The hydrofluoric acid generated in this way would etch the glass on the places printed on. When completed, the whole is washed off with warm water and lye.

LIQUID FOR BRIGHTENING COMMON QUALITIES OF BLACK OR COLORED INKS.—Demar varnish, 1 oz.; balsam fir, ½ oz.; oil bergamot, 25 drops; balsam of copaiba, 35 drops; creosote, 10 drops; copal varnish, 50 drops. Use in small quantities. The whites of fresh eggs are also brighteners of colored inks, but they must be applied a little at a time, as they dry very hard, and are apt to take away the suction of rollers if used for any extended period.

GOOD REDUCING DRYER.—Brown's (genuine) Japan. Use in small quantities. *Hardening Gloss For Inks.*—Gum Arabic dissolved in alcohol or a weak dilution of oxalic acid. Use in small quantities, and mix with the ink as the latter is consumed.

TO GIVE DARK INKS A BRONZE OR CHANGEABLE HUE.—Dissolve 1½ lbs. gum shellac in 1 gal. 65 per cent alcohol or cologne spirits for 24 hours. Then add 14 ozs. aniline red. Let it stand a few hours longer, when it will be ready for use. Add this to good blue, black, or other dark ink, as needed in quantities to suit, when if carefully done they will be found to have a rich bronze or changeable hue.

QUICK DRYER FOR INKS USED ON BOOKBINDERS' CASES.—Beeswax, 1 oz., gum arabic (dissolved in sufficient acetic acid to make a thin mucilage), ¼ oz., Brown Japan, ¼ oz. Incorporate with 1 lb. of good Cut ink. *To Renew a Hard Roller.*—Wash the roller carefully with lye cover the surface with a thin layer of molasses and lay it aside till the next morning, then wash it with water, and let it hang till dry enough for using.

SAVAGE'S PRINTING INK.—Pure balsam of copaiba, 9 ozs.; lampblack, 3 ozs.; indigo and Prussian blue, each 5 drams; Indian red, ¾ oz.; yellow soap, 3 ozs. Mix, and grind to the utmost smoothness.

PRINTING INK.—Set on a fire in a large iron pot 12 gals. of clear linseed oil, boil, and stir until it smokes, then ignite it, remove it from the fire and let it burn until a sample will draw into strings between the fingers. Put the lead on to extinguish the flame, then add 1 lb. of resin to each qt. of oil; dissolve, and add gradually in slices 1¾ lbs. of soap; heat the pot until the solution is complete, when the varnish is ready. Two sorts are kept, one thick, and the other thin, so as to mix when required; the difference is caused in the boiling and firing being kept up for different periods. For large printing type a thin is required, as thick ink would only print in patches; for small type very stiff ink is used, to prevent it running off. For making black ink, mix together mineral lampblack, 8 lbs.; vegetable black, 7 lbs.; indigo and Prussian blue of each 5 ozs. Indian red, 2 ozs.; grind this with sufficient varnish, gradually adding as the grinding goes on. For colored ink use colored pigments, according to the required shade.

GUM FOR BACKING LABELS.—Mix pure dextrine with boiling water until it assumes the consistency of ordinary mucilage. Apply with a full bodied, evenly made camel's hair brush. The paper should not be too thin or unsized. It will dry quickly and adhere when slightly wet.

PROF. BOTTGER'S PORTABLE INK.—Make the strongest possible solution of aniline black in water or alcohol, and soak thick unsized paper thoroughly to imbibe mixture, and then dry. Put in a botttle and add water as required.

Coloring and Sizing of Paper.—Paper is adulterated with plaster of Paris, sometimes to the extent of 30 per cent., to increase the weight. Brown paper is mixed with ochre and clay, the manufacturers say, to give it a nice brown color, but doubtless, the true reason is, to make it heavier. White soap, glue, starch, and dissolved resin with a few pounds of alum, form a good size for printing paper to mix with the pulp. Four or five pounds oxide of cobalt (smalts), give a beautiful blue tinge to fine writing paper, when added to 100 lbs. of the rags. Writing paper is sized by being dipped 5 or 6 sheets at a time into a composition made from skins and other animal substances, a large pile of it being afterwards pressed to force out the superfluity, although machines now exist making fine writing paper, sized with gelatine, dried, and cut into sheets, at the rate of 60 feet a minute in length, and 70 inches wide. Almost any desired shade may be imparted to paper by the use of several of the coloring pigments mentioned on page 132. It requires great skill and judgment to rightly proportion the various ingredients for coloring the pulp.

To Pulp Straw for Paper Making.—The straw is placed in a boiler, with a large quantity of strong alkali, and with a pressure of steam equal to from 120 to 150 pounds per square inch, the extreme heat being attained in superheating the steam after it leaves the boiler, by passing it through a coiled pipe over a fire, and thus the silica is destroyed, and the straw softened to pulp, which, after being freed from the alkali by working it in cold water, is subsequently bleached and beaten in the ordinary rag machine.

To Transfer Pictures from Paper to Wood for Re-engraving.—Soak the print in a saturated solution of alcohol and white caustic potash to soften the ink, then transfer to the block under roller pressure.

To Transfer Prints, &c.—Take of gum sandarac, 4 ozs.; mastic, 1 oz.; Venice turpentine, 1 oz.; alcohol, 15 ozs. Digest in a bottle, frequently shaking, and it is ready for use. Directions: use, if possible, good plate glass of the size of the picture to be transferred, go over it with the above varnish, beginning at one side, press down the picture firmly and evenly as you proceed, so that no air can possibly lodge between; put aside, and let dry perfectly, then moisten the paper cautiously with water, and remove it piecemeal by rubbing carefully with the fingers; if managed nicely, a complete transfer of the picture to the glass will be effected.

Paper for Draughtsmen, &c.—Powdered tragacanth, 1 part; water, 10 parts; dissolve and strain through clean gauze; then lay it smoothly upon the paper previously stretched upon a board. This paper will take either oil or water colors.

To Apply Decalcomine Pictures.—Varnish the pictures carefully with the prepared varnish (which can be obtained with the pictures), with an ornamenting pencil, being careful not to get the varnish on the white paper. In a few minutes the picture will be ready to lay on the panel, and the paper can be removed by wetting it, and when thoroughly dry, it should be varnished like an oil painting. Be particular to purchase only these transfer pictures which are covered with a gold leaf on the back, for they will show plainly on any colored surface, while the plain pictures are used only on white or light ground.

ENGRAVING ON WOOD.—In order to make this subject rightly understood we will state that the log of box is cut into transverse slices, 1 inch in depth, in order that the face of the cut may be on a level with the surface of the printers' type, and receive the same amount of pressure; the block is then allowed to dry, the longer the better, as it prevents accidents by warping and splitting, which sometimes happens after the cut is executed, if too green. The slice is ultimately trimmed into a square block, and if the cut is large, it is made in various pieces and strongly clamped and secured together. The upper surface of the wood is carefully prepared, so that no inequalities may appear upon it, and it is then consigned to the draughtsman to receive the drawing. He covers the surface with a light coat of flake white mixed with weak gum water, and the thinner the coat the better for the engraver. The French draughtsmen use an abundance of flake white, but this is liable to make the drawing rub out under the engraver's hands, or deceive him as to the depth of line he is cutting in the wood. The old drawings of the era of Durer seem to have been carefully drawn with pen and ink on the wood; but the modern drawing being very finely drawn with the pencil or silver point is obliterated easily, and there is no mode of "setting" or securing it. To obviate this danger the wood engraver covers the block with paper, and tears out a small piece to work through, occasionally removing the paper to study the general effect. It is now his business to produce in relief the whole of the drawing; with a great variety of tools he cuts away the spaces, however minute, between each of the pencil lines, and should there be tints wanted on the drawing to represent sky and water, he cuts such parts of the block into a series of close lines, which will, as near as he can judge, print the same gradation of tint; should he find he has not done so completely, he can re-enter each line with a broader tool, cutting away a small shaving, thus reducing their width and consequently their color. Should he make some fatal error that cannot otherwise be rectified, he can cut out the part in the wood, and wedge a plug of fresh wood in the place, when that part of the block can be re-engraved. An error of this kind in a wood-cut is a very troublesome thing; in copper engraving it is scarcely any trouble, a blow with a hammer on the back will obliterate the error on the face, and produce a new surface, but in wood the surface is cut entirely away except where the lines occur, and it is necessary to cut it deep enough not to touch the paper, as it is squeezed through the press upon the lines in printing. To aid the general effect of a cut, it is sometimes usual to lower the surface of the block before the engraving is executed, in such parts as should appear light and delicate; they thus receive a mere touch of the paper in the press, the darker parts receiving the whole pressure and coming out with double brilliancy. When careful printing is bestowed on cuts it is sometimes usual to insure this good effect by laying thin pieces of card or paper on the tympan, of the shape needed, to secure pressure on the dark parts only.

DIE SINKING.—When a die is required for a coin or medals, the engraver takes a piece of soft steel of suitable dimensions, generally

3 or 4 inches in length, and about an inch greater in diameter than the coin or other article required, on this he hollows out the exact form of the desired impression by cutting away the steel by degrees, with small, well-tempered, case-hardened tools. As soon as this work is thoroughly accomplished the steel is hardened by being heated red hot in a crucible with charcoal and oil or bone-dust, and then plunged into cold water. When a great number of coins of one sort are required, the original die is termed the matrix, and copies are made from it by taking impressions from it in soft steel, which is in relief, and is called the puncheon, and from which, when it has been hardened, other dies are produced by pressure, exactly similar to the matrix, and in *intaglio*, which are case-hardened in their turn before they are fit to transmit an impression to any metal used for money. The metal used for our coinage, whether gold, silver, copper, or bronze, is stamped in a cold and solid state; but medals and casts can also be produced by a method called casting *en cliche*, in which the metal is used in a soft state. For this purpose an alloy is used, consisting of $\frac{1}{4}$ lead, $\frac{1}{4}$ tin, and $\frac{1}{2}$ bismuth, which fuses readily at the boiling point, 212° Fah. When the metal is soft, resembling paste in consistency, the die is placed upon it, and the impression produced by a smart blow from a mallet; the surface of the metal sets instantly, from coming into contact with the cold die, and thus readily retains the form that has been given to it. Copies of medals may be readily made in this way, but each face will be obtained in a separate piece, and these must be joined to give representations of the coin in a complete form. Ornamental work is produced in thin metal for gas fitting, cornices, parts of cruet-stands, trays, &c., by means of a pair of dies, on one of which the pattern is formed in relief, and on the other in *intaglio*, the metal being placed between them, and brought into the desired shape by pressure. Dies are also made in metal for forming articles in gutta-percha and leather, and producing embossed figures on the cloth covers of books, as well as on cardboard, paper, &c.

Steelplate Engraving.—As regards steelplate engraving, it has proved immensely superior to the old copper plate system. A soft steel plate is first engraved with the required subject in the most finished style of art either by hand or mechanically, or the two combined, and the plate is then hardened; a softened steel cylinder is then rolled over the hardened plate, with great pressure by powerful machinery, until the engraved impression appears in relief,—the hollow lines of the original becoming ridges upon the cylinder, the roller is re-converted to the condition of ordinary steel, and hardened, after which it serves for returning the impression to any number of decarbonized plates, every one of which becomes absolutely a *counterpart* of the original, and every plate, when hardened, would yield the enormous number of 150,000 impressions, without any perceptible difference between the first and the last. In one instance, from one engraving of the Queen's head on the postage stamp, over 6,000 plates were produced from the original, and plates for bank-note printing are multiplied in the same way. Great caution must be used in the various processes of annealing and hardening, as only slight carelessness would result in ruining the most costly plates. The method in use in the Bank of England is as follows: the work to be hardened is enclosed in a wrought-iron box with a loose cover, a false bottom, and with three ears projecting from its surface about midway; the steel is surrounded on all sides with carbon from leather, driven in hard, and the cover and bottom are carefully luted with moist clay; thus prepared, the case is placed in the vertical position, in a bridge fixed across a great tub, which is then filled with water almost to touch the flat bottom of the case; the latter is now heated in the furnace as quickly as will allow the uniform penetration of the heat. When sufficiently hot, it is removed to its place in the hardening tub, the cover of the iron box is removed, and the neck or gudgeon of the cylinder is grasped *beneath the surface of the carbon*, with a long pair of tongs, upon which a couplet is dropped to secure the grasp. It only remains for the individual to hold the tongs with a glove whilst a smart tap of the hammer is given to their extremity; this knocks out the false bottom of the case and the cylinder, and the tongs prevent the cylinder from falling on its side, and thus injuring its delicate but still hot surface. For square plates, a suitable frame is attached by four slight claws, and it is the frame which is seized by the tongs; the latter are sometimes held by a chain which removes the risk of accident to the individual. The steel comes out of the water as smooth to the touch as at first, and mottled with all the tints of case-hardened gunlocks.

Writing Inscriptions on Metals.—Take ¼ lb. of nitric acid and 1 oz. of muriatic acid. Mix, shake well together, and it is ready for use. Cover the place you wish to mark with melted beeswax; when cold, write your inscription plainly in the wax clear to the metal with a sharp instrument; then apply the mixed acids with a feather, carefully filling each letter. Let it remain from 1 to 10 minutes, according to appearance desired; then throw on water, which stops the process, and remove the wax.

Etching Fluids.—*For copper.*—Aquafortis, 2 ozs.; water, 5 ozs. *For steel.*—Iodine, 1 oz.; iron filings, ½ dr.; water, 4 ozs. Digest till the iron is dissolved. *For fine touches.*—Dissolve 4 parts each of verdigris, sea salt, and sal-ammoniac, in 8 parts vinegar, add 16 parts water; boil for a minute, and let it cool.

Engravers' Border Wax.—Beeswax, 1 part; pitch, 2 parts; tallow, 1 part. Mix. *Engravers' cement.*—Rosin, 1 part; brick dust, 1 part. Mix with heat.

Moulds and Dies.—Copper, zinc, and silver in equal proportions; melt together under a coat of powdered charcoal, and mould into the form you desire. Bring them to nearly a white heat, and lay on the thing you would take the impression of, press with sufficient force, and you will get a perfect and beautiful impression.

Cast Engravings.—Take the engraved plate you wish to copy and arrange a support of suitable materials round it, then pour on it the following alloy in a state of perfect fusion: tin, 1 part; lead, 64 parts; antimony, 12 parts. These "cast plates" may be worked off on a common printing press, and offer a ready mode of procuring cheap copies of the works of our celebrated artists.

Black Stencil Ink.—Triturate together, 1 pt. pine soot and 2 pts. Prussian blue with a little glycerine, then add 3 pts. gum arabic and sufficient glycerine to form a thin paste.

Indelible Stencil Inks. 1. Varnish, such as is used for ordinary printing ink, 1 lb.; black sulphuret of mercury, 1 lb.; nitrate of silver, 1 oz.; sulphate of iron, 1 oz.; lampblack, 2 tablespoonfuls. Grind all well together; thin with spts. turpentine as desired. 2. Sulphate of manganese, 2 parts; lampblack, 1 part; sugar, 4 parts; all in fine powder and triturated to a paste in a little water. *Permanent Red.*—Vermilion, 4 parts; sulphate of iron, 1 part; drying oil to mix. Any other color will answer besides red.

BLUE RULING INK.—Good vitriol, 4 ozs.; indigo, 1 oz.; pulverize the indigo, add it to the vitriol, let it stand exposed to the air for 6 days, or until dissolved; then fill the pots with chalk, add fresh gall, ½ gill, boiling it before use.

BLACK RULING INK.—Take good black ink, and add gall as for blue; do not cork it, as it prevents it from turning black. See 16 different inks on page 215.

TO PRINT A PICTURE FROM THE PRINT ITSELF.—The page or picture is soaked in a solution, first of potassa, and then of tartaric acid. This produces a perfect diffusion of crystals of bitartarate of potassa through the texture of the unprinted part of the paper. As this salt resists oil, the ink roller may now be passed over the surface, without transferring any part of its contents except to the printed part.

TO CLEAN OLD OIL-PAINTINGS.—Dissolve a small quantity of salt in stale urine; dip a woollen cloth in the mixture, and rub the paintings over with it till they are clean; then wash them with a sponge and clean water; dry them gradually, and rub them over with a clean cloth. Should the dirt not be easily removed by the above preparation, add a small quantity of soft soap. Be very careful not to rub the paintings too hard.

TO RENEW OLD OIL-PAINTINGS.—The blackened lights of old pictures may be instantly restored to their original hue by touching them with deutoxide of hydrogen diluted with six or eight times its weight of water. The part must be afterwards washed with a clean sponge and water.

MAGIC PAPER.—Take lard oil, or sweet oil, mixed to the consistence of cream, with either of the following paints, the color of which is desired: Prussian blue, lampblack, Venetian red, or chrome green, either of which should be rubbed with a knife on a plate or stone until smooth. Use rather thin but firm paper; put on with a sponge, and wipe off as dry as convenient; then lay them between uncolored paper, or between newspapers, and press by laying books or some other flat substance upon them until the surplus oil is absorbed, when it is ready for use.

RUBBER HAND STAMPS.—Set up the desired name and address in common type, oil the type and place a guard about ½ inch high around the form; now mix plaster of Paris to the proper consistence, pour in and allow it to set. Have your vulcanized rubber all ready, as made in long strips 3 inches wide and ⅛ of an inch thick, cut off the size of the intended stamp, remove the plaster cast from the type, and place both the cast and the rubber in a screw press, applying sufficient heat to thoroughly soften the rubber, then turn down the screw hard and let it remain until the rubber receives the exact impression of the cast and becomes cold, when it is removed, neatly trimmed with a sharp knife, and cemented to the handle ready for use.

To Make Door Plates.—Cut your glass the right size, and make it perfectly clean with alcohol or soap; then cut a strip of tin-foil sufficiently long and wide for the name, and with a piece of ivory or other burnisher rub it lengthwise to make it smooth; now wet the glass with the tongue (as saliva is the best sticking substance), or if the glass is very large, use a weak solution of gum arabic, or the white of an egg in half a pint of water, and lay on the foil, rubbing it down to the glass with a bit of cloth, then also with the burnisher; the more it is burnished the better it will look; now mark the width on the foil which is to be the height of the letter, and put on a straight edge, and hold it firmly to the foil, and with a sharp knife cut the foil, and take off the superfluous edges; then either lay out the letters on the back of the foil (so they shall read correctly on the front) by your own judgment, or by means of pattern letters, which can be purchased for that purpose; cut with the knife, carefully holding down the pattern or straight edge, whichever you use; then rub down the edge of all the letters with the back of the knife, or edge of the burnisher, which prevents the black paint or japan, which you next put over the back of the plate from getting under the foil; having put a line above and one below the name, or a border around the plate or not, as you bargain for the job. The japan is made by dissolving asphaltum in just enough turpentine to cut it; apply with a brush, as other paint, over the back of the letters, and over the glass forming a background. This is used on the iron plate of the frame also, putting it on when the plate is a little hot, and as soon as it cools, it is dry. A little lampblack may be rubbed into it if you desire it any blacker than it is without it.

Reliable Formulæ for Photographers.—No. 1. *Silver Bath for Albumen Paper, for Summer use.*—Crystal nitrate of silver, 40 grains; nitrate of ammonia, 35 grains; filtered rain water, 1 oz.; saturated solution bicarbonate of soda, about 8 or 10 drops, or enough to make the bath *slightly alkaline.* No. 2. *For winter use.* Nitrate of silver 2½ ozs.; nitrate of soda 2 ozs.; glycerine 3 ozs.; pure water 40 ozs. Make it a little alkaline with aquas ammonia. No. 3. *Another Silver Bath.* Silver, from 40 to 45 grs. (according to temperature;) nitrate of ammonia, 20 grs.; distilled or ice water, 1 oz. Float 45 seconds to 1 minute. No. 4. *Sal Soda Toning Bath.* Distilled or melted ice water 64 ozs.; acid solution chloride of gold, (4 grs. to the oz.) 1 oz.; saturated solution of sal soda, ½ oz. Make it a full half hour before you wish to use it, and during the cold weather use the water slightly warm. No. 5. *Chloride of Lime Bath.* Water, 40 ozs.; chloride of lime, 5 grains; chloride of gold, 4 grs. No. 6. *Bicarbonate of Soda Bath.* Chloride of gold solution (1 gr. to the oz. of water,) 1 oz.; luke warm water, 16 ozs.; bicarbonate of soda, (saturated solution,) 10 minims. Make up fresh every time you prepare to tone. Make half an hour before using. Precipitate the gold in the old solutions with protosulphate of iron. No. 7 *Fixing Bath.* Hyposulphite of soda, 1 part to 8 of water, and if the paper blisters in the washing, soap the prints for 5 minutes in a solution of common salt. No. 8. *Bath for Salting the Paper.* Pure rain water, 60 ozs.; chloride of ammonium, 360 grs.; gelatine, 120 grs.

Photograph Painting in Oil Colors.—Tints for the First Painting.—Flesh.—*White and Light Red.*—White, Naples yellow, and vermilion. White, vermilion, and light red. *Gray, Pearly, and Half Tints.*—White, vermilion, and black. White and terre verde. White, black, Indian red, and raw umber. *Deep Shades.*—Light red and raw umber.—Indian red, lake and black. *Carnations.* —White and Indian red (powerful color). White and rose madder. White and lake. HAIR.—*Light Hair.*—White and yellow ochre. White and Roman ochre. White and Vandyke brown for the dark parts. White and raw umber for the dark parts. *Dark Brown Hair.* —Raw and burnt umber. White and raw umber. White and Vandyke brown. TINTS FOR THE SECOND AND THIRD PAINTING. *High Lights.* White and Naples yellow. *Carnations.* Rose madder and white. Indian red, rose, madder, and white. *Green Tints.*—White and ultramarine, with any of the yellows. White and terre verte, with the addition of a little raw umber. The above green tints may be converted into green grays. *Gray Tints.*—Ultramarine, light red, and white. Indian red, lake, black and white. White, ultramarine, Indian red, and raw umber. *Purple Tints.*—Any of the lakes or red madders, with ultramarine and white. *Powerful Shadow Tints.* Indian red, purple lake, and black. Indian red, raw umber, and black. *Strong Glazing Colors.*—Light red and lake. Brown madder. Vandyke brown, Indian red, and lake asphaltum. DRAPERIES.—BACK GROUND COLORS.—*Pearly.*—White, vermilion, and blue. White, vermilion, and black. White and black. *Gray.*—White, Venetian red and black. *Yellow.* Yellow ochre and white. *Olive.*—Yellow ochre, terre verte, and umber. *Stone.*—Raw umber and yellow. Black, white, and raw umber. *Sky.*—French blue and white. French blue, vermilion, and white. *Edges of Clouds.*—Yellow ochre and white. *Clouds.*—Indian red, lake, and white. Brown madder, French blue, and white.

PHOTOGRAPH WATER COLORS.—FLESH TINTS. No. 1. *Fair Complexion.*—Light red, a little carmine or vermilion, and Indian yellow. Be careful in using the latter, and. in the flesh tints of very fair children, allow the vermilion to predominate ; carnations, rose madder, and, if the face be full of color, add a little vermilion to it. 2. *Middling Complexion.*—Much the same as No. 1, saving that the light red must be in excess over the other colors—carnations, rose madder, and lake. 3 *Dark Complexion.*—Light red and Indian yellow, or light red and Roman ochre, and, if the complexion be generally ruddy, you may add a little Indian red, but it must be sparingly used, as it is a powerful color, and likely to impart a purple tone to the flesh. Carnations chiefly lake, but if the complexion be warm, lake and a little yellow. The carnations for children's portraits are rose madder and vermilion, inclining more to the latter tint. Aged persons have rose madder, and a little cobalt to give a cold appearance to the color in their cheeks and lips. These tints, Nos. 1, 2, and 3, are indispensable as general washes, for the purpose of receiving the other colors, which are to be worked over them to bring up the complexion to the life. Uncolored photographic portraits vary so much in tone, that the beginner will, perhaps, find some difficulty in mixing up the tints for the washes. He must note that the warm-toned ones do not require so much Indian yellow as the cold ones do.

KEROSENE OR CARBON OIL MANUFACTURE.—Petroleum, or rock oil, is a liquid substance, of a dark color, exuding from the earth and containing certain liquid and solid hydrocarbons such as benzole, or benzine, kerosene, paraffine, asphaltum, &c., in a state of solution, in different proportions. It differs greatly in composition, some samples containing solid paraffine and benzole in large quantities, while others do not. Petroleum is separated from its different products by careful distillation at different temperatures. The crude material is first heated in a retort to a temperature of about 100° Fah. This causes a light oil of a strong odor to pass over into the condenser. The residue is then distilled at about 120° to 160°, the result being burning oil. When this is distilled off, steam is forced into the retort and a heavy oil, fit for lubricating purposes, comes over, a black, tarry mass being left behind. The light oil is now used for mineral turpentine, and as a grease solvent. It is often of a dark color, which is easily removed by agitation, first with sulphuric acid and afterwards with soda-ley and water. In many instances this light oil (benzine) is sold for illuminating purposes under the name of Sunlight Oil, Combination Burning Fluid, Lightning oil, &c. I knew a gentleman in Philadelphia who paid one man over $3000 for the receipt for making, together with the sole right to manufacture, vend and sell, a compound of this kind in that city. The curious, or those interested, will find the receipt under the name of the "Northern Light" under the Grocer's Department in this work. Truth requires me to state that this article requires to be handled with great caution when used for lighting purposes—many lamentable accidents having resulted from a careless use of it. The heavy lubricating oil, when cooled down to 30° Fah., often yields paraffine in large quantities, which is separated by straining and pressure. The asphaltum may be used for pavements, or mixed with grease as a lubricant for heavy machinery. The most important product is, however, the burning oil, which is now used as a cheap and efficient illuminating agent in nearly every household in this country. An average sample of petroleum contains, according to W. B. Tegetmeier, 20 per cent. of benzine or mineral turps, 55 per cent. of burning oil, 22 per cent. of lubricating oil, and 8 per cent. of carbonaceous and tarry matter.

TO DEODORIZE BENZINE.—Shake repeatedly with plumbate of soda (oxide of lead dissolved in caustic soda), and rectify. The following plan is said to be better. Shake repeatedly with fresh portions of metallic quicksilver; let it stand for 2 days, and rectify.

TO PURIFY PETROLEUM OR KEROSENE OIL.—The distillate or crude burning oil is converted into ordinary burning oil by being placed into a tank when it is violently agitated by forcing air through it, and while thus agitated, 1½ to 2 per cent. sulphuric acid is added, after which the agitation is continued 15 or 30 minutes. The oil is then allowed to settle, when the acid and impurities are removed, and any acid remaining in the oil is neutralized. It is then taken to shallow bleaching tanks, where it is exposed to light and air, and allowed to settle. It is next heated by means of a coil of steam pipe running through it, to expel all gaseous vapors which will ignite at a temperature below 110° Fahr. The oil is now called a *fire test* oil, and is ready to be barreled and sent to market. Kerosene oil is *decolorized*, by stirring it up with 1 or 2 per cent. of oil of vitriol, which will carbonize the colloring matter, then with some milk of lime or some other caustic alkali, settling, and re-distilling.

To Bleach Fixed Oils.—Shake strongly for some minutes, 300 parts of the oil with 40 parts water containing 1 part permangate of potassa; allow the mixture to stand in a warm place for some hours, and then filter. This renders the oil colorless. *To purify oil.* Into 1000 parts by weight of oil, put a mixture of 6 parts solution of ammonia and 6 parts water, agitate the barrel well until the alkali is perfectly mixed, which may be done in 15 minutes. The barrel is then sealed hermetically, and after 3 days' repose, the oil is decanted and filtered. The residue is used for the manufacture of soap. *To Clarify Coal Oil.*—Place in a close vessel 100 lbs. crude coal oil, 25 qts. water, 1 lb. chloride of lime, 1 lb. soda, and ½ lb. oxide of manganese. The mixture is violently agitated, and allowed to rest for 24 hours when the clear oil is decanted and distilled. The 100 lbs. coal oil are to be mixed with 25 lbs. resin oil; this is one of the principal points in the manipulation; it removes the gummy parts from the oil, and renders them inodorous. The distillation spoken of may terminate the process, or the oils may be distilled before they are defecated and precipitated.

Oil for Fine Mechanism.—Oil for fine mechanism can be prepared by putting zinc and lead shavings, in equal parts, into good Florence olive oil, and placing in a cool place until the oil becomes colorless. Unequalled for sewing machines, &c.

To Make Linseed and Cotton Seed Oils.—In making linseed oil quite a variety of machinery is used, more or less expensive according to the enterprise and capital of the manufacturer. The seed is first passed through iron rollers, to be crushed or ground, one of the rollers is made to revolve more rapidly than the other, which subjects each seed to a pulling, as well as to a crushing process. The meal is taken from the mill to the "chasers," when it is subjected to another crushing process, more severe than the first. The chasers are two large circular stones about 5 feet diameter, and 18 inches thick, rolling upon a third stone in the manner of an old-fashioned bark or cider mill. These heavy stones start the oil from the seed, and to keep it from adhering to the chasers it is moistened with water. The meal is next put into an iron cylinder, which is kept revolving over a fire until the water is evaporated. Much of the skill of making oil depends upon this heating process. It must not be scorched, and yet it must be brought up to a high temperature, so that it will readily give out its oil. The presses are of various structure, some of them are patented, and others not open to public inspection. In one, the vats or hoops holding about 2 bushels each, were placed opposite each other against two immense beams or uprights, made fast in the foundations of the building. The followers were forced down upon the meal by 2 large levers worked by hydraulic power. The meal is kept under pressure about an hour, and the two presses work up about 92 bushels of seed every 24 hours, the mill being kept running night and day. The product is not far from 2 gals. of oil from a bushel of seed, a little more or less, according to the quality of the seed and the skill in pressing. The cakes, as taken from the press, are generally sold by the ton without grinding, and are generally exported in this form, but when there is a market in the vicinity of the mill, the cakes are put under the chasers, ground into meal, bagged and sent to the feed stores. The price of the cake is from $30 to $40 per ton; ground into meal it retails at about $2 per 100 lbs. The process of making the cotton seed oil and cake is nearly the same. The seed of the upland cotton is surrounded with a husk, to which the cotton adheres. It is surrounded with a soft down after it leaves the gin, and in this condition it is purchased from the planter. The seed makes better oil and better meal when it is deprived of this hull and down. The yield of oil is about 90 gallons per 100 bushels of the Sea Island, or 2 gals. to 56 lbs. of the hulled cotton seed.

To Make Coal Oil.—Break the coal or shale into small pieces and put from 10 to 16 cwt. in an iron retort, heated to a dull red color. Lute the retort door and keep up the retort for 24 hours. By this process a vapor is thrown off which passes through ranges of cisterns until it condenses, when it is run into cisterns. This crude oil, when refined and purified, is sold as paraffine oil, and solid paraffine for making candles is made from it.

Neat's Foot Oil.—After the hair and hoofs have been removed from the feet of oxen, they yield, when boiled with water, a peculiar fatty matter, which is known as *Neat's Foot Oil*; after standing, it deposits some solid fat, which is separated by filtration; the oil then does not congeal at 32°, and is not liable to become rancid. It is often mixed with other oils. This oil is used for various purposes, such as harness dressing, oiling tower clocks, &c. *Tallow Oil.*—The oil is obtained from tallow by pressure. The tallow is melted, and when separated from the ordinary impurities by subsidence, is poured into vessels and allowed to cool slowly to about 80°, when the stearine separates in granules, which may be separated from the liquid part by straining through flannel, and is then pressed, when it yields a fresh portion of liquid oil. It is used in soap manufacture, &c. *Lard oil* is obtained from hog's lard by pressure, when the liquid part separates, while the lard itself becomes much harder. According to Braconet, lard yields 0.62 of its weight of this oil, which is nearly colorless. It is employed for greasing wool, and other purposes.

Economic Lubricators.—1. India rubber, 4 lbs.; dissolved in spts. turpentine; common soda, 10 lbs.; glue, 1 lb.; water, 10 gals.; oil, 10 gals. Dissolve the soda and glue in the water by heat, then add the oil, and lastly the dissolved rubber. 2. *To Lessen Friction in Machinery.*—Grind together black lead with 4 times its weight of lard or tallow. Camphor is sometimes added, 7 lbs. to the hundred weight. 3. *Anti-Friction Grease.*—Tallow, 100 lbs.; palm oil, 70 lbs.; boil together, when cooled to 80°, strain through a sieve, and mix with 28 lbs. soda, and 1½ gals. water. For winter take 25 lbs. more oil in place of the tallow. 4. *Booth's Railway Axle Grease.*—Water, 1 gal.; clean tallow, 3 lbs.; palm oil, 6 lbs.; common soda, ½ lb.; or tallow 2 lbs.; palm oil, 10 lbs. Heat to about 212°, and stir well until it cools to 70°. 5. *Drill Lubricator.*—For wrought iron, use 1 lb. soft soap mixed with 1 gal. of boiling water. It insures good work and clean cutting.

To Remedy Slip of Driving Belts.—Dab on a little of the sticky oil which oozes away from the bearings of machinery.

Blasting Powders.—Reduce *separately* to powder, 2 parts chlorate of potassa and 1 part red sulphuret of arsenic; mix very lightly together, or powder separately, 5 parts chlorate of potassa; 2 parts red sulphuret of arsenic, and 1 part ferrocyanide of potassium (prussiate of potassa); mix carefully, or, mix carefully as before, after having separately reduced to powder equal parts chlorate of potassa and ferrocyanide potassium. These possess eight times the explosive force of gunpowder and must be used with the greatest caution.

BLASTING ROCKS, &C.—In small blasts, 1 lb. of powder will loosen about 4½ tons. In large blasts, 1 lb. of powder will loosen about 2½ tons; 50 or 60 lbs. of powder, enclosed in a resisting bag hung or propped up against a gate or barrier, will demolish any ordinary construction. One man can bore, with a bit 1 inch in diameter, from 50 to 60 inches per day of 10 hours in granite, or 300 to 400 ins. per day in limestone, Two strikers and a holder can bore with a bit 2 ins. in diameter 10 feet per day in rock of medium hardness.

TO MAKE DUALIN.—Dualin is made from paper stock, saturated with nitrate of potassium and dried in a furnace. Then ground and mixed with nitro-glycerine. *Component parts of nitro-glycerine.* To 4¾ lbs. concentrated sulphuric-acid and 2⅓ lbs. of concentrated nitric acid, add 1 lb. of glycerine.

LABOR ON EMBANKMENTS.—*Single horse and cart.* A horse with a loaded dirt cart employed in excavation and embankment, will make 100 lineal feet, or 200 feet in the distance per minute, while moving. The time lost in loading, dumping, awaiting, etc,=4 minutes per load. A medium laborer will load with a cart in 10 hours, of the following earths; measured in the bank: *Gravely earth* 10. *Loam* 12, and *Sandy earth* 14 cubic yards; *carts* are loaded as follows: *Descending hauling*, ⅓ of a cubic yard in bank; *Level hauling* 2-7 of a cubic yard in bank; *Ascending hauling*, ¼ of a cubic yard in bank, *Loosening, &c.* In *loam*, a three-horse plow will loosen from 250 to 800 cubic yards per day of 10 hours. The *cost* of loosening earth to be loaded will be from 1 to 8 cents per cubic yard, when wages are 105 cents per day. The cost of trimming and bossing is about 2 cents per cubic yard. *Scooping.* A scoop load will measure 1-10 of a cubic yard, measured in excavation. The time lost in loading, unloading and trimming, per load, is 1¼ minutes. The time lost for every 70 feet of distance, from excavation to bank, and returning is 1 minute. In *Double Scooping*, the time lost in loading, turning, &c., will be 1 minute; and in *Single Scooping*, it will be 1¾ minutes. (*Ellwood Morris.*

HAULING STONE.—A cart drawn by horses over an ordinary road will travel 1.1 miles per hour of trip. A 4-horse team will haul from 25 to 36 cubic feet of lime stone at each load. The time expended in loading, unloading, &c., including delays, averages 35 minutes per trip. The cost of loading and unloading a cart, using a horse cram at the quarry, and unloading by hand, when labor is $1.25 per day, and a horse 75 cents, is 25 cents per perch=24.75 cubic feet. The work done by an animal is greatest when the velocity with which he moves is ⅙ of the greatest with which he can move when not impeded, and the force then exerted .45 of the utmost force the animal can exert at a dead pull.

HAY.—270 cubic feet of new meadow hay, and 216 and 243 from large or old stacks, will weigh a ton, 297 to 324 cubic feet of dry clover weigh a ton.

ICE.—To compute the number of tons an ice-house will contain, calculate the number of cubic feet in an ice-house, and divide by 35;

this gives the number of tons the ice-house will contain it if is closely packed.

EARTH DIGGING.—*Number of cubic feet of earth in a ton.* Loose earth 24; coarse sand 18.6. Clay 18.6. Earth with gravel 17.8. Clay with gravel, 14.4. Common soil 15.6. The volume of earth and sand in bank exceeds that in embankment in the following proportions; sand 1-7, clay 1-9, gravel 1-11, and the volume of rock in embankments quarried in large fragments exceeds that in bank fully one half.

WEIGHT OF EARTH, ROCK, &c.—A cubic yard of sand or ground weighs about 30 cwt.; mud, 25 cwt.; marl, 26 cwt.; clay, 31 cwt.; chalk, 36 cwt.; sandstone, 39 cwt.; shale, 40 cwt.; quartz, 41 cwt.; granite, 42 cwt.; trap, 42 cwt.; slate, 43 cwt.

TO DETERMINE WEIGHT OF LIVE CATTLE.—Measure in inches the girth around the breast, just behind the shoulder blade, and the length of the back from the tail to the fore part of the shoulder blade. Multiply the girth by the length, and divide by 144. If the girth is less than 3 feet, multiply the quotient by 11. If between 3 and 5 feet, multiply by 16. If between 5 and 7 feet, multiply by 23. If between 7 and 9 feet, multiply by 31. If the animal is lean, deduct 1-20 from the result, or take the girth and length in feet, multiply the square of the girth by the length, and multiply the product by 3.36. The result will be the answer in pounds. The live weight multiplied by 6.05, gives a near approximation to the net weight.

GAUGING STREAMS.—Multiply the square root of the cube of the height in inches of the water on the sill of the weir or gauge by the constant 17.13, which will give the number of gallons per minute. If the water has any initial velocity it must be determined by experiment, and in that case multiply the square of the height by the square of the velocity, and by 0.8; to the product add the cube of the height, extract the square root of the sum, and multiply by 17.13 as before.

STOWAGE OF COALS.—The following information will be valuable to many coal dealers and consumers who may be in doubt as to the capacity of their coal bins. A box 4 feet long, 3 ft., 5 in., wide, and 2 ft., 8 in., deep, has a capacity of 36½ cubic feet, and will contain 2000 lbs., or one ton of Beaver Meadow or Lehigh (American) coal. The spaces occupied by one ton of the undermentioned English coals, economic weight are:—Haswell's Wallsend, 45·25 cubic feet. North Percy, Hartley (Newcastle) 46·96 cubic feet. Balcarras Arley (Lancashire) 44·35 cubic feet. Cannel (Wigan, Lancashire) 46·37 cubic feet. Duffryn (Welsh) 42·09 cubic feet. Pontypool (Welsh) 40·22 cubic feet. Hence, a shed 16 feet high, 20 feet broad, and 30 feet long, will hold over 212 tons of Haswell's Wallsend (Newcastle) coals, about 207 tons of Cannel, and 228 of Duffryn. The *average* space occupied by one ton of Newcastle coal, economic weight, is 44 cubic feet, that of one ton of Lancashire coal, 44½ cubic feet, and that of 1 ton of Welsh coal, 41 cubic feet. Therefore a shed of the above dimensions, would, on the average, hold 217 tons of Newcastle coal, 216 of Lancashire, and 234 of Welsh. From the above data, any intending purchaser can easily calculate the capacity of his coal bins, sheds, &c., and in many cases secure a good bargain by laying in a large stock when coals are cheap.

COMPOSITION TACKS FOR MUNTZ METAL ON SHIPS.—Copper 87 parts, zinc 4 parts, tin 9 parts.

RESULTS OF J. H. CHEEVERS' EXPERIMENTS WITH VULCANIZED RUBBER BELTING AND LEATHER, DITTO.

Rubber.	Lbs.	*Leather.*	Lbs.
Belt slipped on Iron pulley at	90	Belt slipped on Iron pulley at	48
" " Leather "	128	" " Leather "	64
" " Rubber "	183	" " Rubber "	128

Deductions from the above: Rubber belts for equivalent resistances with leather belts, may be reduced respectively 46, 50 and 30 per cent.

Vulcanized Rubber belting has greater endurance than leather, its resistance to slipping being from 50 to 84 per cent. greater.

MILL FOR SPINNING WOOL AND WEAVING MERINOS.—Nineteen machines to prepare the combed wool, having together 350 rollers; 16 mules with 3,400 spindles; one winding machine of 60 rollers to prepare the warp; 2 warping machines; 2 self-acting feeders; 100-power looms; 2 lathes for wood and iron, and one pump require in all 30 horse power. Produce: 13,600 cops of woolen thread, of 45 cops to the pound, each measuring 32 yards. The looms make 115 revolutions per minute, and produce daily 4 pieces of double width merino of 68 yards each, and 4 pieces of simple merino of 1.2 to 1.4 yard broad, and each 88 yards long.

COTTON FACTORY.—*Condensing Engine, Cylinder*, 37 in. diam. *Stroke of piston, 7 ft. Volume of piston space*, 53.6 cubic ft. *Average pressure of steam*, 16.73 lbs. per square inch. *Revolutions*, 17 per minute. *Friction of Engine and Shafting*, (indicated) 4.75 lbs. per sq. inch of piston. *Indicated Horses power*, 125. Total power=1. Available, deducting friction=717.

(The foregoing has reference to an English mill, for driving 22,060 Hand mule spindles, with preparation, and 260 looms, with common sizing.)

REMARKS.—Each additional horse's power will drive 305 hand-mule spindles, *with preparation*,
or 230 self-acting "
or 104 throstle "
or 10.5 looms with common sizing.

Including preparation:

1 throstle spindle=3 hand-mule, or 2.25 self-acting spindles.
1 self-acting spindle=1.2 hand-mule spindles.

Exclusive of preparation, taking only the spindle:

1 throstle spindle=3.5 hand-mule, or 2.56 self-acting spindles.
1 self-acting spindle=1.375 hand-mule spindles.

The throstles are the common, spinning 34 twist for power loom weaving; the spindles revolve 4,000 times per minute. The *self-acting* mules are, one half spinning 36's weft, spindles revolving 4,800; the other half spinning 36's twist, spindles revolving 5,200. The hand-mules spinning about equal quantities of 36's weft and twist. Weft spindles 4,700, and twist spindles 5,000 rev. per minute. Average breadth of looms 37 ins. (weaving 37 ins. cloth), making 123 picks per minute. All common calicoes about 60 reed, Stockport count, and 68 picks to the inch. No power consumed by the sizing. When the yarn is dressed instead of sized, one horse's power cannot drive so many looms, as the dressing machine will absorb from .17 to .14 of the power.

SIZE FOR DRESSING COTTON YARN OR WARPS.—Flour 280 lbs ; tallow 1 lb. ; add ½ to 2 per cent. of the amount of flour employed of paraffine. The paraffine may be made to replace the whole, or a part of the tallow employed.

BEAUTIFUL SIZING FOR LINEN.—Crystallized carbonate of soda, 1 part ; white wax, 4 to 6 parts ; stearine 4 to 6 parts ; pure white soap, 4 to 6 parts ; fine Paris white or carbonate of magnesia 20 parts ; potato starch, 40 parts ; fine wheat starch, 160 parts ; boil with sufficient water to form 1600 parts altogether, adding, if desired, some ultramarine to counteract the yellow tint of the linen. The linen is starched with this preparation, afterwards steamed and dried, then sprinkled with soap-water and placed in the stamping mill, afterwards steamed and calendered.

THE MARINER'S COMPASS.—The needle or magnet is said to point always to the north, and as a matter of course the other points, as east, west, &c., are easily found by the needle pointing north and south. In certain parts of the world, however, the needle does not point to the north, but is drawn considerably to the right or left of true north. This is called the variation of the compass, and must be known accurately by the navigator in order to correct and steer the right course. For instance in crossing the Atlantic Ocean, the variation of the compass amounts in sailing vessels to 2½ or 2¾ points westerly, and the course steered must be corrected accordingly. Say that you wish to make a due east course, you must steer 2½ or 2¾ points south of that or to the right hand in order to make a direct course.

Off the Cape of Good Hope in the South Atlantic Ocean, strange enough, the variation of the compass in ships bound to India or Australia is 2¾ points easterly, and in order to make it due east course it is necessary to steer 2¾ to the north or left of her course, while again towards the equator or centre of the globe there is hardly any perceptible variation of the compass at all. The way of finding out how much the compass varies in different parts of the world, is by observations of the sun taken with the compass, and the difference between the true and magnetic or compass bearing is the variation, which must be applied as a correction to the course steered. We have, however, in iron ships or steamers what is called the deviation of the compass to attend to besides the variation. This is the local attraction caused by the iron, and must be carefully understood before steamers or iron ships attempt to go to sea. As in steamers of the Allan or Cunard line, each vessel before proceeding on her first voyage must be carefully swung, and magnets fixed to the deck, besides small chains placed on each side of the compasses in boxes, in order to counteract the attraction of the iron. Thus the compasses are so nicely balanced with the magnets and iron, that it is rare indeed at this day that they get out of order on a trans-Atlantic passage. The consequences to either steamer or sailing ship whose compasses are astray would be terrible to contemplate, even if it were but one-half point, on dark winter nights approaching the land. These difficulties are now happily obviated by the discoveries of modern science, and their application in correcting the compass at sea.

Heat of Water in Steam Boilers, Warming of Buildings, &c. —The following table shows the temperature of water by Fahrenheit's and Centigrade scales of measurements, allowing 14.6 lbs. per square inch to atmosphere :—

Pressure of Steam in Atmospheres.	Temperature.		Press.	Temperature.	
	F.	C.		F.	C.
1	212°	100.°	13	381°	155.°
1.5	230	112.2	14	387	157.7
2	251	121.2	15	393	200.5
2.5	264	128.8	16	398	203.1
3	275	125.	17	404	206.2
3.5	285	140.5	18	409	209.4
4	294	145.5	19	414	212.2
4.5	300	148.8	20	418	214.4
5	308	153.1	21	423	217.2
5.5	314	156.2	22	427	219.4
6	320	160.	23	431	221.2
6.5	326	163.1	24	436	224.4
7	332	166.2	25	439	226.1
7.5	337	169.4	30	457	236.1
8	342	172.2	35	473	245.1
9	351	177.2	40	487	252.7
10	359	181.2	45	491	255.
11	367	186.1	50	511	266.1
12	374	190.			

In warming apartments by hot water pipes or by hot steam, 1 square foot of plate or pipe surface will heat 80 cubic feet of air in exterior or exposed rooms, and 100 in interior rooms to 70° in winter, or use the following formula :—

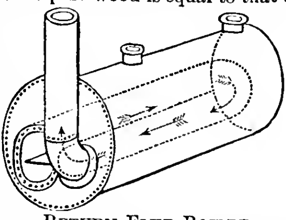
Let P = temperature of pipes,
T = temperature required in building,
t = temperature of external air,
C = cub. feet of air to be warmed per min.,
L = length of pipe in feet,

$$L = \frac{(P - t)\,(T - t)}{P - T} \times {\cdot}0045\ C. \text{ for 4 in. pipes.}$$

Ditto $\times$ ·006 C. for 3in. "

This formula will give number of feet the pipes must measure in length to produce the temperature required in the building.

Value of Fuel.—The evaporative power of *Coke* in the furnace of a steam boiler, and under pressure, is from 7½ to 9 lbs. of fresh water per lb. of coke ; that of *charcoal* 5½ lbs. of fresh water per lb. The evaporative power of 1 cubic foot of pine wood is equal to that of 1 cubic foot of fresh water ; or, in the furnace of a steam boiler, and under pressure, it is 4¾ lbs. fresh water for 1 lb. of wood. One cord of *hardwood* and 1 cord of *soft* wood, such as the general average in Canada, is equal in evaporative effects to 2000 lbs. of anthracite coal. One cord of the kind of wood used by American river steamers in the West, is equal to 12 bushels (960 lbs.) of Pittsburg coal ; 9 cords cotton, ash and cypress wood are equal to 7 cords yellow pine. The densest woods give the greatest heat, as charcoal generates more heat than flame. The evaporative power of *peat* in the furnace of a steam boiler, and under pressure, is 3½ to 5 lbs. of fresh water for every lb. of fuel. *Bituminous coal* is 13 per cent. more effective than *coke* for equal weights, and in England the effects are alike for equal costs. In an experiment under a pressure of 30 lbs. 1 lb. pine wood evaporated 3.5 to 4.75 lbs. water, 1 lb. Lehigh coal, 7.25 to 8.75 lbs. The least consumption of coal yet attained is 1½ lbs



Return Flue Boiler.

per indicated horse-power. It usually varies in different engines from 2 to 8 lbs.. Railway experiments demonstrate 1 ton of Cumberland coal, (2240 lbs.) to be equal in evaporating effect to 1.25 tons of anthracite coal, and 1 ton of anthracite to be equal to 1.75 cords pine wood; also that 2000 lbs. Lackawanna coal are equal to 4500 lbs. best pine wood. Much depends on the kind of boiler used. The *R·turn Flue Boiler* gives very good results in economizing heat. See diagram above.

SPECIFIC GRAVITY.—Is the density of the matter of which any body is composed, compared with the density of another body assumed as the standard, or 1000. This standard is pure distilled water for liquids and solids, and atmospheric air for gaseous bodies and vapors. Thus as gold is 19, and silver 10 times heavier than water, those numbers 19, and 10 are said to represent the specific gravity of gold and silver. The heaviest known substance is iridium, used for pointing gold pens; its specific gravity is 23. The lightest of all liquids has a specific gravity of 0.6, it is called chimogene, and is made from petroleum, it is exceedingly volatile and combustible, being in fact a liquefied gas. Carbonic acid gas or choke damp is 500 times lighter than water, common air 800, street gas about 2000, and pure hydrogen the lightest of all substances, 12,000 times. The heaviest substance has thus 23+12,000, or more than a quarter of a million times more weight than an equal bulk of the lightest; and the substance of which comets consist, has by astronomers been proved to be even several thousand times lighter than hydrogen gas.

APPROVED FRICTION MATCHES.—About the best known preparation for friction matches consists of gum arabic, 16 parts by weight; phosphorus, 9 parts; nitre, 14 parts; peroxyde of manganese, in powder, 16 parts. The gum is first made into a mucilage with water, then the manganese, then the phosphorus, and the whole is heated to about 130° Fah. When the phosphorus is melted the nitre is added, and the whole is thoroughly stirred until the mass is a uniform paste. The wooden matches prepared first with sulphur, are then dipped in this and afterward dried in the air. Friction papers, for carrying in the pocket, may be made in the same manner, and by adding some gum benzoin to the mucilage they will have an agreeable order when ignited.

IMPROVED COLORED FIRES.—*White.*—Saltpetre, 2 parts; sulphur, 2 parts; antimony, 2 parts. *Red.* Nitrate of strontia, 20 parts; chlorate of potash, 5 parts; sulphur, 6½ parts; charcoal, 1 part. *Blue.* Chlorate of potash, 9 parts; sulphur 3 parts; carbonate of copper, 3 parts. *Yellow.*—Nitrate of soda, 24 parts; antimony, 8 parts, sulphur, 6 parts; charcoal, 1 part. *Green.*—Nitrate of baryta, 26 parts; chlorate of potash, 18 parts; sulphur, 10 parts, *Violet.*—Nitrate of strontia, 4 parts; chlorate of potash, 9 parts; sulphur, 5 parts; carbonate of copper, 1 part; calomel, 1 part.

TO RE-COVER HAMMERS IN PIANOS.—Get felt of graduated thickness, cut it in strips the exact width, touch only the two ends with glue, not the part striking the strings. Hold in place with springs of narrow hoop iron.

WATER.—*Fresh Water.*—The component parts by weight and measure is, *Oxygen*, 88.9 by weight, and 1 by measure, *Hydrogen*, 11.1 by weight, and 2 by measure. One cubic inch of distilled water at its maximum density of 39°. 83, the barometer at 30 inches, weighs

252.6937 grs. A cubic foot weighs 62.5 lbs. Rated by the British Imperial standard, a cubic ft. of water at 62° weighs 998.224 ozs., 35.84 cubic ft. of water weigh 1 ton, 39.14 cubic ft. of ice weigh 1 ton. *Sea-Water.* 1 cubic ft. weighs 64.3126 lbs.; 34.84 cubic ft. weigh 1 ton and contains from 4 to 5⅜ ozs. of salt per gal. varying in different parts of the globe; carbonic acid, 62 parts in every 1000 of water. The saline matter in the Dead Sea is 21.722 parts in every 100. Dr. Scoresby's observations of the height of waves in the North Atlantic Ocean record 24 ft., 30 ft., the highest 43 ft., and the mean 18 ft. in western gales. French observers in the Bay of Biscay state a height of wave of 36 ft.; Captain Wilkes writes of 36 ft. in the Pacific and Sir J. Ross of 22 ft. in the South Atlantic. Heights of waves in northwest gales off the Cape of Good Hope have been computed at 40 ft., those off Cape Horn at 32 ft., in the Mediterranean Sea at 15 ft., and in the German Ocean at 14 ft., but in the British waters they are only found to average 8 to 9 ft. The velocity of ocean storm waves was observed by Dr. Scoresby in the North Atlantic to be about 32 miles per hour; Capt. Wilkes records it at 26½ miles in the Pacific, and French mariners in the Bay of Biscay at 60 miles an hour. Dr. Scoresby has estimated the distance between or breadth of his Atlantic storm waves at about 600 feet from crest to crest which is only about half of that stated by some others, and Dr. S. states that the waves of 30 ft. height move at the rate of 32 miles per hour. The mean force of the Atlantic waves for the summer months is over 600 lbs. per sq. ft., during winter 2086 lbs. During a severe gale 6383 lbs. per square ft. has been noted. *Corrosive effects of Sea-Water on Metals, per square foot.* Steel 39 grs., iron 38, copper 9, zinc 8, galvanized iron 1.6, tin 2.

BRAZING CAST IRON.—There are two ways of joining cast iron. 1. Fit the broken pieces exactly together in moulding sand and pour melted iron over the parts to be joined. When cold chip off the superfluous metal and you will have a joint scarcely to be detected. 2. Well tin the parts to be joined, fit together in sand as above, and pour melted brass over them.

MACINTOSH CLOTH.—The material is merely two layers of cotton cemented with liquid India rubber; but the junction is so well effected that the three become, to all intents and purposes, one. The stout and well-woven cloth is coiled upon a horizontal beam like the yard beam of a loom; and from this it is stretched out in a tight state and a nearly horizontal direction; a layer of liquid or rather paste-like solution is applied with a spatula, to a considerable thickness, and the cloth is drawn under a knife edge which scrapes the solution and diffuses it equally over every part of the cloth, which may be 30 or 40 yards long. The cloth is then extended out on a horizontal framework to dry; and when dried a second coating is applied in the same way, and a third or fourth coat if necessary. Two pieces, thus coated, are next placed face to face with great care to prevent creasing or distortion; and being placed between two wooden rollers, they are so thoroughly pressed as to unite durably and permanently. Cloth, thus cemented and doubled and dried, may be cut and made into garments which will bear many a rough trial, and many a deluging, before rain or water can penetrate.

To Petrify Wood—Gum salt, rock alum, white vinegar, chalk and pebbles powder, of each an equal quantity. Mix well together. If, after the ebullition is over, you throw into this liquid any wood or porous substance, it will petrify it.

To Construct an Æolian Harp.—Make a box with the top, bottom, and sides of thin wood, and the ends 1½ inch beech, form it the same length as the width of the window in which it is to be placed. The box should be 3 or 4 inches deep, and 6 or 7 inches wide. In the top of the box, which acts as a sounding board, make 3 circular holes about 2 inches in diameter, and an equal distance apart. Glue across the sounding board, about 2½ inches from each end, 2 pieces of hard wood ¼ inch thick, and ½ inch high, to serve as bridges. You must now procure from any musical instrument maker twelve steel pegs similar to those of a pianoforte, and 12 small brass pins. Insert them in the following manner into the beech: first commence with a brass pin, then insert a steel peg, and so on, placing them alternately ½ in. apart to the number of twelve. Now for the other end, which you must commence with a steel peg, exactly opposite the brass pin at the other end, then a brass pin, and so on, alternately, to the number of 12; by this arrangement you have a steel peg and a brass pin always opposite each other, which is done so that the pressure of the strings on the instrument shall be uniform. Now string the instrument with 12 first violin strings, making a loop at one end of each string, which put over the brass pins, and wind the other ends round the opposite steel pegs. Tune them in unison, but do not draw them tight. To increase the current of air, a thin board may be placed about 2 inches above the strings, supported at each end by 2 pieces of wood. Place the instrument in a partly opened window, and to increase the draft, open the opposite door.

To Construct a Metronome.—Take a cheap clock movement and substitute for the pendulum a wire with a sliding weight, marking the wire with a file at the different points of graduation. Used to indicate the proper time in music.

To Bend Glass Tubes.—Hold the tube in the upper part of the flame of a spirit-lamp, revolving it slowly between the fingers: when red hot it may be easily bent into any desired shape. To soften large tubes a lamp with a double current of air should be used, as it gives a much stronger heat than the simple lamp.

Black Lead Pencils.—The best pencils are made by grinding the black lead into a fine impalpable powder, then forming it into blocks by compression without any cementing substance, and finally sawing it up into the square prisms, which, when placed in grooves in wood, form the black lead pencils of commerce. The color can be graduated to any desired tinge by the intermixture of very finely ground clay. By the process of Prof. Brodie, the most intractable graphite may be reduced to the finest powder with great ease. The mineral is coarsely powdered and mixed with 1-15th of chlorate of potash, to which mixture is added twice its weight of sulphuric acid. Chloric acid is disengaged, and, after the mass has cooled, it is well washed, dried, and heated to redness. During the latter operation, the black lead swells and becomes reduced to so fine a powder that it will swim upon water, a little fluoride of sodium is used to dissolve the silicious impurities. The finest quality is found near Burrowdale in Cumberland, England. It is nearly pure carbon, and perfectly free from grit. It is used principally in the manufacture of lead pencils, the coarser quality being used, when ground, for polishing iron work, glazing gunpowder, as a lubricator for machinery, compounded with four times its weight of lard or tallow, and in the manufacture of crucibles for melting metals, as it is very intractable in an intense heat.

PHILLIP'S FIRE ANNIHILATOR.—Consists of a case containing water, within which is a smaller case containing chlorate of potash and sugar. Dipped in the latter is a small tube containing sulphuric acid; when this tube is broken the chlorate of potash and sugar become ignited, throwing off large quantities of mixed gases which are non-supporters of combustion; the action is maintained by the water in the outer case becoming heated. The gases are conveyed to the fire by means of a flexible tube fitted with a proper nozzle and stopcock. I have seen still another kind constructed of copper in quite an elegant style, fitted with shoulder straps, &c., for easy transportation, in which the gases were generated by means of chemicals on the principle of what may be seen every day in the effervescence of carbonic acid gas from the intermixture of seidlitz powders in water. The chemicals being introduced from white and blue paper packages into the water contained in the copper case.

MANUFACTURE OF CORN STARCH.—*Watt's Patent.*—The corn is steeped in water, ranging in temperature from 70° to 140° Fah., for about a week, changing the water at least once in 24 hours. A certain amount of acid fermentation is thus produced, causing the starch and refuse of the corn to be easily separated afterwards. The swollen corn is ground in a current of clear soft water, and the pulp passed through sieves, with the water into vats. In these the starch gradually settles to the bottom, the clear water is then run off by a tap, and the starch gathered and dried in a proper apartment for the purpose.

REFINING OF SUGAR.—Both cane and beet-root sugar are refined on the same principle, by mixture with limewater, boiling with animal charcoal, and filtration through twilled cotton. In some establishments bullock's blood is used to aid in the clarifying. The albumen of the serum becomes coagulated on the application of heat, forming a network, which rises to the top of the liquor, carrying with it a great part of the impurities. The reddish syrup obtained by the first filtration is next passed through filters into large vats, twelve or fourteen feet deep, upon which are laid coarse ticking, coarsely ground animal charcoal, and a second layer of ticking. The syrup is allowed to flow over the surface of the filter, and runs slowly through the charcoal, coming out perfectly colorless. The concentrated syrup is then boiled in *vacuo*, by means of which two important results are arrived at. The viscid liquid would boil in air at 230° Fah., at which temperature a quantity of uncrystallizable sugar would be formed. By performing the operation in a vacuum-pan the boiling point is brought down to 150° or 160°, no formation of uncrystallizable sugar takes place, and a great saving in fuel is effected. When the concentration reaches a certain point, the syrup is transferred to a vessel heated by steam to 170°, and forcibly agitated with wooden beaters, until it forms thick and granular. From the heating-vats it is transferred into inverted conical moulds of the well-known shape, at the bottom of each of which is a movable plug. The syrup is well stirred to prevent the formation of air-bubbles, and then left at rest for several hours, at the end of which time the plug is removed, and the uncrystallized syrup runs out. The loaves are further freed from all colored matter by a portion of perfectly colorless syrup being run through them. They are then dried in a stove and finished for market by being turned in a lathe. *Crushed or granulated sugar* is made by causing the granular syrup to revolve in a perforated drum, by which means the uncrystallizable portion is separated from the crystals by centrifugal force.

BUTTON MANUFACTURE.—Metal buttons are formed of an inferior kind of brass, pewter, or other metallic compositions. For button metal, see a variety of alloys on pages 291 and 292. Buttons with shanks are usually made of these compositions, which is supplied to the manufacturers in sheets of the required thickness. By means of fly presses and punches, circular disks called *blanks*, are cut out of these sheets. This is mostly performed by females, who can furnish about 30 blanks per minute, or 12 gross per hour. Hand punching is the general mode of cutting out blanks, but more complicated machines, which cut out 8 or 10 blanks at a time, are in use. After being punched, the edges of the blanks are very sharp, and require to be smoothed and rounded. Their surfaces are then planished on the face by placing them separately in a die under a small stamp, and allowing them to receive a small blow from a polished steel hammer. In this state they are ready to receive the shanks or small metal loops by which they are attached to the dress. They are made by a machine in which a coil of wire is gradually advanced towards a pair of shears which cuts off short pieces. A metal finger then presses against the middle of each piece, first bending it and then pressing it into a vice, when it is compressed so as to form a loop; a hammer then strikes the two ends, spreading them into a flat surface, and the shank is pushed out of the machine ready for use. The shanks are attached to the blanks by women, with iron wire, solder and rosin. They are then put into an oven, and when firmly united, form plain buttons. If a crest or inscription is wanted, it is placed in a die and stamped. Buttons are gilded by gold amalgam, by being put into an earthen pan with the proper quantity of gold to cover them, amalgamated with mercury in the following manner: the gold is put into an iron ladle in thin strips, and a small quantity of mercury, say 1 part of mercury to 8 of gold, added to it, the ladle is held over the fire till the gold and mercury are perfectly united. This amalgam being put into the pan with the buttons, as much aquafortis, diluted with water, as will wet them all over, is thrown in, and they are stirred up with a brush till the acid, by its affinity to the copper in the buttons, carries the amalgam to every part of their surface, giving it the appearance of silver; this done, the acid is washed away with clean water. This is called the *quicking* process. In *drying off*, the pan of buttons is heated by a charcoal fire expelling the mercury in the form of a vapor, which, under the improved system, is conducted into on oblong iron flue or gallery, gently sloped downwards, having at its end a small vertical tube dipped into a water cistern, for condensing the mercury, and a large vertical pipe for promoting the draught of the products of the combustion. The gold thus deposited in an exceedingly thin film upon the buttons, presents a dull yellow color, and must now be burnished ; this is effected by a piece of hematites, or bloodstone, fixed on a handle and applied to the button, as it revolves in the lathe.

To render Wood Indestructible.—*Robbins' Process.* The apparatus used consists of a retort or still, which can be made of any size or form, in which resin, coal tar, or other oleaginous substances, together with water, are placed in order to subject them to the heat. Fire being applied beneath the retort containing the coal tar, &c., oleaginous vapor commences to rise, and passes out through a connecting pipe into a large iron tank or chamber (which can also be built of any size), containing the timber, &c., to be operated upon. The heat acts at once upon the wood, causing the sap to flow from every pore, which, rising in the form of steam, condenses on the body of the chamber, and discharges through an escape pipe in the lower part. In this process a temperature of 212° to 250° Fahr. is sufficient to remove the surface moisture from the wood; but after this the temperature should be raised to 300° or more, in order to completely saturate and permeate the body of the wood with the antiseptic vapors and heavier products of the distillation. The hot vapor coagulates the albumen of the wood, and opens the pores, so that a large portion of the oily product or creosote is admitted; the contraction resulting from the cooling process hermetically seals them, and decay seems to be almost impossible. There is a man-hole in the retort, used to change or clean out the contents; and the wood chamber is furnished with doors made perfectly tight. The whole operation is completed in less than one hour, rendering the wood proof against rot, parasites, and the attacks of the *Teredo navilis* or naval worm. *German Stone Coating for Wood.*—Chalk, 40 parts; resin, 50 parts; linseed oil 4 parts; melt together. To this add 1 part of oxide of copper, afterwards 1 part of sulphuric acid; add this last carefully; apply with a brush.

Iron Tube Manufacture.—In the present method of manufacturing the patent welded tube, the end of the skelp is bent to the circular form, its entire length is raised to the welding heat in an appropriate furnace, and as it leaves the furnace almost at the point of fusion, it is dragged by the chain of a draw-bench, after the manner of wire, though a pair of tongs with two bell-shaped jaws; these are opened at the time of introducing the end of a skelp, which is welded without the agency of a mandril. By this ingenious arrangement wrought iron tubes may be made from the diameter of 6 inches internally and about 1-8 to 3-8 of an inch thick, to as small as 1-4 of an inch diameter and 1-10 bore, and so admirable is the joining effected in those of the best description that they will withstand the greatest pressure of water, steam, or gas to which they have been subjected, and they admit of being bent both in the heated and cold state, almost with impunity. Sometimes the tubes are made one upon the other when great thickness is required; but those stout pipes, and those larger than 3 inches, are but seldom required. The wrought iron tubes of hydrostatic presses which measure about $\frac{1}{2}$ an inch internally, and $\frac{1}{4}$ to $\frac{3}{8}$ of an inch thick in the metal, are frequently subjected to a pressure of *four tons* on each square inch.

BRASS TUBES.—Brass or other tubes are formed of rolled metal which is cut to the desired width by means of revolving discs; in the large sizes of tubes, the metal is partially curved in its length by means of a pair of rolls, when in this condition it is passed through a steel hole or a die, a plug being held in such a position as allows the metal to pass between it and the interior of the hole. Oil is used to lubricate the metal, the motion is communicated by power, the drawing apparatus being a pair of huge nippers, which holds the brass, and is attached to a chain and revolves round a windlass or cylinder. The tube in its unsoldered state is annealed, bound round at intervals of a few inches with iron wire, and solder and borax applied along the seam. The operation of soldering is completed by passing the tubes through an air stove, heated with "cokes" or "breezes" which melts the solder, and unites the two eyes of the metal, and forms a perfect tube; it is then immersed in a solution of sulphuric acid, to remove scaly deposits on its surface, the wire and extra solder having been previously removed; it is then drawn through a "finishing hole plate" when the tube is completed. Mandril drawn tubes are drawn upon a very accurately turned steel mandril, by this means the internal diameter is rendered smooth. The tubes drawn by this process are well adapted for telescopes, syringes, small pump cylinders, &c. The brass tubes for the boilers of locomotive engines are now made by casting and drawing without being soldered, and some of them are drawn taper in their thickness. Tubes from 1-10 inch internal diameter and 8 or ten inches long, up to those of two or three inches diameter and 4 or 5 feet long, are drawn vertically by means of a strong chain wound on a barrel by wheels and pinions, as in a crane. In Donkin's tube drawing machine, which is applicable to making tubes, or rather cylinders, for paper-making and other machinery, as large as $26\frac{1}{2}$ inches diameter, and $6\frac{1}{2}$ feet long, a vertical screw is used, the nut of which is turned round by toothed wheels driven by six men at a windlass. The fluted tubes of pencil cases are drawn through oramental plates, with elevations and depressions corresponding to the impressions left on the tube.

LEAD PIPE, is made by forcing lead, while heated to a plastic state, over an annular mandril or die to form the core, by means of hydraulic pressure.

CUTLERY MANUFACTURE.—There are three kinds of steel employed in manufacture of different articles of cutlery, common steel, shear steel, and cast steel. All edge tools which require to be tenacious without being very hard, are made of shear steel. The best scissors, razors, penknives, &c., are made from cast steel, which is able to take a very fine polish, common steel is only used in making cheap articles of cutlery. In making good table-knives, shear steel and cast steel are generally preferred. In the ordinary method of making knives, the blades are cut out of a sheet of steel, and the backs, shoulders and tangs of wrought iron, are attached to the steel blades by welding at the forge. The knife is then ground to the proper shape, and the blade polished and hardened. The fork manufacture is a distinct branch of industry, and the manufacturers of table knives generally buy their forks from the fork makers ready to be put into their handles. In making table knives, two men are generally employed ; one is called the foreman, or maker, and the other the striker. Pen knives are usually forged by a single hand, with hammer and anvil simply ; they are hardened by heating the blades red-hot, and dipping them into water up to the shoulder. Razors are also hardened in the same manner. The grinding and polishing of cutlery are generally performed by machinery, the business of the grinders is divided into grinding, glazing and polishing. Grinding is performed upon stones of various dimensions. Those articles which require temper being ground on wet stones. Glazing is a process by which lustre is given to cutlery ; it is performed with a glazier, consisting of a circular piece of wood, sometimes covered with leather, or an alloy of lead and tin ; it is fixed on an axis like a grindstone. The polishing process is the last, and is performed on a similar piece of wood covered with buff leather. Only articles of cast steel which have been hardened and tempered are subjected to this operation.

ON NEEDLE MANUFACTURE, TEMPERING, &c.—This small but important implement has to go through the hands of about 120 workmen during the process of manufacture. The steel wire, being drawn to the proper size, is submitted to various tests to ascertain its quality, and is then cut into proper lengths by shears, which, by striking 21 blows in a minute, cut in 10 hours fully 400,000 ends of steel wire, which produce about 800,000 needles. These are passed on for further manipulation to other workmen, who straighten and point the pieces of wire. After pointing they are cut in two, so as to form two separate needles of equal length and quality. For each different size a small copper plate is employed. It is nearly square, and has a turned-up edge on two of its sides, the one is intended to receive all the points, while the other resists the pressure of the shears. On this plate a certain number of wires are put with their points in contact with the border, and they are cut together flush with the plate, by means of a small pair of shears moved by the knee of the workman. These evên wires are now taken to the *head-flattener*. This workman, seated over a table with a block of steel before him about 3 inches cube, takes up from 20 to 25 needles between his finger and thumb, spreading them out like a fan, with the points under the thumb, he lays the heads on the steel block, and, with a small flat-faced hammer strikes a few successive blows upon them so as to flatten them in an instant. The heads, having become hardened by hammering, are now annealed by heating and slow cooling, and are handed to the *piercer*, generally a child, who forms the eye in a second by laying the head upon a block of steel, and by driving a small punch through one side with a smart tap of the hammer, and then exactly opposite on the other. The eyes are then trimmed by driving the punch through them again on a lump of lead and, after laying the needle with the punch sticking through it, upon the block of steel, hammering the head on the sides, which causes it to take the form of the punch. The next operator makes the groove at the eye and rounds the head, which he does with a small file. The needles, being thus prepared, are thrown by the workmen pell-mell into a sort of drum or box, in which they are made to arrange themselves in parallel lines by means of a few dexterous shakes of the workman's arm. They are now ready to be tempered, for which purpose they are ranged on sheet-iron plates, about 30 lbs. weight at a time, containing from 250,000 to 500,000 needles, and are placed in a proper furnace, where they are heated to a bright redness for the larger needles, and to a less intense degree for the smaller; they are then removed, and inverted suddenly over a bath of cold water in such a way that all the needles may be immersed at the same time, yet separate from each other. This has the effect of making them very hard and brittle. The water being run off, the needles are removed for further operations. Some manufacturers heat the needles by means of immersion in melted lead, others throw them into a pan along with a quantity of grease, which, being placed on the fire, the oily matter soon ignites, and after it burns out, the needles are found to be in the proper temper; those which are twisted in the tempering being afterwards straightened by the hammer on the anvil.

Polishing is the next and most expensive and prolonged operation. This is effected on bundles containing 500,000 needles intermixed with quartzoze sand, and a little rape-seed oil. Thirty of those bundles are exposed to the vibratory pressure of wooden tables, which make about 20 horizontal double movements per minute, causing the bundles to run over 2 feet each time, or 800 feet per hour. This agitation is kept up about 18 or 20 hours, causing such a movement and attrition as to polish the needles in the bags or bundles. They are then removed from the packets into wooden bowls and mixed with sawdust to remove the grease and other impurities, placed in a cask, which is turned by a winch; more sawdust is introduced as required, and the turning is continued until the needles become clean and bright. They are then winnowed by a fan to clean them from the sawdust and refuse matter, and are subsequently arranged in regular order on a small, somewhat concave, iron tray. The operation of making up the rolls or bags, polishing, winnowing and arranging them, have to be repeated ten times on the best needles. It is found that emery powder mixed with quartz and mica or pounded granite is preferable to anything else for polishing needles by friction in the bags at the first, emery mixed with olive oil, from the second to the seventh operation, putty, or oxide of tin for the eighth and ninth, putty with very little oil for the tenth, and lastly bran to give a finish. In this mode of operating, the needles are scoured in a copper cask studded in the interior with raised points to increase the friction and a quantity of hot soap suds is introduced occasionally to keep them clean. The cask must be slowly turned upon its axis for fear of injuring the mass of needles it contains. They are finally dried in the wooden cask by attrition with saw dust, then wiped with a linen rag or soft leather—the damaged ones being thrown aside. The *sorting* is performed in dry apartments, where all the points are first laid the same way, and the needles arranged in the order of their polish with great rapidity. The workman places 2000 or 3000 needles in an iron ring two inches in diameter, and sets all their heads in one plane, then, on looking carefully at their points, he easily recognizes the broken ones and removes them with an instrument adapted for the purpose. These defective needles pass into the hands of the *pointer* in order to be ground again, when they form articles of inferior value. Those needles bent in the polishing must now be straightened, and the whole are finally arranged by the tact of the finger and thumb of the sorter, and weighed out into quantities for packing into blue papers. The *bluer* puts the final touch to them by taking 25 needles at a time between his fore-finger and thumb, and pressing their points against a small hone-stone of compact micaceous schist, quadrangular in form, mounted in a small lathe, turning them briskly round, giving the points a bluish cast, while he polishes and improves them.

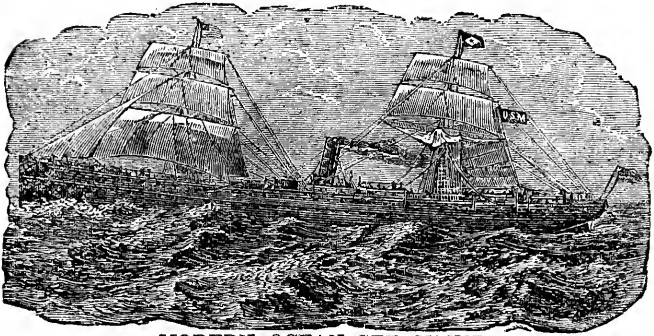
On File Manufacture.—Files are made of bars of steel, rendered doubly hard by a process called *double conversion*, drawn the required size at the tilt hammer, and then shaped, the square and flat ones by the hammer and common anvil only, but those of round, half-round, and three-angled forms, by means of bosses and dies made in the above shapes, which fit into a groove left for them in the anvil. The steel blanks having been thus formed, are next *annealed*, or softened, to render them capable of being cut, by placing a number of them together in a brick oven, rendered air-tight by filling up all the interstices with sand (to prevent the oxidation of the steel, to which it is very liable, if air be admitted,) and then making a fire play as equally as possible all round until they are red hot, when the heat is discontinued, and the steel allowed to cool gradually before it is uncovered. The surface to contain the teeth is now rendered as smooth as possible by grinding or filing; the teeth are then cut with a carefully ground chisel, each incision being made separately. The next and last process, that of hardening, is performed in various ways by different makers, the ordinary method, however, is to cover the files with a kind of composition or protecting varnish to prevent oxidation and scalding of the steel when heated; and, lastly, they are plunged in cold, fresh water to cool them as quickly as possible. Some file-makers coat their files, before tempering, with a composition of cow-dung, or pig-flour, which not only protects the sharp angles of the cuttings from the action of the fire, but furnishes a highly azotized substance, which conduces greatly to still further harden and steelify the finished work. I know several file manufacturers who make use of a bath of melted lead for tempering purposes. The files are first coated with a greasy composition to prevent any oxide adhering, then introduced for a short time into melted lead, or the "metallic bath" as it is called, and then plunged into the tempering liquid. The melted lead may be kept covered with charcoal, or other suitable ingredients, to prevent oxidation. In some manufactories a charcoal fire is kept burning on the surface of the melted lead.

Pen Making.—Pens should be made of the best steel that can be got, as peculiar elasticity is required in them, which could not be obtained if poor steel were used. The steel is cut into slips some 3 feet long and 4 inches broad; these slips are then plunged into a pickle of diluted sulphuric acid so as to remove the scales from the surface; next it is passed between heavy rollers by which it is reduced to the thickness required, and made fit to undergo the first process in pen making. This is performed by a girl, who, seated at a stamping-press provided with a bed and corresponding punch, speedily cuts out the blank, which is perfectly flat. The next step is to perforate the hole which terminates the slit, and to remove any superfluous steel which might interfere with the elasticity of the pen. The embryo pens are then annealed in a muffle, and the maker's name stamped upon them. The pens are next transferred to another class of workmen, who, by means of a press, either make the pens concave, if they are merely to be nibs, or, if they are to be barrel pens, they roll the barrel together. The next process is termed the *hardening*, and consists in placing a number of pens in an iron box which is introduced into a muffle. After they become of a deep red heat they are plunged into a tank of oil, and, when they get cool, the adhering oil is removed by agitation in circular tin barrels; *tempering* is the next step, by heating to the necessary elasticity in a warm bath of oil; and, finally, the whole number of pens are placed in a revolving cylinder along with sand, ground crucible, and other cutting substances, which tends to brighten them up to the natural color of the steel; next the nib is ground down finely, with great rapidity, by a girl, who picks it up with a pair of pliers, and, with a single touch on an emery wheel, perfects it at once. The slit is now made by means of a press. A chisel, or wedge, with a flat side, is affixed to the bed of the press, and the descending screw has a corresponding chisel-cutter, which passing down with the greatest accuracy on the pen, which had been placed on the chisel affixed to the bed, and the slit is made and the pen complete. They are next colored brown or blue, by placing them in a revolving metal cylinder, under which is a charcoal stove, and, by watching narrowly the different gradation of color, the requisite tint is speedily attained; a brilliant polish is subsequently imparted by immersing the pens in lac dissolved in naphtha; they are then dried, counted, selected and placed into boxes for sale.

Gold Pens.—Gold pens are made much in the same manner as steel, with this important difference, that, as they cannot be tempered in the same way that steel is, the necessary elasticity is imparted to them by hammering, and by rubbing them with a small hard stone and water, instead of the tempering, &c., in oil. As gold is too soft of itself to make a durable pen, it is found necessary to attach a minute portion of an alloy of irridium and osmium, by soldering to the tips. This makes an extremely hard and durable point.

Tinning Small Articles.—Dissolve as much zinc scraps in muriatic acid as it will take up, let it settle, then decant the clear, and it is ready for use. Next prepare a suitable iron vessel, set it over the fire, put your tin therein, and melt it, and put as much mutton or beef tallow as will cover the tin about $\frac{1}{4}$ inch thick. This prevents the oxidation of the metal; but be very careful that the tallow does not catch fire. The iron, or any other metal to be tinned, must be *well cleaned*, either with scraping, filing, polishing with sand, or immersion in diluted vitriol. Proceed to wet the articles in the zinc solution, then carefully immerse them in the tallow and melted tin; in a very short time they will become perfectly tinned, when they may be taken out.

To Tin Iron Wire.—Clean the wire thoroughly in a pickle made of sulphuric acid and water (acid, 1 part, water, 2 parts) cover it with a solution of muriate of zinc, and dip in melted tin.



MODERN OCEAN STEAMSHIP.

In its wonderful design, vast power, and nice adaptation to successfully encounter the most tremendous forces in nature, the modern ocean steamship is justly entitled to rank as the proudest achievement of man in the line of modern engineering. For the *Modelling of Vessels*, see page 429.

Engineers of steamships have found that the best lubricants are glycerine for the cylinders and castor-oil for the bearings. When castor-oil is used, the main bearings seldom become heated. Only the best glycerine can be employed with advantage; but when it is of a high grade, the results leave little to be desired.

Comparative Weight of Iron and Wood Hulls.—An iron hull weighs nearly 45 per cent. less than a wood hull. The weight of hull of a vessel with an iron frame and oak planking, compared with a hull entirely of wood, is as 8 to 15.

Lubricant for Turning Tools.—It is said that steel annealed to a straw color can be easily turned by using a mixture of petroleum and turpentine as a lubricant. Alloys which resisted the best tempered tools have been turned by the use of petroleum alone.

Planer Tools.—For *common planing*, use a half side tool, stout and short, and with the point turned up, like a common diamond point; for *planing under*, as in slide rests, &c., use tools sharpened up to a point, with the sharp end turned up with a taper from the point to the thick part of about 2 inches. For squaring up, use a round point tool, cutting from the side.

The United States Government Tempering Secret.—The following process and mixtures, patented by Garman and Siegfried, and owned by the Steel Refining and Tempering Co., of Boston, Mass., cost the U. S. Government $10,000 for the right of using in their shops, and is said to impart extraordinary hardness and durability to the poorest kinds of steel. Siegfried's specification reads as follows: "I first heat the steel to a cherry red in a clean smith's fire, and then cover the steel with chloride of sodium (common salt), purifying the fire also by throwing in salt. I work the steel in this condition, and while subjected to this treatment, until it is brought into nearly its finished form. I then substitute for the salt a compound composed of the following ingredients, and in about the following proportions: One part by weight of each of the following substances: chloride of sodium (salt), sulphate of copper, sal-ammoniac, and sal-soda, together with ½ part by weight of pure nitrate of potassa (saltpetre), said ingredients being pulverized and mixed; I alternately heat the steel and treat it by covering with this mixture and hammering it until it is thoroughly refined and brought into its finished form. I then return it to the fire and heat it slowly to a cherry red, and then plunge it into a bath composed of the following ingredients, in substantially the following proportions for the required quantity: of rain water, 1 gal., alum, sal-soda, sulphate of copper, of each 1½ ozs.; of nitrate of potassa (saltpetre), 1 oz., and of chloride of sodium (salt), 6 ozs. These quantities and proportions are stated as being what I regard as practically the best, but it is manifest that they may be slightly changed without departing from the principles of my invention."

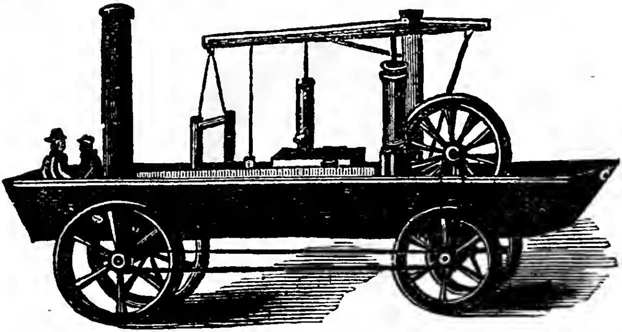
OLIVER EVANS, THE WATT OF AMERICA.

Inventor of the High-Pressure Steam Engine.

In 1793. Oliver Evans, a native of Newport, Delaware, invented the High-pressure Engine, and in 1804 he constructed an engine in Philadelphia, working on the high-pressure system, and placed it on a large scow mounted on wheels, as shown in the following cut. Although the whole weight was equal to 200 barrels of flour, yet his small engine propelled it up Market street and round the circuit to the Water Works, where it was launched into the Schuylkill. A paddle-wheel was then applied to its stern, and it thus sailed down that river to the Delaware, a distance of 16 miles, in the presence of thousands of spectators.

In milling appliances, he invented the grain elevator, the conveyer, the drill, the descender, and the hopper-box, besides other labor-saving inventions of great utility to the miller, He also wrote the "Young Steam Engineer's Guide," and a highly valuable work entitled "The Young Millwright's Guide." Although equally deserving of fame, he failed to reap the substantial honors accorded to Watt in England.

PAPIER MACHE, is used for fancy articles, such as the covers for albums, ink-stands, blotting books, paper knives, etc., as well as for the cells of galvanic batteries. It is obtained from old paper made into a pulp with a solution of lime, and gum or starch, pressed into the form required, coated with linseed oil, baked at a high temperature, and finally varnished. The pulp is sometimes mixed with clay, sand, chalk. etc., and other kinds are made of a paste of pulp and lime, and used for ornamenting wood, inlaying, etc.



PRIMING POWDER FOR PERCUSSION CAPS.—Reduce 40 parts of gunpowder to very fine dust; mix to a thin paste with water, next add chlorate of potassa, 21 parts, previously reduced to a very fine powder; make the paste rather thin and deposit a small drop at the bottom of the cap. The mixture is liable to explode if incautiously handled.

BALLOON VARNISH.—Melt India rubber in small pieces with its weight of linseed oil, and thin with spirits turpentine.

ARTIFICIAL CORAL.—Yellow resin, 4 parts; vermilion, 1 part; melt very fine for ornamental work, &c.

GOLD BEATER'S SKIN is prepared by extending the peritoneal membranes of cæcum, washing them first with plain water, then with a solution of alum and lastly with a solution of isinglass and spices.

HOME-MADE MICROSCOPE.—Remove the bottom from a common pill box and insert a piece of window glass, paint the inside black, and make a small eye hole in the lid. In this hole insert a single drop of Canada balsam and allow it to cool. It possesses magnifying power.

TO REMOVE TIN FROM COPPER VESSELS, immerse the article in a solution of blue vitriol. To remove tin from plates without acid, boil the scrap tin with soda ley in presence of litharge.

SOUND.—In dry air at 82° sound travels 1,142 ft. per second, or about 775 miles per hour; in water, 4,900 ft. per second; in iron, 17,500 ft.; in copper, 10,378 ft.; and in wood from 12 to 16,000 ft. per second. In water, a bell heard at 45,000 ft., could be heard in the air out of the water but 656 ft. In a balloon the barking of dogs can be heard on the ground at an elevation of 4 miles. Divers on the wreck of the Hussar frigate, 100 ft. under water, at Hell Gate, near New York, heard the paddle wheels of distant steamers hours before they hove in sight. The report of a rifle on a still day may be heard at 5,300 yds.; a military band at 5,200 yds. The fire of the English on landing in Egypt was distinctly heard 130 miles. Dr. Jamieson says he heard, during calm weather, every word of a sermon at a distance of 2 miles. The bell of Notre Dame, Montreal, Que., weighs 28,560 lbs.; that of the City Hall, N. Y., 22,300 lbs.; of St. Paul's, London, 11,470; "Big Ben," Westminster, 30,350; "Great Tom," of Oxford, 18,000; St. Peter's, Rome, 18,607; Rouen, France, 40,000; St. Ivan's, Moscow, 127,830; one unhung at Moscow, 440,000, and one in China weighs 120,000 lbs.

TABLE OF FOREIGN WEIGHTS AND MEASURES

REDUCED TO THE STANDARD OF THE UNITED STATES.

(The two right hand figures are the hundredth parts of a whole number.)

FRANCE.

Metre	3·28 feet.
Decimetre (1-10th metre)	3·94 inches.
Velt	2·00 galls.
Hectolitre	26·42 galls.
Decalitre	2·64 galls.
Litre	2·11 pints.
Kilolitre	35·32 feet.
Hectolitre	2·84 bush.
Decalitre	9·08 quarts.
Millier	2·205 lbs.
Quintal	220·54 lbs.
Kilogramme	2·21 lbs.

AMSTERDAM.

100 lbs. 1 centner	108·93 lbs.
Last of grain	85·25 bush.
Ahm of wine	41·00 galls.
Amsterdam foot	0·93 foot.
Antwerp foot	0·94 foot.
Rhineland foot	1·03 feet.
Amstersdam ell	2·26 feet.
Ell of the Hague	2·28 feet.
Ell of the Brabant	2·30 feet.

NETHERLANDS.

Ell	3·28 feet.
Mudde of Zak	2·84 bush.
Vat hectolitre	26·42 galls.
Kan litre	2·11 pints.
Pond kilogramme	2·21 lbs.

HAMBURG.

Last of grain	89·64 bush.
Ahm of wine	38·25 galls.
Hamburg foot	0·96 foot.
Ell	1·92 feet.

PRUSSIA.

100 lbs. of 2 Cologne marks each	103·11 lbs.
Quintal, 110 lbs	113·42 lbs.
Sheffel of grain	1·56 bush.
Eimar of wine	18·14 galls.
Ell of cloth	2·19 feet.
Foot	1·03 feet.

DENMARK.

100 lbs. 1 centner	110·28 lbs.
Barrel or toende of corn	3·95 bush.
Viertel of wine	2·04 galls.
Copenhagen or Rhineland foot	1·03 feet.

SWEDEN.

100 lbs. or 5 lispunds	73·76 lbs.
Kan of corn	7·42 bush.
Last	75·00 bush.
Cann of wine	69·09 galls.
Ell of cloth	1·95 feet.

RUSSIA.

100 lbs. of 32 laths each	90·26 lbs.
Chertwert of grain	5·95 bush.
Vedro of wine	3.25 galls.
Petersburgh foot	1·18 feet.
Moscow foot	1·10 feet.
Pood	36·00 lbs.

SPAIN.

Quintal, or 4 arrobas	101·44 lbs.
Arroba	25·36 lbs.
Arroba of wine	4·43 galls.
Fanega of grain	1·60 bush.

PORTUGAL.

100 lbs	101·19 lbs.
22 lbs. (1 arroba)	22·26 lbs.
4 arrobas of 22 lbs. (1 quintal)	89·05 lbs.
Alquiere	4·75 bush.
Mojo of grain	23·03 bush.
Last of salt	70·00 bush.
Almude of wine	4·37 galls.

SICILY.

Cantar ogroso	192·50 lbs.
Cantaro sottile	175·00 lbs.
100 lbs	70·00 lbs.
Salma grossa of grain	9·77 bush.
Salma generale	7·85 bush.
Salma of wine	23·06 galls.

NAPLES.

Cantaro groso	196·50 lbs.
Cantaro picolo	106·00 lbs.
Carro of grain	52·24 bush.
Carro of wine	264·00 galls.

ROME.

Rubbio of grain	8·36 bush.
Barih of wine	15·31 galls.

GENOA.

100 lbs. or peso groso	76·87 lbs.
100 lbs. or peso sottile	69·89 lbs.
Mina of grain	3·43 bush.
Mezzarola of wine	39·22 galls.

FLORENCE AND LEGHORN.

100 lbs. or 1 cantaro	74·86 lbs.
Moggio of grain	16·59 bush.
Barile of wine	12·04 galls.

VENICE.

100 lbs. peso groso	105·18 lbs.
100 lbs. peso sottile	64·04 lbs.
Moggio of grain	9·08 bush.
Anifora of wine	137·00 galls.

TRIESTE.

100 lbs	123·60 lbs.
Stajo of grain	2·34 bush.
Orna or eimer of wine	14·94 galls.
Ell for woolens	2·22 feet.
Ell for silk	2·10 feet

MALTA.

100 lbs. 1 cantar	174·50 lbs.
Salma of grain	8·22 bush.
Foot	0·85 foot.

SMYRNA.

100 lbs. (1 quintal)	129·48 lbs.
Oke	2·83 lbs.
Quillot of grain	1·46 bush.
Quillot of wine	13·50 galls.

CHINA.

Tail	1·33 oz.
16 tails 1 catty	1·33 lbs.
100 catties 1 picul	133·25 lbs.

PAPER TABLE FOR PRINTERS' AND PUBLISHERS' USE,

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5	40	60	80	120	160	5	10
6	48	72	96	144	192	6	12
7	56	84	112	168	224	7	14
8	64	96	128	192	256	8	16
9	72	108	144	216	288	9	18
10	80	120	160	240	320	11	
11	88	132	176	264	352	12	2
12	96	144	192	288	384	13	4
13	104	156	208	312	416	14	6
14	112	168	224	336	448	15	8
15	120	180	240	360	480	16	10
16	128	192	256	384	512	17	12
17	136	204	272	408		18	14
18	144	216	288	432		19	16
19	152	228	304	456		20	18
20	160	240	320	480		22	
21	168	252	336	504		23	2
22	176	264	352			24	4
23	184	276	368			25	6
24	192	288	384			26	8
25	200	300	400			27	10
26	208	312	416			28	12
27	216	324	432			29	14
28	224	336	448			30	16
29	232	348	464			31	18
30	240	360	480			33	
31	248	372	496			34	2
32	256	384	512			35	4
33	264	396	528			36	6
34	272	408	544			37	8
35	280	420	560			38	10
36	288	432	576			39	12
37	296	444	592			40	14
38	304	456	608			41	16
39	312	468				42	18
40	320	480				44	

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N. B.—The weight of a ream of paper and the price per pound being given, the cost per ream or quire may be known at once by consulting the READY RECKONER TABLE.

To Remove Printer's Ink form Paper Pulp.—Potash 4 lbs; dissolve in as little boiling water as possible, and add 3½ lbs. tallow, boil for 3 hours, and add while cooling and stirring, 3 gals. rain water. Boil the paper pulp, keeping it covered with water, and to each 20 gals. pulp, add 1 gal. of the above mixture; beat and stir thoroughly, and the black printing ink will rise to the surface; skim it off as long as it continues to rise.

Colored Paper.—The papers made from colored rags are the brown packing paper and coarse colored paper, such as sugar and pin papers. According to Wagner, colored pin paper requires to every 50 kilos (see the French measures and their English equivalents described elsewhere) of dry pulp the several under-mentioned substances:—

Yellow	2.05	Kilos	Acetate of Lead,
	0.45	"	Bichromate of Potash,
Blue	2.05	"	Sulphate of Iron,
	1.05	"	Ferrocyanide of Potash,
Green	3.00	"	Blue,
	1.05	"	Yellow,
Violet	1.05	"	Extract of Logwood,
Rose	6.00	"	Extract of Brazil Wood,
Buff	3.00	"	Oil of Vitriol,
	3.00	"	Chloride of Lime.

Ultra marine and aniline blue are also used in coloring. In variegated paper chemical, mineral and vegetable colorings are used according to the desired colors. Body colors are rendered fluid by a solution of gum arabic or alum in the size, which can be applied by a brush or sponge when only one side is to be colored. Variegated and tapestry papers are an important part of the manufacture.

French Composition for Printer's Rollers.—For a 24-inch roller, take Russian isinglass, ¼ oz; gelatine ¼ oz; when the usual composition, compounded of glue, 1 lb; molasses 1 pt. is ready for pouring add the above to it; let all boil 15 minutes longer, then cast in the usual way.

Pasteboard and other Papers.—Pasteboard is made in 3 ways: 1. By placing the pulp in a form: form-board. 2. By pressing several damp sheets to form a thick card: elastic pasteboard. 3. By pasting together the finished paper sheets; sized pasteboard. 1. Form-board is an inferior kind employed for ordinary purposes of packing, book-binding, etc. It is made, from waste paper, refuse rags, and the coarse parts of the pulp. Clay or chalk is sometimes present to 25 per cent. of the weight of this pasteboard. It is made in a coarse ribbed form, goes through the same process of knotting as the paper sheet, and is dried and dressed under a roller.

2. Elastic pasteboard is of better material, and presents a smoother surface; 6 to 12 sheets of paper previously dampened are placed together and pressed into one compact sheet. A separate and harder kind of pasteboard is the thick elastic board, used for binding books. The inner layer is made of coarse stuff, saw dust, etc. 3. Size pasteboard, or cardboard is made of 2 to 15 sheets of sized paper, pressed and satined. There are varieties of this cardboard, such as Bristol-board, London-board, the former being extensively used for water-color drawings, mounting-board, ornamental-board, etc.

BRONZE PRINTING.—Take a small portion of strong lithographic varnish and grind with York Brown, when well ground, thin down with thin varnish and gold size equal parts. This will do for letter press or lithograph printing, for paper, cloth, silk, &c.

Another Way.—Print as with common printers' ink, then dust on or rub over with good pale or other colored bronze powder, allow it to set, then shake or brush off the superfluous bronze with a light soft brush.

GOLD PRINTING.—Have gold leaf cut the proper form to suit your job, and use gold size instead of ink as in the usual way on the type. Apply the gold leaf to the size until the impression is covered, using a gilders tip, or by a dexterous use of the thumb, and forefinger of the right hand slightly moistened, raise the gold leaf with the accompanying paper and apply to the size. When all is covered dab it down gently with a ball or soft cushion of cotton or other proper material, and remove the superfluous gold with a soft brush, and if the size has been well applied it will assume a splendid appearance. Use a good firm roller for gold and bronze printing.

COLORED INKS FOR PRINTERS.—21 *Tints.*—In every case use good varnish, the greatest cleanliness, a good marble slab, a good muller for grinding, and never compound a surplus quantity over and above the present requirements. Grind, blend, and finely pulverize the ingredients, in each and every instance. Good work demands smooth good ink, free from gritty particles. For a good RED, grind in English vermilion, with a little lake. DEEP RED use Indian red and lake. BRIGHT RED, add carmine to pale vermilion. DEEP SCARLET, add a little portion of vermilion to carmine. BLUE, Prussian blue. BRIGHT PALE BLUE, cobalt, also verditure and indigo for other shades of blue. GREEN, to pale chrome add Chinese blue; vary the colors by varying the proportions of the different pigments. EMERALD GREEN, grind pale blue with a little Chinese blue, then add the emerald until the color suits. DEEP BRONZE BLUE, Chinese blue. DEEP BROWN, burnt umber, with a small quantity of scarlet lake. PALE BROWN, burnt sienna with a little scarlet lake. DEEP LILAC, add a little carmine to cobalt blue; for a *pale lilac*, reverse the proportions of each. BRIGHT PINK, crimson, lake or carmine as you prefer. Blue and black inks intermixed, will evolve a DEEP BLUE INK; carmine and blue, will yield a PURPLE INK; yellow and blue, a GREEN INK; yellow and carmine, a VERMILION INK; yellow and black, a BRONZE GREEN; yellow, blue, and black, a DEEP GREEN Ink; carmine, yellow and black, a BROWN INK.

COPPER PLATE PRINTER'S INK is made by adding Frankfort black in proper quantity to the usual linseed oil burnt as for common printing ink. See page 545.

GOLD LEAF.—According to the color, gold leaf is demoninated *deep, medium, fine, red, pale red, deep orange, lemon, pale white*, &c. Deep gold admits very little alloy, the quantity being usually about $2\frac{1}{2}$ of silver and $2\frac{1}{2}$ copper, making 5 in all. A medium kind is made of 42 parts pure gold, 12 silver and 6 copper. The gold is first made into small ingots $1\frac{1}{2}$ x $\frac{3}{4}$ in. and 3-16 in. thick. The ingot is passed repeatedly between 2 polished steel rollers, until it becomes a long ribbon only 1-800 in. thick. The ribbon being cut into inch square pieces, 150 of these are interleaved with thick paper, and enclosed in a parchment case called a *kutch*. The kutch is subjected to a long continued series of blows administered with a 16 lb. hammer, and to all parts of both surfaces equally. When each piece has been stretched out by this beating to 4 in. square, the kutch is opened, the pieces are cut into 4 of 2 in. square each, and these are interleaved in a book of gold-beater's skin called a *shoder*, the 150 pieces being now 600. Another beating with a 9 lb. hammer spreads out these as before and another cutting augments the number from 600 to 2400. These are separated into 3 packets of 800 each, and each of these packets is again beaten in a book of gold beater's skin called a *mould*; this beating, lasting 4 hours, is done with a 7 lb. hammer. The leaves of gold now reduced to the proper thickness, are cut into $3\frac{1}{4}$ in. square which are interleaved in books and made up in packs. Leaf gold is the thinnest substance produced in the mechanical arts, being only the 280.000 of an inch in thickness, a single grain covering 56 square ins. Dentist's gold is thicker than the ordinary leaf gold.

ARTIFICIAL WRITING SLATE.—Sand (fine), 82 parts; lampblack, 8 parts; boiled linseed or cotton seed oil, 10 parts; boil thoroughly together, then add spirits turpentine in order to reduce the mixture for easy application to a thin piece of paste-board. When dry, apply another coat, dry again, give it a third coat and finish off by rubbing smooth with a piece of cotton waste soaked in spirits turpentine. Makes most superb memorandum books, &c.; use a slate pencil.

THE DRUMMOND LIGHT is produced by directing a jet of mixed oxygen and hydrogen upon a pencil of pure lime, the gases being conveyed in separate tubes or pipes, to within a very short distance from the aperture at which they are to be delivered, and the flowing together and mixing in a very minute quantity before combustion takes place. This arrangement is adopted to ensure safety. The gases are used in the proportion of 2 of hydrogen to 1 of oxygen, which form a dreadfully explosive mixture.

TO ENGRAVE ON COPPER. NEW METHOD.—Coat the copper with any of the silvering solutions described in this work, cover this with colored varnish, then draw the lines with a sharp point in the manner of using a diamond for stone engraving, and etch them in with perchloride of iron.

TO ENAMEL COPPER VESSELS.—Pulverize finely 12 parts of fluor spar, 12 parts unground gypsum, and 1 part borax, and fuse together in a crucible; when cold, mix with water to a paste, and apply to the interior with a paint brush; when dry the vessel should be thoroughly baked in a muffle or furnace.

TEMPERING POINTS OF TOOLS.—After being tempered the volume of the tool is slightly increased, and consequently its specific gravity is decreased. As the expansion or increase, of volume is so very slight, it is quite immaterial which is plunged into the liquid first; however, every moment the edge is kept out it is cooling, and the tempering may be rendered defective thereby. Mercury tempers the hardest, then water, then salt water, then oil of various kinds—as whale oil. As oil cools the metal more slowly, it is not tempered so hard but the tenacity is increased.

HARD TINNING COMPOUND.—An alloy of nickel, iron and tin has been introduced as an improvement in tinning metals, by the firm of Blaise & Co., Paris. In an experiment to show the tenacity of the nickel, a piece of cast iron tinned with the compound was subjected for a few minutes to a white heat under the blast, and, although the tin was consumed, the nickel remained as a permanent coating upon the iron. The proportions of nickel and iron mixed with the tin, in order to produce the best tinning, are 10 ozs. of the best nickel and 7 ozs. of sheet iron, to 10 lbs. of tin. These metals are mixed in a crucible to prevent the oxidation of the tin by the high temperature necessary for the fusion of the nickel; the metals are covered with 1 oz. of borax and 3 ozs. pounded glass. The fusion is complete in half an hour, when the composition is run off through a hole made in the flux. In tinning metals with this composition the workman proceeds in the ordinary manner.

TO RECOVER GOLD FROM QUARTZ.—Pulverize the quartz rock as usual, and fuse the mass with lime and oxide of iron. When fused, immerse thin plates of wrought iron in the mixture. The plates soon become coated with a thin film of gold, and are then withdrawn and immersed in a bath of melted lead, which removes the adhering gold, when the plates can at once be returned to the fused quartz and the operation repeated as frequently as the case may require. Another method, when the metal is disseminated through quartz pyrites or lead, is to pulverize the ore as usual and wash the whole with a stream of water, which carries away the lighter portions of sand, leaving the heavy metals behind. It is further freed from impurities by being amalgamated with quick-silver, which is afterwards distilled off. In this state it generally contains from 2 to 10 per cent. of silver or tellurium. It is further refined by being finely granulated and boiled with concentrated sulphuric acid until every other constituent is boiled out. Gold by being alloyed, loses much of its ductility and malleability, but gains in fusibility and hardness. Gold alloys are assayed in two ways, first, by rubbing the article on a touchstone (which is a velvety, black flinty variety of jaspar) so as to make a metallic streak, which is touched with *aqua regia*, and the effect is compared with that of a similar streak made by an alloy of known composition. By this means an experienced operator can estimate the amount of alloy in any mixture correctly within one per cent. Full information regarding the second process can be seen under the article on REFINING GOLD AND SILVER.

GOLD MINING IN COLORADO.—From the veins of Gilpin County alone nearly 600 tons of ore are raised daily, or 180,000 tons annually. Nearly 500 lodes have been assayed or mapped in a circle of three miles in diameter; fully a thousand lodes have been recorded, and more or less work performed on each. From fifteen to twenty miles of reputable lodes are known to exist, upon which there is not less than 8 miles of shafting, the deepest being 800 feet. There is not less than 20 miles of drifting on these veins, following the ore deposit in the crevices, and the official assays show the ore to be worth from \$40 to \$130 per ton. The tailings, or refuse of ore put through the stamps, are found to be worth \$20 per ton, notwithstanding from 10 to 20 per cent. of the precious metal passes down the stream. The average shipments of bullion from this one county verges on \$2,600,-000 annually. The machinery required for this immense production consists of 83 stamp mills, 185 engines in place, 4367 horse power, and 1597 stamps, of which there are over 800 in use, requiring 1703 horse power. There are 30 engines used at the shafts of mines for raising ore from the veins and keeping them free from water. These mills contain from 5 to 50 stamps, mostly driven by steam. The ore, broken into fragments, is fed into a battery in which the stamps are raised and allowed to fall, crushing the ore fine enough to flow through a screen placed in front. Mercury is fed in this battery, and the pulverized ore mixed with sufficient water is then made to flow over wide plates of copper amalgamated with quicksilver. The gold, or part of it, adheres, forming an amalgam with the mercury, which is afterwards scraped off, squeezed hard, and the lump retorted in a close retort of iron for the purpose of vaporizing the mercury and getting the gold almost pure; the retorts being subsequently shipped to the East for minting. Each stamp is calculated to do from ½ to ¾ of a ton in 24 hours, requiring about one horse power to each stamp head. Most of the ore is reduced in leased mills abandoned by companies. These mill men charge their customers between $3 and $4 per ton for doing this work and returning the retort of gold. The tailings are partially caught in the best mills on blankets, and reworked at a profit; the bulk, however, passes outside, a portion stopping to be shovelled into a pile, the balance going on to the stream. The waste is nearly or quite equal to the gross yield in bullion. The most profitable branch of vein mining and reduction by the *smelting process* was undertaken by Prof. Hill in 1867, in connection with some Boston and Providence capitalists, and is managed with much ability, energy and skill, compensated by enormous profits, of which the outside public know little or nothing, from the vigilance with which all such information is suppressed. From the road side you see from 20 to 30 piles of ore sending forth sulphurous emanations into the air. These piles are first started on a layer of wood, and are run up in a pyramid form some 5 to 6 feet, with diameter at base of from 16 to 20 feet, and then fired, the sulphur affording the only fuel, after the exhaustion of the wood, to keep the fire going from four to six weeks. This ore has been passed through the sampling works and been paid for, the amount lying thus in piles at one time amounting to, perhaps, $80,000. After roasting sufficiently to drive off the sulphur, and oxidize a portion of the iron, these piles are cooled and the ore carried to the smelting furnaces, where under a heavy heat, more sulphur is driven off, and the silica or *gangue* matter is made to unite with the oxide of iron to form a slag. At the end of the smelting some 8 or 10 tons are thus reduced to one called "matte," containing from $1,500 to $2,000 in the precious metals, and from 40 to 60 per cent of copper. This product is then shipped in bags to Swansea, England, for separation into the several metals contained. The establishment contains three smelting furnaces and three calcining furnaces, capable of reducing from 20 to 25 tons of ore per day. The tailings which are concentrated along the streams, and are also sold to this establishment, average from $35 to $40 per ton. These works are doubtless the most profitable of the kind known in the world. In working tolerably high grade sulphuretted ores, if the facilities do not admit of sending them to England, the best way is to erect a common furnace, having the fire surfaces of good soap stone; then, to every 150 lbs. of ore, put in one bushel of charcoal and 10 per cent of salt. The ore will readily melt to a slag, and will be pretty well desulphurized. The slag can be drawn off, and when cold can be broken up, and worked like free gold ore.

Recovering Silver by the Patio Process.—The operation known by this name is sometimes conducted on an immense scale. In one instance at the hacienda of Regla near Real de Monte, there is an establishment the floor of which is 1½ acres in extent, built in the most substantial manner, slightly sloped to facilitate the flow of water. The flooring consists of well matched pine boards, and this vast receptacle sometimes contains as much as 1000 tons of argentiferous slime, 30 tons of salt, 3 tons sulphate of copper, and 18,000 lbs. of mercury in various stages of the amalgamating process. The reason why this takes place in the well known manner is because there is an affinity between the different ingredients employed in the operation.

On Correspondences.—The affinity above referred to as existing between different materials, arises from a nature inseminated or implanted in each substance by the Creator, by virtue of which such a mutual affinity exists between them that when an intermixture takes place, they, as it were attract each other, and rush together in mutual embrace. Closely connected with these affinities, as showing the cause of their existence and origin, we have in the science of correspondences a most wonderful and instructive study, entering in its varied ramifications, so deeply into the inherent nature of every created thing, that there is nothing, and can be nothing in the universe but what comes within its consideration. The transcendent importance of the subject is such that it is deserving of vastly more elaborate consideration than the transient notice of a single paragraph, but as it would be a violation of order to enter into an extended explanation in this place, the reader is referred to the appendix for further illustration.

Mercury or Quicksilver.—The ore is cinnabar of a bright vermilion color. Its specific gravity is 8098. It is produced in immense quantities at the New Almaden mine in Santa Clara County, 12 miles from the town of San Jose, which is 54 miles from San Francisco, Cal. The process by which the fluid metal is extracted is one of great simplicity. There are 6 furnaces, near which the ore is deposited from the mine, and separated according to its quality; the larger masses are first broken up and then all is piled up under sheds near the furnace doors. The ore is next heaped on the furnaces, and a steady though not a strong fire is applied; as the ore becomes heated the quicksilver is sublimed, and being condensed it falls by its own weight, and is conducted by pipes, which lead along the bottom of the furnace to small pots or reservoirs imbedded in the earth, each containing from 1 to 2 gallons of the metal. The furnaces are kept going night and day, while large drops or minute streams of the pure metal are constantly trickling down into the receivers; from there it is carried to the store house and deposited in large cast iron tanks or vats, the largest of which is capable of containing 20 tons of quicksilver. Seven or eight days are required to fill the furnaces, extract the quicksilver and remove the residuum. The miners and those who merely handle the quicksilver are not injured thereby, but those who work about the furnaces and inhale the fumes of the metal are seriously affected. Salivation is common, and the attendants on the furnaces are compelled to desist from their labour every three or four weeks, when a fresh set of hands is put on. The horses and mules are also salivated, and from 20 to 30 of them die every year from the effects of the mercury.

SMELTING OF COPPER.—After the ore is raised from the mine, it is freed from its matrix and sorted, the purest portions being broken into pieces the size of a nut. The first calcination is effected in a reverberatory furnace, the heat not being raised too high. At the end of 12 hours the ore is converted into a black powder, containing sulphide of copper, oxide and sulphide of iron, and earthy impurities. The roasted ore is next fused with a quantity of silicious slag, by which means it is converted into a fusible slag, consisting of silicate of iron and sulphides of iron and copper, which sink through the slag, forming at the bottom a heavy mass, termed a *matt.* The matt thus procured is, while melted, run into water, by which it is granulated. The product obtained is called *coarse metal.* It is roasted once more for twenty-four hours, by which means the larger proportion of the sulphide of iron is converted into oxide. It is then calcined with some copper ore known to contain oxide of copper and silica. The oxide of copper transforms any remaining sulphide of iron into oxide, which is taken up by the silica to form a slag, through which the sulphide of copper sinks. This matt contains about 80 per cent. of copper, and is known by the name of *fine metal.* It is cast into pigs, the lower portions of which contain most of the impurities; the metal extracted from the upper portions being known in the market as best selected copper. The fine metal has now to be freed entirely from sulphur by a final calcination, at a heat just short of that required to fuse it. During the process the metal becomes oxidized at the surface. The oxide thus formed decomposes the rest of the sulphide, sulphurous acid escaping, the metallic copper remaining behind. The metal obtained is run off into moulds, forming ingots full of bubbles, from the escape of the sulphurous acid gas. These ingots, which are known as *pimple,* or blistered copper, from their peculiar appearance, have now to undergo the process of refining. They are placed in a reverberatory furnace, and kept in a melted state for upwards of 20 hours, to oxidize the last traces of foreign metals. Slags are formed on the surface and skimmed off, and a great deal of oxide is produced which is absorbed by the metal. To reduce this oxide, the surface of the melted metal is covered with anthracite or charcoal, and towards the last a young tree is thrust in. This process, which is called poling, disengages the whole of the oxygen from the oxide diffused through the mass. The above is, as nearly as possible, the method of copper-smelting, as employed in England, the processes adopted in Saxony and North America being nearly indentical with it, the difference merely being modifications to suit the various impurities contained in the ore. When the ore consists of oxide or carbonate of copper only, it is reduced to the metallic state by simple fusion with charcoal and subsequent poling.

SMELTING OF LEAD.—The ore having been brought to the surface, is first sorted by hand, the purest portions being set aside ready for smelting. The rest is broken by hammers into lumps as large as a walnut, and again sorted. The remainder is then crushed in a mill, and sifted through coarse sieves, the coarser portions being set aside for the stampers, and the finer being subjected to the process of *jig-*

ging. This consists in plunging a sieve containing the ore into water, and shaking it dexterously, so that the smallest particles pass through leaving the larger pieces in the sieve, with the lightest and least metallic portions uppermost. If the sorted galena be tolerably free from gangue, about 1½ tons of the ore is mixed with 1-15th to 1-40th its weight of lime, and heated to dull redness in a reverberatory furnace, through which a current of air is passing. By this means a large portion of the sulphur is burnt off as sulphurous acid, oxide of lead and sulphate of lead being formed, and much of the ore remaining undecomposed. When the roasting has been carried sufficiently far, the furnace doors are shut and the heat is raised. The sulphate and oxide of lead re-act on the undecomposed sulphide, a large quantity of sulphurous acid is formed which passes off, leaving large quantities of metallic lead behind. The fire is now damped, and a quantity of lime thrown in, which forms a very infusible slag, allowing the metallic lead to be drawn off into moulds. This is smelted with an additional portion of ore. Lead is refined by being melted in a shallow pan in a reverberatory furnace. By this operation any tin or antimony it may contain is oxidized and removed. When a ladleful of the lead under this operation cools with a peculiar crystalline surface; the process is discontinued, and the metal is run off into pigs. For some purpose, such for instance as the making of red lead for the manufacture of flint glass, it is necessary that the lead should be almost chemically pure, as a proportion of copper for instance, amounting only to a few grains per ton, would color the glass and spoil the batch. Silver may be profitably extracted from lead, even when it contains only three or four ounces to the ton, by Pattinson's process. This process depends upon the fact that, as lead solidifies, the first portions that crystallize are pure lead. The operation is, therefore, performed by melting the metal in an iron pot and allowing it to cool gradually; as it cools, the crystals of pure lead are removed by a perforated ladle, and the process continually repeated with fresh portions of lead until the mass contains about 300 ounces to the ton. It is then submitted to *cupellation.*

To Construct a Barometer.—Get a strong glass tube 34 inches long and of a smooth even bore. Close one end by means of a spirit lamp and blow pipe, or Bunsen burner, and fill the tube with pure, clean, dry mercury, excluding all bubbles of air. Now place your finger over the open end of the tube, and cautiously insert it in a small cistern or vessel partially filled with mercury. Do not remove your finger until the end of the tube which it covers is safely below the surface of the mercury in the vessel. When the tube is thus inserted remove your finger and the contents will fall until the height of the mercury is nearly 30 ins. above the level of the mercury in the cistern beneath. In the barometer the mercury never rises above 31 inches and seldom falls below 27. The tube may be fitted into a grooved wooden case, the scale attached in the proper place, and the final adjustment made by comparison with a correct instrument.

Smelting of tin.—To extract the metal, the ore is first stamped or washed to get rid of the lighter particles of sand or earth adhering to it. It is then roasted to free it from arsenic and sulphur, and again washed to carry off the sulphate of copper and oxide of iron. The washed ore is mixed with from one-fifth to one-eighth its weight of powdered anthracite, or charcoal, and a small portion of lime to form a fusible slag with any of the remaining gangue. The charge is placed in the hearth of a low crowned reverberatory furnace, and the doors are closed up. Heat is applied very gradually for five or six hours, care being taken to raise the temperature high enough to cause the carbon to reduce the tin without melting the silicious gangue, which would form with the binoxide an enamel too troublesome to remove. When nearly all the tin is reduced, the heat is raised considerably, the slags being thus rendered fluid and capable of floating on the surface of the melted metal. The tin is then run off into cast iron pans from which it is ladled off into moulds to form ingots. The tin thus procured is far from being pure, it is therefore submitted to the process of lignation, which consists in heating the ingots to incipient fusion. By this means the purer tin, which fuses at a comparatively low heat, separates, running down and leaving the impure portions behind. The less fusible portion, when remelted, forms *block tin*, and the part which has run out is again melted and run out with wet stakes. The steam thus formed bubbles up to the surface, carrying with it all the mechanical impurities contained in the tin. The mass is then skimmed and allowed to cool. When just about to set, the upper half is ladled out, the other metals and impurities having sunk into the bottom half, from the tendency that this metal has to separate from its alloys. The finest quality of tin is frequently heated to a temperature just short of its melting point. At this heat, it becomes brittle, and is broken up into masses, showing the crystals of the metal, and forming what is known as *grain tin*. The formation of crystals is to some extent a guarantee of its purity, since impure tin does not become brittle in this way. English tin generally contains small quantities of arsenic, copper, iron and lead. Tin fuses at 442° Fahr., but it is not sensibly volatilized at that or any higher temparature. For the manufacture of tin plate the best soft charcoal iron is obliged to be used. After it has been rolled and cut to the requisite size, its surface is made chemically clean by immersion for a few minutes in dilute sulphuric acid. The sheets are then heated to a red heat in a reverberatory furnace, withdrawn, allowed to cool, hammered flat, passed between polished rollers, and are now washed in dilute acid. This preparation is needed to free the surface of the iron from the slightest portion of oxide, to which the tin would not adhere. In order to tin them they are plunged one by one into a vessel of tallow, from which they are transferred to a bath of tin. From this they are taken, after a certain time, allowed to drain, and dipped again. The superfluous tin at the edge of the plate is removed by dipping it in the melted tin once more, and detaching it by giving the plate a sharp blow.

ROYAL BRITISH WASHING POWDER.—Soda ash, 10 lbs; carbonate of soda (ordinary soda), 10 lbs.; crush into coarse grains. Have a thin solution of glue, or decoction of linseed oil ready, into which pour the soda until quite thick, and spread out on boards, in a warm apartment, to dry, then pack up into nice square packages for sale, labelling neatly. Used to soften hard water; finds a ready sale at a good profit. *Another Way to soften Hard Water.* Stir 1 oz. fresh lime in a bucket of water, pour all into a barrel of water, rummage well; when it settles, the water will be soft, pure, and fit for use. *Seltzer Aperient.* Calcined magnesia, 1 lb.; tartaric acid, in crystals, 1½ lbs.; loaf sugar, 1½ lbs.; bicarbonate of soda, 1 lb. Powder all carefully, dry separately, mix, and add of ess. lemon and orange, of each, ½ fl. dr. Cork tightly in warm dry bottles, after passing through a fine sieve. 1 tablespoonful to a tumbler of water acts as a mild cathartic.

LIQUID BLACK LEAD POLISH.—A good and reliable substitute for powdered stove polish, can be thus made: black lead, pulverized, 2 lbs.; spts. turpentine, 2 gills; water, 2 gills; sugar, 2 ozs.; mix.

USEFUL ITEMS FOR DAILY REMEMBRANCE.

LEGAL BREVITIES.—A note dated on Sunday is void. A note optained by fraud, or from one intoxicated, is void. If a note be lost or stolen, it does not release the maker, he must pay it. An endorser of a note is exempt from liability, if not served with notice of its dishonor within 24 hours of its non-payment. A note by a minor is void. Notes bear interest only when so stated. Principals are responsible for their agents. Each individual in partnership is responsible for the whole amount of the debts of the firm. Ignorance of the law excuses no one. It is a fraud to conceal a fraud. It is illegal to compound a felony. The law compels no one to do impossibilities. An agreement without a consideration is void. Signatures in lead pencil are good in law. A receipt for money is not legally conclusive. The acts of one partner bind all the others. Contracts made on Sunday cannot be enforced. A contract with a minor is void. A contract made with a lunatic is void. Written contracts concerning land must be under seal.

A TABLE OF DAILY SAVINGS AT COMPOUND INTEREST.

Cents per Day	*Per Year*	*In Ten Years*	*Fifty Years*
2¾	$ 10	$ 130	$ 2,900
5¼	20	260	5,800
11	40	520	11,600
27½	100	1,300	29,000
55	200	2,600	58,000
1.10	400	5,200	116,000
1.37	500	6,500	145,000

By the above table it appears that if a mechanic, or clerk saves 2¾ cents per day from the time he is 21 till he is 70, the total with interest will amount to $2,900, and a daily saving of 27½ cents reaches the important sum of $29,000. Save all you can in a prudent manner for a time of possible want, but act justly by paying your debts, and liberally by assisting those in need, and helping in a good cause.

ON PROFANE SWEARING.—Let every man do his best to discountenance this abominable habit, and shun it as an accursed sin in every possible way. No respectable person will allow himself to be guilty of it. Business men who make a practice of it will find themselves avoided by the best class of customers, for I know that some persons can suffer no mental punishment equal to that inflicted by being compelled to listen to profane language. Besides, every man known as a profane swearer, will not be credited by those whose good opinion is worth having, even when he may be speaking the truth.

ACT WELL YOUR PART, DON'T BE SELFISH.—Remember that it is by imparting happiness to others, and making ourselves useful, that we receive happiness. Stand by this truth, live it out, and always keep doing something useful for the common good, doing it well, and acting sincerely. Endeavour to keep your heart in the attitude of cherishing good will to all, thinking and speaking evil of no one, and always with a kind word for every body. Selfishness is its own curse; it is a starving vice. The man who does no good gets none. He is like the heath in the desert, neither yielding fruit nor seeing when good cometh, a stunted dwarfish, miserable shrub. Let all your influence be exerted for the purpose of doing all you can for the common good and individual welfare of every one.

Married Life, its Joys and Sorrows.—A good wife is the greatest earthly blessing. A wife never makes a greater mistake than when she endeavours to coerce her huband with other weapons than those of love and affection. Those weapons are a sure pull if he has any thing human left in him. Forbear mutual upbraidings. In writing letters, during temporary separation, let nothing contrary to love and sincere affection be expressed; such letters from a wife have a most powerful emotional effect, sometimes little understood by those who write them. It is the mother who moulds the character and destiny of the child as to the exteriors, therefore let calmness, peace, affection, and firmness rule her conduct towards her children. Children are great imitators, whether they have scolding or peaceful mothers, they are generally sure to learn from the examples set before them, and thus the consequent joy or sorrow is transferred to other families, therefore let mothers take heed to their conduct. It is not possible to exercise judgment and prudence too much before entering on the married life. Be sure that the affections on both sides are so perfectly intertwined around each other, that the two as it were, form one mind ; this requires time, and a thorough mutual knowledge on both sides. Marry in your own religion, and into a different blood and temperament from your own. Bend your whole powers to avoid depreciatory remarks, jibing and anger in every form, and specially avoid everlastingly dishing up any unsuccessful past action that was done from a good motive and with the best intentions at the time. Let nothing foreign to the spirit of love and mutual affection intervene to cause distance between husband and wife ; to this end let self-denial rule over each, and reciprocal unselfishness. Avoid habitual fault-finding, scolding, &c., as you would perdition itself; many men tremble as they cross their threshold into the presence of scolding wives. Let husband and wife cultivate habits of sobriety, and specially avoid drunkenness in every form. What a dreadful spectacle it is to see a husband transformed into a demon, tottering homeward to a broken-hearted wife, whose noble self-sacrificing devotion to him seems to partake more off the nature of heaven than of earth. Never part, even for a journey, without kind and endearing words, and as a kiss symbolizes union from interior affection, do not dispense with it on such occasions, repeating it when you return. In one word, let love rule supreme.

In all your dealings with woman, take a lesson from the cooing dove, speak softly, deal gently, kindly and considerately with her in every way. Let every husband and every wife cherish for each other the heavenly flame of affection, and let no rude, harsh, or embittered expression on either side chill the sacred fire. If ever adoration of the creature may hope for pardon, surely the worship rendered by man to a kind, pure, affectionate and loving wife, heaven's best gift, may invoke forgiveness. What countless millions of women have sacrificed health, strength and life in attendance on sick and dying husbands, children and strangers? How many have perished by rushing through fire and water to save their children, and starved themselves that they might live? In how many hospitals has she proved herself an angel of mercy, and her sweet voice uttered words of comfort and cheer? Therefore let woman have her full rights, even that of voting if she desires it, for a good woman's influence will ever be used for a good purpose; but let woman act towards man as indicated in the above advice for man to act towards woman, and she would be all but omnipotent, for man in a manner would move heaven and earth to serve her, and would do unspeakably more for her than can ever be done by all the fussy croakers, old maids, and woman's rights associations and lecturers in the creation. Love in the family is the one thing needful to regenerate the earth and cause the wilderness to become as Eden, and the desert to blossom as the rose. Reversed love and discord have broken more hearts, and caused more sorrow, estrangement, and downright death, than war, pestilence and all other causes combined. It palsies energy and ambition, engenders gloom and despair, and transforms manhood into an icicle. Statistics prove that the married live longer on the average by several years, than the unmarried, a most satisfactory proof that the married state is pre-eminently the life designed for man, therefore let all interested do their utmost to make it the happiest.

In reference to the maintenance of health, many valuable prescriptions and much good advice will be found under the *Medical Department* in this work, but truth requires us to state that for the purpose of mitigating the pains and labour incident to woman at the most eventful and critical periods of her life, nothing within the whole compass of nature will compare with water, in its varied applications. This intimation is made for the purpose of directing enlightened and intelligent action on the subject as necessity may call for it. Past experience sustains us when we say that all may enjoy the great blessing of good health in the free use of the bath, the temperate use of proper diet, plenty of exercise, pure air, warm clothing and abstinence from every excess inimical to health.

CHILDREN AND HOME CONVERSATION.—Children hunger perpetually for new ideas. They will learn with pleasure from the lips of parents what they deem drudgery to learn from books, and even if they have the misfortune to be deprived of many educational advantages they will grow up intelligent if they enjoy in childhood the privilege of listening to the conversation of intelligent people. Let them have many opportunities of learning in this way. Be kind to them, and don't think it beneath you to answer their little questions, for they proceed from an implanted faculty which every true man and woman should take a great delight in gratifying.

HOME AFTER BUSINESS HOURS.—Happy is the man who can find that solace and that poetry at home. Warm greetings from loving hearts, fond glances from bright eyes, and welcome shouts of merry hearted children, the many thousand little arrangements for comfort and enjoyment, that silently tell of thoughtful and expectant love, these are the ministrations that reconcile us to the prose of life.

Think of this ye wives and daughters of business men ! Think of the toils, the anxieties, the mortification and wear that fathers undergo to secure for you comfortable homes, and compensate them for their toils by making them happy by their own fireside.

WELL WORTHY OF IMITATION.—A worthy Quaker thus wrote :—"I expect to pass through this world but once. If, therefore, there be any kindness I can do to any fellow being, let me do it now, let me not defer nor neglect it, for I will not pass this way again." Were all to act thus how many would be made happy !

ANOTHER SENSIBLE QUAKER.—A Quaker lately propounded the momentous question to a fair Quakeress, as follows : "Hum ! yea and verily; Penelope, the spirit urgeth and moveth me wonderfully to beseech thee to cleave unto me, flesh of my flesh, and bone of my bone." "Hum ! truly, Obadiah, thou hast wisely said. Inasmuch as it is not good for man to be alone, lo, I will sojourn with thee."

TABLE CONVERSATION.—Instead of swallowing your food in sullen silence, or brooding over your business, or severely talking about others, let the conversation at the table be genial, kind, social and cheering. Don't bring any disagreeable subject to the table in your conversation, any more than you would in your dishes. Avoid scandalizing people, and never cherish a jubilant feeling over the infirmities or misfortunes of others. The more good company you have at your table the better. Hence the intelligence, refinement and appropriate behaviour of a family given to hospitality. Never feel that intelligent visitors can be anything but a blessing to you and yours.

KEEP THE HOUSE CLEAN AND WELL VENTILATED.—A neat, clean, fresh aired, sweet, cheerful, well arranged house, exerts a moral influence over its inmates, and makes the members of a family peaceable and considerate of each other's feelings; on the contrary, a filthy squalid, noxious dwelling, contributes to make its inhabitants selfish, sensual, and regardless of the feelings of others. Never sleep in a small close bedroom, either during summer or winter, without free ventilation from door or windows, unless otherwise supplied with abundance of fresh air. It will be seen that a person's house usually corresponds with his character.

SAFE BUSINESS RULES.—BUSINESS MEN, in business hours, attend ONLY to business matters. SOCIAL CALLS are best adapted to the SOCIAL CIRCLE. Make your business known IN FEW WORDS, without loss of time. Let your dealings with a stranger be MOST CAREFULLY considered, and TRIED FRIENDSHIP duly appreciated. A MEAN ACT will soon recoil, and a MAN OF HONOUR WILL BE ESTEEMED. Leave "TRICKS OF TRADE" to those whose education was never completed. Treat ALL with respect, CONFIDE IN FEW, WRONG NO MAN. Be never afraid to say No, and ALWAYS PROMPT to acknowledge and rectify a wrong. Leave nothing for to-morrow that SHOULD be done to-day. Because a friend is polite, do not think his TIME is valueless. Have a PLACE for everything, and EVERY thing in its place. To preserve LONG friendship, keep A SHORT CREDIT, the way to GET CREDIT is to be punctual ; the way to PRESERVE IT is NOT TO USE it much. SETTLE OFTEN; have SHORT accounts. Trust no man's APPEARANCES, they are often deceptive, and assumed for the purpose of obtaining credit. Rogues generally dress well. The rich are generally PLAIN MEN. Be WELL SATISFIED before you give a credit, that those TO WHOM YOU GIVE IT are SAFE MEN to be trusted.

Habits of a Man of Business.—A sacred regard to the principles of justice forms the basis of every transaction, and regulates the conduct of the upright man of business. 1. He is strict in keeping his engagements. 2. Does nothing carelessly or in a hurry. 3. Employs nobody to do what he can easily do himself. 4. Leaves nothing undone that ought to be done, and which circumstances permit him to do. 5. Keeps his designs and business from the views of others, yet he is candid with all. 6. Is prompt and decisive with his customers, and does not overtrade his capital. 7. Prefers short credit to long ones; and cash to credit at all times, either in buying or selling; and small profits in credit cases with little risk, to the chance of better gains with more hazards. 8. He is clear and explicit in his bargains. 9 Leaves nothing of consequence to memory which he can and ought to commit to writing. 10. Keeps copies of all his important letters which he sends away, and has every letter, invoice, &c., belonging to his business, titled, classed and put away. 11. Never suffers his desk to be confused by many papers lying upon it. 12. Keeps everything in its proper place. 13. Is always at the head of his business, well knowing that if he leaves it, it will leave him. 14. Holds it as a maxim, that he whose credit is suspected is not to be trusted. 15. Is constantly examining his books, and sees through all his affairs as far as care and attention will enable him. 16. Balances regularly at stated times, and then makes out and transmits all his accounts current to his customers, both at home and abroad. 17. Avoids as much as possible all sorts of accommodation in money matters and law-suits where there is the least hazard. 18. He is economical in his expenditure, always living within his income. 19. Keeps a memorandum book in his pocket, in which he notes every particular relative to appointments, addresses, and petty cash matters. 20. Is cautious how he becomes security for any person. 21. And is generous when urged by motives of humanity. Let every man act strictly to these habits; when once begun will be easy to continue in, ever remembering that he had no profits by his pains whom Providence does not prosper, and success will attend his efforts. Let him also remember that the true achievements of life do not consist in making startling strikes, but in the solid performance of daily duty.

How to Make a Fortune.—Cornelius Vanderbilt, on being interrogated as to the best way to make a fortune, is reported to have said in reply, "There is no secret about it, all you have to do is to attend to your business and go ahead." "There is nothing," said George Law, "so easy as making money when you have money to make it with; the only thing is to see the crisis and take it at its flood." Alexander T. Stewart, the millionaire merchant prince of New York, who died April 10, 1876, once said to an anxious enquirer, "I consider honesty and truth great aids in making a fortune." This was sterling advice, and when it is supplemented by good management, ardent application to business, and strong self-reliance, as it was in an eminent degree in Mr. Stewart's own case, it cannot fail to tell with irresistable power in favor of the man who follows it.

True Charity.—Mr. Stewart's idea of charity was that in order to help men you must assist them to get work to help themselves, and not cherish in them a spirit of cringing dependence by giving them money for nothing. "Himself a man of strong self-reliance, he believed that the best service you could do men was to teach them to rely on themselves—to present them opportunities which only could be improved by individual effort. He had no charity for idleness, or the ambition to reap when you have not sown." As observed by his executor, Judge Hilton, "It is more charitable to furnish employment to men and women, than it is to destroy their self-respect by giving them money, as to paupers. Mr. Stewart never believed in helping people to live without work. We have 9,600 persons on the pay roll of A. T. Stewart & Co., and I think that I will best carry out Mr. Stewart's views, and be practically charitable by maintaining the business which will keep those 9,600 persons in honorable employment, so that they can support themselves and the thousands of families dependent upon them." Of Mr. Stewart's honesty and rigidly fair dealing there are numerous accounts. "What do you mean by saying what you know to be untrue," he once demanded of a clerk who was trying his best to convince a woman that a piece of calico would not fade. "The calico won't wash, she'll demand her money back and she'll be right. I don't want goods represented for what they are not." It was this perfect honesty towards his customers that was Mr. Stewart's leading characteristic; and it was his invariable custom, when questioned as to his explanation for his success, to reply with much emphasis. "Truth, truth is the talismanic word; and if I have one earthly wish or desire greater than another, it is that in this respect my example may be commended and followed by young men entering into business, and especially by young merchants." On this firm basis of truth and integrity he conducted his colossal business, not by reckless risks or bargains, but by steady adherence to business, perfect system, and close attention to the least details as well as the largest.

It is much to be regretted that Mr. Stewart did not, during his long and most successful business career, see fit to inaugurate and carry out to completion any such system of public beneficence as was at all commensurate with the ample means at his command, and that the performance of such important offices should be delegated or intrusted in an optional way, to another. Every man, prospered and blest with the almost boundless prosperity meted out to Mr. Stewart, owes a duty to society which should never be neglected in this way. The generous conduct of that great and good philanthrophist, George Peabody, is in this respect most worthy of double honor, and his esteemed name will be deservedly and gratefully remembered by generations yet unborn, for the memorable services which he rendered in his princely bequests to the industrious poor of London, and the education of the colored population of the South.

The following extracts from a letter written by Dr. Franklin to the Rev. George Whitefield (in response to a letter of thanks for relief derived by the latter from the application of electricity in a case of paralysis) very clearly defines the mutual duty of mankind to each other. The following is the first part of Franklin's letter :—

PHILADELPHIA, June 6, 1753.

SIR : I received your kind letter of the 2d inst., and am glad to hear that you increase in strength. I hope you will continue mending till you recover your former health and firmness. Let me know whether you still use the cold bath, and what effect it has. As to the kindness you mention, I wish it could have been of greater service to you. But if it had, the only thanks I should desire is, that you would always be equally ready to serve any other person that may need your assistance, and so let good offices go round, for mankind are all of a family. For my own part, when I am employed in serving others, I do not look upon myself as conferring favors, but on paying debts.

In my travels and since my settlement, I have received much kindness from men, to whom I shall never have any opportunity of making the least direct return, and numberless mercies from God, who is infinitely above being benefited by our services. Those kindnesses from men I can therefore only return on their fellow-men and I can only show my gratitude for those mercies from God, by a readiness to help his other children and my brethren. For I don't think that thanks and compliments, though repeated weekly, can discharge our real obligation to each other, and much less those to our Creator. You will see in this my notion of good works, that I am far from expecting to merit heaven by them. By heaven we understand a state of happiness infinite in degree and eternal in duration; I can do nothing to merit such rewards. He that for giving a draught of water to a thirsty person, should expect to be paid with a good plantation, would be modest in his demands, compared with those who think they deserve heaven for the little good they do on earth. Even the mixed imperfect pleasures we enjoy in this world, are rather from God's goodness than our merit! how much more such happiness of heaven! for my part, I have not the vanity to think I deserve it, the folly to expect it, nor the ambition to desire it, but content myself in submitting to the will and disposal of that God who made me, who has hitherto preserved and blessed me, and in whose fatherly goodness I may well confide, that he will never make me miserable, and that even the afflictions I may at any time suffer, shall tend to my benefit.

CORRESPONDENCE OR SYMBOLIC MEANING OF COLORS.—*White* was the emblem of light, religious purity, innocence, faith, joy and life. In the judge, it indicates integrity, in the sick, humility, in the woman, chastity.

Red, the ruby, signifies fire, divine love, heat of the creative power, and royalty. White and red roses, express love and wisdom. The red color of the blood has its origin in the action of the heart, which corresponds to, or symbolizes love. In a bad sense, red corresponds to the infernal love of evil, hatred, etc.

Blue, or the sapphire, expresses heaven, the firmament, truth from a celestial origin, constancy and fidelity.

Yellow, or gold, is the symbol of the sun, of the goodness of God, of marriage, and faithfulness. In a bad sense, yellow signifies inconstancy, jealousy and deceit.

Green, the emerald, is the color of the spring, of hope, particularly of the hope of immortality and of victory, as the color of the laurel and palm.

Violet, the amethyst, signifies love and truth, or passion and suffering. Purple and scarlet signify things good and true from a celestial origin.

Black corresponds to despair, darkness, earthliness, mourning, negation, wickedness and death.

THE BEST THINGS.—The best theology—a pure and beneficent life. The best philosophy—a contented mind. The best law—the golden rule—The best education—self-knowledge. The best statesmanship—self-government. The best medicine cheerfulness and temperance. The best art—painting a smile on the brow of childhood. The best science—extracting sunshine from a cloudy wray. The best war—to war against internal evils and selfishness. The best music—the laughter of an innocent child. The best journalism—printing the true and the beautiful only on memory's tablet. The best telegraphing—flashing a ray of sunshine into a gloomy heart. The best biography—the life which writes charity in the largest letters. The best mathematics—that which doubles the most joys and divides the most sorrows. The best navigation—steering clear of the lacerating rocks of personal contention. The best diplomacy—effecting a treaty of peace with one's own conscience. The best engineering—building a bridge of love, faith, and trust, in the Divine, over the river of death.

SAVE A LITTLE.—Every man who is obliged to work for his living, should make a point to lay up a little money for that "rainy day" which we are all liable to encounter when least expected. The best way to do this is to open an account with a savings bank. Accumulated money is always safe; it is always ready to use when needed. Scrape together five dollars, make your deposit, receive your bank book, and then resolve to deposit a given sum, small though it be, once a month, or once a week, according to circumstances. Nobody knows without trying it, how easy a thing it is to save money when an account with a bank has been opened. With such an account a man feels a desire to enlarge his deposit. It gives him lessons in frugality and economy, weans him from habits of extravagance, and is the very best guard in the world against intemperance, dissipation and vice. The following table is appended in order to exhibit the time required by money to double itself when loaned at the designated rates of interest:—

Rate per cent.	Time in which a Sum will double.	
	Simple Interest.	Compound Interest
2	50 years.	35 years 1 day.
2 1-2	40 years.	28 years 26 days.
3	33 years 4 months	23 years 164 days.
3 1-2	28 years 208 days.	20 years 54 days.
4	25 years.	17 years 246 days.
4 1-2	22 years 81 days.	15 years 273 days.
5	20 years.	15 years 75 days.
6	16 years 8 months	14 years 327 days.
7	14 years 104 days.	10 years 89 days.
8	12 1-2 years.	9 years 2 days.
9	11 years 40 days	8 years 16 days.
10	10 years.	7 years 100 days.

WAGES TABLE.

SALARIES AND WAGES BY THE YEAR, MONTH, WEEK OR DAY, SHOWING WHAT ANY SUM FROM $20 TO $1600 PER ANNUM, IS PER MONTH, WEEK OR DAY.

Per Year	Per Month.	Per Week.	Per Day.	Per Year.	Per Month	Per Week.	Per Day
$	$ c.	$ c.	$ c.	$	$ c.	$ c.	$ c.
20 is	1.67	.38	.05	280 is	23.33	5.37	.77
25	2.08	.48	.07	285	23.75	5.47	.78
30	2.50	.58	.08	290	24.17	5.56	.79
35	2.92	.67	.10	295	24.58	5.66	.81
40	3.33	.77	.11	300	25.00	5.75	.82
45	3.75	.86	.12	310	25.83	5.95	.85
50	4.17	.96	.14	320	26.67	6.14	.88
55	4.58	1.06	.15	325	27.08	6.23	.89
60	5.00	1.15	.16	330	27.50	6.33	.90
65	5.42	1.25	.18	340	28.33	6.52	.93
70	5.83	1.34	.19	350	29.17	6.71	.96
75	6.25	1.44	.21	360	30.00	6.90	.99
80	6.67	1.53	.22	370	30.83	7.10	1.01
85	7.08	1.63	.23	375	31.25	7.19	1.03
90	7.50	1.73	.25	380	31.67	7.29	1.04
95	7.92	1.82	.26	390	32.50	7.48	1.07
100	8.33	1.92	.27	400	33.33	7.67	1.10
105	8.75	2.01	.29	425	35.42	8.15	1.16
110	9.17	2.11	.30	450	37.50	8.63	1.23
115	9.58	2.21	.32	475	39.58	9.11	1.30
120	10.00	2.30	.33	500	41.67	9.59	1.37
125	10.42	2.40	.34	525	43.75	10.07	1.44
130	10.83	2.49	.36	550	45.83	10.55	1.51
135	11.25	2.59	.37	575	47.92	11.03	1.58
140	11.67	2.69	.38	600	50.00	11.51	1.64
145	12.08	2.78	.40	625	52.08	11.99	1.71
150	12.50	2.88	.41	650	54.17	12.47	1.78
155	12.92	2.97	.42	675	56.25	12.95	1.85
160	13.33	3.07	.44	700	58.33	13.42	1.92
165	13.75	3.16	.45	725	60.42	13.90	1.99
170	14.17	3.26	.47	750	62.50	14.38	2.05
175	14.58	3.36	.48	775	64.58	14.86	2.12
180	15.00	3.45	.49	800	66.67	15.34	2.19
185	15.42	3.55	.51	825	68.75	15.82	2.26
190	15.83	3.64	.52	850	70.83	16.30	2.33
195	16.25	3.74	.53	875	72.92	16.78	2.40
200	16.57	3.84	.55	900	75.00	17.26	2.47
205	17.08	3.93	.56	925	77.08	17.74	2.53
210	17.50	4.03	.58	950	79.17	18.22	2.60
215	17.92	4.12	.59	975	81.25	18.70	2.67
220	18.33	4.22	.60	1000	83.33	19.18	2.74
225	18.75	4.31	.62	1050	87.50	20.14	2.88
230	19.17	4.41	.63	1100	91.67	21.10	3.01
235	19.58	4.51	.64	1150	95.83	22.06	3.15
240	20.00	4.60	.66	1200	100.00	23.01	3.29
215	20.42	4.70	.67	1250	104.17	23.29	3.42
250	20.83	4.79	.69	1300	108.33	24.93	3.56
255	21.25	4.89	.70	1350	112.50	25.89	3.70
260	21.67	4.99	.71	1400	116.67	26.85	3.81
265	22.08	5.08	.73	1450	120.84	27.80	3.98
270	22.50	5.18	.74	1500	125.00	28.77	4.11
275	22.92	5.27	.75	1600	133.34	30.68	4.38

NOTE.—If the desired sum is not in the table, double some number; for instance if the salary or wages is $2000, double the sums opposite $1000, and so on with the rest.

WAGES TABLE.

WAGES TABLE, CALCULATED ON A SCALE OF TEN HOURS LABOR PER DAY. THE TIME, IN HOURS AND DAYS IS NOTED IN THE LEFT HAND COLUMN, AND THE AMOUNT OF WAGES UNDER THE RESPECTIVE HEADINGS AS NOTED BELOW.

Wages.	$1.00	$1.50	$2.00	$2.50	$3.00	$3.50	$4.00	$4.50	$5.00	$5.50	$6.00
Hours. ½	.1	1¼	.1⅔	.2	.2⅓	3	.3½	.2¾	.4½	.4½	.5
1	.1⅔	.2½	.3⅓	.4⅙	.5	6	.6⅔	.7½	.8⅓	.9⅙	.10
2	.3⅓	.5	.6⅔	.8⅓	.10	11⅔	.13⅓	.15	.16⅔	.18⅓	.20
3	.5	.7½	.10	.12½	.15	17½	.20	.22½	.25	.27½	.30
4	.6⅔	.10	.13½	.16⅔	.20	23⅓	.26⅔	.30	.33⅓	.36⅔	.40
5	.8⅓	.12½	.16⅔	.21	.25	29⅙	.33⅓	.37½	.41⅔	.46	.50
6	.10	.15	.20	.25	.30	35	.40	.45	.50	.55	.60
7	.11⅔	.17½	.23⅓	.29½	.35	41	.46⅔	.52½	.58⅓	.64⅙	.70
8	.13⅓	.20	.26⅔	.33⅓	.40	46⅔	.53⅓	.60	.66⅔	.73⅓	.80
9	.15	.22½	.30	.37½	.45	52½	.60	.67½	.75	.82½	.90
Days.											
1	.16⅔	.25	.33⅓	.41⅔	.50	.58⅓	.66⅔	.75	.83⅓	.91⅔	1.00
2	.33⅓	.50	.66⅔	.83⅓	1.00	1.16⅔	1.33⅓	1.50	1.66⅔	1.83⅓	2.00
3	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
4	.66⅔	1.00	1.33⅓	1.66⅔	2.00	2.33⅓	2.66⅔	3.00	3.33⅓	3.66⅔	4.00
5	.83⅓	1.25	1.66⅔	2.08⅓	2.50	2.91⅔	3.33⅓	3.75	4.16⅔	4.58⅓	5.00
6	1. 00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	00	5.50	6.00

Wages.	$6.50	$7.00	$7.50	$8.00	$9.00	$10.00	$11.00	$12.00	$13.00	$14.00	$15.00
Hours. ½	.5½	.6	.6¼	.6⅔	.7½	.8⅓	.9	.10	.11	.12	.12½
1	.11	.11⅔	.12½	.13⅓	.15	.16⅔	.18⅓	.20	.22	.23½	.25
2	.21⅔	.23⅓	.25	.26⅔	.30	.33⅓	.36⅔	.40	.43⅓	.46⅔	.50
3	.32½	.35	.37½	.40	.45	.50	.55	.60	.65	.70	.75
4	.43⅓	.46⅔	.50	.53⅓	.60	.66⅔	.73⅓	.80	.86⅔	.93⅓	1.00
5	.54⅙	.58⅓	.62½	.66⅔	.75	.83⅓	.91⅔	1.00	1.08⅓	1.16⅔	1.25
6	.65	.70	.75	.80	.90	1.00	1.10	1.20	1.30	1.40	1.50
7	.76	.81⅔	.87½	.93⅓	1.05	1.16⅔	1.28⅓	1.40	1.52	1.63⅓	1.75
8	.86⅔	.93⅓	1.00	1.06⅔	1.20	1.33⅓	1.46⅔	1.60	1.73⅓	1.86⅔	2.00
9	.97½	1.05	1.12½	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25
Days.											
1	1.08⅓	1.16⅔	1.25	1.33⅓	1.50	1.66⅔	1.83⅓	2.00	2.17	2.33⅓	2.50
2	2.16⅔	2.33⅓	2.50	2.66⅔	3.00	3.33⅓	3.66⅔	4.00	4.34	4.66⅔	5.00
3	3.25	3.50	3.75	4.00	4.50	5.00	5.50	6.00	6.51	6.99⅔	7.50
4	4.33⅓	4.66⅔	5.09	5.33⅓	6.00	6.66⅔	7.33⅓	8.00	8.68	9.33	10.00
5	5.41⅔	5.83⅓	6.25	6.66⅔	7.00	8.33⅓	9.16⅔	10.00	10.85	11.66⅓	12.50
6	6.50	7.00	7.50	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00

If the desired number of days or amount of wages is not in the table, double or treble any suitable number of days or amount of money as the case may be, until you obtain the desired number of days and the wages to correspond.

To Reduce the Price of Wheat, in Sterling, per Imperial Quarter, to Dollars and Cents.—Reduce the shillings per quarter into dollars and cents, at 24.2 cts. per shilling, and divide by 9⅓, the number of United States bushels in an imperial quarter.

Example.—Required the price of wheat per U. S. bushel in Liverpool, when it fetches 58s. 6d. per imperial quarter. 58s. 6d equals $14 15, which, divided by 9⅓, gives $1.51½ the price per bushel.

INTEREST TABLE,

AT SIX PER CENT., IN DOLLARS AND CENTS, FROM ONE DOLLAR TO TEN THOUSAND.

	1 day.	7 days.	15 days.	1 mo.	3 mos.	6 mos.	12 mos.
$	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
1	00	00	00¼	00½	01½	03	06
2	00	00¼	00½	01	03	06	12
3	00	00¼	00¾	01½	04½	09	18
4	00	00½	01	02	06	12	24
5	00	00½	01¼	02½	07½	15	30
6	00	00¾	01½	03	09	18	36
7	00	00¾	01¾	03½	10½	21	42
8	00	01	02	04	12	24	48
9	00	01	02¼	01½	13½	27	54
10	00	01¼	02½	05	15	30	60
20	00¼	02½	05	10	30	60	1 20
30	00½	03½	07½	15	45	90	1 80
40	00¾	01½	10	20	60	1 20	2 40
50	01	06	12½	25	75	1 50	3 00
100	01½	11¾	25	50	1 50	3 00	6 00
200	03	23½	50	1 00	3 00	6 00	12 00
300	05	35	75	1 50	4 50	9 00	18 00
400	07	46½	1 00	2 00	6 00	12 00	24 00
500	08	58½	1 25	2 50	7 50	15 00	30 00
1000	17	1 16½	2 50	5 00	15 00	30 00	60 00
2000	33	2 33½	5 00	10 00	30 00	60 00	120 00
3000	50	3 50	7 50	15 00	45 00	90 00	180 00
4000	67	4 66½	10 00	20 00	60 00	120 00	240 00
5000	83	5 83½	12 50	25 00	75 00	150 00	300 00
10000	1 67	11 66½	25 00	50 00	150 00	300 00	600 00

AT SEVEN PER CENT., IN DOLLARS AND CENTS, FROM ONE DOLLAR TO TEN THOUSAND.

1	00	00	00¼	00½	01¾	03½	07
2	00	00¼	00½	01¼	03½	07	14
3	00	00½	00¾	01¾	05¼	10½	21
4	00	00½	01	02⅛	07	14	28
5	00	00¾	01½	03	08¾	17½	35
6	00	00¾	01¾	03½	10½	21	42
7	00	01	02	04	12¼	21½	49
8	00	01	02¼	01⅔	14	28	56
9	00	01¼	02½	05¼	15¾	31½	63
10	00¼	01¼	03	05¾	17½	35	70
20	00⅔	02¾	06	11⅔	35	70	1 40
30	00½	04	09	17½	52½	1 05	2 10
40	00¾	05½	12	23⅓	70	1 40	2 80
50	01	06¾	15	29¼	87½	1 75	3 50
100	02	13½	20	58⅓	1 75	3 50	7 00
200	04	27¼	58	1 16⅔	3 50	7 00	14 00
300	06	40¾	87½	1 75	5 25	10 50	21 00
400	08	54½	1 17	2 33⅛	7 00	14 00	28 00
500	10	68	1 46	2 91⅔	8 75	17 50	35 00
1000	19½	1 36	2 92	5 83⅛	17 50	35 00	70 00
2000	39	2 72¼	5 83	11 66⅔	35 00	70 00	140 00
3000	58	4 08¼	8 75	17 50	52 50	105 00	210 00
4000	78	5 44½	11 67	23 33⅛	70 00	140 00	280 00
5000	97	6 80½	14 58	29 16⅔	87 50	175 00	350 00
10000	1 94	13 61	29 17	58 33	175 00	350 00	700 00

READY RECKONER, 2,000 LBS. TO THE TON.

For Computing the Price of Coals, Hay, or any other commodity, sold by the Ton or part of a Ton. If the desired amount or quantity is not in the Table, add two numbers together.

Lbs.	cts. 25	cts. 50	$ ct. 1.00	$ cts. 2.00	$ cts. 3.00	$ cts. 5.00	$ cts. 6.00	$ cts. 7.00	$ cts. 8.00	$ cts. 9.00	$ cts. 10.00	$ cts. 11.00	$ cts. 12.00	$ cts. 13.00	$ cts. 14.00	$ cts. 15.00	$ cts. 16.00	$ cts. 17.00	$ cts. 19.00	$ cts. 20.00	$ cts. 25.00	$ cts. 30.00	$ cts 40.00
3	....	....	....	.....	.....	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	4	5	6
7	....	....	....	1	1	2	2	2	3	3	4	4	4	5	5	5	6	6	7	7	9	10	14
10	....	....	1	1	2	3	3	4	4	5	5	6	6	7	7	8	8	9	10	10	13	16	20
20	....	1	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	25	30	40
30	....	1	2	3	5	8	9	11	12	14	15	17	18	20	21	23	24	26	29	30	38	46	60
50	1	1	3	5	8	13	15	18	20	23	25	28	30	33	35	38	40	43	48	50	63	74	1.00
70	1	2	4	7	11	18	21	25	28	32	35	39	44	46	49	53	56	60	67	70	88	1.06	1.40
80	1	2	4	8	12	20	24	28	32	36	40	44	48	52	56	60	64	68	76	80	1.00	1.20	1.60
90	1	2	5	9	14	23	27	32	36	41	45	50	52	59	63	68	72	77	86	90	1.13	1.36	1.80
100	1	3	5	10	15	25	30	35	40	45	50	55	60	65	70	75	80	85	95	1.00	1.25	1.50	2.00
200	3	5	10	20	30	50	60	70	80	90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.90	2.00	2.50	3.00	4.00
300	4	8	15	30	45	75	90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.85	3.00	3.75	4.50	6.00
400	5	10	20	40	60	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.80	4.00	5.00	6.00	8.00
500	6	13	25	50	75	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.75	5.00	6.25	7.50	10.00
600	8	15	30	60	90	1.50	1.80	2.10	2.40	2.70	3.00	3.60	3.60	3.90	4.20	4.50	4.80	5.10	5.70	6.00	7.50	9.00	12.00
700	9	18	35	70	1.05	1.75	2.10	2.45	2.80	3.15	3.50	3.85	4.20	4.55	4.90	5.25	5.60	5.95	6.65	7.00	8.75	10.50	14.00
800	10	20	40	80	1.20	2.00	2.40	2.80	3.20	3.60	4.00	4.40	4.80	5.20	5.60	6.00	6.40	6.80	7.60	8.00	10.00	12.00	16.00
900	11	23	45	90	1.35	2.25	2.70	3.15	3.60	4.05	4.50	4.95	5.40	5.85	6.30	6.75	7.20	7.65	8.55	9.00	11.25	13.50	18.00
1000	13	25	50	1.00	1.50	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.50	10.00	12.50	15.00	20.00
1100	14	28	55	1.10	1.65	2.75	3.30	3.85	4.40	4.95	5.50	6.05	6.60	7.15	7.70	8.25	8.80	9.35	10.45	11.00	13.75	16.50	22.00
1200	15	30	60	1.20	1.80	3.00	3.60	4.20	4.80	5.40	6.00	6.60	7.20	7.80	8.40	9.00	9.60	10.20	11.40	12.00	15.00	18.00	24.00
1300	16	33	65	1.30	1.95	3.25	3.90	4.55	5.20	5.85	6.50	7.15	7.80	8.45	9.10	9.75	10.40	11.05	12.35	13.00	16.25	19.50	26.00
1400	18	35	70	1.40	2.10	3.50	4.20	4.90	5.60	6.30	7.00	7.70	8.40	9.10	9.80	10.50	11.20	11.90	13.30	14.00	17.50	21.00	28.00
1500	19	38	75	1.50	2.25	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.25	12.00	12.75	14.25	15.00	18.75	22.50	30 00
1600	20	40	80	1.60	2.40	4.00	4.80	5.60	6.40	7.20	8.00	8.80	9.60	10.40	11.20	12.00	12.80	13.60	15.20	16.00	20.00	24.00	32.00
1700	21	43	85	1.70	2.55	4.25	5.10	5.95	6.80	7.65	8.50	9.35	10.20	11.05	11.90	12.75	13.60	14.15	16.15	17.00	21.25	25.50	34.00
1800	23	45	90	1.80	2.70	4.50	5.40	6.30	7.20	8.10	9.00	9 90	10.80	11.70	12.60	13.50	14.40	15.30	17.10	18.00	22.50	27.00	36.00
1900	24	48	95	1.90	2.85	4.75	5.70	6.65	7.60	8.55	9.50	10.45	11.40	12.35	13.30	14.25	15.20	16.15	18.05	19.00	23.75	28.50	38.00

READY RECKONER, 2,240 LBS. TO THE TON.

For Computing the Price of Coals, Hay, or any other commodity sold by the Ton, or parts of a Ton. If the desired amount or quantity is not in the Table, add two or three numbers together.

Lbs.	cts. 25	cts. 50	$ ct. 1.00	$ ct. 2.00	$ ct. 3.00	$ ct. 5.00	$ ct. 6.00	$ cts. 7.00	$ cts. 8.00	$ cts. 9.00	$ cts. 10.00	$ cts. 11.00	$ cts. 12.00	$ cts. 13.00	$ cts. 14.00	$ cts. 15.00	$ cts. 16.00	$ cts. 17.00	$ cts. 19.00	$ cts. 20.00	$ cts. 21.00	$ cts. 23.00	$ cts. 24.00	$ cts. 25.00
20	....	....	....	2	3	4	5	6	7	8	9	10	11	12	13	13	14	15	17	18	19	21	21	22
25	....	....	1	2	3	5	7	8	9	10	11	12	13	15	16	17	18	19	21	22	23	26	27	28
30	....	....	1	3	4	7	8	9	11	12	13	15	16	17	19	20	21	23	25	27	28	31	32	33
50	...	1	2	4	6	11	13	16	18	20	22	25	27	29	31	33	36	38	42	45	47	51	54	56
70	....	2	3	6	9	15	19	22	25	28	31	34	37	41	44	47	50	53	59	62	66	72	75	78
80	....	2	4	7	11	18	21	25	29	32	36	39	43	46	50	51	57	61	68	71	75	82	86	89
90	....	2	4	8	12	20	24	28	32	36	40	44	48	52	56	60	64	68	76	80	84	92	96	1.00
100	1	2	4	9	13	22	27	31	36	40	45	49	51	58	63	67	71	76	85	89	94	1 03	1.07	1.12
200	2	4	9	18	27	45	54	63	71	80	89	98	1.07	1.16	1.25	1.34	1.42	1.52	1.70	1.79	1.88	2.05	2.14	2.23
300	3	7	13	27	40	67	80	94	1.07	1.21	1.34	1.47	1.61	1.74	1.88	2.01	2.14	2.28	2.54	2 68	2.81	3.08	3.21	3.35
400	4	9	18	36	54	89	1.07	1.25	1.43	1.61	1.79	1.96	2.14	2.32	2.50	2.68	2.86	3.04	3.39	3.57	3.75	4.11	4.29	4.46
500	6	11	22	45	67	1.12	1.34	1.56	1.79	2.01	2.23	2.46	2.68	2.90	3.13	3.35	3.57	3.79	4.24	4.46	4.69	5.13	5.36	5.58
600	7	13	27	54	80	1.34	1.61	1.88	2.14	2.41	2.68	2.95	3.21	3.48	3.75	4.02	4.29	4.55	5.09	5.36	5.63	6.16	6.43	6.70
700	8	16	31	63	94	1.56	1.87	2.19	2.50	2.81	3.12	3.44	3.75	4.06	4.38	4.69	5.00	5.31	5.94	6.25	6.56	7.19	7.50	7.81
800	9	18	36	71	1.07	1.79	2.14	2.50	2.86	3.21	3.57	3.93	4.29	4.64	5.00	5.36	5.71	6.07	6.79	7.14	7.50	8.21	8.57	8.93
900	10	20	40	80	1.21	2.01	2.41	2.81	3.21	3.62	4.02	4.42	4.82	5.22	5.63	6.03	6.43	6.83	7.63	8.04	8.44	9.24	9.64	10.04
1000	11	22	45	89	1.34	2.23	2.68	3.13	3.57	4.02	4.46	4.91	5.36	5.80	6.25	6.70	7.14	7.59	8.48	8.93	9.38	10.27	10.71	11.16
1100	12	25	49	98	1.47	2.46	2.95	3.44	3.93	4.42	4.91	5.40	5.89	6.38	6.88	7.37	7.86	8.35	9.33	9.82	10.31	11.29	11.79	12.28
1200	13	27	54	1.07	1.61	2.68	3.21	3.75	4.29	4.82	5.36	5.89	6.43	6.96	7.50	8.04	8.57	9.11	10.18	10.71	11.25	12.32	12.86	13.39
1300	14	29	58	1.16	1.74	2.90	3.48	4.06	4.64	5.22	5.80	6.38	6.96	7.54	8.13	8.70	9.28	9.87	11.03	11.61	12.19	13.35	13.93	14.51
1400	16	31	62	1.25	1.87	3.12	3.75	4.38	5.00	5.62	6.25	6.87	7.50	8.12	8.75	9.37	10.00	10.62	11.87	12.50	13.13	14.37	15.00	15.62
1500	17	33	67	1.34	2.01	3.35	4.02	4.69	5.36	6.03	6.70	7.37	8.04	8.70	9.38	10.04	10.71	11.38	12.72	13.39	14.06	15.40	16.07	16.74
1600	18	36	71	1.43	2.14	3.57	4.28	5.00	4.71	6.43	7.14	7.86	8.57	9.28	10.00	10.71	11.43	12.14	13.57	14.28	15.00	16.43	17.14	17.86
1700	19	38	76	1.52	2.28	3.79	4.56	5.31	6.07	6.83	7.59	8.35	9.11	9.86	10.63	11.38	12.14	12.90	14.42	15.18	15.94	17.45	18.21	18.97
1800	20	40	80	1.61	2.41	4.02	4.82	5.63	6.43	7.23	8.04	8.84	9.64	10.44	11.25	12.05	12.86	13.66	15.27	16.07	16.88	18.48	19.29	20.09
1900	21	42	85	1.70	2.54	4.24	5.09	5.94	6.78	7.63	8.48	9.33	10.18	11.03	11.88	12.72	13.57	14.42	16.12	16.96	17.81	19.51	20.36	21.20
2000	22	45	89	1.78	2.68	4.46	5.36	6.25	7.14	8 03	8.93	9.82	10.71	11.61	12.50	13.39	14.28	15.18	16.96	17.86	18.75	20.53	21.43	22.32
2100	23	47	94	1.87	2.81	4.69	5.62	6.56	7.50	8.44	9.37	10.31	11.25	12.19	13.13	14.06	15.00	15.94	17.81	18.75	19.69	21.56	22.53	33.44

READY RECKONER, to find the Price of any Number of Pounds, Yards Pieces, or Bushels, from 2 cents to $3.00.

The first column contains the NUMBER, the top columns the PRICES.

Nos	2 ct.	3 ct.	4 ct.	5 ct.	6 ct.	6¼ ct.	7 ct.	8 ct.	9 ct.	10 ct.	11 ct.
2	. 4	. 6	. 8	.10	.12	.12½	.14	.16	.18	.20	.22
3	. 6	. 9	.12	.15	.18	.18¾	.21	.24	.27	.30	.33
4	. 8	.12	.16	.20	.24	.25	.28	.32	.36	.40	.44
5	.10	.15	.20	.25	.30	.31¼	.35	.40	.45	.50	.55
6	.12	.18	.24	.30	.36	.37½	.42	.48	.54	.60	.66
7	.14	.21	.28	.35	.42	.43¾	.49	.56	.63	.70	.77
8	.16	.24	.32	.40	.48	.50	.56	.64	.72	.80	.88
9	.18	.27	.36	.45	.54	.56¼	.63	.72	.81	.90	.99
10	.20	.30	.40	.50	.60	.62½	.70	.80	.90	1.00	1,10
11	.22	.33	.44	.55	.66	.68¾	.77	.88	.99	1.10	1.21
12	.24	.36	.48	.60	.72	.75	.84	.96	1.08	1.20	1.32
13	.26	.39	.52	.65	.78	.81¼	.91	1.04	1.17	1.30	1.43
14	.28	.42	.56	.70	.84	.87½	.98	1.12	1.26	1.40	1.54
15	.30	.45	.60	.75	.90	.93¾	1.05	1.20	1.35	1.50	1.65
16	.32	.48	.64	.80	.96	1.00	1.12	1.28	1.44	1.60	1.76
17	.34	.51	.68	.85	1.02	1.06¼	1.19	1.36	1.53	1.70	1.87
18	.36	.54	.72	.90	1.08	1.12½	1.26	1.44	1.62	1.80	1.98
19	.38	.57	.76	.95	1.14	1.18¾	1.33	1.52	1.71	1.90	2.09
20	.40	.60	.80	1.00	1.20	1.25	1.40	1.60	1.80	2.00	2.20
25	.50	.75	1.00	1.25	1.50	1.56¼	1.75	2.00	2.25	2.50	2. 5
30	.60	.90	1.20	1.50	1.80	1.87½	2.10	2.40	2.70	3.00	3.30
40	.80	1.20	1.60	2.00	2.40	2.50	2.80	3.20	3.60	4.00	4.40
50	1.00	1.50	2.00	2.50	3.00	3.12½	3.50	4.00	4.50	5.00	5.50
60	1.20	1.80	2.40	3.00	3 60	3.75	4.20	4.80	5.40	6.00	6.60
70	1.40	2.10	2.80	3.50	4.20	4.37½	4.90	5.60	6.30	7.00	7.70
80	1.60	2.40	3.20	4.00	4.80	5.00	5.60	6.40	7.20	8.00	8.80
90	1.80	2.70	3.60	4.50	5.40	5.62½	6.30	7.20	8.10	9.00	9.90
100	2.00	3.00	4.00	5.00	6.00	6.25	7.00	8.00	9.00	10.00	11.00

Nos	12 ct.	12½ct.	13ct.	14 ct.	15 ct.	16 ct.	18 ct.	18¾ct.	19 ct.	20 ct.	21 ct.
2	.24	.25	.26	.28	.30	.32	.36	.37½	.38	.40	.42
3	.36	.37½	.39	.42	.45	.48	.54	.56¼	.57	.60	.63
4	.48	.50	.52	.56	.60	.64	.72	.75	.76	.80	.84
5	.60	.62½	.65	.70	.75	.80	.90	.93¾	.95	1.00	1.05
6	.72	.75	.78	.84	.90	.96	1.08	1.12½	1.14	1.20	1·26
7	.84	.87½	.91	.98	1.05	1.12	1.26	1.31¼	1.33	1.40	1.47
8	.96	1.00	1.04	1.12	1.20	1.28	1.44	1.50	1.52	1.60	1.68
9	1.08	1.12½	1.17	1.26	1.35	1.44	1.62	1.68¾	1.71	1.80	1.89
10	1.20	1.25	1.30	1.40	1.50	1.60	1.80	1.87½	1.90	2.00	2.10
11	1.32	1.37½	1.43	1.54	1.65	1.76	1.98	2.06¼	2.09	2.20	2.31
12	1.44	1.50	1.56	1.68	1.80	1.92	2.16	2.25	2.28	2.40	2.52
13	1.56	1.62½	1.69	1.82	1.95	2.08	2.34	2.43¾	2.47	2.60	2.73
14	1.68	1.75	1.82	1.96	2.10	2.24	2.52	2.62½	2.66	2.80	2.94
15	1.80	1.87½	1.95	2.10	2.25	2.40	2.70	2.81¼	2.85	3.00	3.15
16	1.92	2.00	2.08	2.24	2.40	2.56	2.88	3.00	3.04	3.20	3.36
17	2.04	2.12½	2.21	2.38	2.55	2.72	3.06	3.18¾	3.23	3.40	3.57
18	2.16	2.25	2.34	2.52	2.70	2.88	3.24	3.37½	3.42	3.60	3.78
19	2.28	2.37½	2.47	2.66	2.85	3.04	3.42	3.56¼	3.61	3.80	3.99
20	2.40	2.50	2.60	2.80	3.00	3.20	3.60	3.75	3.80	4.00	4.20
25	3.00	3.12½	3.25	3.50	3.75	4.00	4.50	4.68¾	4.75	5.00	5.25
30	3.60	3.75	3.90	4.20	4.50	4.80	5.40	5.62½	5.70	6.00	6.30
40	4.80	5.00	5.20	5.60	6.00	6.40	7.20	7.50	7.60	8.00	8.40
50	6.00	6.25	6.50	7.00	7.50	8.00	9.00	9.37½	9.50	10.00	10.50
60	7.20	7.50	7.80	8.40	9.00	9 60	10.80	11.25	11.40	12.00	12.60
70	8.40	8.75	9.10	9.80	10.50	11.20	12.60	13.12½	13.30	14.00	14.70
80	9.60	10.00	10.40	11.20	12.00	12.80	14.40	15.00	15.20	16.00	16.80
90	10.80	11.25	11.70	12.60	13.50	14.40	16.20	16.87½	17.10	18.00	18.90
100	12.00	12.50	13.00	14.00	15.00	16.00	18.00	18.75	19.00	20.00	21.00

The first column on the left contains the NUMBER of the Article, and the column on the tops of the tables the PRICE.

Nos	22 ct.	23ct.	24 ct.	25 ct.	26 ct.	27 ct.	28 ct.	29 ct.	30 ct.	31 ct.	31¼ct.
2	.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.62½
3	.66	.69	.72	.75	.78	.81	.84	.87	.90	.93	.93¾
4	.88	.92	.96	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.25
5	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.56¼
6	1.32	1.38	1.44	1.50	1.56	1.62	1.68	1.74	1.80	1.86	1.87½
7	1.54	1.61	1.68	1.75	1.82	1.89	1.96	2.03	2.10	2.17	2.18¾
8	1.76	1.84	1.92	2.00	2.08	2.16	2.24	2.32	2.40	2.48	2.50
9	1.98	2.07	2.16	2.25	2.34	2.43	2.52	2.61	2.70	2.79	2.81¼
10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.12½
11	2.42	2.53	2.64	2.75	2.86	2.97	3.08	3.19	3.30	3.41	3.43¾
12	2.64	2.76	2.88	3.00	3.12	3.24	3.36	3.48	3.60	3.72	3 75
13	2.86	2.99	3.12	3.25	3.38	3.51	3.64	3.77	3.90	4.03	4.06¼
14	3.08	3.22	3.36	3.50	3.64	3.78	3.92	4.06	4.20	4.34	4.37½
15	3.30	3.45	3.60	3.75	3.90	4.05	4.20	4.35	4.50	4.55	4.68¾
16	3.52	3.68	3.84	4.00	4.16	4.32	4.48	4.64	4.80	4.96	5.00
17	3.74	3.91	4.08	4.25	4.42	4.59	4.76	4.93	5.10	5.27	5.31¼
18	3.96	4.14	4.32	4.50	4.68	4.86	5.04	5.22	5.40	5.58	5.62½
19	4.18	4.37	4.56	4.75	4.94	5.15	5.32	5.51	5.70	5.89	5.93¾
20	4.40	4.60	4.80	5.00	5.20	5.40	5.60	5.80	6.00	6.20	6.25
25	5.50	5,75	6.00	6.25	6.50	6.75	7.00	7.25	7.25	7.75	7.81¼
30	6.60	6.90	7.20	7.50	7.80	8.10	8.40	8.70	9.00	9.30	9.37½
40	8.80	9.20	9.60	10.00	10.40	10.80	11.20	11.60	12.00	12.40	12.50
50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50	15.00	15 50	15.62½
60	13.20	13.80	14.40	15.00	15.60	16.20	16.80	17.40	18.00	18.60	18.75
70	15.40	16.10	16.80	17.50	18.20	18.90	19.60	20.30	21.00	21.70	21.87½
80	17.60	18.40	19.20	20.00	20.80	21.60	22.40	23.20	24.00	24.80	25.00
90	19.80	20.70	21.60	22.50	23.40	24.30	25.20	26.10	27.00	27.90	28.12¼
100	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	31.25

Nos	32 ct.	33ct	33⅓ct.	34 ct	35 ct	36 ct.	37 ct.	37½ct.	38 ct.	39 ct.	40 ct.
2	.64	.66	.66⅔	.68	.70	.72	.74	.75	.76	.78	.80
3	.96	.99	1.00	1.02	1.05	1.08	1.11	1.12½	1.14	1.17	1.20
4	1.28	1.32	1.33⅓	1.36	1.40	1.44	1.48	1.50	1.52	1.56	1.60
5	1.60	1.65	1.66⅔	1.70	1.75	1.80	1.85	1.87½	1.90	1.95	2.00
6	1.92	1.98	2.00	2.04	2.10	2.16	2.22	2.25	2.28	2.34	2.40
7	2.24	2.31	2.33⅓	2.38	2.45	2.52	2.59	2.62½	2.66	2.73	2.80
8	2.56	2.64	2.66⅔	2.72	2.80	2.88	2.96	3.00	3.04	3.12	3.20
9	2.88	2.97	3.00	3.06	3.15	3.24	3.33	3.37½	3.42	3.51	3.60
10	3.20	3.30	3.33⅓	3.40	3.50	3.60	3.70	3.75	3.80	3.90	4.00
11	3.52	3.63	3.66⅔	3.74	3.85	3.96	4.07	4.12½	4.18	4.29	4.40
12	3.84	3.96	4.00	4.08	4.20	4.32	4.44	4.50	4.56	4.68	4.80
13	4.16	4.29	4.33⅓	4.42	4.55	4.68	4.81	4.87½	4.94	5.07	5.20
14	4.48	4.62	4.66⅔	4.76	4.90	5.04	5.18	5.25	5.32	5.46	5.60
15	4.80	4.95	5.00	5.10	5.25	5.40	5.55	5.62½	5.70	5.85	6.00
16	5.12	5.28	5.33⅓	5.44	5.60	5.76	5.92	6.00	6.08	6.24	6.40
17	5.44	5.61	5.66⅔	5.78	5.95	6.12	6.29	6.37½	6.46	6.63	6.80
18	5.76	5.94	6.00	6.12	6.30	6.48	6.66	6.75	6.84	7.02	7.20
19	6.08	6.27	6.33⅓	6.46	6.65	6.84	7.03	7.12½	7.22	7.41	7.60
20	6.40	6.60	6.66⅔	6.80	7.00	7.20	7.40	7.50	7.60	7.80	8.00
25	8.00	8.25	8.33⅓	8.50	8.75	9.00	9.25	9.37½	9.50	9.75	10.00
30	9.60	9.90	10.00	10.20	10.50	10.80	11.10	11.25	11.40	11.70	12.00
40	13.80	12.20	13.33⅓	13.60	14.00	14.40	14.80	15.00	15.20	15.60	16.00
50	16.00	16.50	16.66⅔	17.00	17.50	18.00	18.50	18.75	19.00	19.50	20.00
60	19.20	19.80	20.00	20.40	21.00	21.60	22.20	22.50	22.80	23.40	24.00
70	22.40	23.10	23.33⅓	23.80	24.50	25.20	25.90	26.25	26.60	27.30	28.00
80	25.60	26.40	26.66⅔	27.20	28.00	28.80	29.60	30.00	30.40	31.20	32.00
90	28.80	29.70	30.00	30.60	31.50	32.40	33.30	33.75	34.20	35.10	36.00
100	32.00	33.00	33.33⅓	34.00	35.00	36.00	37.00	37.50	38.00	39.00	40.00

The first column on the left contains the NUMBER of the Article, and the column on the tops of the Tables the PRICE.

Nos	41 ct.	42 ct.	43 ct.	44 ct.	45 ct.	46 ct.	47 ct.	48 ct.	49 ct.	50 ct.	51 ct.
2	.82	.84	.86	.88	.90	.92	.94	.96	.98	1.00	1.02
3	1.23	1.26	1.29	1.32	1.35	1.38	1.41	1.44	1.47	1.50	1.53
4	1.64	1.68	1.72	1.76	1.80	1.84	1.88	1.92	1.96	2.00	2.04
5	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55
6	2.46	2.52	2.58	2.64	2.70	2.76	2.80	2.88	2.94	3.00	3.06
7	2.87	2.94	3.01	3.08	3.15	3.22	3.29	3.36	3.43	3.50	3.57
8	3.28	3.36	3.44	3.52	3.60	3.68	3.76	3.84	3.92	4.00	4.08
9	3.69	3.78	3.87	3.96	4.05	4.14	4.23	4.32	4.41	4.50	4.59
10	4.10	4.20	4.30	4.40	4.50	4.60	4.70	4.80	4.90	5.00	5.10
11	4.51	4.62	4.73	4.84	4.95	5.06	5.17	5.28	5.39	5.50	5.61
12	4.92	5.04	5.16	5.28	5.40	5.72	5.64	5.76	5.88	6.00	6.12
13	5.33	5.46	5.59	5.72	5.85	5.98	6.11	6.24	6.37	6.50	6.63
14	5.74	5.88	6.02	6.16	6.30	6.44	6.58	6.72	6.86	7.00	7.14
15	6.15	6.30	6.45	6.60	6.75	6.90	7.05	7.20	7.35	7.50	7.65
16	6.56	6.72	6.88	7.04	7.20	7.36	7.52	7.68	7.84	8.00	8.16
17	6.97	7.14	7.31	7.48	7.65	7.82	7.99	8.16	8.33	8.50	8.67
18	7.38	7.56	7.74	7.92	8.10	8,28	8.46	8.64	8.82	9.00	9.18
19	7.79	7.98	8.17	8.30	8.55	8.74	8.93	9.12	9.31	9.50	9.69
20	8.20	8.40	8.60	8.80	9.00	9.20	9.40	9.60	9.80	10.00	10.20
25	10.25	10.50	10,75	11.00	11.25	11.50	11.75	12.00	12.25	12.50	12.75
30	12.30	12.60	12.90	13.20	13.50	13.80	14.10	14.40	14.70	15.00	15.30
40	16.40	16.80	17.20	17.60	18.00	18.40	18.80	19.20	19.60	20.00	20.40
50	20.50	21.00	21.50	22.00	22.50	23.00	23.50	24.00	24.50	25.00	25.50
60	24.60	25.20	25.80	26.40	27.00	27.60	28.20	28.80	29.40	30.00	30.60
70	28:70	29.40	30.10	30.80	31.50	32.20	32.90	33.00	34.30	35.00	35.70
80	32.80	33.60	34.40	35.20	36.00	36.80	37.60	38.40	39.20	40.00	40.80
90	36.90	37.80	38.70	39.60	40.50	41.40	42.30	43.20	44.10	45.00	45.92
100	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00	50.00	51.00

Nos	52 ct.	53 ct.	54 ct.	55 ct.	56 ct.	57 ct.	58 ct.	59 ct.	60 ct.	61 ct.	62 ct.
2	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24
3	1.56	1.59	1.62	1.65	1.68	1.71	1.74	1.77	1.80	1.83	1.86
4	2.08	2.12	2.16	2.20	2.24	2.28	2.32	2.36	2.40	2.44	2.48
5	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00	3.05	3.10
6	3.12	3.18	3.24	3.30	3.36	3.42	3.48	3.54	3.60	3.66	3.72
7	3.64	3.71	3.78	3.85	3.92	3.99	4.06	4.13	4.20	4.27	4.34
8	4.16	4.24	4.32	4.40	4.48	4.56	4.64	4.72	4.80	4.88	4.96
9	4.68	4.77	4.86	4.95	5.04	5.13	5.22	5.31	5.40	5.49	5.58
10	5.20	5.30	5.40	5.50	5.60	5.70	5.80	5.90	6.00	6.10	6.20
11	5.72	5.83	5.94	6.05	6.16	6.27	6.38	6.49	6.60	6.71	6.82
12	6.24	6.36	6.48	6.60	6.72	6.84	6.96	7.08	7.20	7.32	7.44
13	6.76	6.89	7.02	7.15	7.28	7.41	7.54	7.67	7.80	7.93	8.06
14	7.28	7.42	7.56	7.70	7.84	7.98	8.12	8.26	8.40	8.54	8.68
15	7.80	7.95	8.10	8.25	8.40	8.55	8.70	8.85	9.00	9.15	9.30
16	8.32	8.48	8.64	8.80	8.96	9.12	9.28	9.44	9.60	9.76	9.92
17	8.84	9.01	9.18	9.35	9.52	9.69	9.86	10.03	10.20	10.37	10.54
18	9.36	9.54	9.72	9.90	10.08	10.26	10.44	10.62	10.80	10.98	11.16
19	9.88	10.07	10.26	10.45	10.64	10.83	11.02	11.21	11.40	11.59	11.78
20	10.40	10.60	10.80	11.00	11.20	11.40	11.60	11.80	12.00	12.20	12.40
25	13.00	13.25	13,50	13.75	14.00	14.25	14.50	14.75	15.00	15.25	15.50
30	15.60	15.90	16.20	16.50	16.80	17.10	17.40	17.70	18.00	18.30	18.60
40	20.80	21.10	21.60	22.00	22.40	22.80	23.20	23.60	24.00	24.42	24.80
50	26.00	26.50	27.00	27.50	28.00	28.50	29.00	29.50	30.00	30.50	31.00
60	31.20	31.80	32.40	33.00	33.60	34.20	34.80	35.40	36.00	36.60	37.20
70	36.40	37.10	37.80	38.50	39.20	39.90	40.60	41.30	42.00	42.70	43.40
80	41.60	42.40	43.20	44.00	44.80	45.60	46.40	47.20	48.00	48.80	49.60
90	46.80	47.70	48.60	49.50	50.40	51.30	52.20	53.10	54.00	54.90	55.80
100	52.00	53.00	54.00	55.00	56.00	57.00	58.00	59.00	60.00	61.00	62.00

If the Number required is not found in the Tables, add two Numbers together; for instance, if 35 bushels are required, add the prices opposite 30 and 5 together; and so for 365 bushels—treble the value of 100, and add 60 and 5 together.

Nos	62½ct.	63 ct.	64ct.	65 ct.	66 ct.	66⅔ct.	67 ct.	68 ct.	69 ct.	70 ct.	71 ct.
2	1.25	1.26	1.28	1.30	1.32	1.33⅓	1.34	1.36	1.38	1.40	1.42
3	1.87½	1.89	1.92	1.95	1.98	2.00	2.01	2.04	2.07	2.10	2.13
4	2.50	2.52	2.56	2.60	2.64	2.66⅔	2.68	2.72	2.76	2.80	2.84
5	3.12½	3.15	3.20	3.25	3.30	3.33⅓	3.35	3.40	3.45	3.50	3.55
6	3.75	3.78	3.84	3.90	3.96	4.00	4.02	4.08	4.14	4.20	4.26
7	4.37½	4.41	4.48	4.55	4.62	4.66⅔	4.69	4.76	4.83	4.90	4.97
8	5.00	5.04	5.12	5.20	5.28	5.33⅓	5.36	5.44	5.52	5.60	5 68
9	5.62½	5.67	5.76	5.85	5.94	6.00	6.03	6.12	6.21	6.30	6.39
10	6.25	6.30	6.40	6.50	6.60	6.66⅔	6.70	6.80	6.90	7.00	7.10
11	6.87½	6.93	7.04	7.15	7.26	7.33⅓	7.37	7.48	7.59	7.70	7.81
12	7.50	7.56	7.68	7.80	7.92	8.00	8.04	8.16	8.28	8.40	8.52
13	8.12½	8.19	8.32	8.45	8.58	8.66⅔	8.71	8.84	8.97	9.10	9.23
14	8.75	8.80	8.96	9.10	9.24	9.33⅓	9.38	9.52	9. 66	9.80	9.94
15	9.37½	9.45	9.60	9.75	9.90	10.00	10.05	10.20	10.35	10.50	10.65
16	10.00	10.08	10.24	10.40	10.56	10.66⅔	10.72	10.88	11.04	11.20	11.36
17	10.62½	10.71	10.88	11.05	11.22	11.33⅓	11.39	11.56	11.73	11.90	12.07
18	11.25	11.34	11.52	11.70	11.88	12.00	12.06	12.24	12.42	12.60	12.78
19	11.87½	11.97	12.16	12.35	12.54	12.66⅔	12.73	12.92	13.11	13.30	13.49
20	12.50	12.60	12.80	13.00	13.20	13.33⅓	13.40	13.60	13.80	14.00	14.20
25	15.62½	15.75	16.00	16.25	16.50	16.66⅔	16.75	17.00	17.25	17.50	17.75
30	18.75	18.90	19.20	19.50	19.80	20.00	20.10	20.40	20.70	21.00	21.30
40	25.00	25.20	25.60	26.00	26.40	26.66⅔	26.80	27.20	27.60	28.00	28.40
50	31.25	31.50	32.00	32.50	33.00	33.33⅓	33.50	34.00	34.50	35.00	35.50
60	37.50	37.80	38.40	39.00	39.60	40.00	40.20	40.80	41.40	42.00	42.60
70	43.75	44.10	44.80	45.50	46.20	46.66⅔	46.90	47.60	48.30	49.00	49.70
80	50.00	50.40	51.20	52.00	52.80	53.33⅓	53.00	54.40	55.20	56.00	56.80
90	51.25	56.70	57.60	58.50	59.40	60.00	60.30	61.20	62.10	63.00	63.90
100	62.50	63.00	64.00	65.00	66.00	66.66½	67.00	68.00	69.00	70.00	71.00

Nos	72 ct.	73 ct.	74 ct.	75 ct.	76 ct.	77 ct.	78 ct.	79 ct.	80 ct.	81 ct.	82 ct.
2	1.44	1.46	1.48	1.50	1.52	1.54	1.56	1.58	1.60	1.62	1.64
3	2.16	2.19	2.22	2.25	2.28	2.31	2.34	2.37	2.40	2.43	2.46
4	2.88	2.92	2.96	3.00	3.04	3.08	3.12	3.16	3.20	3.24	3.28
5	3.60	3.65	3.70	3.75	3.80	3.85	3.90	3.95	4.00	4.05	4.10
6	4.32	4.38	4.44	4.50	4.56	4.62	4.68	4.74	4.80	4.86	4.92
7	5.04	5.11	5.18	5.25	5.32	5.39	5.46	5.53	5.60	5.67	5.74
8	5.76	5.84	5.92	6.00	6.08	6.16	6.24	6.32	6.40	6.48	6.56
9	6.48	6.57	6.66	6.75	6.84	6.93	7.02	7.11	7.20	7.29	7.38
10	7.20	7.30	7.40	7.50	7.60	7.70	7.80	7.90	8.00	8.10	8.20
11	7.92	8.03	8.14	8.25	8.30	8.47	8.58	8.69	8.80	8.91	9.02
12	8.64	8.76	8.88	9.00	9.12	9.24	9.36	9.48	9.60	9.72	9.84
13	9.36	9.49	9.62	9.75	9.88	10.01	10.14	10.27	10.40	10.53	10.66
14	10.08	10.22	10.36	10.50	10.64	10.78	10.92	11.06	11.20	11.34	11.48
15	10.80	10.95	11.10	11.25	11.40	11.55	11.70	11.85	12.00	12.15	12.30
16	11.52	11.68	11.84	12.00	12.16	12.32	12.48	12.64	12.80	12.96	13.12
17	12.24	12.41	12.58	12.75	12.92	13.09	13.26	13.43	13.60	13.77	13.94
18	12.96	13.14	13.32	13.50	13.68	13.86	14.04	14.22	14.40	14.58	14.76
19	13.68	13.87	14.06	14.25	14.44	14.63	14.82	15.01	15.20	15.39	15.58
20	14.40	14.60	14.80	15.00	15.20	15.40	15.60	15.80	16.00	16.20	16 40
25	18.00	18 25	18.50	18.75	19.00	19.25	19.50	19.75	20.00	20.25	20.50
30	21.60	21.90	22.20	22.50	22.80	23.10	23.40	23.70	24.00	24.30	24.60
40	28.80	29.20	29.60	30.00	30.40	30.80	31.20	31.60	32.00	32.40	32.80
50	36.00	36 50	37.00	37.50	38.00	38.50	39.00	39.50	40.00	40.50	41.00
60	43.20	43.80	44.40	45.00	45.60	46.20	46.80	47.40	48.00	48.60	49.20
70	50.40	51.10	51.80	52.50	53.20	53.90	54.60	55.30	56.00	56.70	57.40
80	57.60	58.40	59.20	60.00	60.80	61.60	62.40	63.20	64.00	64.80	65.60
90	64.80	65.70	66.60	67.50	68.40	69.30	70.20	71.10	72.00	72.90	73.80
100	72.00	73.00	74.00	75.00	76.00	77.00	78.00	79.00	80.00	81.00	82.00

If the Number required is not found in the Tables, add two Numbers together; for instance, if 35 bushels are required, add the prices opposite 20 and 5 together; and so for 365 bushels—treble the value of 100, and add 60 and 5 together.

Nos	83 ct.	84 ct.	85 ct.	86 ct.	87 ct.	87½ct.	88 ct.	89 ct.	90 ct.	91 ct.	92 ct.
2	1.66	1.68	1.70	1.72	1.74	1.75	1.76	1.78	1.80	1.82	1.84
3	2.49	2.52	2.55	2.28	2.61	2.62½	2.64	2.67	2.70	2.73	2.76
4	3.32	3.36	3.40	3.44	3.48	3.50	3.52	3.56	3.60	3.64	3.68
5	4.15	4.20	4.25	4.30	4.35	4.37½	4.40	4.45	4.50	4.55	4.60
6	4.98	5.04	5.10	5.16	5.22	5.25	5.28	5.34	5.40	5.46	5.52
7	5.81	5.88	5.95	6.02	6.09	6.12½	6.16	6.23	6.30	6.37	6.44
8	6.64	6.72	6.80	6.88	6.96	7.00	7.04	7.12	7.20	7.28	7.36
9	7.47	7.56	7.65	7.74	7.83	7.87½	7.92	8.01	8.10	8.19	8.28
10	8.30	8.40	8.50	8.60	8.70	8.75	8.80	8.90	9.00	9.10	9.20
11	9.13	9.24	9.35	9.46	9.57	9.62½	9.68	9.79	9.90	10.01	10.12
12	9.96	10.08	10.20	10.32	10.44	10.50	10.56	10.68	10.80	10.92	11.04
13	10.79	10.92	11.05	11.18	11.31	11.37½	11.44	11.57	11.70	11.83	11.96
14	11.62	11.76	11.90	12.04	12.18	12.25	12.32	12.46	12.00	12.74	12.88
15	12.45	12.60	12.75	12.90	13.05	13.12½	13.20	13.35	13.50	13.65	13.80
16	13.28	13.44	13.60	13.76	13.92	14.00	14.08	14.24	14.40	14.56	14.72
17	14.11	14.28	14.45	14.62	14.79	14.87½	14.96	15.13	15.30	15.47	15.64
18	14.94	15.12	15.30	15.48	15.66	15.75	15.84	16.02	16.20	16.38	16.56
19	15.77	15.96	16.15	15.34	16.53	16.62½	16.72	16.91	17.10	17.29	17.48
20	16.60	16.80	17.00	17.20	17.40	17.50	17.60	17.80	18.00	18.20	18.40
25	20.75	21.00	21.25	21.50	21.75	21.87½	22.00	22.25	22.50	22.75	23.00
30	24.90	25.20	25.50	25.80	26.10	26.25	26.40	26.70	27.00	27.30	27.60
40	33.20	33.60	34.00	34.40	34.80	35.00	35.20	35.60	36.00	36.40	36.80
50	41.50	42.00	42.50	43.00	43.50	43.75	44.00	44.50	45.00	45.50	46.00
60	49.80	50.40	51.00	51.60	52.20	52.50	52.80	53.40	54.00	54.60	55.20
70	58.10	58.80	59.50	60.20	60.90	61.25	61.60	62.30	63.00	63.70	64.40
80	66.40	67.20	68.00	68.80	69.60	70.00	70.40	74.20	72.00	72.80	73.60
90	74.70	75.60	76.50	77.40	78.30	78.75	79.20	80.10	81.00	81.90	82.80
100	83.00	84.00	85.00	86.00	87.00	87.50	88.00	89.00	90.00	91.00	92.00

Nos	93 ct.	94 ct.	95 ct.	96 ct.	97 ct.	98 ct.	99 ct.	$1.	$2.	$3.
2	1.86	1.88	1.90	1.92	1.94	1.96	1.98	2.	4.	6.
3	2.79	2.82	2.85	2.88	2.91	2.94	2.97	3.	6.	9.
4	3.72	3.76	3.80	3.84	3.88	3.92	3.66	4.	8.	12.
5	4.65	4.70	4.75	4.80	4.85	4.90	4.95	5.	10.	.15.
6	5.58	5.64	5.70	5.76	5.82	5.88	5.94	6.	12.	18.
7	6.51	6.58	6.65	6.72	6.79	6.86	6.93	7.	14.	21.
8	7.44	7.52	7.60	7.68	7.76	7.84	7.92	8.	16.	24.
9	8.37	8.46	8.55	8.64	8.73	8.82	8.91	9.	18.	27.
10	9.30	9.40	9.50	9.60	9.70	9.80	9.90	10.	20.	30.
11	10.23	10.34	10.45	10.56	10.67	10.78	10.89	11.	22.	33.
12	11.16	11.28	11.40	11.52	11.64	11.76	11.88	12.	24.	36.
13	12.09	12.22	12.35	12.48	12.61	12.74	12.87	13.	26.	39.
14	13.02	13.16	13.30	13.44	13.58	13.72	13.86	14.	28.	42.
15	13.95	14.10	14.25	14.40	14.55	14.70	14.85	15.	30.	45.
16	14.88	15.04	15.20	15.36	15.52	15.68	15.84	16.	32.	48.
17	15.81	15.98	16.15	16.32	16.49	16.66	16.83	17.	34.	51.
18	16.74	16.92	17.10	17.28	17.46	17.64	17.82	18.	36.	54.
19	17.67	17.86	18.05	18.24	18.43	18.62	18.81	19.	38.	57.
20	18.60	18.80	19.00	19.20	19.40	19.60	19.80	20.	40.	60.
25	23.25	23.50	23.75	24.00	24.25	24.50	24.75	25.	50.	75.
30	27.90	29.20	28.50	28.80	29.10	29.40	29.70	30.	60.	90.
40	37.20	37.60	38.00	38.40	38.80	39.20	39.00	40.	80.	120.
50	46.50	47.00	47.50	48.00	48.50	49.00	49.50	50.	100.	150.
60	55.80	56.40	57.00	57.60	58.20	58.80	59.40	60.	120.	180.
70	65.10	65.80	66.50	67.20	67.90	68.60	69.30	70.	142.	210.
80	74.40	75.20	76.00	76.80	77.60	78.40	79.20	80.	160.	240.
90	83.70	84.60	85.50	86.40	87.30	88.20	89.10	90.	180.	270.
100	93.00	94.00	95.00	96.00	97.00	98.00	99.00	100.	200.	300.

Weight, Stature, &c., of Man.—The mean weight, and stature of the human body at birth, and at every subsequent age, together with the expectancy of life from 20 to 70 years of age, is as follows.

MALES.			FEMALES.			YEARS.		YEARS.	
Age	Feet.	Lbs.	Age	Feet.	Lbs.	Age.	Expectancy.	Age.	Expectancy.
0	1.64	7.06	0	1.62	6.42	20	41½	46	24
2	2.60	25.01	2	2.56	23.53	21	40¾	47	23¼
4	3.04	31.38	4	3.00	28.67	22	40	48	22½
6	3.44	38.80	6	3.38	35.29	23	39½	49	22
9	4.00	49.95	9	3.92	47.10	24	38¾	50	21¼
11	4.36	59.77	11	4.26	56.57	25	38	51	20¼
13	4.72	75.81	13	4.60	72.65	26	37¼	52	19¾
15	5.07	96.40	15	4.92	89.04	27	36½	53	19
17	5.36	116.56	17	5.10	104.34	28	35¾	54	18¼
18	5.44	127.59	18	5.13	112.55	29	35	55	17¾
20	5.49	132.46	20	5.16	115.30	30	34½	56	17
30	5.52	140.38	30	5.18	119.82	31	33¾	57	16¼
40	5.52	140.42	40	5.18	121.81	32	33	58	15½
50	5.49	139.95	50	5.04	123.86	33	32½	59	15
60	5.38	136.07	60	4.97	119.76	34	31¾	60	14½
70	5.32	131.27	70	4.97	113.60	35	31	61	14
80	5.29	127.54	80	4.94	108.80	36	30½	62	13½
90	5.29	127.54	90	4.94	108.81	37	29¾	63	13
						38	29	64	12½
						39	28¼	65	11¾
						40	27¾	66	11¼
Mean.... 103.66			Mean ... 93.73			41	27	67	10¾
						42	26½	68	10¼
						43	25¾	69	9¾
						44	25¼	70	9¼
						45	24½		

The weight of the male infant at birth is 7 lbs. avoirdupois; that of the female is not quite 6½ lbs. The maximum weight (140½ lbs.) of the male is attained at the age of 40; that of the female (nearly 124 lbs.) is not attained until 50; from which ages they decline afterwards; the male to 127½ lbs., the female to 100 lbs., nearly a stone. The full grown adult is 20 times as heavy as a new born infant. In the first year he triples his weight, afterwards the growth proceeds in geometrical progression, so that if 50 infants in their first year weigh 1000 lbs., they will in the second weigh 1210 lbs.; in the third 1331 lbs.; in the fourth 1464 lbs.; the term remaining very constant up to the ages of 11-12 in females; and 12-13 in males; where it must be nearly doubled; afterwards it may be continued, and will be found very nearly correct up to the age of 18 or 19, when the growth proceeds very slowly. At an equality of age the male is generally heavier than the female. Towards the age of 12 years only, an individual of each sex, has the same weight. The male attains the maximum weight about the age of 40, and he begins to lose it very sensibly towards 60. At 80 he loses about 13.2328 lbs.; and the stature is diminished 2·756 inches. Females attain their maximum weight about 50. The mean weight of a mature man is 104 lbs., and of an average woman 94 lbs. In old age they lose about 12 or 14 lbs. Men weigh most at 40, women at 50 and begin to lose weight at 60. The mean weight of both sexes in old age is that which they had at 19.

When the male and female have assumed their complete development, they weigh almost exactly 20 times as much as at birth, while the stature is about 3½ times greater.

Children lose weight during the first three days after birth; at the age of a week they sensibly increase; after 1 year they triple their weight; then they require 6 years to double their weight, and 13 to quadruple it. In a child the head is equal to a fifth part, and in a full grown man to an eighth part of the height of the individual. The human skeleton weighs from 9 lbs. 6 ozs. to 16 lbs., and the blood 27 or 28 lbs. A calcined human body leaves a residuum of only 8 ozs. All besides is restored to the gaseous elements.

Weight of Cast Iron Pipes of Different Thicknesses, from 1 inch to 22 inches in Diameter. 1 foot in Length.

Diam	Thickn	Weight.	Diam	Thickn	Weight.	Diam.	Thickn	Weight.
Ins.	Ins.	Lbs.	Ins.	Ins.	Lbs.	Ins.	Ins.	Lbs.
1.	.1/4	3.06	7.1/2	.1/2	39.22		.3/4	104.76
	.3/8	5.05		.5/8	49.92		.7/8	123.3
1.1/4	.1/4	3.67		.3/4	60.48		1.	142.16
	.3/8	6.		.7/8	71.76	14.	.1/2	71.07
1.1/2	.3/8	6.89		1.	83.28		.5/8	89.61
	.1/2	9.8	8.	.1/2	41.64		.3/4	108.46
1.3/4	.3/8	7.8		.5/8	52.68		.7/8	127.6
	.1/2	11.04		.3/4	64.27		1.	147.03
2.	.3/8	8.74		.7/8	76.12	14.1/2	.1/2	73.72
	.1/2	12.23		1.	88.2		.5/8	92.66
2.1/4	.3/8	9.65	8.1/2	.1/2	44.11		.3/4	112.1
	.1/2	13.48		.5/8	56.15		.7/8	131.86
2.1/2	.3/8	10.57		.3/4	68.		1.	151.92
	.1/2	14.66		.7/8	80.5	15.	.1/2	75.96
	.5/8	19.05		1.	93.28		.5/8	95.72
2.3/4	.3/8	11.54	9.	.1/2	46.5		.3/4	115.78
	.1/2	15.91		.5/8	59.92		.7/8	136.15
	.5/8	20.59		.3/4	71.7		1.	156.82
3.	.3/8	12.28		.7/8	84.7	15.1/2	.1/2	78.4
	.1/2	17.15		1.	97.98		.5/8	98.78
	.5/8	22.15	9.1/2	.1/2	48.98		.3/4	119.49
	.3/4	27.56		.5/8	62.02		.7/8	140.4
3.1/4	.1/2	18.4		.3/4	75.32		1.	161.82
	.5/8	23.72		.7/8	88.98	16.	.1/2	80.87
	.3/4	29.64		1.	102.9		.5/8	101.82
3.1/2	.1/2	19.66	10.	.1/2	51.46		.3/4	123.14
	.5/8	25.27		.5/8	65.08		.7/8	144.76
	.3/4	31.2		.3/4	78.99		1.	166.6
3.3/4	.1/2	20.9		.7/8	93.24	16.1/2	.1/2	83.3
	.5/8	26.83		1.	108.84		.5/8	104.82
	.3/4	33.07	10.1/2	.1/2	53.88		.3/4	126.79
4.	.1/2	22.05		.5/8	68.11		.7/8	149.02
	.5/8	28.28		.3/4	82.68		1.	171.6
	.3/4	34.94		.7/8	97.41	17.	.1/2	85.73
4.1/4	.1/2	23.35		1.	112.68		.5/8	107.96
	.5/8	29.85	11.	.1/2	56.34		.3/4	130.48
	.3/4	36.73		.5/8	71.19		.7/8	153.3
4.1/2	.1/2	24.49		.3/4	86.4		1.	176.58
	.5/8	31.4		.7/8	101.83	17.1/2	.1/2	88.23
	.3/4	38.58		1.	117.6		.5/8	111.06
4.3/4	.1/2	25.7	11.1/2	.1/2	58.82		.3/4	134.16
	.5/8	32.91		.5/8	74.28		.7/8	157.59
	.3/4	40.43		.3/4	90.06		1.	181.33
5.	.1/2	26.94		.7/8	106.14	18.	.5/8	114.1
	.5/8	34.34		1.	122.62		.3/4	137.84
	.3/4	42.28	12.	.1/2	61.26		.7/8	161.9
5.1/2	.1/2	29.4		.5/8	77.36		1.	186.24
	.5/8	37.44		.3/4	93.7	19.	.5/8	120.24
	.3/4	45.94		.7/8	110.48		.3/4	145.2
6.	.1/2	31.82		1.	127.42		.7/8	170.47
	.5/8	40.56	12.1/2	.1/2	63.7		1.	195.92
	.3/4	49.6		.5/8	80.4	20.	.5/8	126.33
	.7/8	58.96		.3/4	97.4		.3/4	152.53
6.1/2	.1/2	34.32		.7/8	114.72		.7/8	179.02
	.5/8	43.68		1.	132.35		1.	205.8
	.3/4	53.3	13.	.1/2	66.14	21.	.5/8	132.5
	.7/8	63.18		.5/8	83.46		.3/4	159.84
7.	.1/2	36.66		.3/4	101.08		.7/8	187.6
	.5/8	46.8		.7/8	118.97		1.	215.52
	.3/4	56.96		1.	137.28	22.	.5/8	138.6
	.7/8	67.6	13.1/2	.1/2	68.64		.3/4	167.24
	1.	78.39		.5/8	86.55		.7/8	196.46

WEIGHT OF BRASS, COPPER, STEEL, PLATE IRON, WROUGHT IRON PIPE, ETC.

Diameter and Side of Square.	BRASS. Weight of Round.	BRASS. Weight of Square.	COPPER. Weight of Round.	COPPER. Weight of Square.	STEEL. Weight of Round.	STEEL. Weight of Square.	LEAD. Weight of Round.	LEAD. Weight of Square.
Inches.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1/4	.17	.22	.19	.24	.17	.21		
3/8	.39	.50	.42	.51	.33	.48		
1/2	.70	.90	.75	.96	.67	.85		
5/8	1.10	1.40	1.17	1.50	1.04	1.33		
3/4	1.59	2.02	1.69	2.16	1.50	1.91		
7/8	2.16	2.75	2.31	2.94	2.05	2.61		
1	2.83	3.60	3.02	3.84	2.67	3.40	3.87	4.93
1 1/8	3.58	4.56	3.82	4.86	3.38	4.34	4.90	6.25
1 1/4	4.42	5.63	4.71	6.	4.13	5.32	6.06	7.71
1 3/8	5.35	6.81	5.71	7.27	5.06	6.44	7.33	9.33
1 1/2	6.36	8.10	6.79	8.65	6.02	7.67	8.72	11.11
1 5/8	7.47	9.51	7.94	10.15	7.07	9.	10.24	13.04
1 3/4	8.66	11.03	9.21	11.77	8.20	10.14	11.87	15.12
1 7/8	9.95	12.66	10.61	13.53	9.41	11.98	13.63	17.36
2	11.32	14.41	12.08	15.38	10.71	13.63	15.51	19.75
2 1/8	12.78	16.27	13.64	17.36	12.05	15.80	17.51	22.29
2 1/4	14.32	18.24	15.29	19.47	13.51	17.20	19.63	25.
2 3/8	15.96	20.32	17.03	21.69	15.05	19.17	21.80	27.80
2 1/2	17.68	22.53	18.87	24.03	16.68	21.21	24.24	30.86
2 5/8	19.50	24.83	20.81	26.50	18.39	23.41	26.72	34.02
2 3/4	21.40	27.25	22.84	29.08	20.18	25.70	29.33	37.34
2 7/8	23.39	29.78	24.92	31.79	22.06	28.10	32.05	40.81
3	25.47	32.43	27.18	34.61	24.23	30.60	34.90	44.44

PLATE IRON.

Thickness in parts of an inch.	IRON.
1/16	2.5
1/8	5.0
3/16	7.5
1/4	10.0
5/16	12.5
3/8	15.0
7/16	17.5
1/2	20.0
5/8	25.0
3/4	30.0
7/8	40.0
1	

FLAT CAST IRON.

Size.	Weight.
Ins.	Pounds.
1/4	9.37
3/8	14.06
1/2	18.75
5/8	23.43
3/4	28.12
7/8	32.81
1	37.50
1 1/8	42.18
1 1/4	46.87
1 3/8	51.56
1 1/2	56.25
1 5/8	60.93
1 3/4	65.62
1 7/8	70.31
2	75.

WR'T IRON PIPE.

Int. Diam. Inchs.	Weight per Foot.
1/8	.24
1/4	.42
3/8	.56
1/2	.85
3/4	1.13
1	1.67
1 1/4	2.26
1 1/2	2.69
2	3.66
2 1/2	5.77
3	7.55
3 1/2	9.05
4	10.73
4 1/2	12.49
5	14.56
6	18.76
7	23.
8	28.

PLANTING TABLE.

No. and Distance of Plants per acre.

Feet Distance.	No. of Hill.
1	43,560
1 1/2	19,369
2	10,890
2 1/2	6,969
3	4,840
3 1/2	3,556
4	2,722
4 1/2	2,151
5	11,742
5 1/2	1,449
6	1,210
6 1/2	1,031
7	889
7 1/2	775
8	680
8 1/2	602
9	538
9 1/2	482
10	436
10 1/2	361
12	302
15	193
18	135
20	108
25	69
30	48

RELATIVE STRENGTH OF BODIES TO RESIST TORSION, LEAD BEING 1.

Tin	1.4	Gun Metal	5.0	English Iron	10.1
Copper	4.3	Cast Iron	9.0	Blistered Steel	16.6
Yellow Brass	4.6	Swedish Iron	9.5	Shear Steel	17.0

CAPACITIES, SIZE AND WEIGHT OF COPPERS.

Depth in Inches.	Gallons	Weight in pounds.	Depth in inches.	Gallons	Weight in pounds.	Depth in inches.	Gallons	Weight in pounds.
9¾	1	1½	24	15	22½	29½	29	43½
12¼	2	3	24½	16	24	30	30	45
14	3	4½	25	17	25½	32	36	54
15½	4	6	25½	18	27	34	43	64½
16½	5	7½	26	19	28½	35	48	72
17½	6	9	26½	20	30	36	53	79½
18½	7	10½	26¾	21	31½	37	58	87
19½	8	12	27	22	33	38	63	74½
20¼	9	13½	27¼	23	34½	39	67	100½
21	10	15	27½	24	36	40	71	106½
21½	11	16½	27¾	25	37½	45	104	156
22	12	18	28	26	39	50	146	219
22½	13	19½	28½	27	40½			
23¼	14	21	29	28	42			

WEIGHT OF SQUARE AND ROUNDCAST IRON.

Square per Foot.				Round per Foot.			
Size.	Weight.	Size.	Weight.	Size.	Weight.	Size.	Weight.
Inches square.	Pounds.	Inches Square.	Pounds.	Inches Diam.	Pounds.	Inches Diam.	Pounqs.
½	.78	4	50.	½	.61	4⅛	41.76
⅝	1.22	4⅛	53.14	⅝	.95	4¼	44.27
¾	1.75	4¼	56.44	¾	1.38	4⅜	46.97
⅞	2.39	4⅜	59,81	⅞	1.87	4½	49.70
1	3.12	4½	63.28	1	2.45	4⅝	52.50
1⅛	3.95	4⅝	66.84	1⅛	3.10	4¾	55.37
1¼	4.88	4¾	70.50	1¼	3.83	4⅞	58.32
1⅜	5.90	4⅞	74.26	1⅜	4.64	5	61.35
1½	7 03	5	78.12	1½	5.52	5⅛	64.46
1⅝	8 25	5⅛	82.08	1⅝	6.48	5¼	67.64
1¾	9.57	5¼	86.13	1¾	7.51	5⅜	70.09
1⅞	10.98	5⅜	90.28	1⅞	8.62	5½	74.24
2	12.50	5½	94.53	2	9.81	5⅝	77.65
2⅛	14.11	5⅝	98.87	2⅛	11 .08	5¾	91.14
2¼	15.81	5¾	103.32	2¼	12.42	5⅞	84.71
2⅜	17.62	5⅞	107.86	2⅜	13.84	6	88.35
2½	19.53	6	112.50	2½	15.33	6¼	95.87
2⅝	21.53	6¼	122.08	2⅝	16.91	6½	103.69
2¾	23.63	6½	132.03	2¾	18.56	6¾	111.82
2⅞	25.83	6¾	142.38	2⅞	20.28	7	120.26
3	28.12	7	153.12	3	22.18	7¼	129.
3⅛	30.51	7¼	164.25	3⅛	23.96	7½	138.05
3¼	33.	7½	175.78	3¼	25.92	7¾	147.41
3⅜	35.59	7¾	187.63	3⅜	27.95	8	157.08
3½	38.28	8	200.12	3½	30,16	8¼	167.05
3⅝	41.06	8¼	212.56	3⅝	32.25	8½	177.19
3¾	43.94	8½	225.78	3¾	34.51	8¾	187.91
3⅞	46.92	8¾	239.25	3⅞	36.85	9	198.79
		9	253.12	4	39.27	9¼	210.

WEIGHT OF IRON PER FOOT.

Round. Size	Wg't.	*Square.* Size	Wg't.	*Flat.* Size.	Wg't.	*Flat.* Size.	Wg't.	*Flat.* Size.	Wg't.
1/4	.163	1/4	.208	1 x1/4	.833	1 3/4x1/2	2.91	4 1/2x3/4	11.25
3/8	.368	3/8	.468	1 1/8x1/4	.937	2 x1/2	3.33	5 x3/4	12.50
1/2	.654	1/2	.833	1 1/4x1/4	1.04	2 1/4x1/2	3.74	5 1/2x3/4	13.75
5/8	1.02	5/8	1.30	1 3/8x1/4	1.14	2 1/2x1/2	4.16	6 x3/4	15.00
3/4	1.47	3/4	1.87	1 1/2x1/4	1.25	2 3/4x1/2	4.58	1 x7/8	2.91
7/8	2.00	7/8	2.55	1 3/4x1/4	1.45	3 x1/2	5.00	1 1/8x7/8	3.28
1	2.61	1	3.33	2 x1/4	1.66	3 1/2x1/2	5.83	1 1/4x7/8	3.64
1 1/8	3.31	1 1/8	4.21	2 1/4x1/4	1.87	4 x1/2	6.66	1 3/8x7/8	4.01
1 1/4	4.09	1 1/4	5.20	2 1/2x1/4	2.08	5 x1/2	8.33	1 1/2x7/8	4.37
1 3/8	4.95	1 3/8	6.30	2 3/4x1/4	2.29	6 x1/2	10.00	1 3/4x7/8	5.10
1 1/2	5.89	1 1/2	7.50	3 x1/4	2.50	1 x5/8	2.08	2 x7/8	5.83
1 5/8	6.91	1 5/8	8.80	3 1/4x1/4	2.70	1 1/8x5/8	2.34	2 1/4x7/8	6.56
1 3/4	8.01	1 3/4	10.20	3 1/2x1/4	2.91	1 1/4x5/8	2.60	2 1/2x7/8	7.29
1 7/8	9.20	1 7/8	11.71	3 3/4x1/4	3.12	1 3/8x5/8	2.86	2 3/4x7/8	8.02
2	10.47	2	13.33	4 x1/4	3.33	1 1/2x5/8	3.12	3 x7/8	8.75
2 1/8	11.82	2 1/8	15.05	4 1/2x1/4	3.75	1 3/4x5/8	3.64	3 1/2x7/8	10.20
2 1/4	13.25	2 1/4	16.87	5 x1/4	4.17	2 x5/8	4.16	4 x7/8	11.66
2 3/8	14.76	2 1/2	20.80	6 x1/4	5.00	2 1/4x5/8	4.68	4 1/2x7/8	13.12
2 1/2	16.36	2 3/4	25.20	1 x3/8	1.25	2 1/2x5/8	5.20	5 x7/8	14.58
2 3/4	19.79	3	30.00	1 1/8x3/8	1.40	2 3/4x5/8	5.72	5 1/2x7/8	16.04
3	23.56	3 1/8	32.55	1 1/4x3/8	1.56	3 x5/8	6.25	6 x7/8	17.50
3 1/8	25.56	3 1/4	35.20	1 3/8x3/8	1.71	3 1/2x5/8	7.29	1 1/8x1	3.75
3 1/4	27.65	3 3/8	37.96	1 1/2x3/8	1.87	4 x5/8	8.33	1 1/4x1	4.16
3 3/8	29.82	3 1/2	40.80	1 3/4x3/8	2.18	5 x5/8	10.41	1 3/8x1	4.58
3 1/2	32.07	3 3/4	46.87	2 x3/8	2.50	6 x5/8	12.50	1 1/2x1	5.00
3 3/4	36.81	4	53.33	2 1/4x3/8	2.81	1 x3/4	2.50	1 3/4x1	5.83
4	41.88	4 1/4	60.20	2 1/2x3/8	3.12	1 1/8x3/4	2.81	2 x1	6.66
4 1/8	44.54	4 1/2	67.50	2 3/4x3/8	3.43	1 1/4x3/4	3.12	2 1/4x1	7.50
4 1/4	47.28	4 3/4	75.20	3 x3/8	3.75	1 3/8x3/4	3.43	2 1/2x1	8.33
4 3/8	50.11	5	83.33	3 1/2x3/8	4.37	1 1/2x3/4	3.75	2 3/4x1	9.16
4 1/2	53.01	5 1/4	93.20	4 x3/8	5.00	1 3/4x3/4	4.37	3 x1	10.00
4 3/4	59.06	5 1/2	102.20	5 x3/8	6.25	2 x3/4	5.00	3 1/2x1	11.66
5	65.45	6	112.20	6 x3/8	7.50	2 1/4x3/4	5.62	4 x1	13.33
5 1/4	73.02			1 x1/2	1.66	2 1/2x3/4	6.25	4 1/2x1	15.00
5 1/2	80.03			1 1/8x1/2	1.87	2 3/4x3/4	6.87	5 x1	16.66
5 3/4	87.08			1 1/4x1/2	2.08	3 x3/4	8.50	5 1/2x1	18.33
6	95.06			1 3/8x1/2	2.29	3 1/2x3/4	8.75	6 x1	20.00
6 1/2	112.02			1 1/2x1/2	2.50	4 x3/4	10.00	6 1/2x1	21.66

WEIGHT OF FLAT STEEL PER FOOT.

	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2
1/4	.852	.958	1.06	1.17	1.27	1.49	1.70	1.91	2.13	2.34	2.55	2.77	2.99
3/8	1.27	1.43	1.59	1.75	1.91	2.23	2.55	2.87	3.20	3.51	3.83	4.15	4.47
1/2	1.70	1.91	2.13	2.34	2.55	2.98	3.40	3.83	4.26	4.68	5.11	5.53	5.98
5/8	2.13	2.39	2.66	2.92	3.19	3.72	4.26	4.79	5.32	5.85	6.39	6.92	7.45

MOULDERS AND PATTERN MAKERS' TABLE.

Cast Iron being 1,			*Bar Iron,* being 1,			*White Pine,* being 1,		
Bar Iron equal		1.07	Cast Iron equal		.95	Cast Iron equal		13.
Steel	"	1.08	Steel	"	1.03	Brass	"	12.7
Brass	"	1.16	Copper	"	1.16	Copper	"	13.4
Copper	"	1.21	Brass	"	1.09	Lead	"	18.1
Lead	"	1.55	Lead	"	1.48	Zinc	"	11.5

Size and strength of Cast Iron Columns. Iron 1 in. thick.

Diameter in inches.	Height in feet.					
	4	6	8	10	12	14
	Load in Cwts.					
2	72	60	49	40	32	26
2½	119	105	91	77	65	55
3	178	143	145	128	111	97
3½	247	232	214	191	172	156
4	326	318	288	266	242	220
4½	418	400	379	354	327	301
5	522	501	479	452	427	394
6	607	592	573	550	525	497
7	1032	1013	989	959	924	887
8	1333	1315	1289	1259	1224	1185
9	1716	1697	1672	1640	1603	1561
10	2119	2100	2077	2045	2007	1964
11	2570	2550	2520	2490	2450	2410
12	3050	3040	3020	2970	2930	2900

Diameter in inches.	Height in feet.				
	16	18	20	22	24
	Load in Cwts.				
2	22	18	15	13	11
2½	47	40	34	29	25
3	84	73	64	56	49
3½	135	119	106	94	83
4	198	178	160	144	130
4½	275	251	229	208	189
5	365	337	310	285	262
6	469	440	413	386	360
7	848	808	765	725	686
8	1142	1097	1052	1005	959
9	1515	1467	1416	1364	1311
10	1916	1865	1811	1755	1697
11	2358	2305	2248	2189	2127
12	2830	2780	2730	2670	2600

Capacities of Cisterns, in galls.

Diameter from 2 to 25 Feet.

Depth, 10 Inches.

2	feet	19.5	8	feet	313.33
2½	"	30.6	8½	"	353.72
3	"	44.06	9	"	396.56
3½	"	59.97	9½	"	461.40
4	"	78.33	10	"	489.20
4½	"	99.14	11	"	592.40
5	"	122.40	12	"	705.00
5½	"	148.10	13	"	827.4
6	"	176.25	14	"	959.6
6½	"	206.85	15	"	1101.6
7	"	239.88	20	"	1958.4
7½	"	275.40	25	"	3059.9

Weights of Cordwood.

		lbs.	carbon.
1 Cord of	Hickory.......	4468	100
"	Hard Maple...	2864	58
"	Beech.........	3234	64
"	Ash...........	3449	79
"	Birch..........	2368	49
"	Pitch Pine ...	1903	43
"	Canada Pine...	1870	42
"	Yellow Oak....	2920	61
"	White Oak....	1870	81
"	Lombardy Poplar..........	1775	41
"	Red Oak......	3255	70

ARITHMETICAL SIGNS AND THEIR SIGNIFICATION.

$=$ Sign of Equality, and signifies as $4+12=16$.
$+$ " Addition " as $8+8=16$ the sum.
$-$ " Subtraction " as $12-4=8$ the remainder.
$\times$ " Multiplication " as $12\times3=36$ the product.
$\div$ " Division " as $24\div3=8$ or $\frac{24}{3}=8$.
$\sqrt{\ }$ " Square Root " Evolution or Extraction of Square Root.
6^2 Sign of to be Squared " thus $8^2=64$ Involution, or
7^3 " to be Cubed " thus $3^3=27$ the Raising of Powers.

The following table shows weight in tons required to tear asunder bars 1 inch square of the following materials.

Oak............	5⅙ tons.	Wrought Copper..15	tons
Fir.............	5¼ "	English Bar Iron..25	"
Cast Iron........	7¾ "	American Iron....37½	"
Wrought Iron.....10	"	Blistered Steel....59½	"

READY RECKONER TABLE

For computing Wages, Rent, Board, etc. The sum will be found heading the columns, and the days and weeks on the extreme left hand column. If the desired sum is not in the Table, double or treble two or three suitable numbers.

TIME.		$2.50.	$2.75.	$3.00.	$3.25.	$3.50.	$3.75.	$4.00.	$4.25.	$4.50.	$4.75.
Days.	1	.36	.39	.43	.46	.50	.53	.57	.61	.64	.68
	2	.72	.78	.86	.93	1.00	1.07	1.14	1.21	1.28	1.36
	3	1.08	1.17	1.29	1.39	1.50	1.61	1.71	1.82	1.93	2.03
	4	1.44	1.56	1.71	1.86	2.00	2.14	2.28	2.43	2.57	2.71
	5	1.80	1.95	2.14	2.32	2.50	2.68	2.86	3.03	3.21	3.39
	6	2.15	2.34	2.57	2.78	3.00	3.21	3.43	3.64	3.86	4.07
Weeks. 1		2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75
2		5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50
3		7.50	8.25	9.00	9.75	10.50	11.25	12.00	12.75	13.50	14.25
4		10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
5		12.50	13.75	15.00	16.25	17.50	18.75	20.00	21.25	22.50	23.75

TIME.		$5.00.	$5.25.	$5.50.	$5.75.	$6.00.	$6.25.	$6.50.	$6.75.	$7.00.	$8.00.
Days.	1	.71	.75	.79	.82	.86	.89	.93	.96	1.00	1.14
	2	1.43	1.50	1.58	1.64	1.72	1.78	1.86	1.92	2.00	2.28
	3	2.14	2.25	2.37	2.46	2.28	2.67	2.79	2.88	3,00	3.52
	4	2.86	3.00	3.15	3.28	3.44	3.56	3.72	3.84	4.00	4.26
	5	3.57	3.75	3.94	4.10	4.30	4.45	4.65	4.80	5.00	5.72
	6	4.28	4.50	4.73	4.92	5.16	5.34	5.58	5.76	6.00	6.86
Weeks. 1		5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	8.00
2		10.00	10.50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	16.00
3		15.00	15.75	16.50	17.25	18.00	18.75	19.50	20.25	21.00	24.00
4		20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	32.00
5		25.00	26.25	27.50	28.75	30.00	31.25	32.50	33.50	35.00	40.00

WEIGHT OF LEAD PIPE—DIFFERENT SIZES.

Calib'e	AAA Weight per foot		AA Weight per foot		A Weight per foot		B Weight per foot		C Weight per foot		D Weight per foot		DLight Weight per foot		E Weight per foot		ELight Weight per foot	
Inches	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
3/8	1	8	1	5	1	2	1	0	0	13	0	10	—	—	0	8	—	—
1/2	3	0	2	0	1	12	1	4	1	0	0	13	—	—	0	11	0	9
5/8	3	8	2	12	2	8	2	0	1	12	1	8	1	4	1	0	0	12
3/4	4	8	3	8	3	0	2	4	2	0	1	12	1	8	1	4	1	0
1	6	0	4	12	4	0	3	4	2	8	2	0	—	—	1	8	—	—
1 1/4	6	12	5	12	4	12	3	12	3	0	2	8	—	—	2	0	—	—
1 1/2	9	0	8	0	6	4	5	0	4	4	3	8	—	—	3	4	—	—
2	10	12	9	0	7	0	6	0	5	4	4	0	—	—	—	—	—	—

SIZE AND CAPACITIFS OF CRIBS AND BOXES.

Crib 6½ ft. long, 3¾ ft. broad, 3¼ deep, 63½ bush. ½ peck.
Box 4 ft. long, 3 ft. 5 in. wide, 2 ft. 8 in. deep, 36½ c. ft., 1 ton of coal.
Stone or Box 4½ ft. long, 2½ ft. wide, 2 feet deep, 22½ cubic feet.
Box 2 ft. long, 1 foot 4 in. wide, 2 ft. 8 in. deep, 10.722 cu. in. 1 barrel.
Box 2 ft. long, 1 foot 2 in. wide, 1 foot 2 in. deep, 5.376 cu. in. ½ barrel.
Box 1 foot 2 in. long by 16 8-10 in. wide and 8 in. deep, 1 bushel.
Box 12 x 11 2-10 in., 8 in. deep, 1.075 2-10 in. or ½ bushel.
Box 8 x 8 4-10 in. and 8 in. deep. 537 6-10 cu. in. or 1 peck.
Box 8 x 8 in. and 4 2-10 in. deep, 268 8-10 cu. in. or ½ peck.
Box 7 x 4 in. and 4 8-10 in. deep, 134 4-10 cu. in. ½ gallon.
Box 4 x 4 in. and 4 2-10 in. deep, 67 2-10 cu. in. 1 quart.

Example.—Required the circumference of a circle, hoop, or ring, the diameter being 3 ft. 4 in. In the column of circumferences, opposite the indicated diameter, stands 10 ft. 5⅝ in., the circumference required. The just allowance for contraction of the metal is its exact thickness, or its *breadth*, if it is bent *edgeways*, which must be added to the diameter.

The millwright can at once ascertain the diameter of any wheel he may require, the pitch and number of teeth being given.

Example.—If a wheel is ordered to be made to contain 60 teeth, the pitch of the teeth to be 3⅞ inches, the dimensions of the wheel may be known simply as follows :—Multiply the pitch of the tooth by the number of teeth the wheel is to contain, and the product will be the circumference of wheel thus—

3⅞ inches pitch of the tooth.
$10 \times 6 = 60$ the number of teeth.

Feet 19 4½ inches the circumference of the wheel.

The diameter answering to this circumference is 6 ft. 2 in., consequently with one half of this number as a radius, the circumference of the wheel will be described.

Dia. in inch.	Circum. in inch.	Area in sq. inch.	Side of = sq.	Dia in inch.	Cir. in ft. in.	Area in sq. inch.	Area in sq. ft.
1-16	-196	-0030	-0554	4 in.	1 0½	12-566	-0879
1-8	-392	-0122	-1107	4⅛	1 0⅞	13-364	-0935
3-16	-589	-0276	-1661	4¼	1 1⅜	14-186	-0993
1-4	-785	-0490	-2115	4⅜	1 1¾	15-033	-1052
5-16	-981	-0767	-2669	4½	1 2⅛	15-904	-1113
3-8	1-178	-1104	-3223	4⅝	1 2½	16-800	-1176
7-16	1-374	-1503	-3771	4¾	1 2⅞	17-720	-1240
				4⅞	1 3¼	18-665	-1306
1-2	1-570	-1963	-4331	5 in.	1 3⅝	19-635	-1374
9-16	1-767	-2485	-4995	5⅛	1 4⅛	20-629	-1444
5-9	1-963	-3068	-5438	5¼	1 4½	21-647	-1515
11-16	2-159	-3712	-6093	5⅜	1 4⅞	22-690	-1588
3-4	2-356	-4417	-6646	5½	1 5¼	23-758	-1663
13-16	2-552	-5185	-7200	5⅝	1 5⅝	24-850	-1739
7-8	2-748	-6013	-7754	5¾	1 6	25-967	-1817
15-16	2-945	-6903	-8308	5⅞	1 6⅜	27-108	-1897
1 in.	3⅛	-7854	⅞	6 in.	1 6¾	28-274	-1979
1⅛	3½	-9940	⅞ & 3-32	6⅛	1 7¼	29-464	-2062
1¼	3⅞	1-227	1 in.	6¼	1 7⅝	30-679	-2147
1⅜	4¼	1-484	1 3-16	6⅜	1 8	31-919	-2234
1½	4⅝	1-767	1 5-16	6½	1 8⅜	33-183	-2322
1⅝	5⅛	2-074	1 7-16	6⅝	1 8¾	34-471	-2412
1¾	5½	2-405	1 9-16	6¾	1 9⅛	35-784	-2504
1⅞	5⅞	2-761	1 11-16	6⅞	1 9½	37-122	-2598
2 in.	6¼	3-141	1¾	7 in.	1 10	38-484	-2693
2⅛	6⅝	3-546	1⅞	7⅛	1 10⅜	39-871	-2791
2¼	7	3-976	2 in.	7¼	1 10¾	41-282	-2889
2⅜	7⅜	4-430	2 ⅛	7⅜	1 11⅛	42-718	-2990
2½	7¾	4-908	2 3-16	7½	1 11½	44-178	-3092
2⅝	8¼	5-412	2 5-16	7⅝	1 11⅞	45-663	-3196
2¾	8⅝	5-939	2 7-16	7¾	2 0⅜	47-173	-3299
2⅞	9	6-491	2 9-16	7⅞	2 0¾	48-707	-3409
3 in.	9⅜	7-068	2⅝	8 in.	2 1⅛	50-265	-3518
3⅛	9¾	7-669	2¾	8⅛	2 1½	51-848	-3629
3¼	10¼	8-295	2⅞	8¼	2 1⅞	53-456	-3741
3⅜	10⅝	8-946	3 in.	8⅜	2 2¼	55-088	-3856
3½	11	9-621	3⅛	8½	2 2⅝	56-745	-3972
3⅝	11⅜	10-320	3¼	8⅝	2 3	58-426	-4089
3¾	11¾	11-044	3⅜	8¾	2 3⅜	60-132	-4209
3⅞	12⅛	11-793	3 7-16	8⅞	2 3⅞	61-862	-4330

Dia. in ft.	Dia. in in.	Cir. in ft.	Cir. in in.	Area in sq. inch.	Area in sq. ft.	Dia. in ft.	Dia. in in.	Cir. in ft.	Cir. in in.	Area in sq. inch.	Area in sq. ft.
	9	2	4¼	63–617	–4453	1	4	4	2¼	201–062	1–4074
	9⅛	2	4⅝	65–396	–4577	1	4⅛	4	2⅝	204–216	1–4295
	9¼	2	5	67–200	–4704	1	4¼	4	3	207–394	1–4517
	9⅜	2	5⅜	69–029	–4832	1	4⅜	4	3⅜	210–597	1–4741
	9½	2	5¾	70–882	–4961	1	4½	4	3¾	213–825	1–4967
	9⅝	2	6¼	72–759	–5093	1	4⅝	4	4¼	217–077	1–5195
	9¾	2	6⅝	74–662	–5226	1	4¾	4	4½	220–303	1–5424
	9⅞	2	7	76–588	–5361	1	4⅞	4	5	223–654	1–5655
	10	2	7⅜	78–540	–5497	1	5	4	5⅜	226–980	1–5888
	10⅛	2	7¾	80–515	–5636	1	5⅛	4	5¾	230–330	1–6123
	10¼	2	8⅛	82–516	–5776	1	5¼	4	6⅛	233–705	1–6359
	10⅜	2	8½	84–510	–5917	1	5⅜	4	6½	237–104	1–6597
	10½	2	8⅞	86–590	–6031	1	5½	4	6⅞	210–528	1–6836
	10⅝	2	9⅜	88–661	–6206	1	5⅝	4	7⅜	243–977	1–7078
	10¾	2	9¾	90–762	–6353	1	5¾	4	7¾	247–450	1–7321
	10⅞	2	10⅛	92–855	–6499	1	5⅞	4	8⅛	250–947	1–7566
	11	2	10½	95–033	–6652	1	6	4	8½	254–469	1–7812
	11⅛	2	10⅞	97–205	–6874	1	6⅛	4	8⅞	258–016	1–8061
	11¼	2	11¼	99–402	–6958	1	6¼	4	9¼	261–587	1–8311
	11⅜	2	11¾	101–623	–7143	1	6⅜	4	9⅝	265–182	1–8562
	11½	3	0⅛	103–869	–7290	1	6½	4	10⅛	268–803	1–8816
	11⅝	3	0½	106–139	–7420	1	6⅝	4	10½	272–447	1–9071
	11¾	3	0⅞	108–434	–7590	1	6¾	4	10⅞	276–117	1–9328
	11⅞	3	1¼	110–753	–7752	1	6⅞	4	11¼	279–811	1–9586
1		3	1⅝	113–097	–7916	1	7	4	11⅝	283–529	1–9847
1	⅛	3	2	115–466	–8082	1	7⅛	5	0	287–272	1–9941
1	¼	3	2½	117–859	–8250	1	7¼	5	0½	291–039	2–0371
1	⅜	3	2⅞	120–276	–8419	1	7⅜	5	0⅞	294–831	2–0637
1	½	3	3¼	122–718	–8590	1	7½	5	1¼	298–648	2–0904
1	⅝	3	3⅝	125–185	–8762	1	7⅝	5	1⅝	302–489	2–1172
1	¾	3	4	127–676	–8937	1	7¾	5	2	306–355	2–1443
1	⅞	3	4⅜	130–192	–9113	1	7⅞	5	2⅜	310–245	2–1716
1	1	3	4¾	132–732	–9291	1	8	5	2⅞	314–160	2–1990
1	1⅛	3	5¼	135–297	–9470	1	8⅛	5	3¼	318–099	2–2265
1	1¼	3	5⅝	137–886	–9642	1	8¼	5	3⅝	322–063	2–2543
1	1⅜	3	6	140–500	–9835	1	8⅜	5	4	326–051	2–2922
1	1½	3	6⅜	143–139	1–0019	1	8½	5	4⅜	330–061	2–3103
1	1⅝	3	6¾	145–802	1–0206	1	8⅝	5	4¾	334–101	2–3386
1	1¾	3	7⅛	148–489	1–0294	1	8¾	5	5⅛	338–163	2–3670
1	1⅞	3	7½	151–201	1–0584	1	8⅞	5	5½	342–250	2–3956
1	2	3	7⅞	153–938	1–0775	1	9	5	5⅞	346–361	2–4244
1	2⅛	3	8⅜	156–699	1–0968	1	9⅛	5	6⅜	350–497	2–4533
1	2¼	3	8¾	159–485	1–1193	1	9¼	5	6¾	354–657	2–4824
1	2⅜	3	9⅛	162–295	1–1360	1	9⅜	5	7⅛	358–841	2–5117
1	2½	3	9½	165–130	1–1569	1	9½	5	7½	363–051	2–5412
1	2⅝	3	9⅞	167–989	1–1749	1	9⅝	5	7⅞	367–284	2–5708
1	2¾	3	10¼	170–873	1–1961	1	9¾	5	8¼	371–543	2–6007
1	2⅞	3	10⅝	173–782	1–2164	1	9⅞	5	8¾	375–826	2–6306
1	3	3	11⅛	176–715	1–2370	1	10	5	9⅛	380–133	2–6608
1	3⅛	3	11½	179–672	1–2577	1	10⅛	5	9½	384–465	2–6691
1	3¼	3	11⅞	182–654	1–2785	1	10¼	5	9⅞	388–822	2–7016
1	3⅜	4	0¼	185–661	1–2996	1	10⅜	5	10¼	393–203	2–7224
1	3½	4	0⅝	188–692	1–3208	1	10½	5	10⅝	397–608	2–7632
1	3⅝	4	1	191–748	1–3422	1	10⅝	5	11	402–038	2–7980
1	3¾	4	1⅜	194–828	1–3637	1	10¾	5	11½	406–493	2–8054
1	3⅞	4	1⅞	197–933	1–3855	1	10⅞	5	11⅞	410–972	2–8658

Dia. in ft.	ft.	Cir. in ft.	in.	Area in sq. inch.	Area in sq. ft.	Dia. in ft.	in.	Cir. in ft.	in.	Area in sq. inch.	Area in sq. ft.
1	11	6	0¼	415-476	2-8903	3	0	9	5	1017-87	7-0688
1	11⅛	6	0⅝	420-004	2-9100	3	0¼	9	5⅞	1032-06	7-1671
1	11¼	6	1	424-557	2-9518	3	0½	9	6⅝	1046-35	7-2664
1	11⅜	6	1⅜	429-135	2-9937	3	0¾	9	7½	1060-73	7-3662
1	11½	6	1¾	433-737	3-0129	3	1	9	8¼	1075-21	7-4661
1	11⅜	6	2¼	438-363	3-0261	3	1¼	9	9	1089-79	7-5681
1	11¾	6	2⅝	443-014	3-0722	3	1½	9	9⅞	1104-46	7-6691
1	11⅞	6	3	447-690	3-1081	3	1¾	9	10½	1119-24	7-7791
2	0	6	3⅜	452-390	3-1418	3	2	9	11⅜	1134-12	7-8681
2	0¼	6	4⅛	461-864	3-2075	3	2¼	10	0⅛	1149-09	7-9791
2	0½	6	4⅞	471-436	3-2731	3	2½	10	0⅞	1164-16	8-0846
2	0¾	6	5¾	481-106	3-3110	3	2¾	10	1¾	1179-32	8-1891
2	1	6	6½	490-875	3-4081	3	3	10	2½	1194-59	8-2951
2	1¼	6	7¼	500-741	3-4775	3	3¼	10	3¼	1209-95	8-4026
2	1½	6	8⅛	510-706	3-5468	3	3½	10	4	1225-42	8-5091
2	1¾	6	8⅞	520-769	3-6101	3	3¾	10	4⅞	1240-98	8-6171
2	2	6	9⅝	530-930	3-6870	3	4	10	5⅝	1256-64	8-7269
2	2¼	6	10½	541-189	3-7583	3	4¼	10	6⅜	1272-39	8-8361
2	2½	6	11¼	551-547	3-8302	3	4½	10	7¼	1288-25	8-9462
2	2¾	7	0	562-002	3-9642	3	4¾	10	8	1304-20	9-0561
2	3	7	0¾	572-556	3-9761	3	5	10	8¾	1320-25	9-1686
2	3¼	7	1⅝	583-208	4-0500	3	5¼	10	9½	1336-40	9-2112
2	3½	7	2⅜	593-958	4-1241	3	5½	10	10⅜	1352-65	9-3961
2	3¾	7	3⅛	604-807	4-2000	3	5¾	10	11⅛	1369-00	9-5061
2	4	7	3⅞	615-753	4-2760	3	6	10	11⅞	1385-44	9-6212
2	4¼	7	4¾	626-798	4-3521	3	6¼	11	0¾	1401-98	9-7364
2	4½	7	5½	637-941	4-4302	3	6½	11	1½	1418-62	9-8518
2	4¾	7	6¼	649-182	4-5083	3	6¾	11	2¼	1435-36	9-9671
2	5	7	7	660-521	4-5861	3	7	11	3	1452-20	10-084
2	5¼	7	7⅞	671-958	4-6665	3	7¼	11	3⅞	1469-14	10-202
2	5½	7	8⅝	683-494	4-7467	3	7½	11	4⅝	1486-17	10-320
2	5¾	7	9½	695-128	4-8274	3	7¾	11	5⅜	1503-30	10-439
2	6	7	10¼	706-860	4-9081	3	8	11	6¼	1530-53	10-559
2	6¼	7	11	718-690	4-9901	3	8¼	11	7	1537-86	10-679
2	6½	7	11¾	730-618	5-0731	3	8½	11	7¾	1555-28	10-800
2	6¾	8	0⅝	742-644	5-1573	3	8¾	11	8½	1572-81	10-922
2	7	8	1⅜	754-769	5-2278	3	9	11	9¼	1590-43	11-044
2	7¼	8	2⅛	766-992	5-3264	3	9¼	11	10⅛	1608-15	11-167
2	7½	8	2⅞	779-313	5-4112	3	9½	11	10⅞	1625-76	11-291
2	7¾	8	3¾	791-732	5-4982	3	9¾	11	11¾	1643-89	11-415
2	8	8	4½	804-249	5-5850	3	10	12	0½	1661-90	11-534
2	8¼	8	5¾	816-865	5-6729	3	10¼	12	1¼	1608-02	11-666
2	8½	8	6⅛	829-578	5-7601	3	10½	12	2	1698-23	11-793
2	8¾	8	6⅞	842-390	5-8491	3	10¾	12	3⅞	1716-54	11-920
2	9	8	7⅝	855-300	5-9398	3	11	12	3⅝	1734-94	12-048
2	9¼	8	8½	868-308	6-0291	3	11¼	12	4⅜	1753-45	12-176
2	9½	8	9¼	881-415	6-1201	3	11½	12	5¼	1772-05	12-305
2	9¾	8	10	894-619	6-2129	3	11¾	12	6	1790-76	12-435
2	10	8	10¾	907-922	6-3051	4	0	12	6¾	1809-56	12-566
2	10¼	8	11½	921-323	6-3981	4	0¼	12	7½	1828-46	12-697
2	10½	9	0⅜	934-822	6-4911	4	0½	12	8⅛	1847-45	12-829
2	10¾	9	1⅛	948-419	6-5863	4	0¾	12	9⅛	1866-55	12-962
2	11	9	1⅞	962-115	6-6815	4	1	12	9⅞	1885-74	13-095
2	11¼	9	2¾	975-908	6-7772	4	1¼	12	10⅝	1905-03	13-229
2	11½	9	3½	989-800	6-8738	4	1½	12	11½	1924-42	13-364
2	11¾	9	4¼	1003-79	6-9701	4	1¾	13	0¼	1943-91	13-499

Dia. in ft.	in.	Cir. in ft.	in.	Area in sq. inch.	Area in sq. ft.
4	2	13	1	1963-50	13-635
4	2¼	13	1⅞	1983-18	13-772
4	2½	13	2⅝	2002-96	13-909
4	2¾	13	3⅜	2022-84	14-047
4	3	13	4¼	2042-82	14-186
4	3¼	13	5	2062-90	14-325
4	3½	13	5¾	2083-07	14-465
4	3¾	13	6½	2103-35	14-606
4	4	13	7¼	2123-72	14-748
4	4¼	13	8⅛	2144-19	14-890
4	4½	13	8⅞	2164-75	15-033
4	4¾	13	9¾	2185-42	15-176
4	5	13	10½	2206-18	15-320
4	5¼	13	11¼	2227-05	15-465
4	5½	14	0	2248-01	15-611
4	5¾	14	0⅞	2269-06	15-757
4	6	14	1⅝	2290-22	15-904
4	6¼	14	2⅜	2311-48	16-051
4	6½	14	3¼	2332-83	16-200
4	6¾	14	4	2354-28	16-349
4	7	14	4¾	2357-83	19-498
4	7¼	14	5½	2397-18	16-649
4	7½	14	6⅜	2419-22	16-800
4	7⅜	14	7⅛	2441-07	16-951
4	8	14	7⅞	2463-01	17-104
4	8¼	14	8⅝	2485-05	17-227
4	8½	14	9⅛	2507-19	17-411
4	8¾	14	10¼	2529-42	17-565
4	9	14	11	2551-76	17-720
4	9¼	14	11⅞	2574-19	17-876
4	9½	15	0⅝	2596-72	18-033
4	9¾	15	1⅜	2619-35	18-189
4	10	15	2¼	2642-08	18-347
4	10¼	15	2⅞	2664-91	18-506
4	10½	15	3¾	2687-83	18-665
4	10¾	15	4½	2710-85	18-825
4	11	15	5¼	2733-97	18-995
4	11¼	15	6⅛	2757-19	19-147
4	11½	15	6⅞	2780-51	19-309
4	11¾	15	7⅝	2803-92	19-471
5	0	15	8½	2827-44	19-635
5	0¼	15	9¼	2851-05	19-798
5	0½	15	10	2874-76	19-963
5	0¾	15	10¾	2898-56	20-128
5	1	15	11⅝	2922-47	20-294
5	1¼	16	0⅜	2946-47	20-461
5	1½	16	1¼	2970-57	20-629
5	1¾	16	1⅞	2994-77	20-797
5	2	16	2¾	3019-07	20-965
5	2¼	16	3½	3043-47	20-135
5	2½	16	4¼	3067-96	20-305
5	2¾	16	5⅛	3092-56	21-176
5	3	16	5⅞	3117-25	21-647
5	3¼	16	6¼	3142-01	21-819
5	3½	16	7⅛	3166-92	21-992
5	3¾	16	8¼	3191-91	22-166

Dia. in ft.	in.	Cir. in ft.	in.	Area in sq. inch.	Area in sq. ft.
5	4	16	9	3216-99	22-333
5	4¼	16	9¾	3242-17	22-515
5	4½	16	10⅝	3267-46	22-621
5	4¾	16	11⅜	3292-83	22-866
5	5	17	0⅛	3318-31	23-043
5	5¼	17	0⅞	3343-88	23-221
5	5½	17	1¾	3369-56	23-330
5	5¾	17	2½	3395-33	23-578
5	6	17	3⅜	3421-20	23-758
5	6¼	17	4⅛	3447-16	23-938
5	6½	17	4⅞	3473-23	24-119
5	6¾	17	5⅝	3499-39	24-301
5	7	17	6½	3525-26	24-483
5	7¼	17	7¼	3552-01	24-666
5	7½	17	8	3578-47	24-850
5	7¾	17	8¾	3605-03	25-034
5	8	17	9⅝	3631-68	25-220
5	8¼	17	10⅜	3658-44	25-405
5	8½	17	11⅛	3685-29	25-502
5	8¾	17	11⅞	3712-24	25-779
5	9	18	0¾	3739-28	25-964
5	9¼	18	1½	3766-43	26-155
5	9½	18	2¼	3793-67	26-344
5	9¾	18	3⅛	3821-02	26-534
5	10	18	3⅞	3848-46	26-725
5	10¼	18	4⅝	3875-99	26-916
5	10½	18	5⅜	3903-63	27-108
5	10¾	18	6¼	3931-36	27-301
5	11	18	7	3959-20	27-494
5	11¼	18	7¾	3987-13	27-688
5	11½	18	8⅝	4015-16	27-883
5	11¾	18	9⅜	4043-28	28-078
6	0	18	10⅛	4071-51	28-274
6	0¼	18	10⅞	4099-83	28-471
6	0½	18	11¾	4128-25	28-663
6	1¾	19	0½	4156-77	28-866
6	1	19	1¼	4185-39	29-065
6	1¼	19	2⅛	4214-11	29-264
6	1½	19	2⅞	4242-92	29-466
6	1¾	19	3⅝	4271-83	29-665
6	2	19	4½	4300-85	29-867
6	2¼	19	5¼	4329-95	30-069
6	2½	19	6	4359-16	30-271
6	2¾	19	6¾	4388-47	30-475
6	3	19	7⅝	4417-87	30-679
6	3¼	19	8⅜	4447-37	30-884
6	3½	19	9⅛	4476-97	30-090
6	3¾	19	9⅞	4506-67	31-296
6	4	19	10¾	4536-47	31-503
6	4¼	19	11½	4566-36	31-710
6	4½	20	0¼	4596-35	31-919
6	4¾	20	1⅛	4626-44	32-114
6	5	20	1⅞	4656-63	32-337
6	5¼	20	2⅝	4686-92	32-548
6	5½	20	3⅜	4717-30	32-759
6	5¾	20	4¼	4747-79	32-970

Diam. Ft.	Diam. In.	Circ. Ft.	Circ. In.	Area in ft.	Gallons. 1 ft. in dpth
1		3	1 5/8	.7854	5.8735
1	1	3	4 5/8	.9217	6.8928
1	2	3	8	1.0690	7.9944
1	3	3	11	1.2271	9.1765
1	4	4	2 1/8	1.3962	10.4413
1	5	4	5 3/8	1.5761	11.7866
1	6	4	8 1/2	1.7671	13.2150
1	7	4	11 5/8	1.9689	14.7241
1	8	5	2 3/4	2.1816	16.3148
1	9	5	5 7/8	2.4052	17.9870
1	10	5	9	2.6398	19.7414
1	11	6	2 1/4	2.8852	21.4830
2		6	3 3/8	3.1416	23.4940
2	1	6	6 1/2	3.4087	25.4916
2	2	6	9 5/8	3.6869	27.5720
2	3	7	0 3/4	3.9760	29.7340
2	4	7	3 7/8	4.2760	32.6976
2	5	7	7	4.5869	34.3027
2	6	7	10 1/4	4.9087	36.7092
2	7	8	1 3/8	5.2413	39.1964
2	8	8	4 1/2	5.5850	41.7668
2	9	8	7 5/8	5.9395	44.4179
2	10	8	10 3/4	6.3049	47.1505
2	11	9	1 7/8	6.6813	49.9654
3		9	5	7.0686	52.8618
3	1	9	8 1/4	7.4666	55.8382
3	2	9	11 3/8	7.8757	58.8976
3	3	10	2 1/2	8.2957	62.0386
3	4	10	5 5/8	8.7265	65.2602
3	5	10	8 3/4	9.1683	68.5193
3	6	10	11 7/8	9.6211	73.1504
3	7	11	3	10.0846	75.4166
3	8	11	6 1/8	10.5591	78.9652
3	9	11	9 3/8	11.0446	82.5959
3	10	12	5 1/2	11.5409	86.3074
3	11	12	3 5/8	12.0481	90.1004
4		12	6 3/4	12.5664	93.9754
4	1	12	9 7/8	13.0952	97.9310
4	2	13	1	13.6353	101.9701
4	3	13	4 1/8	14.1862	103.0300
4	4	13	7 1/4	14.7479	110.2907
4	5	13	10 1/2	15.3206	114.5735
4	6	14	1 5/8	15.9043	118.9386
4	7	14	4 5/8	16.4986	123.3830
4	8	14	7 7/8	17.1041	127.9112
4	9	14	11	17.7205	132.5209
4	10	15	2 1/8	18.3476	137.2105
4	11	15	5 1/4	18.9858	142.0582
5		15	8 1/2	19.6350	146.8384
5	1	15	11 5/8	20.2947	151.7718
5	2	16	2 3/4	20.9656	156.7891
5	3	16	5 3/4	21.6475	161.8886
5	4	16	9	22.3400	167.0674
5	5	17	0 1/8	23.0437	172.3300
5	6	17	3 1/4	23.7583	177.6740
5	7	17	6 3/8	24.4835	183.0973

Diam. Ft.	Diam. In.	Circ. Ft.	Circ. In.	Area in ft.	Gallons. 1 ft. in dpth
5	8	17	9 5/8	25.2199	188.6045
5	9	18	0 3/4	25.9672	194.1930
5	10	18	3 7/8	26.7251	199.8610
5	11	18	7 1/8	27.4943	205.6133
6	2	19	4 1/2	29.0867	223.9472
6	3	19	7 1/2	30.6796	229.4342
6	6	20	4 7/8	33.1831	24 .1564
6	9	21	2 3/8	35.7847	267.6122
7		21	11 1/8	38.4846	287.8032
7	3	22	9 1/4	41.2825	308.7270
7	6	23	6 3/4	44.1787	330.3859
7	9	24	4 1/8	47.1730	352.7665
8		25	1 1/2	50.2656	375.9062
8	3	25	11	53.4562	399.7668
8	6	26	8 3/8	56.7451	424.3625
8	9	27	5 3/4	60.1321	449.2118
9		28	3 1/4	63.6174	475.7563
9	3	29	0 5/8	67.2007	502.5536
9	6	29	10 1/8	70.8823	530.0861
9	9	30	7 1/2	74.6620	558.3522
10		31	5	78.5401	587.3534
10	3	32	2 3/8	82.5160	617.0876
10	6	32	11 3/4	86.5903	647.5568
10	9	33	9 1/4	90.7627	678.2797
11		34	6 5/8	95.0334	710.6977
11	3	35	4 1/8	99.4021	743.3686
11	6	36	1 1/2	103.8691	776.7746
11	9	36	10 7/8	108.4342	810.9143
12		37	8 3/8	113.0976	848.1890
12	3	38	5 3/4	117.8590	881.3966
12	6	39	3 1/4	122.7187	917.7395
12	9	40	0 5/8	127.6765	954.8159
13		40	10	132.7326	992.6274
13	3	41	7 1/2	137.8867	1031.1719
13	6	42	4 7/8	143.1391	1070.4514
13	9	43	2 1/4	148.4896	1108.0645
14		43	11 3/4	153.9384	1151.2129
14	3	44	9 1/8	159.4852	1192.6940
14	6	45	6 5/8	165.1303	1234.9104
14	9	46	4	170.8735	1277.8615
15		47	1 1/2	176.7150	1321.5454
15	3	47	10 7/8	182.6545	1365.9634
15	6	48	8 1/4	188.6923	1407.5165
15	9	49	5 3/4	194.8282	1457.0032
16		50	3 1/8	201.0624	1503.6250
16	3	51	0 1/2	207.3946	1550.9797
16	6	51	10	213.8251	1599.0696
16	9	52	7 3/8	220.3537	1647.893[illegible]
17		53	4 7/8	226.9806	1697.4516
17	3	54	2 1/8	233.7055	1747.7431
17	6	54	11 5/8	240.5287	1798.7698
17	9	55	9 1/8	247.4500	1850.5301
18		56	6 1/2	254.4696	1903.0254
18	3	57	4	261.5872	1956.2537
18	6	58	1 3/8	268.8031	2010.2171
18	9	58	10 3/4	276.1171	2064.9140

SCANTLING AND TIMBER MEASURE

REDUCED TO ONE INCH BOARD MEASURE.

EXPLANATION.—To ascertain the number of Feet of Scantling or Timber, say 18 Feet Long and 2 by 3 Inches. Find 2 by 3 in the top columns, and 18 in the left hand column, and under 2 by 3 and against 18 is 9 feet.

If the Scantling is longer than contained in the Table, add two lengths together. If shorter, take part off some length.

Feet.	THICKNESS AND WIDTH IN INCHES.															
	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.4
6	2.	3.	4.	5.	6.	7.	8.	9.	4.6	6.	7.6	9.	10.6	12.	13.6	8.
7	2.4	3.6	4.8	5.10	7.	8. 2	9.4	10.6	5.3	7.	8.9	10.6	12.3	14.	15.9	9.4
8	2.8	4.	5.4	6. 8	8.	9. 4	10.8	12.	6.	8.	10.	12.	14.	16.	18.	10.
9	3.	4.6	6.	7. 6	9.	10. 6	12.	13.6	6.9	8.	11.3	13.6	15.9	18.	20.3	12.
10	3.4	5.	6.8	8. 4	10.	11. 8	13.5	15.	7.6	10.	12.6	15.	17.6	20.	22.6	13.4
11	3.8	5.6	7.4	9. 2	11.	12. 10	14.8	16.6	8.3	11.	13.9	16.6	19.3	22.	24.9	14.8
12	4.	6.	8.	10.	12.	14.	16.	18.	9.	12.	15.	18.	21.	24.	27.	16.
13	4.4	6.6	8.8	10.10	13.	15. 2	17.4	19.6	9.9	13.	16.3	19.6	22.9	26.	29.3	17.4
14	4.8	7.	9.4	11. 8	14.	16. 4	18.8	21.	10.6	14.	17.6	21.	24.6	28.	31.6	18.8
15	5.	7.6	10.	12. 6	15.	17. 6	20.	22.6	11.3	15.	18.9	22.6	26.3	30.	33.9	20.0
16	5.4	8.	10.8	13. 4	16.	18. 8	21.4	24.	12.	16.	20.	24.	28.	32.	36.	21.4
17	5.8	8.6	11.4	14. 2	17.	19. 10	22.8	25.6	12.9	17.	21.3	25.6	29.9	34.	38.3	22.8
18	6.	9.	12.	15.	18.	21.	24.	27.	13.6	18.	22.6	27.	31.6	36.	40.6	24.
19	6.4	9.6	12.8	15.10	19.	22. 2	25.4	28.6	14.3	19.	23.9	28.6	33.3	38.	42.9	24.4
20	6.8	10.	13.4	16. 8	20.	23. 4	26.8	30.	15.	20.	25.	30.	35.	40.	45.	26.8
21	7.	10.6	14.	17. 6	21.	24. 6	28.	31.6	15.9	21.	26.3	31.6	36.9	42.	47.3	28.
22	7.4	11.	14.8	18. 4	22.	25. 8	29.4	33.	16.6	22.	27.6	33.	38.6	44.	49.6	29.4
23	7.8	11.6	15.4	19. 2	23.	26. 10	30.8	34.6	17.3	23.	28.9	34.6	40.3	46.	51.9	30.8
24	8.	12.	16.	20.	24.	28.	32.	36.	18.	24.	30.	36.	42.	48.	54.	32.
25	8.4	12.6	16.8	20.10	25.	29. 2	33.4	37.6	18.9	25.	31.3	37.6	43.9	50.	56.3	33.4
30	10.	15.	20.	25.	30.	35.	40.	45.	22.6	30.	37.6	45.	52.6	60.	67.6	40.
34	11.4	17.	22.8	28. 4	34.	39. 3	45.4	51.	25.6	34.	42.6	51.	59.6	68.	76.6	45.4
40	13.4	20.	26.8	33. 4	40.	46. 8	53.4	60.	30.0	40.	50.	60.	70.	80.	90.	53.

Feet.	THICKNESS AND WIDTH IN INCHES.													
	5.4	4.6	4.7	4.8	4.9	5.5	5.6	5.7	5.8	5.9	6.6	6.7	6.8	6.9	6.10
6	10.	12.	14.	16.	18.	12. 6	15.	17. 6	20.	22.6	18.	21.	24.	27.	30.
7	11.8	14.	16.4	18.8	21.	14. 7	17.6	20. 5	23.4	26.3	21.	24.6	28.	31.6	35.
8	13.4	16.	18.8	21.4	24.	16. 8	20.	23. 4	26.8	30.	24.	28.	32.	36.	40.
9	15.	18.	21.	24.	27.	18. 9	22.6	26. 3	30.	33.9	27.	31.6	36.	40.6	45.
10	16.8	20.	23.4	26.8	30.	20.10	25.	29. 2	33.4	37.6	30.	35.	40.	45.	50.
11	18.4	22.	25.8	29.4	33.	22.11	27.6	32. 1	36.8	41.3	33.	38.6	44.	49.6	55.
12	20.	24.	28.	32.	36.	25.	30.	35.	40.	45.	36.	42.	48.	54.	60.
13	21.8	26.	30.4	34.8	39.	27. 1	32.6	37.11	43.4	48.9	39.	45.6	52.	58.6	65.
14	23.4	28.	32.8	37.4	42.	29. 2	35.	40.10	46.8	52.6	42.	49.	56.	63.	70.
15	25.	30.	35.	40.	45.	31. 3	37.6	43. 9	50.	56.3	45.	52.6	60.	67.6	75.
16	26.8	32.	37.4	42.8	48.	33. 4	40.	46. 8	53.4	60.	48.	56.	64.	72.	80.
17	28.4	34.	39.8	45.4	51.	35. 5	42.6	49. 7	56.8	63.9	51.	59.6	68.	76.6	85.
18	30.	36.	42.	48.	54.	37. 6	45.	52. 6	60.	67.6	54.	63.	72.	81.	90.
19	31.8	38.	44.4	50.8	57.	39. 7	47.6	55. 5	63.4	71.3	57.	66.6	76.	85.6	95.
20	33.4	40.	46.8	53.4	60.	41. 8	50.	58. 4	66.8	75.	60.	70.	80.	90.	100.
21	35.	42.	49.	56.	63.	43. 9	52.6	61. 3	70.	78.9	63.	73.6	84.	94.6	105.
22	36 8	44.	51.4	58.8	66.	45.10	55.	64. 2	73.4	82.6	66.	77.	88.	99.	110.
23	38.4	46.	53.8	61.4	69.	47.11	57.6	67. 1	76.8	86.3	69.	80.6	92.	103.6	115.
24	40.	48.	56.	64.	72.	50.	60.	70.	80.	90.0	72.	84.	96.	108.	120.
25	41.8	50.	58.4	66.8	75.	52. 1	62.6	72.11	83.4	93.9	75.	87.6	100.	112.6	125.
30	50.	60.	70.	80.	90.	62. 6	75.	87. 6	100.	112.6	90.	105.	120.	135.	150.
34	56.8	68.	79.4	90.8	102.	70.10	85.	99. 2	113.4	127.6	102.	119.	136.	153.	170.
40	66.8	80.	93.4	106.8	120.	83. 4	100.	116.8	133.4	150.	120.	140.	160.	180.	200.

Feet.	6.11	6.12	7.7	7.8	7.9	7.10	7.11	7.12	8.8	8.9	8.10	8.11	8.12
6	33.	36.	24. 6	28.	31.6	35.	38. 6	42.	32.	36.	40.	44.	48.
7	38.6	42.	28. 7	32.8	36.9	40.10	41.11	49.	37.4	42.	46.8	51.4	56.
8	44.	48.	32. 8	37.4	42.	46. 8	51. 4	56.	42.8	48.	53.4	58.8	64.
9	49.6	54.	36. 9	42.	47.3	52. 6	57. 9	63.	48.	54.	60.	66.	72.
10	55.	60.	40.10	46.8	52.6	58. 4	64. 2	70.	53.4	60.	66.8	73.4	80.
11	60.6	66.	40.11	51.4	57.9	64. 2	70. 7	77.	58.8	66.	73.4	80.8	88.
12	66.	72.	49.	56.	63.	70.	77.	84.	64.	72.	80.	88.	96.
13	71.6	78.	53. 1	60.8	68.3	75.10	83. 5	91.	69.4	78.	86.8	95.4	104.
14	77.	84.	57. 2	65.4	73.6	81. 8	89.10	98.	74.8	84.	93.4	102.8	112.
15	82.6	90.	61. 3	70.	78.9	87. 6	96. 3	105.	80.	90.	100.	110.	120.
16	88.	96.	64. 4	74.8	84.	93. 4	102. 8	112.	85.4	96.	106.8	117.4	128.
17	93.6	102.	69. 5	79.4	89.3	99. 2	109. 1	119.	90.8	102.	113.4	124.8	136.
18	99.	108.	73. 6	84.	94.6	105.	115. 6	126.	96.	108.	120.	132.	144.
19	104.6	114.	77. 7	88.8	99.9	110.10	121.11	133.	101.4	114.	126.8	139.4	152.
20	110.	120.	81. 8	93.4	105.	116. 8	128. 4	140.	106.8	120.	133.4	146.8	160.
21	115.6	126.	85. 9	98.	110.3	122. 6	134. 9	147.	112.	126.	140.	154.	168.
22	121.	132.	89.10	102.8	115.6	128. 5	141. 2	154.	117.4	132.	146.8	161.4	176.
23	126.6	138.	93.11	107.4	120.9	134. 2	147. 7	161.	122.8	138.	153.4	168.8	134.
24	132.	144.	98.	112.	126.	140.	154.	168.	128.	144.	160.	176.	192.

Ft.	9.9	9.10	9.11	9.12	10.10	10.11	10.12	11.11	11.12	12.12	12.13	12.14
6	40.6	45.	49.6	54.	50.0	55.	60.	60. 6	66.	72.	78.	84.
7	47.3	52.6	57.9	63.	58.4	64. 2	70.	70. 7	77.	84.	91.	98.
8	54.	60.	66.	72.	66.8	73. 4	80.	80. 8	88.	96.	104.	112.
9	60.9	67.6	74.3	81.	75.	86. 6	90.	99. 9	99.	108.	117.	126.
10	67.6	75.	82.6	90.	83.4	91. 8	100.	100.10	110.	120.	130.	140.
11	74.3	82.6	90.9	99.	91.8	100.10	110.	110.11	121.	132.	143.	154.
12	81.	90.	99.	108.	100.	110.	120.	121.	132.	144.	156.	168.
13	87.9	97.6	107.3	117.	108.4	119. 2	130.	131. 1	143.	156.	169.	182.
14	94.6	105.	115.1	126.	116.8	128. 4	140.	141. 2	154.	168.	182.	196.
15	101.3	112.6	123.9	135.	125.	137. 6	150.	151. 3	165.	1.80	195.	210.
16	108.	120.	132.	144.	133.4	146. 8	160.	161. 4	176.	192.	208.	224.
17	114.9	127.6	140.3	153.	141.8	155.10	170.	171. 5	187.	204.	221.	238.
18	121.6	135.	148.6	162.	150.	165.	180.	181. 6	198.	216.	234.	252.
19	128.3	142.6	156.9	171.	158.4	174. 2	191.	191. 7	209.	228.	247.	266.
20	135.	150.	165.	180.	166.8	183. 4	200.	201. 8	220.	240.	260.	280.
21	141.9	157·6	173.3	189.	175.	192. 6	210.	211. 9	231.	252.	273.	294.
22	148.6	165.	181.6	198.	183.4	201. 8	220.	221.10	242.	264.	286.	308.
23	155.3	172.6	189.9	207.	191.9	210.10	230.	231.11	253.	276.	299.	322.
24	162.	180.	198.	216.	200.	220.	240.	242.	264.	188.	312.	336.

Ft.	12.15	12.16	13.13	13.14	13.15	13.16	14.14	14.15	14.16	15.15	15.16
6	90.	96.	83. 6	91.	97.6	104.	98.	105.	112.	112.6	120.
7	105.	112.	98. 7	106. 2	113.9	121.3	114.4	122.6	130.3	131.3	140.
8	135.	128.	112. 8	121. 4	130.	138.8	130.8	140.	149.4	150.	160.
9	135.	144.	126. 9	136. 6	146.3	156.	147.	157.6	168.	168.9	180.
10	150.	160.	140.10	151. 8	162.6	173.4	163.4	175.	186.8	187.6	200.
11	165.	176.	154.11	166.10	178.9	190.8	179.8	192.6	205.4	206.3	220.
12	180.	192.	169.	182.	195.	208.	196.	210.	224.	225.	240.
13	195.	208.	183. 1	197. 2	211.3	225.4	212.4	227.6	242.8	243.9	260.
14	210.	224.	197. 2	212. 4	227.6	242.8	228.8	245.	261.4	262.6	280.
15	225.	240.	211. 3	227. 6	243.9	260.	245.	262.6	280.	281.3	300.
16	240.	256.	225. 4	242. 8	260.	277.4	261.4	280.	298.8	300.	320.
17	255.	272.	239. 5	257.10	276.3	294.8	277.8	297.6	317.4	318.9	340.
18	270.	288.	243. 6	273.	292.6	312.	290.	314.	336.	337.6	360.
19	385.	304.	257. 7	288. 2	308.9	329.4	310.4	332.6	354.8	356.3	380.
20	300.	320.	271. 8	303. 4	325.	346.8	326.8	350.	373.4	375.	400.
21	315.	336.	285. 9	318. 6	341.3	364.	343.	367.6	392.	393.9	420.
22	330.	352.	299.10	333. 8	357.6	381.4	359.4	385.	410.8	412.6	440.
23	345.	368.	313.11	348.10	373.9	398.8	375.8	402.6	429.4	431.3	460.
24	369.	384.	338.	361.	390.	416.	392.	420.	448.	450.	480.

LUMBER MEASUREMENT AT SIGHT, ONE INCH BOARD MEASURE.

For Plank, double or treble the Product as may be required. If a Board or Plank is longer or wider than the dimensions here given, add two suitable numbers together. The left hand column contains the length in feet; the width in inches heads each column.

Feet Long.	6 in W	7 in W	8 in W	9 in W	10 in W	11 in W	12 in W	13 in W	14 in W	15 in W	16 in W	17 in W	18 in W	19 in W	20 in W	21 in W	22 in W	23 in W	24 in W	25 in W
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
8	4 0	4 8	5 4	6 0	6 8	7 4	8 0	8 8	9 4	10 0	10 8	11 4	12 0	12 8	13 4	14 0	14 8	15 4	16 0	16 8
9	4 6	5 3	6 0	6 9	7 6	8 3	9 0	9 9	10 6	11 3	12 0	12 9	13 6	14 3	15 0	15 9	16 6	17 3	18 0	18 9
10	5 0	5 10	6 8	7 6	8 4	9 2	10 0	10 10	11 8	12 6	13 4	14 2	15 0	15 10	16 8	17 6	18 4	19 2	20 0	20 10
11	5 6	6 5	7 4	8 3	9 2	10 1	11 0	11 11	12 10	13 9	14 8	15 7	16 6	17 5	18 4	19 3	20 2	21 1	22 0	22 11
12	6 0	7 0	8 0	9 0	10 0	11 0	12 0	13 0	14 0	15 0	16 0	17 0	18 0	19 0	20 0	21 0	22 0	23 0	24 0	25 0
13	6 6	7 7	8 8	9 9	10 10	11 11	13 0	14 1	15 2	16 3	17 4	18 5	19 6	20 7	21 8	22 9	23 10	24 11	26 0	27 1
14	7 0	8 2	9 4	10 6	11 8	12 10	14 0	15 2	16 4	17 6	18 8	19 10	21 0	22 2	23 4	24 6	25 8	26 10	28 0	29 2
15	7 6	8 9	10 0	11 3	12 6	13 9	15 0	16 3	17 6	18 9	20 0	21 3	22 6	23 9	25 0	26 3	27 6	28 9	30 0	31 3
16	8 0	9 4	10 8	12 0	13 4	14 8	16 0	17 4	18 8	20 0	21 4	22 8	24 0	25 4	26 8	28 0	29 4	30 8	32 0	33 4
17	8 6	9 11	11 4	12 9	14 2	15 7	17 0	18 5	19 10	21 3	22 8	24 1	25 6	26 11	28 4	29 9	31 2	32 7	34 0	35 5
18	9 0	10 6	12 0	13 6	15 0	16 6	18 0	19 6	21 0	22 6	24 0	25 6	27 0	28 6	30 0	31 6	33 0	34 6	36 0	37 6
19	9 6	11 1	12 8	14 3	15 10	17 5	19 0	20 7	22 2	23 9	25 4	26 11	28 6	30 1	31 8	33 3	34 10	36 5	38 0	39 7
20	10 0	11 8	13 4	15 0	16 8	18 4	20 0	21 8	23 4	25 0	26 8	28 4	30 0	31 8	33 4	35 0	36 8	38 4	40 0	41 8
21	10 6	12 3	14 0	15 9	17 6	19 3	21 0	22 9	24 6	26 3	28 0	29 9	31 6	33 3	35 0	36 9	38 6	40 3	42 0	43 9
22	11 0	12 10	14 8	16 6	18 4	20 2	22 0	23 10	25 8	27 6	29 4	31 2	33 0	34 10	36 8	38 6	40 4	42 2	44 0	45 10
23	11 6	13 5	15 4	17 3	19 2	21 1	23 0	24 11	26 10	28 9	30 8	32 7	34 6	36 5	38 4	40 3	42 2	44 1	46 0	47 11
24	12 0	14 0	16 0	18 0	20 0	22 0	24 0	26 0	28 0	30 0	32 0	34 0	36 0	38 0	40 0	42 0	44 0	46 0	48 0	50 0
25	12 6	14 7	16 8	18 9	20 10	22 11	25 0	27 1	29 2	31 3	33 4	35 5	37 6	39 7	41 8	43 9	45 10	47 11	50 0	52 1
26	13 0	15 2	17 4	19 6	21 8	23 10	26 0	28 2	30 4	32 6	34 8	36 10	39 0	41 2	43 4	45 6	47 8	49 10	52 0	54 2
27	13 6	15 9	18 0	20 3	22 6	24 9	27 0	29 3	31 6	33 9	36 0	38 3	40 6	42 9	45 0	47 3	49 6	51 9	54 0	56 3
28	14 0	16 4	18 8	21 0	23 4	25 8	28 0	30 4	32 8	35 0	37 4	39 8	42 0	44 4	46 8	49 0	51 4	53 8	56 0	58 4
29	14 6	16 11	19 4	21 9	24 2	26 7	29 0	31 5	33 10	36 3	38 8	41 1	43 6	45 11	48 4	50 9	53 2	55 7	58 0	60 5
30	15 0	17 6	20 0	22 6	25 0	27 6	30 0	32 6	35 0	37 6	40 0	42 6	45 0	47 6	50 0	51 6	55 0	57 6	60 0	62 6
31	15 6	18 1	20 8	23 3	25 10	28 5	31 0	33 7	36 2	38 9	41 6	44 0	46 6	49 0	51 6	54 0	57 0	59 6	62 0	64 6
32	16 0	18 8	21 4	24 0	26 8	29 4	32 0	34 8	37 4	40 0	42 6	45 6	48 0	50 6	53 6	56 0	58 6	61 6	64 0	66 6
33	16 6	19 3	22 0	24 9	27 6	30 3	33 0	35 9	38 6	41 3	44 0	46 6	49 6	52 0	55 0	57 6	60 6	63 0	66 0	68 4
34	17 0	19 10	22 8	25 6	28 4	31 2	34 0	36 10	39 8	42 6	45 6	48 0	51 0	54 0	56 6	59 6	62 6	65 0	68 0	70 6
35	17 6	20 5	23 4	26 3	29 2	32 1	35 0	37 11	40 10	43 9	46 6	49 6	52 6	55 6	58 6	61 0	64 0	67 0	70 0	73 0
36	18 0	21 0	24 0	27 0	30 0	33 0	36 0	39 0	42 0	45 0	48 0	51 0	54 0	57 0	60 0	63 0	66 0	69 0	72 0	75 0

LUMBER AND LOG MEASUREMENT AT SIGHT.

Showing net proceeds (fractions of feet omitted) of Logs in 1 inch boards, deduction saw kerf and slabs. If the required dimension is not in the Table, unite two or three suitable numbers together. The length will be found in the left hand column and the diameter in inches on the head of the other columns.

L. Ft.	Diam. 10	Diam. 11	Diam. 12	Diam. 13	Diam. 14	Diam. 15	Diam. 16	Diam. 17	Diam. 18	Diam. 19	Diam. 20	Diam. 21	Diam. 22	Diam. 23	Diam. 24	Diam. 25	Diam. 26	Diam. 27	Diam. 28	Diam. 29	Diam. 30	Diam. 31	Diam. 32	Diam. 33	Diam. 34	Diam. 35	Diam. 36
10	23	31	40	50	62	75	90	105	122	140	160	180	202	225	250	275	302	330	360	391	422	456	490	526	562	601	640
11	25	34	44	55	69	83	99	116	135	154	176	198	223	248	275	302	333	363	396	430	465	502	539	578	619	661	704
12	27	37	48	61	75	91	108	126	147	169	192	217	243	271	300	331	363	397	432	469	507	547	588	631	675	721	768
13	29	40	52	66	81	98	117	137	159	183	208	235	263	293	325	358	393	430	468	508	549	592	637	684	731	781	832
14	32	43	56	71	88	106	126	148	171	197	224	253	283	313	350	386	433	463	504	547	591	638	686	736	781	841	896
15	34	46	60	76	94	113	135	158	184	211	240	271	303	336	375	413	453	496	540	586	633	683	735	789	844	901	960
16	36	49	64	81	100	121	144	169	196	225	256	289	324	359	400	441	484	530	576	625	676	729	784	842	900	961	1024
17	38	52	68	86	106	128	153	179	208	239	272	307	344	383	425	468	514	563	612	664	718	774	833	895	956	1021	1088
18	41	55	72	91	112	136	162	190	220	253	288	325	364	406	450	496	544	596	648	703	761	820	882	946	1012	1081	1152
19	43	58	76	96	119	143	171	201	232	267	304	343	384	429	475	523	574	630	684	742	803	865	931	999	1069	1141	1216
20	46	61	80	101	125	151	180	211	244	280	320	361	404	352	500	550	605	661	720	782	845	912	980	1052	1125	1202	1280
21	48	64	84	106	131	158	189	222	257	295	336	379	425	473	525	579	635	693	756	820	887	957	1029	1103	1181	1261	1344
22	50	67	88	111	137	166	198	232	269	309	352	397	445	496	550	605	665	726	792	860	930	1004	1078	1156	1238	1322	1408
23	52	70	92	116	144	174	207	243	281	323	368	415	465	519	575	632	695	760	828	898	972	1049	1127	1209	1295	1381	1472
24	54	74	96	122	150	181	216	254	294	338	384	433	486	541	600	662	726	794	864	938	1014	1094	1176	1262	1350	1442	1536
25	56	77	100	127	156	189	225	264	308	351	400	451	506	562	625	689	756	827	900	977	1056	1139	1225	1315	1406	1501	1600
26	59	80	104	132	163	196	234	274	318	366	416	370	526	586	650	716	786	860	936	1016	1098	1184	1274	1368	1462	1562	1664
27	61	83	108	137	169	204	243	285	330	380	432	488	546	606	675	744	826	893	972	1055	1140	1230	1323	1420	1518	1622	1728
28	63	86	112	142	175	212	252	296	342	394	448	506	566	626	700	772	866	926	1008	1094	1182	1276	1372	1472	1574	1682	1792
29	65	89	116	147	182	219	261	306	355	408	464	524	586	649	725	799	886	959	1044	1133	1224	1321	1421	1525	1631	1743	1856
30	68	92	120	152	188	226	270	316	368	422	480	542	606	672	750	826	906	992	1080	1172	1266	1366	1470	1578	1688	1802	1920
31	70	95	124	157	193	234	279	327	380	436	496	560	627	695	775	854	937	1026	1116	1211	1309	1412	1519	1631	1744	1862	1984
32	72	98	128	162	200	242	288	338	392	450	512	578	648	718	800	882	968	1060	1152	1250	1352	1458	1568	1684	1800	1922	2048
33	74	101	132	167	206	249	297	348	404	464	528	596	668	742	825	909	998	1093	1188	1289	1394	1503	1617	1737	1856	1982	2112
34	77	104	136	172	212	256	305	358	416	478	544	614	688	766	850	936	1028	1126	1224	1328	1436	1548	1666	1790	1912	2043	2176
35	79	107	140	177	219	265	315	369	428	492	560	632	708	789	875	964	1058	1159	1260	1367	1479	1594	1715	1841	1968	2102	2240
36	81	110	144	182	224	272	324	380	440	506	576	650	728	812	900	992	1088	1192	1296	1406	1522	1640	1764	1892	2024	2162	2304

TIMBER MEASUREMENT TABLE,

Showing the Cubical contents (fractions of feet omitted) of Round Logs, Masts, Spars, etc. Length of Log is shown in left hand column. Diameter is shown at the head of column. If the desired dimensions are not shown, double some numbers.

L.ft	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.
8	4	5	6	7	8	10	11	12	14	16	17	19	21	23	25	27	29	32	34	37	39	42	45	48	50	53	57	60
9	5	6	7	8	9	11	12	14	16	18	20	22	24	26	28	31	33	36	38	41	44	47	50	53	57	60	64	67
10	5	7	8	9	10	12	14	16	18	20	22	24	26	29	31	34	37	40	43	46	49	52	56	59	63	67	71	75
11	6	7	8	10	12	13	15	17	19	22	24	26	29	32	35	37	41	43	47	50	53	57	61	65	69	73	77	82
12	6	8	9	11	13	15	17	19	21	24	26	29	32	34	38	41	44	47	51	55	58	62	67	71	76	80	85	90
13	7	9	10	12	14	16	18	20	23	26	28	31	34	37	41	44	48	51	56	60	63	68	72	77	82	87	92	97
14	7	9	11	13	15	17	19	22	25	28	31	34	37	40	44	48	52	55	60	64	68	73	78	83	88	94	99	105
15	8	10	12	14	16	18	21	23	26	30	33	36	40	43	47	51	55	59	64	69	73	78	84	89	95	100	106	112
16	9	11	12	14	17	20	22	25	28	32	35	38	42	46	50	55	59	63	68	73	78	83	89	95	101	107	113	119
17	9	11	13	16	18	21	24	27	30	33	37	41	45	49	53	58	63	68	73	78	83	89	95	101	107	114	121	127
18	10	12	14	16	19	22	25	28	32	35	39	43	48	52	57	61	66	72	77	82	88	94	100	106	114	120	128	134
19	10	13	15	17	21	23	27	30	33	37	41	45	50	55	60	65	70	75	81	87	93	99	106	112	120	127	135	142
20	11	13	16	18	21	25	28	31	35	39	44	48	53	58	63	68	74	79	85	91	98	105	112	118	126	134	142	149
21	11	14	16	19	22	26	29	33	37	41	46	50	55	61	66	71	77	83	90	96	103	111	117	124	132	140	149	157
22	12	15	17	20	23	27	31	35	39	43	48	53	58	64	69	75	81	87	94	101	109	116	123	130	139	147	156	164
23	12	16	18	21	24	28	32	36	41	45	50	55	61	66	72	78	85	91	98	105	113	121	128	136	145	154	163	172
24	13	16	19	22	26	30	34	38	42	47	52	58	63	69	75	82	88	95	102	111	118	127	134	143	151	160	170	179
25	14	17	20	23	27	31	35	39	44	49	54	60	66	72	79	85	92	99	107	116	123	131	139	149	158	167	178	187
26	14	17	20	24	28	32	36	41	46	51	57	63	69	75	82	89	96	103	111	120	128	137	145	154	164	174	185	194
27	15	18	21	25	29	33	38	42	48	53	59	65	71	78	85	92	99	107	115	125	133	142	151	160	170	180	192	202
28	15	18	22	26	30	35	39	44	49	55	61	67	74	81	88	95	103	111	120	129	136	147	156	166	177	187	198	209
29	16	19	23	27	31	36	41	45	51	57	63	70	77	84	91	99	107	115	124	134	143	153	162	172	183	194	206	217
30	16	20	24	28	32	37	42	47	53	59	65	72	79	86	94	102	110	119	128	138	148	158	168	177	189	200	213	224
31	17	20	24	29	33	38	43	48	55	61	68	75	82	89	98	106	114	123	132	143	152	163	173	182	195	207	220	232
32	17	21	25	29	34	40	45	50	57	63	70	77	85	92	100	109	118	127	137	148	157	169	178	188	202	214	227	239
33	18	22	26	30	35	41	46	52	58	65	72	79	87	95	104	112	121	130	141	152	162	174	184	194	208	220	234	247
34	19	22	27	31	36	42	48	53	60	67	74	82	90	98	107	116	125	135	145	157	167	179	190	200	214	227	241	254
35	19	23	28	32	37	43	49	55	62	69	76	84	93	101	110	119	129	139	149	161	172	182	196	205	220	234	248	261
36	20	24	29	33	39	44	50	57	64	71	79	86	95	104	113	123	133	143	154	166	177	190	201	212	227	240	255	269

WOOD AND BARK MEASUREMENT AT SIGHT.

The Cord of Wood or Bark is 8 ft. long, 4 ft. high, and 4 ft. wide, as established by law in most of the States and the Dominion of Canada. If the Wood is 8 ft. long, double the Product. Fractions of feet are omitted in the Table. Price will be found heading the columns, number of feet in the left hand column.

Ft.	$1 50	$1 75	$2 00	$2 25	$2 50	$2 75	$3 00	$3 25	$3 50	$4 00	$4 50	$5 00	$5 50	$6 00	$6 50	$7 00	$7 50	$8 00
1	.01	.01	.01	.02	.02	.02	.02	.02	.02	.03	.03	.03	.04	.04	.05	.05	.05	.06
2	.02	.02	.03	.03	.04	.04	.05	.05	.05	.06	.07	.07	.08	.09	.10	.10	.11	.12
3	.03	.04	.04	.05	.06	.06	.07	.07	.08	.09	.10	.11	.13	.14	.15	.16	.17	.18
4	.05	.06	.06	.07	.08	.09	.09	.10	.10	.13	.14	.15	.17	.18	.20	.21	.23	.25
5	.06	.07	.08	.09	.10	.11	.12	.13	.13	.15	.17	.19	.21	.23	.25	.27	.29	.31
6	.07	.08	.09	.11	.12	.13	.14	.15	.16	.18	.21	.23	.25	.28	.30	.32	.35	.37
7	.08	.10	.11	.12	.14	.15	.16	.17	.19	.21	.24	.27	.30	.32	.35	.38	.41	.43
8	.09	.11	.12	.14	.16	.18	.19	.20	.21	.24	.28	.31	.34	.37	.40	.43	.46	.50
16	.19	.23	.25	.28	.31	.35	.37	.40	.43	.49	.55	.62	.68	.74	.81	.87	.93	1.00
24	.28	.33	.37	.42	.47	.52	.56	.61	.65	.75	.84	.93	1.03	1.12	1.22	1.31	1.41	1.50
32	.38	.44	.50	.56	.63	.69	.75	.81	.87	1.00	1.12	1.25	1.37	1.50	1.62	1.75	1.87	2.00
40	.47	.55	.63	.70	.78	.86	.94	1.02	1.09	1.25	1.40	1.56	1.72	1.87	2.03	2.19	2.34	2.50
48	.56	.66	.75	.84	.94	1.03	1.12	1.22	1.31	1.50	1.68	1.87	2.06	2.25	2.44	2.62	2.81	3.00
56	.61	.77	.88	.93	1.09	1.20	1.13	1.42	1.53	1.75	1.96	2.18	2.40	2.62	2.84	3.06	3.28	3.50
64	.75	.88	1.00	1.13	1.25	1.38	1.50	1.62	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
72	.84	.98	1.13	1.27	1.41	1.55	1.69	1.83	1.96	2.25	2.53	2.81	3.09	3.37	3.65	3.93	4.28	4.50
80	.94	1.09	1.25	1.41	1.56	1.72	1.88	2.03	2.18	2.50	2.81	3.13	3.43	3.74	4.06	4.37	4.68	5.00
84	.98	1.15	1.31	1.48	1.64	1.81	1.97	2.13	2.29	2.62	2.95	3.28	3.60	3.94	4.26	4.59	4.92	5.25
88	1.03	1.20	1.33	1.55	1.72	1.89	2.06	2.23	2.40	2.75	3.09	3.43	3.78	4.12	4.47	4.81	5.16	5.50
92	1.08	1.26	1.44	1.62	1.80	1.98	2.15	2.33	2.51	2.87	3.23	3.59	3.95	4.30	4.67	5.03	5.40	5.75
96	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.44	2.62	3.00	3.37	3.75	4.12	4.49	4.87	5.25	5.62	6.00
104	1.22	1.42	1.63	1.83	2.03	2.23	2.44	2.64	2.84	3.25	3.65	4.05	4.47	4.87	5.28	5.69	6.09	6.50
112	1.31	1.53	1.75	1.97	2.19	2.41	2.62	2.84	3.06	3.50	3.93	4.38	4.80	5.24	5.69	6.12	6.56	7.00
120	1.41	1.64	1.88	2.11	2.34	2.58	2.81	3.05	3.28	3.75	4.21	4.68	5.15	5.62	6.09	6.56	7.03	7.50
128	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.49	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00

Time Required for Digestion of different Articles of Food, being Observations made by Dr. Beaumont, Surgeon in the United States Army, on the Canadian, St. Martin, through an Orifice in his Stomach, caused by a Gunshot Wound.

Article	H.	M.
Apples, sweet and mellow	1	50
sour and mellow	2	
sour and hard	2	50
Barley, boiled	2	
Beans, boiled	2	30
Beans and Green Corn, boiled	3	45
Beef, roasted rare	3	
roasted dry	3	30
Steak, broiled	3	
boiled	2	45
boiled, with mustard, etc.	3	30
tendon, boiled	5	30
tendon, fried	4	
old salted, boiled	4	15
Beets, boiled	3	45
Bread, Corn, baked	3	15
Wheat, baked, fresh	3	30
Butter, melted	3	30
Cabbage, crude	2	30
crude, vinegar	2	
crude, vin'r, boil'd.	4	
	4	30
Carrots, boiled	3	15
Cartilage, boiled	4	15
Cheese, old and strong	3	30
Chickens, fricasseed	2	45
Custard, baked	2	45
Ducks, roasted	4	
	4	30
Dumplings, Apple, boiled	3	
Eggs, boiled hard	3	30
boiled soft	3	
fried	3	30
uncooked	2	
whipped, raw	1	30
Fish, Cod or Flounder, fried	3	30
Cod, cured, boiled	2	
Salmon, salt'd and boil'd	4	
Trout, boiled or fried	1	30
Fowls, boiled or roasted	4	
Goose, roasted	3	
Gelatine, boiled	2	30
Heart, Animal, fried	4	
Lamb, boiled	2	30
Liver, Beef's, boiled	2	
Meat and Vegetables, hashed	2	30
Milk, boiled or fresh	2	
	2	15
Mutton, roasted	3	15
broiled or boiled	3	
Oysters, raw	2	55
roasted	3	15
stewed	3	30
Parsnips, boiled	2	30
Pigs, Sucking, roasted	2	30
Feet, soured, boiled	1	00
Pork, fat and lean, roasted	5	15
recently salted, boiled	4	30
" " fried,	4	15
" " broiled	3	15
" " raw	3	
Potatoes, boiled	3	30
baked	3	20
roasted	2	30
Rice, boiled	1	
Sago, boiled	1	45
Sausage, Pork, broiled	3	20
Soup, Barley	1	30
Beef and Vegetables	4	
Chicken	3	
Mutton or Oyster	3	30
Sponge-cake, baked	2	30
Suet, Beef, boiled	5	30
Mutton, boiled	4	30
Tapioca, boiled	2	
Tripe, soured	1	
Turkey, roasted, Wild	2	18
Turkey, roasted, Domestic	2	30
boiled	2	25
Turnips, boiled	3	30
Veal, roasted	4	
fried	4	50
Brains, boiled	1	45
Venison Steak, broiled	1	35

Comparative Value of Various Foods as Productive of Dynamic Force, when Oxidized in the Body.

Cabbage	1.	Veal, lean	2.8	Pea meal	9.
Carrots	1.2	Mackerel	3.8	Wheat flour	9.1
Egg, white of	1.4	Ham, lean	4.	Arrowroot	9.3
Milk	1.5	Bread, crumbs	5.1	Oat meal	9.3
Apples	1.5	Egg, hard boiled	5.4	Cheese	10.4
Ale	1.8	Egg, yolk	7.9	Cocoa	16.3
Fish	1.9	Sugar	8.	Butter	17.3
Potatoes	2.4	Isinglass	8.7	Fat of beef	21.6
Porter	2.6	Rice	8.9	Cod liver oil	21.7

Safe Load in Structures, including Weight of Structure.

In cast-iron columns	= 1/4	breaking weight.
Wrought-iron structures	= 1/4	" "
In cast-iron girders for tanks	= 1/4	" "
In cast-iron for bridges and floors	= 1/6	" "
In timber	= 1-10	" "
Stone and bricks	= 1/8	" "

Weight of Water at its Common Temperature.

1	cubic inch	=	·03617	lb.
12	" inches	=	·434	"
1	" foot	=	62·5	lbs.
1	" "	=	6·25	Imperial gallons.
1	" "	=	7·50	U. S. Gallons.
1·8	" feet	=	112·00	lbs.
35.84	" "	=	2240·00	"
1	Cylindrical inch	=	·02842	"
12	" inches	=	·341	"
1	" foot	=	49·1	"
1	" "	=	5	Imperial gallons.
1	" "	=	6	U. S. gallons.
2·282	" feet	=	112	lbs.
45·64	" "	=	2240	"
11·2	Imperial gallons	=	112	"
224	Imperial gallons	=	2240	"
13·44	United States gallons	=	112	"
268·8	United States gallons	=	2240	"

Note.—5 Imperial gallons equal 6 United States gallons. Hence to convert Imperial gallons into United States gallons add *one-fifth* to the Imperial; and to convert United States gallons into Imperial gallons deduct *one-sixth* from the United States.

A cubic foot of rain water, which weighs 62⅓ lbs., presses at 30 feet deep 13 lbs. per square inch, and at 300 feet is 1,300 lbs. At 36 feet the pressure per square foot is a ton, and at 108 feet nearly 3 tons.

The following Tables show the different Values of the British Imperial and the United States Measures.

U. S. measure for wine, spirits, &c.		British (Im.) measure. galls.	qts.	pts.	gills
42 gals.	= 1 tierce, =	34	3	1	3
63	= 1 hogsh. =	52	1	1	3
126	= 1 pipe, =	104	3	1	3
252	= 1 tun, =	209	3	1	2

U. S. measure for ale and beer.		British (Im.) measure. galls.	qts.	pts.	gills
9 gals.	= 1 firkin, =	9	0	1	1
36	= 1 barrel, =	36	2	0	3
54	= 1 hogsh. =	54	3	1	1
100	= 1 butt, =	109	3	0	3

To convert Imperial Gallons into United States Wine Gallons multiply the Imperial by 1·2. To convert U. S. Gallons into Imperial multiply the U. States Wine gallons by ·833. 51 U. S. Ale Gallons equal 60 Imperial Gallons, therefore to convert one into the other add or deduct 1-60th.

Specific Gravities and Weights of Metals, Woods, Liquids, &c.

Engineers' and Contractors' Pocket Book.

METALS. Names.	Weight, water being 1000.	Number of cubic ins. in a lb.	Weight of a cubic inch in lbs.	STONES, EARTHS, ETC. Names.	Weight, water being 1000.	Weight of a cubic foot in lbs.	Number of cubic feet in a ton.
Platina	19500	1.417	.7053	Marble, average	2720	170.00	13
Pure gold	19258	1.435	.6965	Granite, ditto	2651	165.68	13½
Mercury	13560	2.038	.4904	Purbeck stone	2601	162.56	13¾
Lead	11352	2.435	.4105	Portland ditto	2570	160.62	14
Pure silver	10474	2.638	.3788	Bristol ditto	2554	159.62	14
Bismuth	9823	2.814	.3552	Millstone	2484	155.25	14½
Copper, cast	8788	3.146	.3178	Paving stone	2415	150.93	14¾
-- sheet	8910	3.103	.3225	Craigleith ditto	2362	147.62	15
Brass, cast	7824	3.533	.3036	Grindstone	2143	133.93	16¾
— sheet	8396	3.293	.3037	Chalk, British	2781	173.81	12¾
Iron, cast	7264	3.806	.263	Brick	2000	125.00	17
— bar	7700	3.592	.279	Coal, Scotch	1300	81.15	27½
Steel, soft	7833	3.530	.2833	— Newcastle	1270	79.37	28¼
— hard	7816	3.537	.2827	— Staffordsh'e	1240	77.50	29
Tin, cast	7291	3.790	.2636	— Cannel	1238	77.37	29
Zinc, cast	7190	3.845	.26				

Specific Gravities, &c. of Materials Continued.

Names.	Weight, water being 1000.	Weight of a cubic foot in lbs.	Number of cubic feet in a ton.
Lignum vitæ....	1331	83.31	26¾
Box, French....	1328	83.00	27
— Dutch.....	912	58.00	38½
Ebony, Indian..	1209	75.56	29½
— American	1331	83.18	27
Oak, just felled.	1113	69.56	32¼
— seasoned..	743	46.43	48¼
Bog oak of Irel'd	1046	65.37	34¼
Mahogany,Sp'sh	1063	66.43	33¾
— bay wood	637	39.81	56¼
Medlar tree.....	944	59.00	38
Logwood........	913	57.06	39¼
Olive tree.......	927	57.93	38½
Beech...........	852	53.25	42
Ash	845	52.81	42½
Alder	800	50.00	44¾
Apple-tree......	793	49.56	45¼
Plum-tree.......	755	47.18	47¼
Maple	752	47.00	47½
Teak............	750	46.87	48
Cherry-tree	715	44.68	50
Elm.............	673	42.06	53¼
Walnut..........	671	41.93	53½
Red pine........	657	47.06	54½
Yellow do.......	652	40.76	55
Pear tree	650	40.62	55
Sycamore, chestnut, and lime tree, each....	604	37.75	59¼
Willow.........	585	36.50	61¼
Poplar,white Sp.	529	33.06	67¾
— common..	383	23.93	93
Cedar..	561	35.06	64
White pine......	551	34.43	65
Larch............	530	33.02	68
Cork	240	15.00	149

Names.	Weight, water being 1000.	Weight of an imperial gallon in lbs.
Acid, sulphuric....	1850	18.5
— nitric...	1271	12 7
— muriatic.....	1200	12.0
— fluoric	1060	10.6
— citric.........	1034	10.3
— acetic...... .	1062	10.6
Water from Baltic	1015	10.2
— from the Dead Sea..........	1240	12.4
— from the Mediterranean...	1029	10.3
— from the Irish Channel	1028	10.2
— ice...........	1001	10.1
— distilled	1000	10.0
Oils, expressed		
linseed.........	940	9.4
sweet almond.	932	9.3
whale.........	923	9.2
hempseed.....	926	9.3
Olive..........	915	9.2
Oils, essential		
cinnamon....	1043	10.4
lavender......	894	8.9
turpentine....	870	8.7
amber.........	868	8.7
Alcohol of commerce, at 60° Fahrenheit	825	8.2
Alcohol, absolute...	797	7.9
Ether, nitric........	908	9.1
— muriatic.....	729	7.3
Proof spirit.........	922	9.2
Tar.................	1015	10.1
Vinegar, distilled..	1009	10.1

Expansion of Liquids in Volume from 32° to 212° Fahrenheit.

1000 parts of water	become	1046
" oil	"	1080
" mercury	"	1018
" spirits of wine	"	1110
" air	"	1373

The heat that would raise 1 lb. of water 1° would raise a pound of air 3°.7; 1 lb. air = about 11 cubic feet.

One pound of steam will raise 3657 cubic feet of air 10°, and cause it to expand from 32° to 42°, about 3733 cubic feet.

Permanent Loads on Bridges, &c.

For rough calculations the weight of the bridge itself may be assumed to be (in wrought iron bridges):

For 30 feet spans, single line	....	560 lbs.	per foot run.
" 60 " "	....	672	" "
" 100 " "	....	1,008	" "
" 150 " "	....	1,344	" "
" 200 " "	....	1,680	" "

Dense crowds average 120 lbs. per square foot.

For flooring, 168 to 224 lbs. per square foot, exclusive of the weight of the flooring, is generally allowed.

In storehouses, from 224 to 450 lbs. per square foot.

Strength of the Teeth of Cast Iron Wheels at a given Velocity.

Pitch of teeth in inches.	Thickness of teeth in inches.	Breadth of teeth in inches.	Strength of teeth in horse power at 3 feet per second.	4 feet per second.	6 feet per second.	8 feet per second.
3.99	1.9	7.6	20.57	27.43	41.14	54.85
3.78	1.8	7.2	17.49	23.32	34.98	46.64
3.57	1.7	6.8	14.73	19.65	29.46	39.28
3.36	1.6	6.4	12.28	16.38	24.56	32.74
3·15	1.5	6.	10.12	13.50	20.24	26.98
2.94	1.4	5.6	8.22	10.07	16.44	21.92
2.73	1.3	5.2	6.58	8.78	13.16	17.54
2.52	1.2	4.8	5.18	6.91	10.36	13.81
2.31	1.1	4.4	3.99	5.32	7.98	10.64
2.1	1.0	4.	3.00	4.00	6.00	8.00
1.89	.9	3.6	2.18	2.91	4.36	5.81
1.68	.8	3.2	1.53	2.04	3.06	3.08
1.47	.7	2.8	1.027	1.37	2.04	2.72
1.26	.6	2.4	.64	.86	1.28	1.84
1.05	.5	2.	.375	.50	.75	1.00

Teeth of Wheels.—Multiply one-fourth of the square of the pitch in inches by the breadth of the teeth in inches; the product is the horses' power that the teeth will transmit when the pitch line passes through 4 ft. per second.

In quick speeds or fractional pitches, it may be more convenient to take the following rule:—Multiply the square root of the pitch in inches by the breadth of the teeth in inches; the product is the horses' power at 16 ft. per second.

A general rule to ascertain the length of the teeth is, to take ⅓ of the pitch for the distance from the root to the pitch line, and ¼ of the pitch for the distance from the pitch line to the top.

When wheels drive pinions, let no pinion have less than 8 teeth; rather 11 or 12 if convenient.

When pinion drive wheels, let no pinion have less than 6 teeth; rather 8 or 9.

The number of teeth in a wheel should be prime to the number of teeth in its pinion.

To increase or diminish velocity in a given proportion, and with the least quantity of wheel-work, let the number of teeth on each pinion be to the number of teeth on its wheel as 1 : 3 59. Even to save space and expense, never let the ratio exceed 1 : 6.—Buchanan.

Hicks's Rule for Calculating the Strength of Shafts.—Multiply the horses' power by the assumed number (300), and divide the product by the revolutions per minute; the cube root of the quotient will be the diameter required.

Heating Power of Peat as Compared with Wood.

100 lbs. turfy peat, air dry, average...................... 95 lbs. pine wood.
" fibrous " " " .... 108 " "
" earthy " " " .... 104 " "
" pitchy " " " .... 111 " "

Comparison of Heat by Bulk.

100 cubic feet of turfy peat = 33 cubic feet pine wood in logs.
" " fibrous " = 90 " " "
" " earthy " = 145 " " "
" " pitchy " = 184 " " "

Peat, coal, or coke = 25 to 35 of the peat by weight.
" " " = 30 to 40 per cent. by volume.

Turf is 30 feet deep in upper marshes and it grows 30 inches in a century. In Hanover it grows 8 feet in 60 years. There are in many bogs 3 separated strata or layers of large trees separated by 10 or 12 feet of turf and heath. A carbonizing process gives them the appearance of being burnt. The bogs of Ireland cover 2,830,000 acres to the depth of 5, 12 and even 30 feet; the bogs are ascribed to the prevalence of shallow lakes, which promote the growth of mosses and aquatic plants.

BLOWING ENGINES.

Capacity of air vessels = 20 times the capacity of the blowing cylinder if the cylinder is single-acting.

" " = 10 times of double-acting.

Velocity of air in the passages should not exceed 35 feet per second. Density of blast for iron furnaces, from $2\frac{1}{2}$ to 3 lbs. per square inch.

Each smith's forge requires 150 cube feet of air per minute. Density of smith's forge blast $\frac{1}{4}$ lb. per square inch. Each ton per hour melted in cupola requires 3,500 cube feet per minute. Each finery forge requires 100,000 cube feet per minute for each ton refined. Each blast furnace 20 cube feet per minute for each cube yard capacity of furnace. *Molesworth.* *Manufacture of Pig Iron—Coke or Anthracite Coal*—18 to 20 tons of air are required for each ton.

Charcoal.—17 to 18 tons air are required for each ton. 1 ton of air at 34° = 29,751, and at 60° = 31,366 cubic feet.

Pressure.—The pressure ordinarily required for smelting purposes is equal to a column of mercury from 3 to 7 inches.

Pipes.—Their area, leading to the reservoir, should be ·2 that of the blast cylinder, and the velocity of the air should not exceed 35 feet per second.

A ton of pig iron requires for its reduction from the ore 310,000 cubic feet of air, or 5·3 cubic feet of air for each lb. of carbon consumed. Pressure, ·7 lb. per square inch.

An ordinary eccentric fan, 4 ft. diameter, with 5 blades 10 ins. wide and 14 ins. length, set 1 9-16 ins. eccentric, with an inlet opening of 17·5 ins. diameter, and an outlet of 12 ins. square, making 870 revolutions per minute, will supply air to 40 tuyeres, each of $1\frac{5}{8}$ ins. diameter, and at a pressure per square inch of ·5 inch of mercury.

An ordinary eccentric fan blower, 50 ins. diam., running at 1000 revolutions per minute, will give a pressure of 15 ins. of water, and require for its operation a power of 12 horses. Area tuyere discharge 500 square ins.—*Haswell.*

PROPERTIES OF FUEL.

Kind of Fuel.	Lbs. of water evaporated per pound.	Per cent. of carbon.	Cubic feet of air required for 1 lb. of coal.	Weight per cubic foot.	Cubic feet to stow 1 ton.
Bituminous Coal	7 to 9	80	265	50	44
Anthracite	8 to 10	92	282	54	40
Coke	8 to 10	86	245	31	72
Coke, Nat'l Virginia	8 to 9	80	260	48	48
Coke, Cumberland	8 to 10	80	250	32	70
Charcoal	5 to 6	96	265	24	104
Dry Wood	4 to 5	44	147	20	100
Wood, 20 per ct. water	4	34	115	25	100
Turf, dry (peat)	6	51	165	28	80
Turf, 20 per ct. water	5	40	132	30	75
Illuminating gas	13.8	..	194	0.37	29800
Oil, wax, tallow	14	77	200	59	37
Alcohol	9.56	58	154	52	42

MEMORANDA CONCERNING COAL AND IRON.

First notice of stone coal is B. C. 371.

The coal fields of England were the first practically developed.

First record of stone coal used in England was A. D. 820.

Records of regular mining in England first made in 1180.

Coal first used in London in 1240.

First tax laid on coal in England in 1379.

Tax was repealed in 1831, having been taxed 400 years.

First patent for making iron with pit coal was granted to Simeon Sturtevant, in 1612, but was not successful.

Iron first made in a blast furnace with pit coal with success by a Mr. Darby, of Colebrook Dale, England, in 1713.

On Coal, Steam Heating, Etc.

In 1747 iron was made in England with pit coal, suitable for the manufacture of cannon.

In 1788 the production of iron with pit coal in England was 48,300 tons; with charcoal, 13,000 tons.

In 1864 the production of iron in Great Britain was 5,000,000 tons.

Wooden rails in mines were used in 1777.

Cast-iron rails in mines were used in 1790.

Wrought-iron rails in mines were used in 1815.

Coal gas first made use of practically in 1798.

American Coal Fields.—First coal fields worked in America were the bituminous fields at Richmond, Va., discovered in 1750. This coal was used at Westham, on the James River, to make shot and shell during the War of Independence.

The first use of Anthracite coal was in 1768-69.

First used for smithing purposes in 1790.

First used to burn in a common grate in 1808.

First successful use of Anthracite coal for the smelting of iron was in 1839, at the Pioneer Furnace, at Pottsville, Pa. It had been tried on the Lehigh in 1826, but was unsuccessful.

The great shaft of the Philadelphia and Reading Iron Company has been sunk to a depth of 1,569 ft. from the surface to the great mammoth coal vein which attains a thickness of 25 feet, in that distance passing through no less than 15 coal seams, of which 6 are workable and have an average thickness together of 64 feet. Even then there are a number of coal seams underlying these.

Ventilation.

Each person requires at least from 3 to 4 cubic feet of air per minute. Ordinary windows allow about 8 cubic feet a minute to pass. Sleeping apartments require 1000 cubic feet of space to each occupant. An ordinary gas flame requires as much air as 9 persons.

Warming by Steam.

When the external temperature is 10° below freezing point, in order to maintain a temperature of 60° ; or,

One superficial foot of steam pipe for each 6 superficial feet of glass in the windows ; or,

One superficial foot of steam pipe for every 6 cube of air escaping for ventilation per minute ; or,

One superficial foot of steam pipe for every 120 feet of wall, roof, or ceiling ; or,

One square foot of steam pipe to 80 cubic feet of space ;

One cube foot of boiler is required for every 2,000 cube feet of space to be heated ;

One horse-power boiler is sufficient for 50,000 cube feet of space. Steam should be about 212°.—*Molesworth.*

As usually estimated, 1 square foot of pipe is amply sufficient to heat 75 to 80 cubic feet of air in exterior rooms, and 100 feet in interior rooms.

Thickness of Boiler Iron, and Pressure Allowed by United States Laws.

Pressure equivalent to the Standard for a Boiler 42 inches Diameter and 1/4 inch Thick.

Wire Guage	Thickness in 16ths.	Diameter in Inches.						
		34 ins.	36 ins.	38 ins.	40 ins.	42 ins.	44 ins.	46 ins.
No.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	5	169.9	160.4	152.	144.4	137.5	131.2	125.5
2	4 1/2	158.5	149.7	141.8	134.7	128.3	122.5	117.2
3	4 1/4	147.2	139.1	131.8	125.1	119.2	113.7	108.8
4	4	135.9	128.3	121.6	115.5	110.	105.	100.4
5	3 2/3	124.5	117.6	111.4	105.9	100.8	96.2	92.1
6	3 1/3	113.2	106.9	101.3	69.2	91.7	87.5	83.7
7	3	101.9	96.2	91.2	86.6	82.5	78.7	75.3

Notes on Strength of Boilers.

Boiler Plates and Bolts.—The tensile strength of iron plates and bolts ranges from 42,500 to 62,000 lbs. Mean tensile strength of copper plates, 33,000 lbs. up to 120° ; temperature at 220° = 32,000 lbs. ; at 550° = 25,000 lbs.

Bursting or Collapsing Pressures.—Iron plates should be based upon a strength 2-5 that of ultimate strength of the metal ; for use in salt water, at ½ that of its ultimate strength.

Resistance to collapse much less than to bursting.

Strength of Stay Bolts.—Of iron, for use in salt water, should be taken at 1-7 ; fresh water, 1-6 ; copper, 1-5 of ultimate tensile strength.

Stay-bolts, when screwed and riveted, are ⅓ stronger than when screwed alone.

Relative Strength of Riveted Joints per Square Inch of Single Plate.—Single-lapped, *machine riveted*, rivets 3 diameters, centre to centre, 25,000 lbs. ; *hand riveted*, 24,000 lbs. ; *staggered riveting*, and equidistant from centres, 30,500 lbs. ; *abut joints*, hand riveted—rivets not "*staggered*," and equidistant from centres—single cover or strip, 30,000 lbs. ; rivets set "*square*," single cover or strip, 42,000 lbs. ; double covers or strips, 55,000 lbs.

To Find Requisite Quantity of Water for a Boiler.

Add 15 to the pressure of steam per square inch, divide sum by 18, multiply the quotient by .24 ; product is quantity in U. S. gallons per minute for each horse-power.

To find Height of a Column of Water.

To Supply a Steam Boiler against any Pressure of Steam required.

Multiply pressure in pounds upon a square inch of boiler by 2.5 ; product will be height in feet above the surface of the water in boiler.

Cold Water and Feed Pumps.

The cold-water pump usually = diameter of cylinder × 0.3 when stroke = ½ stroke of engine.

The cold-water pump usually = diameter of cylinder × 0.42 when stroke = ¼ stroke of engine.

Velocity of water in pump passages should not exceed 500 feet per minute. Pump valves should not be of less area than ¼ area of the pump.

Feed Pumps for High Pressure Engines.

Diameter = 1-11 diameter of cylinder when pump's stroke = stroke of the engine.

Diameter = ⅛ diameter of cylinder when ½ stroke of the engine.

Diameter = ⅙ diameter of cylinder when ¼ stroke of the engine.

Feed Pumps for Condensing Engines.

Diameter = 1-11 diameter of cylinder when ½ stroke of the engine.

Diameter = ⅓ diameter of cylinder when ¼ stroke of the engine.

Depreciation of Machinery, etc.

Per annum on first cost.

	Depreciation.	Wear and Tear.	Total.
Engines	6 per cent.	3 per cent.	9 per cent.
Boilers	10 "	3 "	13 "
Machines	7½ "	3½ "	11 "
Millwork and Gearing	4 "	2½ "	6½ "
Bands and belts	— "	45 "	45 "

Iron Turning Tools.

Surface-bored should be at the rate of .... 78.54 feet per minute.
Surface turned " " .... 157.08 " "

Form of Iron-Cutting Tools.

To form and place any tool to cut any surface, let the end be so formed and placed as to make the least possible angle with the surface to be cut, and whatever degree of acuteness may be considered requisite ; let the keenness be given by hollowing out the surface on which the shavings slide.

Table for Foretelling the Weather through the Lunations of the Moon.

(Dr. Herschell and Adam Clarke.)

If the New Moon, the First Quarter, the Full Moon or the Last Quarter, enters—	In Summer.	In Winter.
Between midnight and 2 A. M.	Fair.	Hard frost, unless wind is S. or E.
Bet. 2 and 4 A. M.	Cold, fr't showers.	Snowy and stormy.
" 4 and 6 A. M.	Rain.	Rain.
" 6 and 8 A. M.	Wind and rain.	Stormy.
" 8 and 10 A. M.	Changeable.	Cold rain if wind is W., snow if E.
" 10 and 12 A. M.	Frequent showers.	Cold and high wind.
At 12 M. and 2 P. M.	Very rainy.	Snow and rain.
Bet. 2 and 4 P. M.	Changeable.	Fair and mild.
" 4 and 6 P. M.	Fair.	Fair.
" 6 and 8 P. M.	Fair if wind N. W., rainy if S. or S. E.	Fair and frosty if wind is N. or W., rain or snow if S. or S. E.
" 8 and 10 P. M.	Do.	Do.
" 10 and midnight	Fair.	Fair and frosty.

Observations.—1. The nearer the time of the moon's change, first quarter, full, and last quarter, is to *mid-night*, the fairer the weather during 7 following days. Range for this is from 10 at night till 2 next morning. 2. The nearer to *mid-day* the phases of the moon happen, the more foul or wet weather during the 7 days following. 3. The moon's change entering from 4 to 10 of the afternoon, may expect fair weather.

Force of the Wind.

Miles per Hour.	Feet per Minute.	Feet per Second.	Force in pounds per square foot.	Description.
1	88	1.47	.005	Hardly perceptible
2	176	2.93	.020	Just perceptible.
3	264	4.4	.044	
4	352	5.87	.079	Gentle breeze.
5	440	7.33	0.123	
10	880	14.67	0.492	Pleasant breeze.
15	1,320	22.	1.107	
20	1,760	29.3	1.970	Brisk gale.
25	2,200	36.6	3.067	
30	2,640	44.0	4.429	High wind.
35	3,080	51.3	6.027	
40	3,520	58.6	7.870	Very high wind.
45	3.960	66.0	9.900	
50	4,400	73.3	12.304	Storm.
60	5,280	88.0	17.733	Great storm.
70	6,160	102.7	24.153	
80	7,040	117.3	31.490	Hurricane.
100	8,800	146.6	49.200	

Loss of Light by Use of Shades.—*F. H. Storer.*

Glass, etc.	Th'k-ness.	Loss.	Glass, etc.	Th'k-ness.	Loss.
	Ins.	Pr Ct.		Ins.	Pr Ct.
American Enamelled	1-16	51.23	Window, d'ble, Eng	1-8	9.39
Crown	1-8	13.08	" " Ger.	1-8	13.
Crystal plate	1-8	8.61	" single, Ger	1-16	4.27
English	1-8	6.15	" " ground	1-16	65.75
Porcelain Transpar'cy.	1-3	97.68	" green	1-16	81.95

British Miscellaneous Measures for Various Purposes.

A load of unhewn timber	40 cubic ft.
A load of squared timber	50 "
A load of inch boards	600 sq. ft.
A load of two-inch planks	300 "
A hundred of deals	120 in num.
A hundred of nails	120 "
A thousand of bricks	1200 "
A load of bricks	500 "
A load of lime	32 bushels.
A load of sand	36 "
A sack of potatoes, or coals	224 lbs.
A bushel of salt or flour	56 "
A bushel of wheat	60 "
A bushel of barley	50 "
A bushel of oats	40 "

The Mile, as Measured by Various Nations.

The English mile is	1760 yds.
The Scotch "	1984 "
The Irish "	2240 "
The German "	8106 "
The Dutch and Prussian mile is	6480 "
The Italian mile is	1766 "
The Vienna post mile is	8296 "
The Swiss mile is	9153 "
The Swedish and Danish mile is	7341.5 "
The Arabian mile is	2143 "
The Roman mile is	1628 or 2025 "
The Werst "	1167 or 1337 "
The Tuscan "	1808 "
The Turkish "	1826 "
The Flemish "	6869 "

The British league, or three times our geographical mile of 60 to a degree, or 2025 yards, is 6075 yards. The Brabant league is 6096 yards. The Danish and Hamburg league 8244 yards, the German league 8101, the long German ditto, 10126 yards, the short do. 6859, the Portuguese league is 6760 yards, the Spanish 7416 yards, the Swedish 11700 yards. All of them parts of a degree, but made before the length of a degree was accurately determined.

To Test Quality of Steel.

Good tool steel, with a white heat, will fall to pieces; with bright red heat will crumble under the hammer; with middling heat may be drawn to a needle-point.

To test hardening qualities, draw under a low heat to a gradually tapered square point and plunge into cold water; if broken point will scratch glass, the quality is good.

To test tenacity, a hardened piece will be driven into cast-iron by a hardened hammer—if poor, will be crumbled. Excellence will be in proportion to tenacity in hard state. Soft steel of good quality gives a curved line fracture and uniform gray texture. Tool steel should be dull silver color, uniform, entirely free from sparkling qualities.

Aquafortis, applied to the surface of steel, produces a black spot; on iron the metal remains clean. The slightest vein of iron or steel can be readily detected by this method.

Steel Springs.

Rule 1st—To find elasticity of a given steel-plate spring: Breadth of plate in inches multiplied by cube of the thickness in 1-16 inch, and by number of plates; divide cube of span in inches by product so found, and multiply by 1.66. Result, equal elasticity in 1-16th of an inch per ton of load.

Rule 2d—To find span due to a given elasticity, and number and size of plate: Multiply elasticity in sixteenths per ton, by breadth of plate in inches, and divide by cube of the thickness in inches, and by the number of plates; divide by 1.66, and find cube root of the quotient. Result, equal span in inches.

Rule 3d—To find number of plates due to a given elasticity, span, and size of plates: Multiply the cube of the span in inches by 1.66; multiply the elasticity in sixteenths by the breadth of the plate in inches, and by the cube of the thickness in sixteenths; divide the former product by the latter. The quotient is the number of plates.

Rule 4th—To find the working strength of a given steel-plate spring: Multiply the breadth of plate in inches by the square of the thickness in sixteenths, and by the number of plates; multiply also the working span in inches by 11.3; divide the former product by the latter. Result, equal working strength in tons burden.

Rule 5th—To find span due to a given strength and number, and size of plate; Multiply the breadth of plate in inches by the square of the thickness in sixteenths, and by the number of plates; multiply, also, the strength in tons by 11.3, divide the former product by the latter. Result equal working span in inches.

Rule 6th—To find the number of plates due to a given strength, span, and size of plate: Multiply the strength in tons by span in inches, and divide by 11.3; multiply also the breadth of plate in inches by the square of the thickness in sixteenths; divide the former product by the latter. Result, equal number of plates.

The span is that due to the form of the spring loaded. Extra thick plates must be replaced by an equivalent number of plates of the ruling thickness, before applying the rule. To find this, multiply the number of extra plates by the square of their thickness, and divide by the square of the ruling thickness; conversely, the number of plates of the ruling thickness to be removed for a given number of extra plates, may be found in the same way.

LINEAL EXPANSION OF METALS.

Produced by raising their temperature from 32° to 212° Fahrenheit.

Zinc	1 part in	322	Gold	1 part in	682
Platinum	"	351	Bismuth	"	719
Tin (pure)	"	403	Iron	"	812
Tin (impure)	"	500	Antimony	"	923
Silver	"	524	Palladium	"	1000
Copper	"	581	Platinum	"	1100
Brass	"	584	Flint glass	"	1248
Falmouth tin	"	462	Soft rolled iron	"	819
English brass rod	"	528	Prism of cast iron	"	901
Brass wire	"	517	Reflector metal	"	517
Blistered steel	"	870	Refined silver	"	528

STAIR-CASES.

Width of Tread.	Height of Riser.	Width of Tread.	Height of Riser.
6 inches	$8\frac{1}{2}$ inches.	10 inches	$6\frac{1}{2}$ inches.
7 "	8 "	11 "	6 "
8 "	$7\frac{1}{2}$ "	12 "	$5\frac{1}{2}$ "
9 "	7 "	13 "	5 "

PAINTING.

1 gal.	priming color	will cover	59	superficial	yards.
1 "	white zinc	"	50	"	"
1 "	white paint	"	44	"	"
1 "	lead color	"	59	"	"
1 "	black paint	"	50	"	"
1 "	stone color	"	44	"	"
1 "	yellow paint	"	44	"	"
1 "	blue color	"	45	"	"
1 "	green paint	"	45	"	"
1 "	bright emer. green	"	25	"	"
1 "	bronze green	"	45	"	"

One pound of paint will cover about 4 superficial yards the first coat, and about 6 yds. each additional coat. One pound of putty for stopping every 20 yds. One gallon of tar, and 1 lb. pitch, will cover 12 yds. superficial the first coat, and 17 yds. each additional coat.

PAINTS, &c.—In addition to the very ample information to be found under the Painters Department, the following, transcribed from the ORDNANCE MANUAL, are given.

BOILED OIL.—Raw oil—1.3 parts, copperas—3·15 parts, litharge—6·3 parts, Put the litharge and copperas in a cloth bag and suspend in the middle of the kettle. Boil the oil $4\frac{1}{2}$ hours over a slow fire, then let it stand and deposit the sediment.

DRYINGS.—Mixture of copperas and litharge taken from the boiled oil 60 parts. Spirits turpentine 56 parts, boiled oil 2 parts.

PUTTY.—Spanish whiting, pulverized 81·6 parts, boiled oil 20·4 parts. Make into a stiff paste, if not intended for immediate use raw oil should be used.

WHITE PAINT.

	Inside work.	Outside work.
White lead, ground in oil	80	80.
Boiled oil	14.5	9.
Raw oil	...	9.
Spirits turpentine	8.	4.

New wood-work requires 1 lb. to the square yard for three coats.

LEAD COLOR.—White lead ground in oil 75 parts, lamp black 1 part, boiled linseed oil 23 parts, litharge 0·5 parts, Japan varnish 0·5 parts, spirits turpentine 2·5 parts. Lamp black and litharge are ground separately with oil, then stirred into the white lead and oil.

BLACK PAINT.—Lamp black 28 parts, litharge 1 part, Japan varnish 1 part, boiled linseed oil 73 parts, spirits turpentine 1 part.

GRAY OR STONE COLOR FOR BUILDINGS.—White lead in oil 78 parts, boiled oil 9·5 parts, raw oil 9·5 parts, spirits turpentine 3 parts, Turkey umber 0.5 parts, lamp black 0.25 parts. One square yard of new brick-work requires for 2 coats 1.1 lb., for 3 coats 1.5 lb.

PAINT FOR TARPAULINS.—1st. Olive. Liquid olive color 100 parts, beeswax 6 parts, spts. turpentine 6 parts. Dissolve the beeswax in spts. turpentine, with a gentle heat, and mix the paint warm. 2d. Add 12 ozs. beeswax to 1 gal, linseed oil, boil it two hours; prime the cloth with the mixture, and use it in the place of boiled oil for mixing the paint.

CREAM COLOR. (*For Buildings.*)

	1st coat.	2d coat.
White lead, in oil	66.66	70.
French yellow	3.33	3.33
Japan varnish	1.33	1.33
Raw oil	28.00	24.5
Spirits turpentine	2.25	2.25

One square yard of new brick-work requires for first coat, 0.75 lbs.; for second, 0.3 lbs.

CHEAP PAINT FOR SHEDS AND FENCES.—Melted pitch 6 lbs., linseed oil 1 pt., brick dust, or yellow ochre, 1 lb.

To the above we add the following valuable items :—

TO WATERPROOF AWNINGS.—Immerse first in solution containing 20 per cent. of soap, and repeat the process in a copper solution of equal strength, then wash and dry.

ANILINE INKS.—1. *Violet.* Dissolve 1 part of aniline violet blue in 300 parts of water. A beautiful ink. 2. *Blue Ink.* Dissolve 1 part of soluble Paris blue in 250 parts of water. 3. *Red Ink.* Dissolve 1 part soluble fuchsin in 200 parts boiling water.

INDIA OR CHINESE INK.—Calcined lamp black 100 parts. Boghead shale black, in impalpable powder, 50 parts; Indigo carmine in cakes, 10 parts; Carmine lake, 5 parts; Gum arabic (best quality) 10 parts; Purified ox-gall 20 parts; Alcoholic ext. of musk, 5 parts; Dissolve the gum in 50 to 60 parts of pure water, and filter through a cloth. The indigo, carmine, lake, lamp black, and shale black are mixed with the liquid and the whole ground on a slab with a muller like ordinary colors, but much longer. Now add the ox-gall and ext. of musk slowly, grinding well in. Next dry in the air away from dust, mould into cakes and dry again. When quite firm, compress into bronze moulds with any desired design, wrap up in tin foil and again in gilt paper. A splendid article.

TO DYE, STIFFEN AND BLEACH FELT HATS.—Felt hats are dyed by repeated immersion, drawing and dipping in a hot watery solution of logwood 38 parts, green vitriol 3 parts, verdigris 2 parts; repeat the immersions and drawing with exposure to the air 13 or 14 times, or until the color suits, each step in the process lasting from 10 to 15 minutes. Aniline colors may be advantageously used instead of the above. For a stiffening, dissolve borax 10 parts, carbonate of potash 3 parts, in hot water, then add shellac 50 parts, and boil until all is dissolved; apply with a sponge or a brush, or by immersing the hat when it is cold, and dip at once in very dilute sulphuric or acetic acid to neutralize the alkali and fix the shellac. Felt hats can be bleached by the use, of sulphuric acid gas.

LAUNDRY SECRETS.—A spoonful of ox-gall to a gallon of water will set the colors of almost any goods soaked in it previous to washing. A tea-cup of lye in a pail of water will improve the color of black goods. Nankin should lie in lye before being washed; it sets the color. A strong tea of common hay will preserve the color of French linens. Vinegar in the rinsing water for pink or green calicoes will brighten them. Soda answers the same end for both purple and blue. To bleach cotton cloth, take one large spoonful of sal-soda, one pound of chloride of lime, for thirty yards; dissolve in clean soft water, rinse the cloth thoroughly in cold soft water in order that the cloth may not rot. The above amount of cloth, with the bleaching compound may be whitened in from ten to fifteen minutes.

SUGGESTIONS TO ARTISANS.—Never consider time wasted that is spent in learning rudiments. In acquiring a knowledge of any art or handicraft the greatest difficulty is experienced at the beginning, because our work then possesses little or nothing of interest. Our first lessons in drawing, or music, or with tools, are very simple; indeed so simple are they that we are disposed to undervalue their importance. The temptation is to skip a few pages and begin further on in the book. But such a course is fatal to success. To learn principles thoroughly is to succeed. Be content to learn one thing at a time, whether it be to push a plane square and true, or draw a straight line. Whatever you learn, learn it absolutely, without possible question. This will enable you to advance steadily, step by step, year after year, and some day you will wonder why you have been enabled to distance the geniuses who once seemed so far in advance of you.

Set your heart upon what you have in hand. Valuable knowledge is acquired only by intense devotion. You must give your entire mind to whatever you undertake, otherwise you fail, or succeed indifferently, which is but little better than failure.

Learn, therefore, to estimate properly the value of what is called leisure time. There is entirely too much of this in the world. Do not mistake our meaning. Rest is necessary and play is well in its place, but young men who hope to do something in life must not expect to play one third of their time.

While you resolve to acquire a thorough knowledge of your art, be equally as anxious to know something beyond it. A craftsman ought to be ashamed of himself who knows nothing but the use of his tools. Having the time to acquire it, be careful to properly estimate the value of knowledge. Remember of what use it will be to you in ten thousand instances as you go along in life and be as conscientious in learning rudiments here as elsewhere. Learn to spell correctly, to write a good plain hand, and to punctuate your sentences.

Do not dress beyond your means; never spend your last dollar, unless for food to keep yourself or some one else from starving. You will always feel better to keep a little money in your pocket. At the earliest possible opportunity save up a few dollars and place the amount in a savings bank. It will serve as a magnet to attract other money that might be foolishly spent.

Just as soon as you can command the means, buy a piece of ground. Do not wait until you have saved enough to pay all down, but begin by paying one third or one quarter. Do not be afraid to go in debt for land, for it increases in value.

Marry as soon as you are able to support a wife and can find a good woman who is willing to accept you.—*The American Builder.*

In commending the above advice the editor would enterpose a salutary caution regarding the deposit of money in Savings Banks, while many successful business men, and other possessed of exuberant imagination say that there is no such word as fail, it is palpably manifest that the collapse of no less than *eleven* Savings Banks in New York and its vicinity during the past few months, has furnished ruinous proof to thousands of depositors that the contrary is the truth. In making deposits then, be sure that your savings are put in a *safe* place and that the integrity of the men to whom you intrust them is beyond question.

Miscellaneous Rules, &c., for Engineers, Mill-owners, Mechanics, &c.

GEARING A COMPOUND LATHE.—The term *Compound* or *double geared*, as applied to the screw-cutting gear of a lathe means that there exists, between the gear wheel which is fastened to and revolves with the lathe spindle and the feed screw, two gear wheels of different diameters and revolving side by side, at the same number of revolutions, by reason of being fixed upon the same sleeve or axis. The object of this arrangement is to make, between the speed at which the lathe mandril or spindle will run, and the speed or revolution at which the feed screw will run, a greater amount of difference than is possible in a single geared lathe, and thus to be able to cut threads of a coarser pitch than could be cut in the latter. This is usually accomplished by providing two intermediate wheels of different diameters, both being held by a feather in a sleeve revolving upon an adjustable pin for the purpose.

It is obvious that the smallest of these compounded or coupled wheels will gear into and with the wheel or gear on the feed screw; and that the changes of gear may be made upon the gear running on the lathe mandril and that running on the feed screw, without disturbing the pair of intermediate (and compounded) gears referred to. In many cases, however, only the wheel upon the feed screw need be changed, since a wide range of pitch may be obtained by changing that wheel only.

To find the number of teeth in the wheel required to be placed on the feed screw, we have the following rule:

Divide the pitch to be cut by the pitch of the feed screw, and the product will be the proportional number. Then multiply the number of teeth on the lathe mandril gear by the number of teeth on the smallest gear of the compounded pair, and the product by the proportional number, and divide the last product by the number of teeth in the largest wheel of the compounded pair, and the product is the number of teeth for the wheel on the feed screw.

Suppose, for example, the gear on the lathe mandril contains 40 teeth running into the largest of the compounded gears which contains 50 teeth, and that the small gear of the compounded pair contains 15 teeth; what wheel will be required for the feed screw—its pitch being 2, and the thread requiring to be cut being 20?

Pitch required.		Pitch of feed screw.		Proportional number.
20	$\div$	2	$=$	10

Then—

Mandril gear teeth.		Small compound gear.		Proportional number.		Large compound gear.			
40	$\times$	15	$\times$	10	$\div$	50	$=$	120	$=$ the number of

teeth required upon the wheel for the feed screw. In the above example, however, all the necessary wheels except one are given; and since it is often required to find the necessary sizes of two of the wheels, the following rule may be used:

Divide the number of threads you wish to cut by the pitch of the feed screw, and multiply the quotient by the number of teeth on one of the driving wheels, and the product by the number of teeth on the other of the driving wheels; then any divisor that leaves no remainder to the last product is the number of teeth for one of the wheels driven, and the quotient is the number of teeth for the other wheel driven.

[In this rule the term "wheel driven" means a wheel which has motion imparted to it, while its teeth do not drive or revolve any other wheel; hence the large wheel of the compounded pair is one of the wheels driven, while the wheel on the feed screw is the other of the wheels driven.]

Example.—It is required to cut 20 threads to the inch, the pitch of the feed screw being 2, one of the driving wheels contains 40 teeth and the other 15 :

Pitch required to be cut.		Pitch of feed screw.		Teeth in one driving wheel.		Teeth in other driving wheel.		
20	÷	2	×	40	×	15	=	6000.

Then, $6000 \div 50 = 120$; and hence one of the gears will require to contain 50 and the other 120 teeth ; if we have not two of such wheels, we may divide by some other number instead of 50.

Thus : $6000 \div 60 = 100$; and the wheels will require to have, respectively, 60 and 100 teeth.

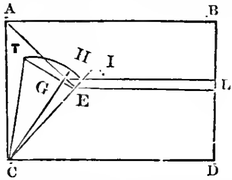
If there are no wheels on the lathe we proceed as follows :

Divide the pitch required by the pitch of the feed screw ; the quotient is the proportion between the revolutions of the first driving gear and the feed screw gear.

Example. Required the gears to cut a pitch of 20, the feed screw pitch being 4 ; here $20 \div 4 = 5$; that is to say, the feed screw must revolve five times as slowly as the first driving gear ; we now find two numbers which, multiplied together, make five : as $2\frac{1}{2} \times 2 = 5$; hence one pair of wheels must be geared $2\frac{1}{2}$ to 1 and the other pair 2 to 1, the small wheel of each pair being used as drivers, because the thread required is finer than the feed screw. *Rose's Complete Practical Machinist, H. Carey Baird & Co., Philadelphia.*

HIPPED ROOFS, MILL HOPPERS, &C.

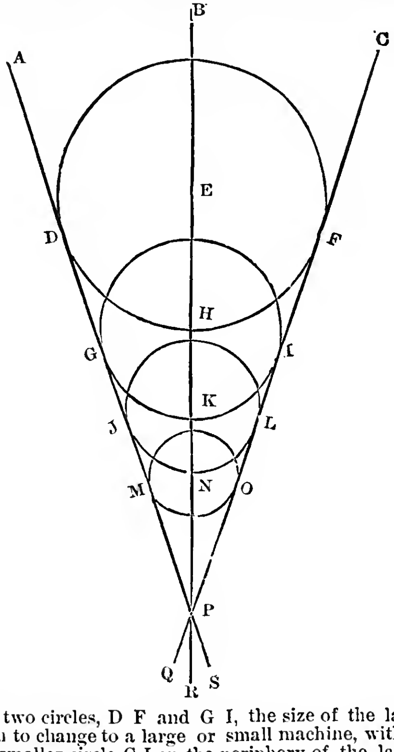
To find the various Angles and proper Dimensions of Materials whereby to construct any figure whose form is the Frustrum of a proper or inverted Pyramid, as Hipped Roofs, Mill Hoppers, &c.



A B C D represents the desired size of plan for a roof, E T represents the height ; draw the line A E to meet the apex or ridge E K on plan ; from E, at right angles with C E and equal to the designed height draw the line E T then the line T C, equal the length of the struts or corners of the roof ; from C, with the distance C F, draw the arc T H, continue the diagonal C E until it cuts the arc E H, through which, and parallel with the apex E K, draw the line I L, which determines the required breadth for each side of the roof : from C, meeting the line I L, draw the line C G, or proper angle for the end of each board by which the roof might require to be covered, and the angle at T is what the boards require to be made in the direction of their thickness, when the corners or angles require to be mitred.

To Compute the Number of Revolutions of a Pinion or Driven when the Number of Revolutions of Driver and the Diameter or the Number of Teeth of Driver and Driven are given.—Multiply the number of revolutions of driver by its number of teeth or its diameter, and divide the product by the number of teeth or the diameter of the driver.

PROPORTION OF CIRCLES.—To assist machinists in enlarging or reducing machinery wheels without changing their respective velocities.



First, lay off two circles, D F and G I, the size of the largest wheels which you wish to change to a large or small machine, with the central point H of the smaller circle G I on the periphery of the largest circle D F: then describe two lines Q C and S A tangent to the circles as shown in diagram, then draw the line R B through their centres; now if you wish to reduce the machine outline a circle of the size you wish to reduce it to; if, say, one-half, have the centre K one-half the distance from E to P and lay off the circle J L, and on its periphery N as a centre lay off a circle M O with their peripheries touching the tangent lines Q C and S A, as shown in diagram. This will make the circle J L one-half the size of the circle D F, and the circle M O one-half the size of the circle G I; leaving J L and M O in the same proportion to each other as D F and G I.

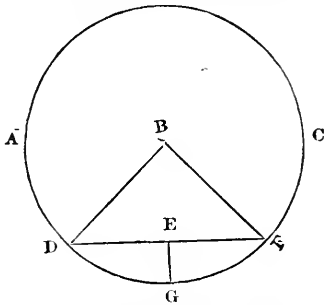
To reduce one-third, have the centre K one-third the distance from E to P; if one-fourth, have the centre K one-fourth the distance from E to

P, &c. This reckoning may be applied beyond the centre E for enlarging machine wheels, and will enable the mechanic to make the alteration without changing their respective velocities.

To Compute the Diameter of a Pinion when the Diameter of the Driver, and the number of Teeth in Driver and Driven are given.—Multiply the diameter of driver by the number of teeth in the pinion and divide the product by the number of teeth in the driver, and the quotient will be the diameter of pinion.

To Compute the Number of Revolutions of a Driver, when the revolutions of Driven and Teeth or Diameter of Driver and Driven are given.—Multiply the number of teeth or the diameter of driven by its revolutions and divide the product by the number of teeth or the diameter of driver.

To Compute the Number of Teeth in each Wheel for a Train of Spur Wheels, each to have a given Velocity.—Multiply the number of revolutions of the driving wheel by its number of teeth, and divide the product by the number of revolutions each wheel is to make to ascertain the number of teeth required for each.



To find the Circumference of any Diameter.—From the centre B describe the circle A C G, with the desired diameter; next place the corner of the square at the centre B, and describe the lines B D and B F; then draw the chord D F; three times the diameter added to the distance from the centre of the chord D E F to the middle of the subtending arc D G F, will be circumference desired.

To find the Circumference of a Circle, or of a pulley.—Multiply the diameter by 3·1416, or as 7 is to 22 so is the diameter to the circumference.

The *areas of circles* are to each other as the squares of their diameters, and a circle contains a greater area than any other plain figure bounded by an equal outline.

To Compute the area of a circle.—Multiply the circumference by one quarter of the diameter; or multiply the square of the diameter by ·7854; or multiply the square of the circumference by ·07958; or multiply half the circumference by half the diameter; or multiply the square of half the diameter by 3·1416

TO FIND THE CIRCUMFERENCE OF AN ELLIPSE.

Rule.—Multiply half the sum of the two diameters by 3·1416, and the product will be the circumference.

Example.—Suppose the longer diameter 6 inches and the shorter diameter 4 inches, then 6 added to 4 equal 10, divided by 2 equal 5. multiplied by 3·1416 equal 15·7080 inches circumference.

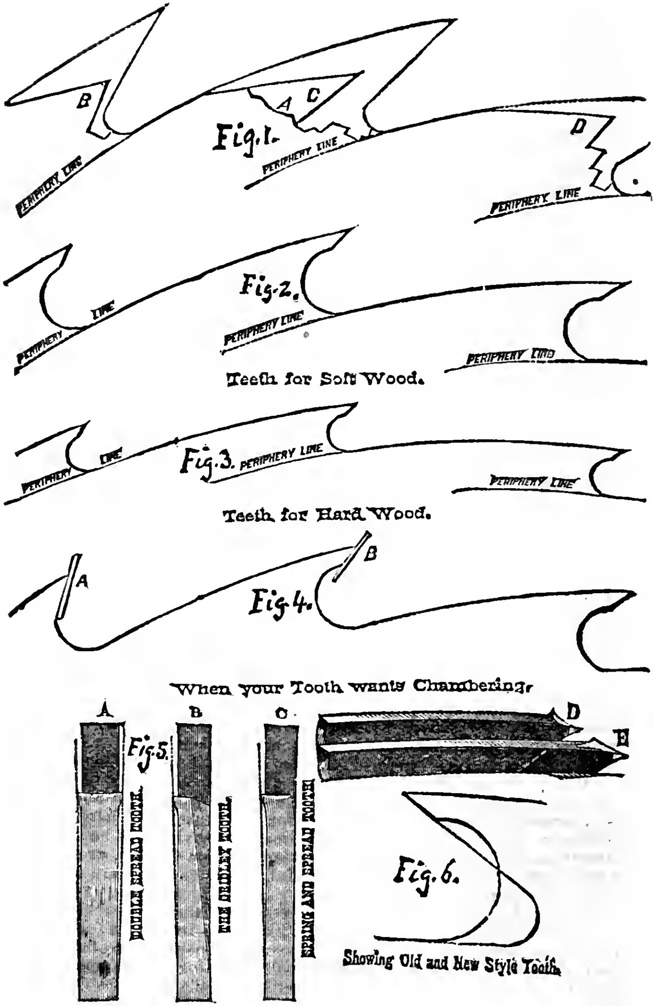
POWER AND CAPACITY OF SAW MILLS, SAW FILING, &c.—As a rule it is admitted by mill-men that for 10,000 ft. per day about 20 horse-power is required ; for 20,000 ft., 30 horse-power ; and for 30,000 ft. 40 horse-power. To secure these results it is indispensable that the operator should make sure of having a good mill and intelligent first class workmen to run it. In hanging the saw, see that the mandril fits accurately in the boxes, so that it will run without heating. When flat collars are used, the steadying pins should be made with a shoulder, as where any other form of pin is used it often happens that a burr or bunch is raised at the corner where the pin enters the collar. Both saw and collar should be tested with a straight edge ; it frequently happens in turning collars that through the lightness or springing of the tool, irregularities in the grain of the iron, &c., the work may not be perfectly true, and in this case the utmost care should be taken to ascertain and correct the deficiency, if any exists, by applying, before the mandril is taken from the lathe, a fine file of just the proper spring, against the face of the collars in order to remove any uneven surfaces that may have been left upon them. If they are not perfectly true, apply a pair that are so, independent of the mandril collars, and so rigid that screwing up the collars cannot act upon or impair the saw.

The saw being tested and found correct, place it on the mandril and tighten up the collars by hand, slowly revolving the saw at the same time, and if it proves to be truthfully hung, screw it home with a wrench tight, and test again with straight edge to see if all is right, revolving the saw and observe closely whether it runs true or not. For large saws a high authority recommends collars that have a perfect bearing of about ½ in. on the outer rim, the other part clear, as they hold tighter than a solid, flat-faced collar, because they are more apt to come fair against the saw.

To correct saws out of round, hold a piece of grindstone or cobblestone against the points of the teeth while the saw revolves, this will grind down the most prominent teeth ; or the longest teeth may be marked with red chalk while the saw is in motion, and afterwards filed down.

The following figures will afford valuable aid to the operator. In fig. 1 the teeth represented by the dotted lines show the teeth as the saw leaves the factory ; the lines at B,C, and D show the condition to which they are frequently reduced by bad filing. These defective teeth contain no chamber for the circulation of saw dust, and teeth filed with sharp, square corners at the bottom frequently break, as shown at A, tooth C. This kind of filing is most destructive to both saw and files, and requires at least double the power necessary to operate a saw with teeth of the proper shape. For good work it is absolutely essential to file back to the periphery line, and the best work will be done, the least labor expended, and less power will be required to operate, when the shape of the teeth is made to conform to the patterns illustrated by Figs. 2 and 3, which also represent the forms best adapted for sawing soft and hard wood respectively. In filing circular saws, an immense saving will be effected by filing from the face or under side, instead of from the top, or upper part of the tooth, as in the former case the full diameter of the saw is retained to a much greater extent.

Fig. 4, at A, represents a tooth that requires gumming, or chambering out in proper shape, as shown at D. This leaves free scope for the dust, without too much crowding, and the useless consumption of power. A good gummer is an article that no sawyer can afford to dispense with, it saves much valuable time and heavy outlay for files, besides doing more rapid and much better work. A good swage or upset is equally important for the purpose of bringing the teeth of the saw to a sharp, keen edge,



DIAGRAMS TO ILLUSTRATE SAW-FILING.

bringing up corners and vacancies occasioned by wear, and spreading the points, so as to ease the body of the saw in passing through the log. Fig. 5, at A, B, C, D, and E, exhibits the different set required for saw teeth as effected by the swage; the dotted lines show the undercut, and Fig. 6 shows the old and new style tooth. Fig. 7, at C, represents the con-

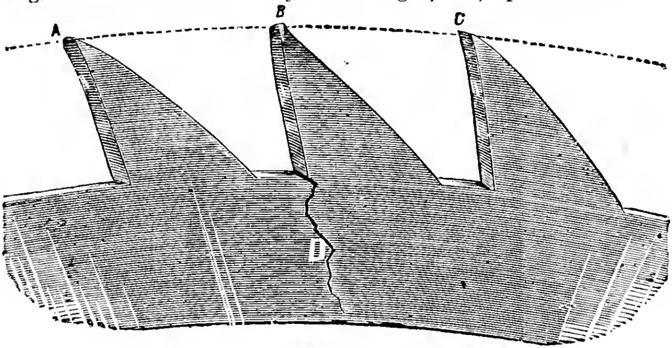


FIG. 7.

dition the tooth should be in for work. Point B shows a tooth that is dull, and a great many teeth are broken, as shown at D, from this very cause. The tooth of a 24 inch circular saw passes through the log 2000 times per minute, 120,000 times per hour, or 1,200,000 times per day, impelled by a tremendous force through knots, &c., and if not kept sharp

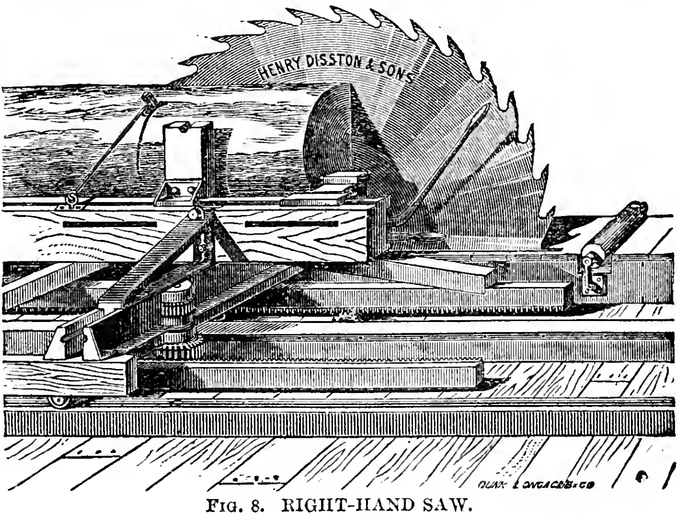


FIG. 8. RIGHT-HAND SAW.

the severe strain is bound to break the teeth. If the teeth were kept properly set and well filed the work would be performed in better shape with half the power. Figs. 8 and 9 represent right and left hand saws, and a very slight inspection of the cuts will enable any person to observe a most important distinction in ordering circular saws. In operating the mill, avoid the use of short bearings for the mandril, and short, tight belts, these, together with the mandril crowding against the collar, are apt to cause heating. A long, free belt, with long bearings, and a saw cutting freely, will give the best results in every case.

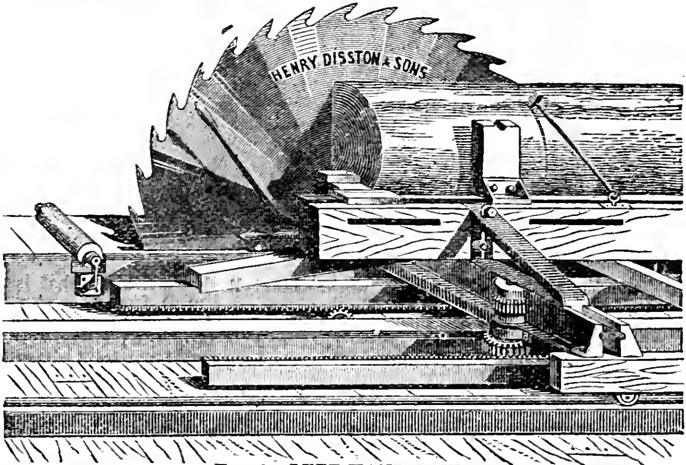


FIG. 9. LEFT-HAND SAW.

The improved pattern of saw teeth, &c., outlined above, is the form originated and commended by the celebrated saw manufacturing firm of Henry Disston & Sons, of Philadelphia, and is the result of the anxious study, experience, and careful labor of many years. The high standing of the firm, together with the excellent reputation of their goods, furnish a sufficient guarantee that every improvement introduced by them will be found based on correct principles.

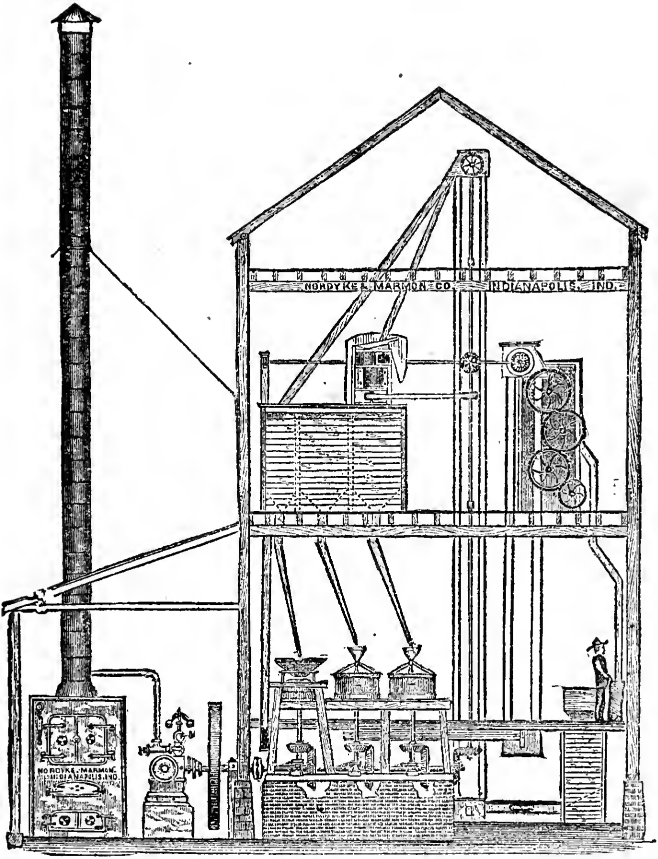
SAW MILL.—*Two Vertical Saws of 34 in. Stroke, Lathes, &c.* Cylinder 10 ins. diam. by 4 ft. Stroke. *Pressure* 90 to 100 lbs. per square in., full stroke. *Revolutions*, 25 per minute. *Boilers*, three plain cylindrical, 30 ins. in diam. by 20 ft. in length.

NOTE. This engine has cut of yellow pine, 30 ft. by 18 ins. in one minute, *Engineers & Contractors Pocket-Book.*

For further information on Saw mills, see page 87.

WEIGHT OF LUMBER PER THOUSAND (M.) FEET BOARD MEASURE.

	DRY.	PARTLY SEASONED.	GREEN.
Pine and hemlock............	2,500 lbs.	2,700 lbs.	3,000 lbs.
Norway and yellow pine.......	3,000 "	4,000 "	5,000 "
Oak and Walnut..............	4,000 "	5,000 "	
Ash and Maple................	3,500 "	4,000 "	



SECTIONAL VIEW OF A COMPLETE FLOUR MILL.

The above cut, from the *Mill Stone*, published by the well known mill furnishing firm of Nordyke & Marmon Co., of Indianapolis, Ind., affords a sectional view of a complete flour mill with a three run outfit, two runs for wheat, and one run for corn.

THE NEW PROCESS OF MILLING, HIGH-GROUND AND PATENT FLOUR, ETC.—In considering this important subject, John W. Hopkins writes to the MILL STONE as follows :—The new process means a first-class steam engine, grinding the flour and heating the mill on a cent's worth of coal to the bushel of wheat, taking the wheat from the car on the side line and never touching it by manual labor until the flour barrels are taken from the packer, instead of the shovelling and sweating which was and still is in vogue in some places.

Where water power is used instead of steam, the new process means the use of turbine wheels, giving over 80 per cent. of the full power of the water, instead of the old breast wheel giving only 50; the boss going into a nice warm mill on a frosty winter morning and finding every thing going right, instead of going into an ice-bound mill of the old breast-wheel style, with a couple of half starved youths trying to cut her loose and knock her to pieces at the same time.

The new process means nicely turned iron shafting and pulleys, with belt gearing, in place of wooden shafts and cog gearing, with two or three old millwrights slashing around with sledge hammers to keep them wedged, and assisted occasionally by two or three millers making frantic efforts to start the break downs. It also means closely jointed old stock burrs, and plenty of them—36 inches in diameter for middlings, and from 42 to 48 inches for wheat, according to the hardness or softness of the wheat—all in perfect balance and true smooth face, and the lands thereof to be from one-third to one-fourth of the whole surface of the burrs, instead of one-half as in by-gone times. It does not, however, mean any particular patent dress, the common equalizing dress is good enough ; but it does mean that the furrows shall be smooth and straight in all directions, not less than two inches broad and deep enough at the eye to bury the largest grain of wheat, and about the fourth of that at the skirt, the draft of the feather edge to be one inch to the foot in diameter of the burr, and all furrows of the same kind to bear the same relation to the centre and circumference, and also that the miller shall have the power and means to alter the speed of any run without affecting the remainder, *i. e.* speed to be altered instead of draft.

To mill under the new process means that the chop shall roll instead of slide between the burrs, or, in other words, the substitution of a system of granulation in place of grinding.

We know a millwright who was lately called to reconstruct the bolting machinery of a considerable merchant mill. Upon mentioning the word purifier, the head miller in charge of the mill gave a jump as if he had received a mild stroke from a galvanic battery. "I want," says he, "nothing but fine cloths, and plenty of them, Nos. 12, 14 and 16," to which I would only say that it must follow, as a matter of course, that if you grind so close as to grind a fourth of the bran into powder, it will require fine cloths to take it out, and even they will fail to do it perfectly, whereas if the grinding is properly done, XX, 10, and 12, will be the thing.

We come now to the middlings—the large particles which have withstood the action of the burrs most, and which have at the same time the highest specific gravity and the greatest bulk. They must be separated from the very light, dead fine brown dust (which is principally pulverized bran, insoluble in the acids of the stomach), the first would not go through the superfine cloths, on account of their bulk, neither would the latter, on account of their lightness. They must, however, not only be separated, but also graded, and while this is almost impossible of accomplishment with cloths alone, it is rendered comparatively easy by the use of cloths and blast combined, and therefore the necessity of the purifier. I do not refer to any particular make or patent in the way of purifiers, as there are several good ones in the market, and any number of poor ones, but whatever kind is used should have capacity enough, and do their work well.

The old process or system that required a man to jump on the burrs every twenty-four or twenty-six hours and slash them all over with a pick so as to make them cut up 15 bushels of wheat an hour, and make 24 bushels of flour to the 100 bushels of wheat, is fast becoming obsolete.

The idea of making such flour either for home consumption, or to ship to foreigners, is played out; the foreigners, in particular, have stopped buying such flour, and want the wheat instead to grind for themselves. Instead of this old-time system it is now required of the miller that the face of the burrs shall be smooth and true, and if any high places develop themselves they must be gently touched by the hand of a master either with pick, diamond, or emery wheel, and not more than six bushels an hour should be ground on a pair of burrs, and this should be ground cool or not at all. Moreover, it should be ground high enough to take off a broad, clean bran, and to make one half middlings, and finally last, though not least, the substitution of the new process, as herein delineated in outline, means to realize 20 cents per bushel more out of the wheat than by the old style, and a showing of a good and satisfactory balance on the right side of the ledger at the end of the year. At least such is the new process or high-grinding system, as I understand it.

FAST AND SLOW GRINDING. VALUABLE ADVICE TO MILLERS. On this all important subject, J. M. Truax, a practical miller, writes to the *Mill Stone* as follows :—"The quantity to be ground must depend upon the texture or density of the stone, the draft, the number and depth of furrows, and the grinding without heating. No more grinding should be done than can be done without heating. The heating is the stopping spot. The quantity that every mill ought to grind is that quantity that can be ground and not heat, whether it is 5, 10, or 20 bushels per hour. If every miller will observe this as his guide, he will do the best work that he is able to do.

In speaking of heating, I mean to say that the grain should not be so heated by pressure or rubbing, as will start the juice or essential oils of the grain. If the grain oil is started by friction, that friction produces heat, and that heat dries and evaporates the grain juice, and the virtue of the flour is impaired. Any amount of cooling will not repair the damage done by heating. The steam that rises from the hot running mill is the vapor from out of the essential oils of the grain, and is lost in the bread. To recommend the grinding of 10, 15 or 25 bushels of wheat per hour, is bad advice, imprudent. Millers differ in the selection of stones, and differ about their dress, and the motion of their mill. One will have one kind and way, and another another kind and way; but whatever way they select, when they go to grinding, their quantity per hour should be that which they can grind and not heat, whether it is 3, 5, 10 or 20 bushels per hour. Do not impair the substance for the bulk per hour. Blood heat is as high as can be warranted without impairing the product. It may be an ambition to grind fast, but an old adage is "haste makes waste." If millers are ambitious, let that ambition be applied to the making of a perfect running mill. Select the very best burrs, and put in a thoroughly common sense dress; a dress that will granulate the whole kernel as nearly as possible. Keep the stones as far apart as possible, and keep the texture or grain of the stones clean. Let this be the miller's ambition. But stop adding to quantity when the mill is at blood heat, and as much less heat as they are able to, and let the bread makers and eaters have in the flour all the virtue that mother earth has produced.

One of the great evils in milling is low grinding, and its evil effects are only second to those produced by fast grinding. Wheat is composed of two parts—an inner and an outer part. The inner part is meaty, and the outer is a shuck, or skin, or hull; the meaty is pulverizable, while the hull or covering is a leather-like substance, and has thickness, which thickness equals the meshes of No. 14 or 15 bolting cloth. Now, the question arises, how shall the miller grind this compound kernel and clean this leather-like covering, and granulate the inner meat to a proper fineness for bread purposes, and not over rub or grind to dust a part of the hull? This is the question. And how is wheat being ground all over the world to-day? I need not answer, for all know that heavy grinding has been the order. The lands or face of one burr rubs the other, or nearly so. So much so that that portion of the bran that is caught between the face of the mill near the skirt is more than twice overground, and this overgrinding or rubbing the bran makes a brown dust, and blackens the flour. It is like brown paint, and bolts with the flour and goes into the bread.

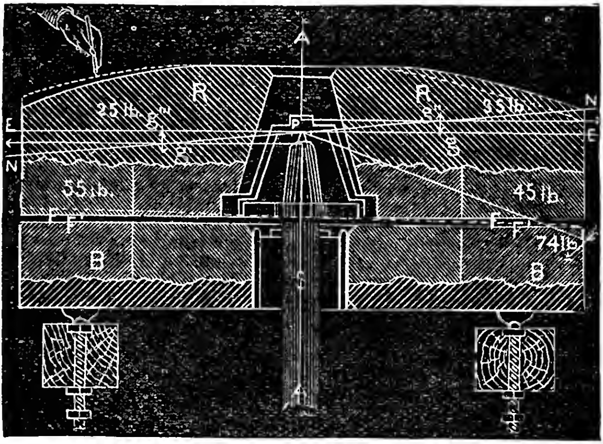
This is a mistake, and should be avoided. Bran may make bread, but not the bread millers feel proud of. And to avoid this, millers must run a lighter mill. Heavy grinding is an evil. It not only powders a portion of the bran and blackens the flour; but grinds at the same time a portion of the kernel to dust; also destroying its juicy substance; and at the same time the fine ground dust is rubbed into the texture of the stone, and the face of the stone becomes glazed and smooth, and of course dull.

Millers, so dress your mill as will enable you to grind the inner part of the kernel to flour, and avoid making brown paint dust from the bran. A miller that runs a heavy mill is likely to look for a medicine to doctor his flour. Medicine for flour is a poor substitute for a good dress and clean stones. Bread eaters much prefer the full life of the cereals, not a doctored article. Grain once killed by overgrinding and heating will not be brought to life by the best medicines. All the flour-doctors in the world can not repair the life that is first produced in natural growth. They may help a deadened flour, but a whole reparation is impossible. Throw away the drugs! Let us have a pure flour."

BALANCING MILLSTONES.—To examine the conditions relative to balancing, and to trace the effects produced by an unbalanced runner, to their cause, we refer to the adjoining figure in which R, R, represents a section of the runner-stone; B, B, a section of the nether stationary or bed-stone, S, the mill-spindle provided at the upper end with a steel pivot P, upon which the runner-stone is suspended, so as to admit of free oscillation. The distance from the face F, F, of the runner-stone to the pivot P, is found in practice to be from 5 to 8 inches, according to the size of the stone. Since the thickness of the runner-stone varies from 12 to 20 inches, this would bring the centre of gravity of the runner-stone below the point of suspension P, a condition favorable to stability, or, in other words, the millstone, when disturbed, will oscillate until equilibrium is restored. It will not be so easily upset. In order that the runner-stone may be in "balance," or the distance between the face F, F, of the runner-stone and the face of F', F', of the bed-stone, be equal, when the latter is perfectly horizontal, and former freely suspended; the weight of the portion of the runner on one side of the line, A, A, drawn through the point of suspension P, and perpendicular to the faces F', F,' must be equal to the corresponding half on the other side of the same line. Should this not be the case, the deficiency is easily made up by cutting a cavity at the light side, near the circumference, and filling it with an amount of lead sufficient to establish a proper equilibrium.

Mill stones when balanced while at rest are usually found, when running, not to retain an equal distance between the face; one side will drag —bear harder on the meal subjected to its action, consequently a millstone in this condition will grind unevenly. It is said to be out of "running balance."

From the very nature of the construction of the French millstone (the kind used at present most exclusively), being an assemblage of blocks, called "burr blocks," of various sizes, and on an average about 5 inches thick, the remainder of the body of the mill stone being made up of spawls, all cemented together with plaster of Paris; it is evident that the material can not easily be distributed symmetrically as to weight. To illustrate—conceive a line E, E, drawn through the pivot P, and parallel to the face F, F. We will also suppose a section 6 inches thick cut out of the center of the mill stone. Such section from a mill stone 4 feet in diameter would weigh about 260 pounds, taking the weight of the plaster at 90 pounds per cubic foot, and that of the burr block at 160 pounds.

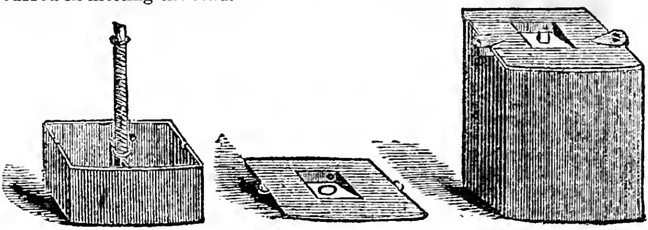


Now it may happen that in the construction of the mill stone, 45 pounds may be placed to the right of the center line A, A, and below the horizontal line E, E; 35 pounds may come above this line on the same side of A, A; 55 pounds and 25 pounds may chance to be on the opposite, below and above E, E, respectively. The sum of the weights on the right of A, A, is equal to the sum of the weights on the left, viz.: 80 pounds. The standing balance still obtains. The center of gravity g, and g' of each half of our section taken separately, however, will not be in or at equal distances from the line E, E, with the material thus distributed; but will fall above on the right to g'', and below on the left to g'''; a line joining these centers of gravity will take the direction N, N. Now when a mill stone so constructed is rotated about its axis A, A, the center of gravity g''' will rise, and g'' tend to fall. The line N, N, would become nearer horizontal as the speed increases, the line E, E, becomes inclined and the face F, F, untrue. The mill stone is out of "running balance."

The amount of pressure produced in our example assumed, we compute as follows: We draw a line through the center of gravity g'' parallel to the face F, F, until it meets the perpendicular line A, A; we similarly draw a line through g'''. We will also suppose the centers of gravity g'' and g''' to be removed $\frac{1}{4}$ of an inch from their proper place on the line E, E. The centrifugal force would be given, by the known expression $\frac{m v^2}{r}$ where m, represents the mass, or the weight divided by the force of gravity, in our case for $\frac{1}{2}$ of the section $\frac{80}{32}$ v, is the velocity in this instance, for the point g'' or g''' and in a stone 4 feet in diameter at 175 revolutions per minute, 18 feet per second, about; r represents the radius, equal to P, $g = 1$ ft. in our case. Hence substituting these values is the formula, we obtain $\frac{80.18.18.}{32.1.} = 810$ lbs. for the centrifugal force. The part of this force which is effective in producing the pressure at X equals 810. Cosine of the angle EP $x = 734$ pounds nearly. The force acts with the lever arms $g\ g''$ $\frac{1}{4}$ inch and PX $= 25$ inches. We have, therefore, for the total pressure at the point X $\frac{734}{4.25} \times 2 = 14.68$ pounds; an amount frequently present in mill stones in actual use, producing, by this unequal pressure, a flour or meal less advantageous to the miller, both as regards quality and quantity.

What is required, therefore, to adjust the "Running Balance" without disturbing the "Standing Balance" is to add or remove the same weight from each side. Thus, if we add 10 pounds to the part weighing 25 pounds, and the same amount to the part weighing 45 pounds, we have not disturbed the standing balance, while we have made the weights of the parts above and below the line E, E, equal respectively.

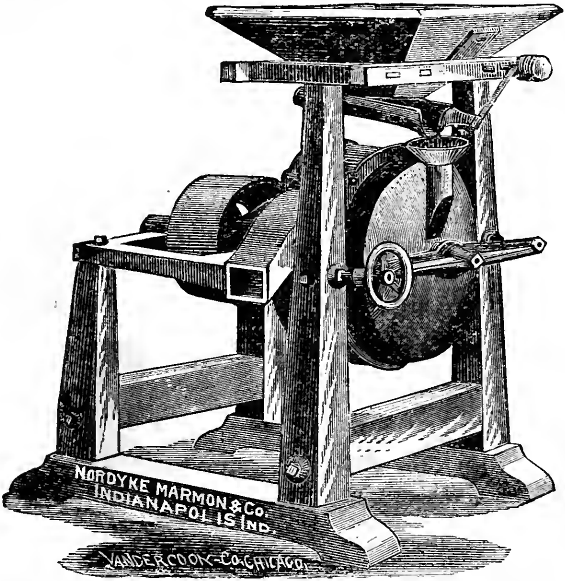
To balance in an actual case, we proceed as follows: First, put the runner-stone in good standing-balance, having leveled the bed-stone, and trammed the spindle previously. We then raise the stone, place two strips of wood between the faces, start the runner and turn off the back true with the face with a chisel, having first arranged a firm rest. We then remove the strips, run the stone at its proper speed, and mark the high side by bringing a pencil against it. The high side requires, as we have seen, an addition of weight at the top, close to the circumference, and the opposite low point at the bottom, near the circumference and the face. By means of two long leather straps, we tie several bars of lead at these places, repeating the operation until the proper amount of weight is found, which is then securely fixed to the stone, making a proper allowance for any plaster removed from the stone, or any waste incurred in melting the lead.



Several patent balances which facilitate the operation have been introduced. A more common one consists of a cast iron box, which is inserted in the stone at the circumference, and in which a weight can be raised or lowered by means of a screw. All that is required in this case is to find the high point in the manner described; raise the weight at this point, and lower it at the opposite low point, thus taking weight from the upper half of the stone and adding it to the lower half and the reverse.

It is not to be supposed that if a mill stone is put in good running balance, that it will remain in this condition for any length of time. But, on the contrary, its balance will change from the effects of the weather; that is, by an unequal absorption of moisture, due to an unequal distribution of the plaster forming the back, and from an unequal wear of the face as well. It is, therefore, expedient to frequently examine the balance and adjust the same. *V. Bachman in Mill Stone.*

The art of balancing mill stones is greatly simplified by an ingenious arrangement used by the Nordyke & Marmon Co., of Indianapolis, Ind., who imbed 5 cast iron boxes, like the one represented in the right hand cut, in the body of the runner stone. They are placed in the runner with the lid of the box a little below the plaster back with the rounding part in contact with the band. The left hand figure illustrates the inner adjustable box, and screw for adjusting the same when in the stone. It will be noticed it has two parts, divided by a partition. The cover to this inner box, shown in the central figure, is secured with a screw, and fits down upon the box and close over the division, so that either side may be used when the weight is wanted at a point between any two of the balance boxes. These balance boxes gives the miller full control of the runner ; a wrench is the only tool required, and the requisite weights, when once placed in the box, are not liable to derangement like those ordinarily used.



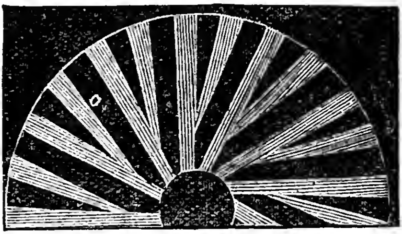
THE NORDYKE & MARMON PORTABLE GRIST MILL.

The above illustration represents a Portable Grist Mill made by the extensive mill furnishing firm of Nordyke, Marmon & Co., Indianapolis, Ind. It is constructed of the best French burr, is self-oiling, self-feeding, adjustable-balanced, and is well calculated to render efficient service to farmers, saw-mill owners, &c., as it dispenses with skilled attendance, is well adapted to any kind of suitable power, and is capable of grinding 20 bushels of corn per hour. The great variety and immense number of first class water and steam mills erected by this firm all over the fertile regions of the West and South, form a sufficient attestation of their abilities and resources as flouring mill contractors, engineers, and mechanical experts. In addition to their regular mill furnishing business, which has expanded to vast proportions since its establishment in 1851, this firm publish the *Mill Stone* (terms $1 per annum), a monthly journal of paramount utility to every miller, farmer, and mechanic. Of this periodical, suffice it to say, that one of the articles transferred to these pages and credited to the *Mill Stone*, has been pronounced by a practical man belonging to the craft, to be worth of itself $10 to any miller. The articles are pregnant with interest to every miller and will doubtless be read and studied with the attention which they deserve.

NUMBER OF MESHES IN BOLTING CLOTH.—The following Table exhibits the number of meshes contained in each number of cloth from No. 0000 to No. 16, of Dufour & Co.'s Anchor Brand of Bolting cloth :

No. 0000	contains	400	No. 7	contains	7,744
" 000	"	576	" 8	"	8,464
" 00	"	1,024	" 9	"	10,000
" 0	"	1,764	" 10	"	12,100
" 1	"	2,704	" 11	"	14,400
" 2	"	3,600	" 12	"	16,900
" 3	"	4,096	" 13	"	19,600
" 4	"	4,624	" 14	"	22,500
" 5	"	5,184	" 15	"	25,600
" 6	"	6,400	" 16	"	28,900

MILL STONE DRESS.—On this subject a practical miller writes to the *Mill Stone* as follows: "In the first place the burr must be brought to a perfectly true face, and then lay off the furrows with a straight edge, $1\frac{1}{4}$ inches wide at the eye, and $1\frac{3}{4}$ inches wide at the skirt. Let the flare be on the feather edge, and just as many quarters as may be thought best, and which will depend somewhat on the speed. I generally give a four foot burr from 13 to 16 leading furrows, stepping them off with a pair of compasses on the outside edge of burr, from 9 to 12 inches apart, and



then dividing the spaces between them into quarters. The accompanying draft of the dress that I use will give a very good idea of my plan. I have been using this dress for years, and find it gives better satisfaction in quality of flour than any other dress I ever used. It grinds cooler and longer than the old style of dress, and it will grind wet or damp wheat better, because there is less friction about it and there is more room for the meal to get out from under the burrs, and therefore the meal must be better."

ESTIMATE OF THE SPEED, POWER, CAPACITY AND DRESS OF MILL-STONES AS PRACTICED IN GREAT BRITAIN FOR GRINDING WHEAT WHERE NO EXHAUST OR COMBINED BLAST AND EXHAUST ARE USED. *The Miller.*

Diameter of Millstone.		Revolutions per Minute.	Horse power.	Average capacity per hour of grinding in bush. through the journey.	Usual dress.	Draught from fore edge of furrow.
Feet.	Inches.					Inches.
2	6	200	2½	2½	7.3	2½
2	10	180	2¾	2¾	8.3	2½
3	0	170	3	3	9.3	2½
3	2	160	3¼	3¼	9.3	2¾
3	4	150	3½	3½	10.3	3
3	6	140	3¾	3¾	10.3	3
3	8	130	3⅞	3⅞	10.3	3
3	10	125	3⅞	Nearly 4	11.3	3
4	0	120	4	4	10.4	3
4	2	115	4⅛	4¼	10.4	3
4	4	110	4¼	4½	11.4	3¼
4	6	105	4½	5	12.4	3½
4	8	100	4¾	6	12.4	3¾
4	10	95	5	6½	12.4	4
5	0	90	6	7	12.4	4½

In reference to the foregoing Table, *The Miller* quotes the opinion of a Scotch engineer and millwright whose experience entitles him to rank as an authority, to the effect that there should be only four standard diameters of millstones, viz.: 3 ft. 3 ft. 6 ins. 4 ft. 4 ft. 6 ins. for which the speed should be 170 revolutions for the 3 ft., 155, 135, and 115 for the other sizes respectively, and he estimates that all their sizes would each absorb 6 indicated horse power to grind 4 bushels of wheat per hour; in other words, the smallest stone at its high rate of speed, with equal duty, would require as much power to propel it as would be taken by the largest stone with its low rate of speed. The same authority expresses a conviction, based on a mature experience of 30 years, that a vast improvement could be effected on the system presented in the above Table by taking the 4 foot stone, running at 135, as the standard for universal use in grinding wheat. It is recommended further that all mills should be so constructed that the *velocity of the stones* could be varied at pleasure, *when in operation*, either by running each pair by conical pulleys or drums, or by a separate engine, as the state of the weather, or the different varieties of wheat, may demand.

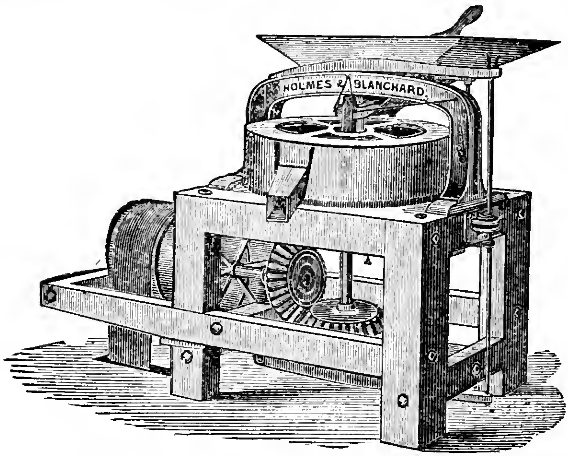
Concerning the blast and exhaust the *Miller* remarks:

"It is stated by some parties favorable to the combined Blast and Exhaust that, by the adoption of that system, a saving of power is effected, and that eight bushels of wheat can be ground by *six*-horse power. The power, however, being unlimited, the quantity ground can be increased almost indefinitely, in the above proportion, according to the weight of the millstone, sixteen bushels per hour often being ground on this system. The application of the Exhaust, drawing the air through the eye of the running millstone, does not produce a greater current than that of atmospheric pressure, the millstones grind somewhat faster, and there is a corresponding amount of economic power, the millstones working more freely. Many advantages in this respect result from the adoption of the simple Exhaust, having for its object the removal only of the stive from the millstone case."

TO REMOVE GLAZE FROM MILLSTONES.—Take the burrs, clean all the flour off with a broom and wash them with first rate vinegar. This will leave the stones free from glaze. The better way is to wash the stones at night and leave them to dry until morning. A miller who has used the method for 25 years, recommends to take up the stones while warm, and wash them with a mixture of one half pail of soft water and one quart sharp vinegar, applied with a woollen cloth. *Leffel's News.*

SPEED AND PITCH OF BOLT.—An experienced miller writes on this subject as follows :

Many years of practical experience in custom milling and in grinding all kinds of wheat, hard and soft, wet and dry, has convinced me that the best speed to give a bolt cloth to accomplish the most and best work, is 200 feet per minute. The reel should have $\frac{1}{4}$ to $\frac{3}{8}$ inch pitch per foot and should be kept as full as its capacity requires. Reels when working on hard wheat should have more pitch than when working on soft wheat. More millers get into trouble with their bolts by running them too fast than by any other cause. The faster you run the cloth after you get up to 200 feet per minute, the less it will bolt and you can give it speed enough to carry all the flour, middlings and bran together out of the tail end of the reel. *Leffel's News.*



THE HOLMES AND BLANCHARD PORTABLE MILL.

The above illustration represents an excellent type of a geared Portable Grinding Mill manufactured by the well known mill furnishing firm of Holmes & Blanchard, Boston, Mass. They also manufacture the same class of mill, at less cost, with vertical pulley. The stones are made in one entire piece from the best French burrs, and are well adapted for flouring wheat, grinding corn, grain, feed, plaster, salt, coffee, spices, &c. The makers claim that the capacity of their mills, of which they build a great variety, can be increased to almost any extent, by an increase of power or speed, or they can be worked with light power by diminishing the speed and quantity of work. Their mills, now numbering many hundreds of every size and class, are highly spoken of by the purchasers, and the writer can bear witness to the utility of one which rendered excellent service to a large community on his own premises in New Brunswick, Canada, until its career of usefulness was terminated by a fire which destroyed the mill building with all its contents.

The following Table exhibits the proper speed, power required, performance, &c., of the Holmes & Blanchard Portable Mills.

DIAMETER OF STONES	BEST SPEED PER MINUTE.		BUSHELS CORN GROUND PER HOUR.			H. P. required.	SIZE OF PULLEYS.	
	Steam or wa'r power.	Animal Power.	Fine.	Coarse.	Cracked.		Dia. Inches.	Face. Inches
42 inches.	275		20	30	200	15	28	10
36 "	300		15	22	150	10	24	10
33 "	325		12	18	150	8	20	8
30 "	325		10	16	150	6	20	8
26 "	325		8	14	125	5	16	6
24 "	350	200	6	12	100	4	16	6
20 "	350	275	4	8	40	3	14	5
18 "	350	275	3	6	30	2	14	5
16 "	350	275	2	4	30	1½	14	5

To find the Length of a Driving Belt before the Pulleys are in Position.—Add the circumference of the two pulleys, divide the product by two, and add the quotient thus obtained to double the distance between the centres of the two shafts, which will give the length of belt required. For a cross belt, add the circumference of the two pulleys, multiply the product by three, and divide by two; the quotient added to double the distance between centres of both shafts will give the length required. Horse-power of a belt equals velocity in feet per minute multiplied by the width, the sum divided by 1000.

One inch single belt, moving at 1000 ft. per minute = 1 horse power.

Double belts about 700 ft. per minute, per one in. in width = 1 horse power.

For double belts of great length, over large pulleys, allow about 500 ft. per minute per inch of width per horse-power.

Power should be communicated through the lower running side of a belt, the upper side to carry the slack.

Average breaking weights of a belt, 3–16 × 1 inch wide. Leather, 350 lbs ; 3 ply rubber, 600 lbs. The strength of a belt increases as its width. The co-efficient of safety for a laced belt is leather = 1-16 breaking weight, rubber = 1-3 do.

To Determine where to cut Bell holes in Floors.—Measure the distance in inches from centre of driving shaft to under side of floor, on the upper side make a mark over the centre of shaft. Now measure the distance from centre of shaft on machine to be driven to floor, making a mark on the floor immediately beneath the centre, then measure the distance between the two marks. Transfer these figures to a board or paper, draw off the driving and the driven pulleys, after finding their diameters at the distance from each other and the floor line previously obtained, and draw the lines representing the belt cutting the floor lines which will show where the belt passes through the floor. The drawing, can be made to a scale to reduce it to convenient dimensions, maintaining the proportions. The holes may now be marked off on the floor and cut with a certainty of being correct. In making the drawing it is best to do it full size on the floor if room can be had, and allowance must be made for the thickness of flooring.

WORKING VALUE OF PULLEYS.—Pulleys covered with leather, iron pulleys polished, and mahogany pulleys polished, rank for working value as 36, 24, and 25 per cent. respectively, wood and iron uncovered being almost identical. The smoother a pulley is turned the greater will be the power imparted by it, and the better will be the hold of the belt. A pulley which is slightly higher in the middle of its width exerts the greatest power in retaining the belt from slipping off as well as making it last longer by imparting the greatest tension to the middle, or strongest part of the belt, to the manifest relief of the edges or weakest part. To obtain the best results from belts it is necessary, in lacing or cementing the ends, that the latter should be cut exactly square across, and the junction should be equally true, otherwise the belt will be strained and torn on the tightest side, besides being rendered liable to run off the pulley at any time.

Belts connecting pulleys perpendicular to each other should be kept tight, and should me made of firm, well stretched leather, in order to work to the best advantage.

TO COMPUTE THE HORSE-POWER OF A BELT, ITS VELOCITY AND THE NUMBER OF SQUARE INCHES IN CONTACT WITH THE SMALLEST PULLEY BEING KNOWN.—Divide the number of square inches of belt in contact with the pulley by 2, multiply this quotient by the velocity of the belt in feet per minute, and this amount divided by 36,000 and the quotient will be the number of horse-power.

TO COMPUTE THE WIDTH OF BELTS REQUIRED FOR TRANSMITTING VARIOUS NUMBERS OF HORSE-POWER.—Multiply 36,000 by the number of horse-power, divide the product by the number of feet the belt is to run per minute, divide the quotient by the number of feet or parts of a foot in length of belt contact with the smaller pulley; divide the last quotient by 6, and the result will be the desired width of the belt in inches.*

TO PREVENT ACCIDENTS FROM SHAFTING.—These may be rendered impossible by loose sleeves formed of tin or zinc fitted to the shafting, and lined with cloth or leather to prevent noise.

TO GRIND BURRS INTO FACE WITH WATER.—Make the face of the stone absolutely true, then bosom each stone slightly and grind them in water at a low speed. Let the speed be high enough, however, to bring the water to the lands. To grind in face the spindle should be slightly loose in the bush and the running stone made to oscillate 1-16 of an inch or more. This will prevent the burrs from creasing each other, and will leave a perfect face. The bosom of the mill should be two brans at the eye and one bran at the skirt; just enough to prevent centre riding. A wedge face from eye to skirt, is faulty for the manufacture of pure flour. The bran should lie horizontally throughout its passage through the mill. The furrows serve as squashing surfaces. Where there are furrows, no bosoming is demanded. *Leffel's News.*

TO PREVENT BURRS HEATING.—Dress from centre to circumference, leaving no bosom. Draw a line across the centre, each way, dividing a four foot burr into 16 squares or divisions, and other sizes, more or less,

* NOTE The above estimate is based on the rule of allowing each square inch of belting in contact with the pulley to raise half a pound 1 ft. high in 1 minute and the raising of 36,000 lbs. same height in same time as a horse-power.

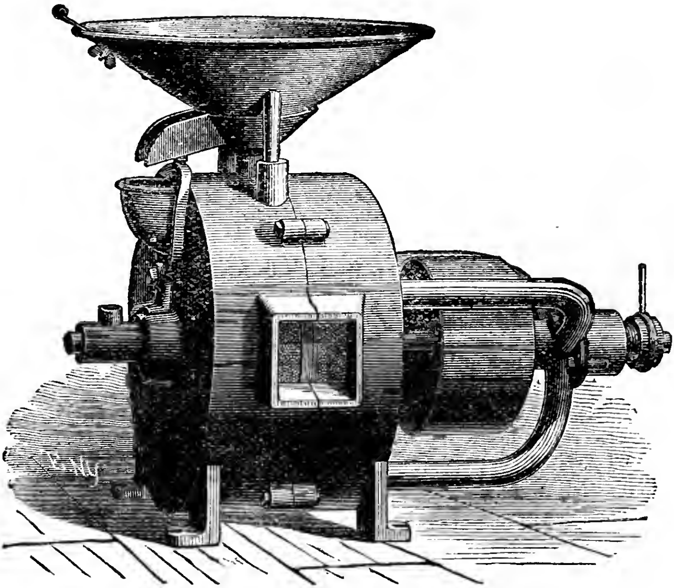
in the same proportion, with all straight furrows. Let the draft be $\frac{1}{3}$ the diameter of the rock. Lay off the lands and furrows $\frac{1}{4}$ inch each observing to dress smooth. Sink the furrow at the eye $\frac{1}{4}$ inch deep for corn, and run out to $\frac{3}{16}$ at the periphery; for wheat $\frac{3}{16}$ at the eye, and $\frac{1}{8}$ at the periphery. When thus furnished, crack the lands in straight lines, square with the draft of cross lines, so as to make the lands face in the runner and bed direct.

SIMPLE ALARM FOR MILL HOPPERS.—Take a piece of spring steel about $\frac{1}{2}$ in. wide, and bend one end of it so as to form a foot by which to screw it to the bottom of the shoe, the balance of the spring passing up through and into the hopper, and bent over at its upper end so as to form a pendant to which rivet a small bell. As soon as the grain in the hopper gets below the bell, it will commence to ring and thus notify the attendant. *Leffel's News.*

TEMPERATURE OF OAT MEAL KILN. GRINDING OF OATMEAL.—In response to a request from a correspondent, Mr. Gray, an experienced miller, says, "There is no given temperature in drying oats; it is the plate you bring to the necessary heat, not the house. Oats are not all the same grade, some kinds are thinner in the hull than others. I always preferred a cast iron plate in place of tile, as you get more heat. I do not think a perforated cylinder will make sweet meal, that is still the great want in the country, the meal is stewed in the drying, and has not a fine taste. The good old plan to find out when your kiln floor is ready to receive the oats is just to spit on the plate and if it raises the bead you can at once load your kiln six inches deep with the oats. The cold oats will cool it down a little when the miller must look to his furnace and keep up the same heat he started with—not any hotter. It will soon begin to steam, and in about half an hour skim off the oats with the hand down to the plate, and he will see whether it is hot or cold; when the oats are dry, say two inches on the bottom, that will be perhaps over an hour, take the wooden shovel and clean off its breadth around three squares of the kiln by throwing them over on the oats. Then turn the oats over to the one end (not the sides) neatly turning *them on top from the bottom.* This takes some practice. When done your kiln head will be same as at beginning. It will steam again after about an hour; when the steam is off, turn it over again but reverse the end (turn back). Don't let the furnace get too hot now, keep its temperature down rather. In about an hour more the miller will find his oats dry. He must now open his furnace doors and cool down, let the oats lay on the kiln 20 minutes even after they are dry. He will find that this will give them a sweet taste. Never dry with seeds as it imparts to the meal a tar taste. I have tried a good many kinds of millstones for oat meal, and I find in my long experience that four foot porous burrs driven 120 revolutions, with a three toed rynd loose on the spindle and resting in 3 dents in the runner, are the best. I think the 20 inch vertical burrs will make the oat meal too floury, as oat meal don't take so much friction, the stones being kept so high—more so than in making flour." *Leffel's News.*

Note.—"*Leffel's Milling and Mechanical News,*" from which the above items are transcribed, is a monthly journal (terms 50 cents per annum), published by James Leffel& Co., manufacturers of the celebrated Leffel Turbine Wheel, Springfield, Ohio. The paper is edited with consummate ability, and it is safe to say that very many of the items contained in it are singly well worth the whole year's subscription tenfold.

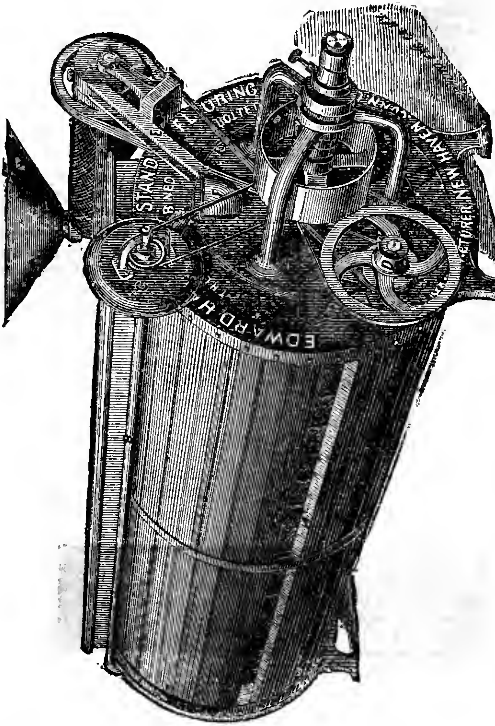
The *Indianapolis Mechanical Journal* (monthly, 50 cents per annum), J. H. Kerrick, publisher, Indianapolis. Ind., is a most useful periodical to every one who either operates or wishes to procure machinery, and the *Western Manufacturer* (monthly, $2 per annum), Coyne & Co., publishers (and Patent Agents) Chicago, Ills., is unexcelled on the subject of statistics and general information of interest to manufacturers.



HARRISON'S IMPROVED STANDARD GRINDING MILL.

The above illustration represents a new improved light standard 20 inch grinding mill as constructed by Edward Harrison, of New Haven, Conn. It weighs 600 lbs. and the manufacturer claims for it a grinding capacity (with from 6 to 20 horse-power) of from 6 to 40 bushels per hour, and that with 1200 revolutions per minute, it has a grinding surface equal to ¼ more than a common 48 inch run with 175 turns per minute. He claims that the high speed adds a large grinding surface to the burrs, that the grain is exploded into meal, bran, &c., as soon as it touches the burrs, that the vertical position of the stones permits easy delivery of the meal and cool grinding, and that there is not only no possibility of the runner following up the bed face and grinding itself out of true, but that, on the contrary, the runners are self-facing (the bed being stationery, the runner rigid, no pivot, bale and driver being used) and grind themselves so true that with but little additional labor they will run to within the thousandth part of an inch without touching.

The mill in its complete form, combining grinder, scourer, and bolter, (the last two are shown in the next cut) is a decided novelty, and when contrasted with other mills, presents many startling points of difference. Briefly described, the bolter, or mill-case is a cylinder about 10 ft. long by 3 ft. in diam., made of staves and held together by a band and iron heads, into one of which the grinder is fitted, which is merely a 20 inch pair of burrs, set vertically, with the runner turning on the inside, its spindle passing horizontally through the bed stone in a journal about 10 ins. in length. The scourer and bolter is connected to the grinder by ingenious machinery. On the top of the case a ventilator runs the entire length, having an opening of about 20 superficial square feet, which is constructed for cooling the bolter quickly, the opening being covered with a fibrous cloth material which permits the air to escape freely, causing a low and even temperature, while detaining the fine flour dust. A discharge spout runs the whole length of the case. The silk bolter occupies nearly the entire space in the cylinder, and is fully protected from hot



HARRISON'S COMBINED GRINDER, SCOURER, AND BOLTER.

substances passing into it from the grinder by a wire screen. The middlings cloth is attached to the finer silk, on the reel, continuously, and around it the middlings chamber is formed the full circumference of the reel-head, through which passages connect to the delivery spout, in the middle of the cylinder head at the tail of the mill, while sweeps are attached to the reel of the bolter for scraping the flour up to the discharge opening.

Horse Power of Streams.—Taking Watt's estimate that the average power of a horse is sufficient to raise 33,000 lbs. 1 foot in vertical height per minute (by means of compound pulleys) a waterfall has one horse power for every 33,000 lbs. of water flowing in the stream per minute, for each foot of fall. To compute the power of a stream, therefore, multiply the area of its cross section in feet by the velocity in feet per minute, and we have the number of cubic feet flowing along the stream per minute. Multiply this by $62\frac{1}{2}$, the number of pounds in a cubic foot of water, and this by the vertical fall in feet, and we have the foot-pounds per minute of the fall; dividing by 33,000 gives us the horse-power.

For example: a stream flows through a flume 10 feet wide, and the depth of the water is 4 feet; the area of the cross section will be 40 feet. The velocity is 150 feet per minute — $40 \times 150 = 6000 =$ the cubic feet of water flowing per minute. $6000 \times 62\frac{1}{2} = 375,000 =$ the pounds of water flowing per minute. The fall is 10 feet; $10 \times 375,000 = 3,750,000 =$ the foot pounds of the waterfall. Divide 3,750,000 by 33,000 and we have $113\frac{21}{33}$ as the horse-power of the fall.

Rule.—Divide the continued product of the width, the depth, the velocity of the water per minute, the height of the fall, and the weight of a cubic foot of water ($62\frac{1}{2}$ lbs.) by 33,000.

Example.—The flume of a mill is 10 feet wide, the water is 3 feet deep, the velocity is 100 feet per minute, and the fall 11 feet. What is the horse-power of the fall?

Operation.—$(10 \times 3 \times 100 \times 11 \times 62\frac{1}{2}) \div 33,000 = 62\frac{1}{2}$ horse-power.

"Almost every man has about him in his daily walk sufficient apparatus for a tolerably accurate estimate of the quantity of water flowing in any stream. A walking stick, a jack-knife, and a watch, provided the walking-stick is just three feet long, are all the tools necessary for the purpose.

"Take a section of the stream as uniform in breadth and depth as possible, and measure off upon its bank some definite length, say from one to four hundred feet, according to the rapidity of the water; set a stake close to the water at each end of this section, then throw into the water, opposite the upper stake, a green twig or limb of a tree or other object of such specific gravity as to nearly but not quite sink, and of such size that one portion shall remain at the surface while another portion nearly touches bottom, the object being to get the average speed of the water. The resistance caused by the bed and banks of the stream necessitate some care in this part of the experiment.

"Note accurately the time the object is passing from stake to stake, and repeat the operation several times and at as many points towards the opposite shore; the sum of the several times divided by the number of points at which the speed was taken, gives the average speed of the water.

"Now measure the depth at several equidistant points across the stream, as a, b, c, d, e, f, (the diagram showing a cross section of the stream). The sum of these depths divided by the number of points at which the depth was measured gives the average depth; this average depth multiplied by the breadth of the stream gives the area of the cross section; this area, multiplied by the length of the section, gives the cubic contents of the body of water embraced in the section. Thus we have the quantity and its velocity, which are elements necessary to show the value of a stream for manufacturing purposes, provided it has sufficient fall anywhere to render it available.

"Allowing 62 pounds for each cubic foot of water, a supply of 1,000 cubic feet per minute, and a fall of 10 feet, we have $1,000 \times 62 = 62,000$ pounds ; $62,000 \times 10 = 620,000$ pounds momentum, which last divided by $33,000 = 18.7$-horse power, one-fifth of which being deducted for friction and loss, would leave in this case about 15-horse power." *The Millstone.*

Water-wheels lose from 10 to 50 per cent. of the power, and the actual power of the steam engine is less than that indicated by the horse-power, owing to a loss by friction, the amount of which depends on the perfection of the machinery, arrangement, &c. For horse-power of steam-engines, consult page 370.

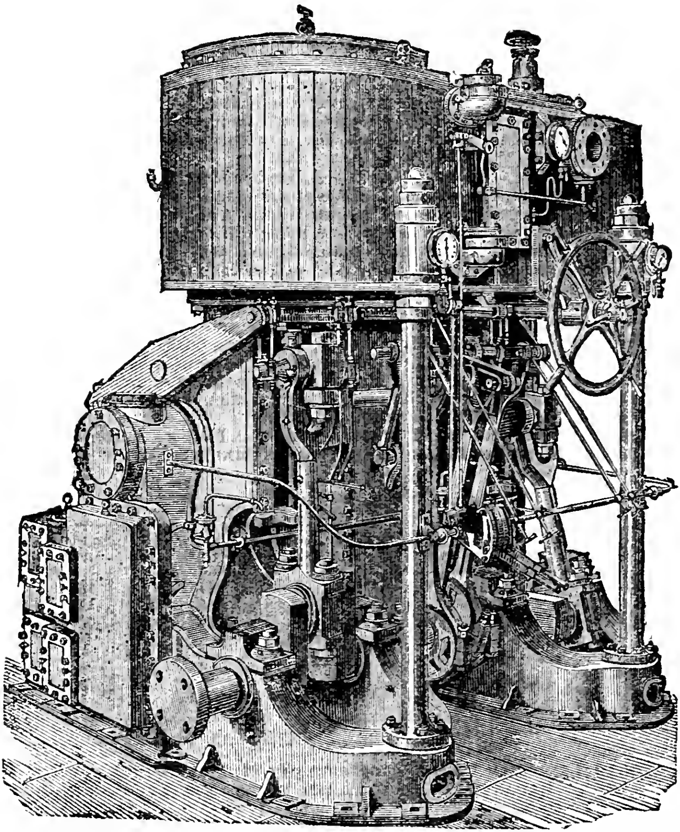
PERFORMANCE, &c., OF A HORSE —A horse will travel 400 yds. in 4½ minutes at a *walk*, 400 yds. in 2 minutes at a *trot*, and 400 yds. in 1 minute, at a *gallop*. The usual work of a horse is taken at 22,500 lbs. raised 1 foot per minute, for 8 hours per day. A horse will *carry* 250 lbs. 25 miles per day of 8 hours. An average draught-horse will draw 1,600 lbs. 23 miles per day on a level road, weight of wagon included. The average weight of a horse is 1,000 lbs. ; his strength is equal to that of 5 men. In a *horse mill* moving at 3 feet per second, track 25 feet diameter, he exerts with the machine the power of 4½ horses. The greatest amount a horse can pull in a horizontal line is 900 lbs. ; but he can only do this momentarily, in continued exertion, probably half of this is the limit. He attains his growth in 5 years, will live 25, average, 16 years. A horse will live 25 days on water, without solid food, 17 days without eating or drinking, but only 5 days on solid food, without drinking.

TABLE EXHIBITING THE PERFORMANCE OF A HORSE AT DIFFERENT RATES OF SPEED ON RAILROADS, CANALS, TURNPIKES, &c., DRAWING FORCE 83⅓ lbs.

Speed per hour. Miles.	Duration of day's work —hours.	Useful effect for 1 day in tons, drawn 1 mile.		
		On canal— tons.	On a railroad— tons.	On a turnpike—tons.
2½	11½	520	115	14
3	8	243	92	12
3½	6	154	82	10
4	4½	102	72	9
5	$2\frac{9}{10}$	52	57	7.3
6	2	30	48	6
7	1½	19	41	5
8	1⅛	12.8	36	4.5
9	$\frac{9}{10}$	9.	32	4.
10	¾	6.5	28.8	3.6

GAIN IN FUEL AND INITIAL PRESSURE OF STEAM REQUIRED WHEN ACTING EXPANSIVELY, COMPARED WITH NON-EXPANSION OR FULL STROKE.

Point of Cutting Off.	Gain in Fuel.	Initial Pressure Required.		Point of Cutting Off.	Gain in Fuel.	Initial Pressure Required.	
		Cutting Off.	Full Stroke.			Cutting Off.	Full Stroke.
Stroke.	Per cent.	Stroke.	Stroke.	Stroke.	Per cent.	Stroke.	Stroke.
⅞	11.7	1.01	1.	⅜	49.6	1.32	1.
¾	22.4	1.03	1.	¼	58.2	1.67	1.
⅝	32.	1.09	1.	⅛	67.6	2.6	1.
½	41.	1.18	1.				

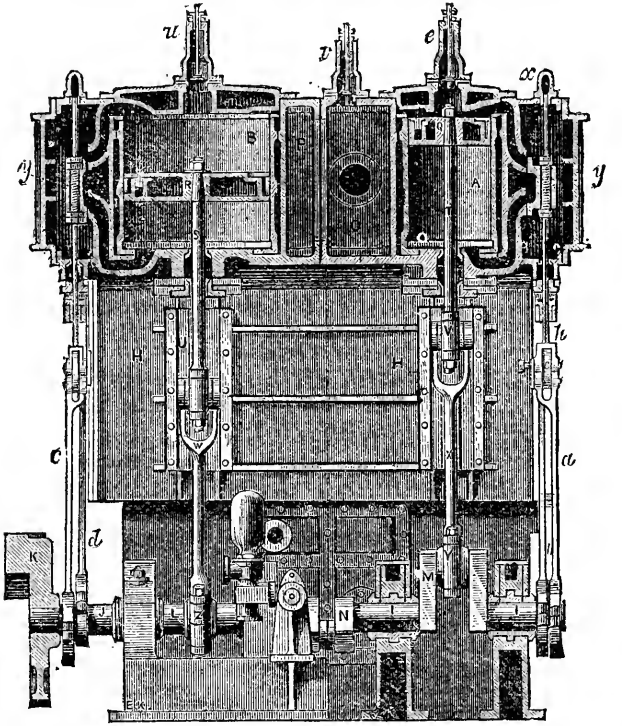


IMPROVED COMPOUND SURFACE CONDENSING MARINE ENGINE.

EXTRAORDINARY DUTY OF STEAM MACHINERY.—Two Locomotives belonging to the Pennsylvania R. R. Co., are credited with the following performances :—

Engine No. 55 ran two years, ten months, and twenty-five days, and made 161,476 miles, without once being off her wheels, or receiving other repairs than such as are common to round-house work. The cost of running her during this period was $1.88 per mile. The other engine, No. 422, ran three years, six months and nineteen days, and made 153,280 miles, at a cost of $2.44 per mile without undergoing the slightest repairs.

To find the Quantity of Water necessary for a Steam boiler.—Ascertain the number of lbs. of coal consumed per hour, divide it by 7·5, and the quotient will be the desired quantity of water in cubic ft. per hour. A cubic ft. of water weighs 62·5 lbs. See page 629.



The above sketch represents an outline of the least-complicated and lowest-priced form of compound-engine, as at present constructed on the Clyde, in Scotland, and on the Delaware, in the United States. The cranks Y, Z, are coupled at an angle of 90° ; only two cylinders, A and B, are used ; a uniform distribution of steam pressure is secured by a large allowance of steam pipe, and by the steam reservoir, O, P, between the two cylinders. The valves, y, y, are adjusted like those of an ordinary engine, the essential difference being that the steam exhausted by the first cylinder, A, is used over again in the second and largest one, B, the combination effecting a steam expansion of about six times, the pressure in the boiler usually ranging between 60 and 75 lbs. per square inch.

In the City of Peking, a 5,000 ton vessel, built on the Delaware for the Pacific Mail Company, there are two pairs of compound engines, with cylinders of 51 and 88 ins. diam. The crank shafts are 18 ins. diam. Boiler pressure is 60 lbs. Steam is expanded 9 times. The boilers are 10 (cylindrical in form, with cylindrical flues), 10½ ft. long, 13 ft. diam.; shells, 13-16 in. thick, with 520 ft. of grate surface, 16,500 sq. ft. of heating surface, and 1,600 sq. ft. of superheating surface, with smoke stacks, 8½ ft. diam., and 70 ft. high.

The simplest form of superheater used on board steamers consists of a wrought-iron drum filled with tubes. They are placed usually in the up-takes, or at the base of the funnel of a marine boiler, so disposed that the waste heat and flame from the furnaces will pass through the tubes and around the shell of the drum, the steam being inside. Connection is made with the boiler and steam pipes of the engine, and fitted with stop valves to govern the admission of steam according to requirements. A safety valve and gauge glass is also fitted, to show whether the superheater is clear of water, as priming is liable to fill it up. It has been shown that this contrivance often effects a saving of 20 to 25 per cent. in the fuel consumed.

TABLE *for finding the* CONSUMPTION *of* COAL *per Hour in Steamers, either Paddle or Screw* (*the same Screw being used throughout*), *at any Rate of Speed, the Consumption for a particular Rate being known.* (*At a given Amount of Coal, the Engineer may determine the most prudent Rate of Engine for reaching next coaling Port.*)

Speed.	Consumption of Coal.	Speed.	Consumption. of Coal.	Explanation.
3	.216	9	5 83	The speed for the consumption of an unit of coal is supposed here to be 5, which may be 5 miles or knots, or 5 times any number of miles or knots; then if 5 of such number of miles require 1 unit of coal per hour, 9 of such units will, by the table, require 5.83 units of coal, and 3 of them .216 units of coal.
3½	.343	9½	6.86	
4	.512	10	8 00	
4½	.729	10½	9.26	
5	1 000	11	10 65	
5½	1 331	11½	12.15	
6	1.728	12	13.82	
6½	2.197	12½	15 61	
7	2.744	13	17.58	
7½	3.375	13½	19.68	
8	4.096	14	21.95	
8½	4.910			

It will be evident that this table is calculated on the principle that the horse power varies very nearly as the cube of the speed; the enormous increase of consumption at increased velocities is in fact a little greater than that shown by the Table.

The advantages indicated above to be obtained at low velocities are evidently independent of those obtained at those velocities by using the steam expansively. *Engineer's and Contractor's Pocket Book.*

TO PRESERVE BOILER TUBES.—A coating of red-lead and boiled linseed oil, applied to iron boiler tubes acts as a powerful preservative.

A lacquer of linseed oil and caoutchouc applied to the walls of a steam boiler prevents the adhesion of sediment so that the scale admits of easy removal.

TO PROTECT POLISHED STEEL OR IRON FROM RUST.—Go over the surface with paraffine, or steep the iron for a few minutes in a solution of sulphate of copper and then transfer it into a solution of hyposulphite of soda acidulated with hydrochloric acid. The result is a blue-black coating not affected by air or water.

BREAKING AND CRUSHING STRAINS OF IRON AND STEEL. AVERAGE CALCULATIONS.

Breaking strain of wrought iron	= 23 tons	per sq. inch	of section.
Crushing do, do.	= 17 "	do.	do.
Breaking strain of cast iron	= $7\frac{1}{2}$ "	do.	do.
Crushing do. do.	= 50 "	do.	do.
Breaking strain of steel bars	= 50 "	do.	do.
Crushing do. do.	= 166 "	do.	do.

MEMORANDA OF TEMPERATURES FOR ENGINEERS, &c.—Melting ice is 32° ; boiling water at atmospheric pressure or exposed to air 212° ; steam at 60 lbs. pressure by steam guage 307° ; usual heat of superheated steam 380° to 400° ; smoke in the funnel 600° ; water in hot well from 100° to 120°. For raising steam, the horizontal surfaces over the fire, have double the value of vertical surfaces for economy of heat. Boiler plates increase in strength up to 570° of heat, and get weaker with the increase of temperature.

Temperatures at sundry subterranean depths, in deg. Fahr.

At 68 ft.	47,9	At 621 ft.	50.7	At 1290 ft.	58.3	At 1662 ft.	61.2
" 299 "	48.8	" 939 "	57.8	" 1414 "	59.4	" 1900 "	61.4

Fresh water begins to freeze at 32°, called the freezing point, but salt water not till $28\frac{1}{2}$°. The atoms lose the motion called heat, and become fixed in crystals.

CONSUMPTION OF FUEL IN MARINE BOILERS.—This will average about $15\frac{1}{2}$ lbs. of coal per square foot per hour. In 4 furnaces 3 ft. wide by 6 ft. long with 72 sq. ft. of surface, about 12 tons of coal will be burnt per day.

feet. lbs.

Thus, $\dfrac{72 \times 15\frac{1}{2}}{112}$ = 9.9 cwts. per hour, say 10 cwts. per hour or 12 tons per day. A much simpler and equally correct rule is, that one foot in width of fire bar equals 1 ton of coal per day; so that in the example above the total width of four furnaces is 3ft. × =12 ft. wide, or 12 tons per day as before.

A ship having 40 ft. beam and ordinary condensing engines, will require 40 tons of coal per day to drive her at 10 knots. The reason for stating this is, that it is well known from ordinary experience of average steamers that the beam squared equals the consumption of fuel for 40, 50, or 60 days, according to whether the engines are ordinary jet, surface condensing, or compound. Thus, in present example :—

days———

4,0)160,0	5,0)160,0	6,0)160,0
40 tons for one day for ordinary condensing.	32 tons for surface condensing.	26 tons 8 cwt. for compound engines.

A pair of surface condensing engines (not compound) having 40 inch cylinders, doing average work, will require 16 tons of coal per day ; it being a well known practical fact that the diameter of one cylinder, squared and divided by 100, gives the average consumption of fuel in this class of engine per day. Thus, in present example :—

$42^2 = 40 \times 40 = 1000$; then, = 16 tons per day.

Compound engines burn $\frac{1}{5}$ less, and ordinary jet $\frac{1}{5}$ more than the above. *Reed's Engineer's Hand Book.*

RATIO OF COMBUSTION PER HOUR UNDER VARIOUS BOILERS.—Cornish, = $3\frac{1}{2}$ lbs. per square foot; land boilers = 10 to 20 lbs. (English) 13 to 14 lbs.; marine boilers (natural draught), 10 to 18 lbs.; (blast), 30 to 60 lbs.; locomotive boilers, 80 to 120 lbs.

TO FIND HORSE POWER OF ENGINE TO RAISE WATER TO A GIVEN HEIGHT.—Weight of column of water × by its velocity, in feet, per minute, product ÷ 33,000 = H. P.

TO FIND THE VELOCITY REQUIRED TO DISCHARGE A GIVEN VOLUME OF WATER IN ANY GIVEN TIME.—Number of cubic feet × 144; product ÷ by area of pipe, or opening in inches = Velocity.

TO ASCERTAIN THE BREADTH OF THE PORTS.—Half the throw of the valve should be at least equal to the lap on the steam side added to the breadth of the port. If this breadth does not give the required area of port, increase the throw of valve until the area is attained.

PROPER LIFT OF POPPET VALVES.—The best results from poppet or conical valves are obtained by giving them a lift equivalent to one half the semi-diameter of a circle, or $\frac{1}{4}$ the diameter of the valve. This will afford an opening equivalent to the area of the port and the eccentries and the lifting toes should be adjusted so as to produce this effect.

TO FIND DIMENSIONS OF CHIMNEY FOR A LAND ENGINE.—Multiply number of lbs. of coal consumed under the boiler per hour by 12; divide the product by square root of the height of chimney in feet. Quotient is area of chimney at smallest point in square inches.

TABLE SHOWING DIAMETER AND HEIGHT OF CHIMNEY FOR ANY BOILER.

Horse-power of Boiler.	Alt. of Chimney in Feet.	Interior Diameter at Top	H. P. of Boiler.	Alt. of Chimney in Feet.	Interior Diameter at Top.
10	60	14 inches.	70	120	30 inches.
12	75	14 "	90	120	34 "
16	90	16 "	120	135	38 "
20	99	17 "	160	150	43 "
30	105	21 "	200	165	47 "
50	120	26 "	250	180	52 "
60	120	27 "	380	195	57 "

TO CLEAN GREASY COTTON WASTE.—Boil it in a strong solution of common soda in water, and save the resultant soapy liquid to keep your drills and reamers lubricated when drilling iron.

TO CLEAN GREASE FROM BOLTS.—Moisten with benzine, roll in sawdust, and brush afterward.

CALCULATIONS REGARDING DIMENSIONS, POWER, &C., OF STEAM BOILERS.—Good authorities consider it quite a safe practice to allow

9 square ft. heating surface for Cylinder boilers per H. P.
12 " " " " " flue " " "
15 " " " " " tubular " "

One half the circumference of the boiler multiplied into the length and reduced to square feet will give the heating surface in cylinder boilers; or, the heating surface in the shell of flue and tubular boilers. To find the heating surface in the tubes or flues, multiply their external circumference by their length and reduce to square feet. The heating surface of the tubes or flues added together and then adding the heating surface in the shell, will give the total heating surface. This divided by 12 or 15 as the case may be will give the horse power of any particular boiler in terms of heating surface as given above. This is to be understood as being purely conventional and arbitrary, and not the actual horse power, which can only be determined by an experimental test, made by a competent expert.

The following Tables will serve as a guide in the selection of boilers, and may be quite serviceable to millwrights and others.

TABLE I.—H. P. OF CYLINDER BOILER AT 9 FEET.

H. P.	Diam.	Length.	Heating Surface
10	36 in.	19 ft.	90 sq. ft.
12	38	22	108
15	40	26	135
18	44	28	162
20	46	30	180

TABLE II.—H. P. OF 2 FLUE BOILERS AT 12 FEET.

H. P.	Diam. Boiler.	Diam. Flues.	Length.	Heat. Surf.
15	34 in.	10 in.	18 ft.	176 sq. ft
18	36	12	20	222
20	40	14	20	254
22	44	16	18	260
25	46	17	20	302

TABLE III.—H. P. OF 5 FLUE BOILERS AT 12 FEET.

H. P.	Diam. Boiler.	Diam. Flues.	Length.	Heat Surf.
20	44 in.	2—10 in. 3— 8	14 ft.	245 sq. ft.
25	46	1—13 2— 9 2— 8	16	
30	50	1—14 2—10 1— 8	18	356

TABLE IV.—H. P. OF BOILERS WITH 6-INCH LAP WELDED TUBES AT 12 FEET.

H. P.	Diam.	Length.	No of Flues.	Heat Surf.
15	42 in.	12 ft.	6	179 ft.
20	42	16	6	239
25	44	18	7	302
30	46	18	9	363
36	46	20	10	434
42	48	20	12	503

TABLE V.—H. P. OF BOILERS WITH 3-INCH TUBES AT 15 FEET.

H. P.	Diam.	Length.	No of Tubes.	Heat Surf.
15	36 in.	8 ft.	30	227 ft.
19	36	10	30	283
22	36	12	30	339
27	40	12	36	402
31	44	12	42	465
36	44	14	42	513
42	48	14	50	638

In regard to the diameter and length of a boiler, it might be observed that cylinder boilers are usually made from 18 to 30 feet in length, and from 30 to 48 inches in diameter. Flue boilers from 18 to 24 feet in length, and from 36 to 60 inches in diameter. Tubular from 8 to 18 feet in length, and from 30 inches to 5 feet in diameter.

Boilers having lap-welded tubes increase in extra cost when their lengths exceed 18 feet. These tubes would have to be made to order, which, in case of repairs, might cause considerable loss of time in having to wait for them to be made. It is better to keep the diameters of boilers below 4 feet than go over it, using two or more boilers as may be needed to furnish the requisite amount of steam.

In large and important works the subjects of boilers, engines, etc., ought to be referred to a competent mechanical engineer, who will advise as to the kind, size, and number to be employed. *The Mill Stone.*

To find the contents of cylinder boilers multiply the area of the head in inches by the length in inches and divide the product by ·1728 ; the quotient will be the number of cubic feet of water the boiler will contain. Example : Diameter of head, 36 inches ; area of head, 1017.87 inches ; length of boiler, 20 feet or 240 inches. Now multiply 1017.87 by 240 and the product will be 244,283.80 ; divide this by .1728 and the result will be 141.37 cubic feet, which will be the contents of the shell.

In flue boilers, multiply area of the head in inches by the length of the shell in inches ; multiply the combined area of the flues in inches by their length in inches, subtract this product from the first and divide the remainder by ·1728 ; the quotient will be the number of cubic feet of water the boiler will contain.

To find the Length of Belting when closely Rolled.—The sum of the diameters of the roll and the eye in inches, multiplied by the number of turns made by the belt, and this product multiplied by the decimal .1309, will be the length of the belt in feet. *Auchinchloss.*

To Measure Scantlings, Joists, Plank, Sills, &c.—*Rule.*—Multiply the width, the thickness and the length together (the width and thickness in inches and the length in feet), and divide the product by 12 ; the result will be the square feet. *To Measure Boards*—Multiply the length (in feet) by the width (in inches) and divide the product by 12 ; the result will be the number of square feet it contains.

Explosive force of various substances used for fire arms, artillery, blasting, &c.

	Heat.	Volume of Gas.	Estimated Explosive Force.
Blasting Powder	509	0.173 liter.	88
Artillery "	608	0.225 "	137
Sporting "	641	0.216 "	139
Powder, Nitrate of Soda for its base	764	0.248 "	190
Powder, Chlorate of Potash for its base	972	0.318 "	309
Gun Cotton	590	0.801 "	472
Picric Acid	687	0.780 "	536
Picrate Potash	578	0.585 "	680
Gun Cotton mixed with Chl. Potash	1420	0.484 "	680
Picric Acid " " "	1424	0.408 "	582
Picrate " " "	1422	0.337 "	478
Nitro-Glycerin	1320	0.710 "	939

The above instructive table is by the celebrated M. Berthelot, who further describes nitro-glycerin as "really the ideal of portable force. It burns completely without residue ; in fact, gives an excess of oxygen ; it developes twice as much heat as powder, three and a half times more gas, and has seven times the explosive force, weight for weight, and, taken volume for volume, it possesses twelve times more energy." From the extreme danger of the work, none but a competent chemist should attempt to manufacture it.

Many other explosives derive their energy from nitro-glycerin. *Dynamite* is nitro-glycerine compounded with rotten-stone, or silicious, or infusorial earth, tripoli, &c.; a compound of nitro-glycerin and saw-dust has been sold under the name of *dualin;* a mixture of plaster of Paris and nitro-glycerin has been sold under the name of "selenitic powder;" and fine powder, blended with nitro-glycerin, has been vended under the name of "lithofracteur," or "rendrock." The practical miner will be interested in the above, as well as in the following :—

TABLE SHOWING THE QUANTITY OF GOLD TO THE TON OF ORE, CORRESPONDING TO THE WEIGHTS IN GRAINS OBTAINED FROM 400 GRAINS OF MINERAL.

If 400 grains of Ore give Fine Gold,	One ton of Ore will yield,			If 400 Grains of Ore give Fine Gold,	One ton of Ore will yield,		
Grains.	Ozs.	Dwts.	Grs.	Grains.	Ozs.	Dwts.	Grs.
.001..........	0	1	15	.200.........	16	6	16
.002	0	3	6	.300.........	24	10	0
.003......... .	0	4	21	.400.........	32	13	8
.004..........	0	6	12	.500.........	40	16	16
.005..........	0	8	4	.600.........	49	0	0
.006..........	0	9	19	.700.........	57	3	8
.007..........	0	11	10	.800.........	65	6	16
.008..........	0	13	1	.900.........	73	10	0
.009..........	0	14	16	1.000.........	81	13	8
.010..........	0	16	8	2.000	163	16	16
.020..........	1	12	16	3.000.	245	0	0
.030..........	2	9	0	4.000.........	326	13	8
.040..........	3	5	8	5.000.........	408	6	16
.050..........	4	1	16	6.000.........	490	0	0
.060..........	4	18	0	7.000	570	13	8
.070..........	5	14	8	8.000.........	653	6	16
.080..........	6	10	16	9.000.........	735	0	0
.090..........	7	7	0	10.000.........	816	13	8
.100..........	8	3	8	20.000.........	1633	6	16

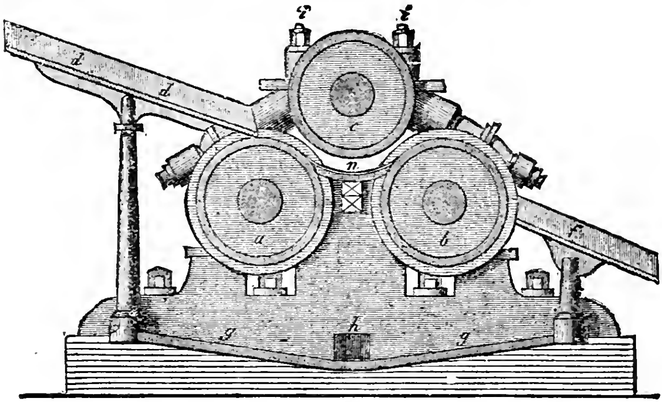
Mr. Black, of San Francisco, estimates that in mining operations the average cost of handling a cubic yard of auriferous gravel with the pan is $20; with the rocker, $5; with the long tom, $1; and with the hydraulic process, 20c. See other items for miners on page 451. An excellent compilation on this subject is "The Miner's Hand-Book," by Julius Silvermith, for sale by D. Van Nostrand, New York.

TABLE SHOWING THE AVERAGE VELOCITIES OF VARIOUS BODIES.,

	Per hour.		Per sec.
A man walks....................................	3 miles,	or	4 feet.
A horse trots......	7 "	or	10 "
A horse runs....................................	20 "	or	29 "
Steamboat runs..................................	18 "	or	26 "
Sailing vessel runs.............................	10 "	or	14 "
Slow rivers flow................................	3 "	or	4 "
Rapid rivers flow..............	7 "	or	10 "
A moderate wind blows...........................	7 "	or	10 "
A storm moves....................	36 "	or	52 "
A hurricane moves...............................	80 "	or	117 "
A rifle ball "	1000 "	or	1466 "
Sound "	743 "	or	1142 "
Light "	192000 miles per sec.		
Electricity "	288000 " " "		

Parker's Philosophy.

ENORMOUS RESULTS OF STEAM POWER.—The aggregate steam-power in use in the world is at present three and one-half millions horse-power employed in stationary engines, and ten millions horse-power in locomotive engines. This force is maintained without the consumption of animal food, except by the miners who dig the coals, and the force maintained in their muscles is to the force generated by the product of their labor about 1 to 1,080. This steam-power is equal to the working force of 25 millions of horses, and one horse consumes three times as much food as one man. The steam-power, therefore, is equivalent to the saving of food for 75 millions of human beings. Further, three power-looms attended by one man, produce 78 pieces of cotton fabric, against 4 pieces produced by one hand-loom, worked by one man in the year 1800. A carpenter's planing machine does the work of twenty men.



SUGAR MILL.

SUGAR MILL.—The sugar canes are crushed in a press consisting of three hollow cast iron rollers, represented in the cut by *a b c*, placed horizontally in a cast iron frame. By means of the screws, *i*, *i*, the approximate distance of the rollers is adjusted. One roller is half as large as the others, and is moved by three cogged wheels fitted on to the axis of the rollers. The sugar canes are transferred from the slate gutter, *d*, *d*, to the rollers, *a*, *c*, which press them a little, and from thence they are carried to the arched plate, *n*, to the rollers *c*, *b*. The pressed sugar canes fall over the gutter *f*, the expressed juice collecting in *g*, *g*, and running off through *h*. The middle roller is termed the king roller ; the side cylinders are individually the side roller and macasse.

SUGAR MILL.—*For Expressing 20,000 lbs of Cane Juice per day. Non-condensing Engine.* Cylinder 15 ins. in diameter by 4 ft. stroke. *Pressure*, 50 lbs. per sq. in., cut off at ½ the stroke of the piston. *Revolutions.* 36 per minute. *Boiler.* One of 62 ins. diam. by 30 ft. in length, with 2 18-in. return flues. *Grates.* 36 Square ft. *Rolls.* Two sets of three each, of 24 ins. diam. by 5 ft. in length ; geared 2½ to 36 of engine, giving a speed of periphery of 15½ ft. per minute. *Fly-Wheel.* 18 ft. diam. ; weight 5 tons.

This arrangement of a second set of rolls is a late improvement ; its object, that of expressing the cane a second time. An increase of 30 per cent. is effected by it.

FOR A CROP OF 3000 BOXES OF SUGAR OF 500 LBS. EACH.—*Cylinder.* 10 ins. in diam. by 4 ft. stroke. *Pressure,* 60 lbs. per square in. *Revolutions* 48, driving 1 set of rolls, 24 ins by 4 ft., at a speed of periphery of 36 ft. per minute. *Boiler.* 52 ins. by 24 ft., with 2 16-in return flues. *Grate Surface.* 25 square ft. *Fly Wheel.* 16 ft. diam.; weight. 4 tons. *Engineers' and Contractors' Pocket Book.*

COTTON PRESS. *Non-condensing Engine. For* 1000 *Bales in* 12 *hours.* Cylinder 14 in. in diam. by 4 ft. stroke. *Pressure.* 40 lbs. per sq.. at full stroke. *Revolutions.* 60 per minute. *Boilers.* Three, plain cylindical, without flues, 30 in. in diam. by 26 ft. in length. *Grates.* 32 square ft. *Presses.* Four, geared 6 to one, with 2 screws each of 7½ in. diam., by 1⅝ in. pitch. *Shaft (Wrought Iron).* Journal, 8½ in. *Fly-wheel.* 16 ft. diameter, weight, 4 tons.

RULES TO ASCERTAIN THE PRESSURE OV SLIDE VALVES.—Multiply the unbalanced area of the valve in inches by the pressure of steam in lbs. per square inch, and the weight of the valve in lbs., and multiply the sum by 0·15

TO GET AN ENGINE INTO LINE AND SQUARE THE SHAFT.—Set up two lines, one parallel to the axis of the cylinder, or through the cylinder, if possible, and the other perpendicular to the first, in the same plane. These are reference lines to measure from, to bring the shaft and guide into line.

HINT TO MACHINISTS.—In turning steel or other hard metal, use a drip composed of petroleum 2 parts, and turpentine 1 part. This will ensure easy cutting and perfect tools when otherwise the work would stop owing to the breakage of tools from the severe strain.

TO MELT BRASS TURNINGS AND FILINGS WITH LITTLE WASTE.—Compress firmly in a crucible until it is full; then cover, and lute the top with pipe or fire-clay. Brass scraps may be melted with new brass, putting it in with the zinc after the copper is melted.

TO TEMPER ANVILS.—Heat the anvil and immerse it in a tank of cold water to a depth of two or three inches, or play a stream of cold water from a hose on its face.

PROPER SIZE, SPEED, &C., OF EMERY WHEELS.

Diam. of Wheel in inches.	Rev. per minute.	Number of Emery.	Grade of Cut.
2	5600	8 to 10	Wood Rasp.
4	3000	16 to 20	Rasp File.
6	2000	24 to 30	Rough File.
8	1500	36 to 40	Bastard File.
10	1200	46 to 60	Second Cut File.
12	1100	70 to 80	Smooth File.
14	900	90 to 100	Superfine File.
16	750	120	Dead Smooth File.
18	700		
20	600		
22	550		
24	500		
26	450		
30	400		
36	325		

Emery wheels may be trued by means of a diamond tool, a red hot iron, or by a file applied to the wet periphery of the wheel. For emery cement, see page 424. In using emery paper or cloth for finishing, the paper, although the easiest to destroy, imparts the smoothest polish to the metal, and the longer it is used the better it polishes.

Number, Weight, Size, Length, and Breath of Tin Plates.

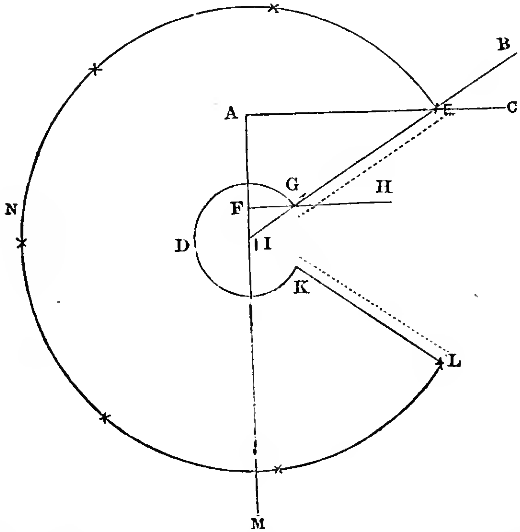
Brand Mark.	No. of Sheets in Box.	Length and Breadth. Inches. Inches.	Weight per Box. Cwt.	qr.	lbs.	
1 C	225	14 by 10	1	0	0	Each 1 x advances $1.75 to $2.00
1 x	225	14 by 10	1	1	0	
1 xx	225	14 by 10	1	1	21	
1 xxx	225	14 by 10	1	2	14	
1 xxxx	225	14 by 10	1	3	7	
1 xxxxx	225	14 by 10	2	0	0	
1 xxxxxx	225	14 by 10	2	0	21	
D C	100	17 by 12½	0	3	14	In addtion, a great varity of sizes are imported for special purposes, usually costing a little more in proportion than those which are esteemed regular sizes.
D x	100	17 by 12½	1	0	14	
D xx	100	17 by 12½	1	1	7	
D xxx	100	17 by 12½	1	2	0	
D xxxx	100	17 by 12½	1	2	21	
D xxxxx	100	17 by 12½	1	3	14	
D xxxxxx	100	17 by 12½	2	0	7	
S D C	200	15 by 11	1	1	27	
S D x	200	15 by 11	1	2	20	
S D xx	200	15 by 11	1	3	13	
S D xxx	200	15 by 11	2	0	6	
S D xxxx	200	15 by 11	2	0	27	
S D xxxxx	200	15 by 11	2	1	20	
S D xxxxxx	200	15 by 11	2	2	13	
T T T Taggers,	225	14 by 10	about 1	0	0	
1 C	225	12 by 12				About the same weight per Box, as the plates above of similar brand, 14 to 10.
1 x	225	12 by 12				
1 xx	225	12 by 12				
1 xxx	225	12 by 12				
1 xxxx	225	12 by 12				
1 C	112	14 by 20				
1 x	112	14 by 20				
1 xx	112	14 by 20				
1 xxx	112	14 by 20				
1 xxxx	112	14 by 20				
Leaded or Ternes 1 C	112	14 by 20	1	0	0	*For Roofing.*
Leaded or Ternes 1 x	112	14 by 20	1	1	0	

OIL CANISTERS, (*from* 2½ *to* 125 *galls.*) WITH THE QUANTITY AND QUALITY OF TIN REQUIRED FOR CUSTOM WORK.

Galls.	Quantity and Quality.	Galls.	Quantity and Quality.
2½	2 Plates, I X in body.	33	13½ Plates, IX in body, 3 breadths high.
3½	2 " S DX "		
5½	2 " DX "	45	13½ Plates, S D X in body
8	4 " IX "	60	13½ " D X "
10	3½ " DX "	90	15¼ " D X " *
15	4 " DX "	125	20 " D X "

* The bottom tier of plates to be placed lengthwise.

VARNISHES FOR PIPES AND IRON-WORK.—Coal tar, 30 gals.; tallow, 6 lbs.; rosin, 1½ lbs.; lamp-black, 3 lbs.; fresh slaked lime, finely sifted, 30 lbs. Stir all thoroughly together, and apply hot. *Another.*—Tar oil, 20 lbs.; asphaltum, 5 lbs.; powdered rosin, 5 lbs. Heat all together in an iron kettle, very carefully, to prevent ignition.

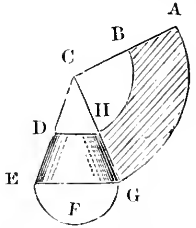


TO STRIKE OUT CAN TOPS AND BEVEL COVERS FOR VESSELS.—Describe the angle M A C, and from the point F, the altitude height you desire the breast, erect a perpendicular line H; then on the line C, mark the point E one-half the diameter of the can, and on the line H mark the point G one-half of the opening in the top of breast; draw the line B to cross through the points E and G to intersect the line M; place one foot of the compasses at the point I and the other on the point E, and delineate the circle E N L; next, span the compasses from point I to point G and outline the circle G D K; then span from A to E, and step the compasses six times on the circle E N L, which gives the dimensions of the breast. The allowance for the locks is represented by the dotted lines.

BEAUTIFUL BRONZE, APPLICABLE TO ALL METALS.—Take 10 parts aniline red (fuchsine), and 5 of aniline purple, and dissolve in 100 parts of 95 per cent. alcohol, taking care to help the solution by placing the vessel in a sand or water bath. As soon as the solution is effected, 5 parts of benzoic acid are added, and the whole is boiled from five to ten minutes until the greenish color of the mixture is transformed into a fine light-colored, brilliant bronze. Apply with a brush.

IMITATION NICKEL PLATING.—Coarse rasped granulated zinc is boiled for some time in a mixture of 3 parts by weight of sal ammoniac, and

10 of water, the objects immersed and stirred up with a zinc rod. The deposit is silvery bright, and resists mechanical action as well as a coating of nickel. The process can be recommended for goods which are meant for a second coating of some other metal, since any other is easily deposited on zinc.



HOW TO STRIKE OUT THE FRUSTRUM OF A CONE.—In the figure E G H D represent the desired frustrum; continue the lines D E and G H until they meet at the apex C; then from C as a centre, with the radius C H, lay off the arc H B; also from C, with the radius C G, describe the arc G A; make G A twice the length of E F G, drawing the line C A, and G H A B, is the desired outline of the plate you require.

TO FIND THE AREA OF AN ELLIPSE.

Rule.—Multiply the longer diameter by the shorter diameter, and by ·7854, and the product will be the area.

Example.—Required the area of an ellipse whose longer diameter is 6 inches and shorter diameter 4 inches?

$$6 + 4 + \cdot 7854 = 18 \cdot 8496, \text{ the area.}$$

TO FIND THE SURFACE OF A SPHERE OR GLOBE.—Multiply the diameter by the circumference; or multiply the square of the diameter by 3·1416; or multiply four times the square of the radius by 3·1416.

NO. OF AMERICAN MACHINE MADE CUT NAILS IN A POUND AS VERIFIED BY ACTUAL COUNT.

SIZE.	NUMBER.	SIZE.	NUMBER.	SIZE.	NUMBER.
3 penny	408	6 penny	156	12 penny	52
4 "	275	8 "	100	20 "	32
5 "	227	10 "	66	30 "	25

SPIKES.

Boat.			*Ship.*		
No. 4	1-4 in.	13 to 1 lb.	No. 4	5-16 in.	8 to 1 lb.
No. 5	5-16 in.	8 "	No. 5	3-8 in.	6 "
No. 6	3-8 in.	5 "	No. 6	3-8 in.	5 "
No. 7	5-8 in.	4 "	No. 7	3-8 in.	3½ "
			No. 8	3-8 in.	3 "
			No. 9	9-16 in.	2 "
			No. 10	9-16 in.	1½ "

NOTE ON FORGINGS.—Iron, while heating, if exposed to air, will *oxydize*; when at white heat, if in contact with coal, it will *carbonize*, or become steely. Iron should be heated as rapidly as possible.

TO RESTORE BURNT IRON.—Give a smart heat, protected from the air; if injured by *cold hammering*, anneal slowly and moderately; if *hard* or *steely*, give one or more smart heats, to extract the carbon.

COST OF A PENNSYLVANIA RAILROAD PASSENGER CAR.—The London *Engineering* gives in detail the cost of constructing one first-class Standard Passenger Car, at the Altoona shops of the Pennsylvania R.R., the total cost being $4,423.75. The principal items are as follows :—

Labor	$1263 94	57 Sash Balances	44 61
Proportion of Fuel and Stores	28 61	61 Lights Glasses	65 83
2480 feet Poplar	86 80	2 Stoves	77 56
3434 feet Ash	127 08	25 Sets Seat Fixtures	50 50
1100 feet Pine	20 90	3 Bronze Lamps	13 50
2350 feet Yellow Pine	70 50	2 Bronze Door Locks	15 20
500 feet Oak	10 00	Butts and Hinges	15 58
450 feet Hickory	13 50	13 Basket Racks	77 35
700 feet Michigan Pine	49 00	12 Sash Levers	42 00
400 feet Cherry	16 00	61 Bronze Window Lifts	24 40
439 feet Maple vineer	24 14	61 Window Fasteners	16 47
4 pairs Wheels and Axles	332 85	238 Sheets Tin	41 44
2 pairs Passenger Car Trucks	533 62	273 lbs. Galvanized Iron	25 31
13 gallons Varnish	52 34	96 yards Scarlet Plush	228 87
45 lbs. Glue	14 33	44 yards Green Plush	109 99
2925 lbs. Iron	87 75	61 yards Sheeting	10 30
792 lbs. Castings	16 99	243 lbs. Hair	72 95
Screws	51 88	12 Springs	22 96
Gas Regulator and Gauge	25 25	12 Spiral Elliptic Springs	20 29
2 Two-Light Chandeliers	50 72	1 Head Lining	80 63
2 Gas Tanks	84 00	2 packets Gold Leaf	14 58
1 Air-Brake, complete	131 79	Various small items	261 44
			$4,423 75

COMPARATIVE COST OF FREIGHT BY WATER AND RAIL.—The Missisipi Transportation Co. have proved by actual test that a single Towboat can transport at one trip from the Ohio to New Orleans, 29,000 tons of coal loaded in barges. They estimate that in this way the boat and its tow, worked by a few men, carries as much freight to its destination as 3,000 cars and 100 locomotives, manned by 600 men, could transport, and they propose to undertake the shipment of wheat, pork, and other produce on the same plan.

A standard locomotive of the New York Central Railroad, 32½ tons weight, with cylinders 16 inches diameter, 24-inch stroke, 60-inch drivers with four drivers and four truck wheels, will haul over the Central Railroad, with its level grades and straight line, 1,000 tons, or say 50 loaded cars. The same locomotive would work as follows :

20-foot grade	460 tons	or say 23 loaded cars.
40-foot grade	290 tons	or say 14½ loaded cars.
60-foot grade	205 tons	or say 10 loaded cars.
80-foot grade	150 tons	or say 8 loaded cars.
100-foot grade	120 tons	or say 6 loaded cars.

PASSENGER CARS—4 FEET 8½ INCHES GAUGE.—For 60 persons ; Body 48 ft.; length over platform, 54 ft.; width, 9 ft. 6 ins.; height at sides, 7 ft. 10 ins.; at dome, 10 ft. 3 ins.; saloon, 6 ft.× 2 ft. 9 ins.; passage between seats, 1 ft. 10 ins.; seats 1 ft. 4 ins. wide, 3 ft. 2 ins. long inside, 1 ft. 4 ins. from floor; sash lights, 2 ft.× 2 ft. 7 ins.; doors, 2 ft. 3 in.× 6 ft. 4 ins.; framing—2 side sills, 5½× 9 ; 4 inside do., 4×9 ; end do., 6×9 ; transom beams, 9×14 ; pillars, 2×3 ; end do., 5 ins. rad. ; flooring 1⅛ ins., double, laid diagonal, crossed at angle of 45° ; 2 truss rods, 1⅛ ins., iron ; dome braced by iron knees, 2×⅜ ins. ; platforms, 2 ft. 6 ins. wide ; bumper beam, 7×8 at centre, 4×3½ at ends ; weight, empty, 39,000 lbs. ; dead weight per passenger, 650 lbs. ; weight, loaded, 46,980 lbs. ; load on each wheel, light, 3,250 lbs.; if loaded, 3,915 lbs.

SLEEPING COACH.—For 64 passengers : Body 61 ft. long, 8 ft. 10 ins, wide inside, 7 ft. 10 ins. high at sides, 9 ft. 7 ins. at dome ; carried on twelve 33-in. wheels, 16 elliptic springs, 36-in. centres, 5 leaves, 5-16 ins., 1 do., $\frac{3}{8}\times3\frac{1}{2}$, steel—weight, $93\frac{3}{4}$ lbs. each—and 8 rubber springs over axles, 8×7; dead weight, without passengers, 26 tons, or 812.5 lbs. per passenger; if loaded, 945.5 lbs. per passenger; load on each wheel—5.042 lbs. Western Palace Cars, on 16 wheels, loaded, weigh, 78,500 lbs., or 4,907 lbs. load on each wheel.

BOX CARS.—27 ft. 5 ins. long, 8 ft. 6 ins. wide, 7 ft. 3 ins. high at sides, 8 ft. at roof; doors, 5 ft.$\times$5 ft. 10 ins.; track to top of car, 10 ft. 10 ins.; timbers—2 side sills, $4\frac{1}{4}\times8$; 4 inside do., $3\frac{1}{2}\times8$; end do., $5\times8\frac{1}{2}$; transoms, 5×12; pillars for doors, $3\frac{1}{2}\times4$; end do., $3\frac{1}{2}\times4\frac{1}{2}$; plates, $5\times3\frac{1}{2}$; ridge beam, $2\frac{1}{2}\times3\frac{1}{2}$; rafters—$1\frac{3}{4}\times3\frac{1}{2}$ at sides, $1\frac{3}{4}\times12$ at centre; intermediates $1\frac{3}{4}\times2\frac{1}{2}$; weight, 17,800 lbs.; do., loaded, 37,800 lbs.; dead weight for each ton carried, if loaded, 1,780 lbs.; load on each wheel, if light, 2,225 lbs.; if loaded to capacity, 4,725 lbs.

BAGGAGE CARS.—45 ft. long, 9 ft. 4 ins. wide, 7 ft. 4 ins. at sides, 9 ft. at crown of roof; end doors, 2 ft. 2 ins.$\times$6 ft. 4 in.; end side doors, 3 ft. $\times$6 ft. 2 ins.; centre doors, 3 ft. 10 ins. $\times$ 6 ft. 2 ins.; timbers—6 longitudinal sills, $5\frac{1}{2}\times9\frac{1}{2}$; 4 truss rods, $1\frac{1}{8}$ ins., iron; weight of car, 27,000 lbs.; capacity, 12 tons; total weight, if loaded, 51,000 lbs.; carried on 8 wheels =6,375 lbs. on each wheel.

COAL CARS—8 WHEELS.—10-ton, 8-wheel cars: Body, 20 ft. long, 21 ft. 10 in. over all; 7 ft. wide, 7 ft. 8 in. over all$\times$4 ft. high; from top of rail to body, 2 ft. $6\frac{1}{2}$ ins.; rail to centre of buffer, 2 ft. $7\frac{1}{2}$ ins.; buffers, 10×12 ins.; 2 ft. 1 in. centre to centre; total weight, empty, 13,440 lbs.; loaded, 35,840 lbs.; per wheel=4,480 lbs.

COAL CARS—4 WHEELS.—6 tons, 4 wheels: Body, 11 ft. long; over all, 13 ft.$\times$6 ft. 7 ins. wide; 7 ft. 5 ins. over all$\times$4 ft. 3 ins. high; frame of oak, $4\frac{1}{4}\times8\frac{1}{2}$; end sills, $8\frac{1}{2}\times9\frac{1}{2}$; body carried on 4 oak springs, each $3\times6\frac{3}{4}$; at ends, $2\frac{1}{2}\times6\frac{3}{4}\times9$ ft. long, bolted together · wheels, 5 ft. centre to centre; journal boxes bolted to the springs; weight, empty, 6,720 lbs., loaded, 20,160 lbs.; on each wheel=5,040 lbs.

ENGLISH RAILWAY CARRIAGES—4 FEET $8\frac{1}{2}$ INCHES GAUGE.—Extreme length over buffers, 22 ft.; frame, 17 ft. 11 ins. long$\times$6 ft. 8 ins. wide; body, 18 ft. long$\times$7 ft. 4 ins.$\times$6 ft. 2 ins. high; compartments, each 6 ft. long; sides and ends of under framing, 11×4; transoms, $9\times3\times11\times3$; framing of body, $3\times2\frac{1}{2}\times2\frac{1}{2}\times2\frac{1}{2}$; flooring, 2 thicknesses of $\frac{3}{4}$ boarding, laid diagonally; roof, $\frac{3}{4}$ thick on ribs, $2\frac{1}{2}\times1\frac{3}{4}$, 2 feet apart; doors, 1 ft. 11 ins.$\times$5 ft. 5 ins. high; seats, 1 ft. 6 ins. from floor; wheels, 36 ins. diam 9 ft. centre; journals, 6 ft. 4 ins. apart.

FREIGHT WAGONS.—Bodies, 7 ft. 6 ins. wide$\times$16 ft. long, 20 ft. over buffers; open wagons, sides, 2 ft. to 4 ft. 6 ins. high; covered goods wagons, sides, 6 ft. 9 ins. high.

MECHANICAL MOVEMENTS.

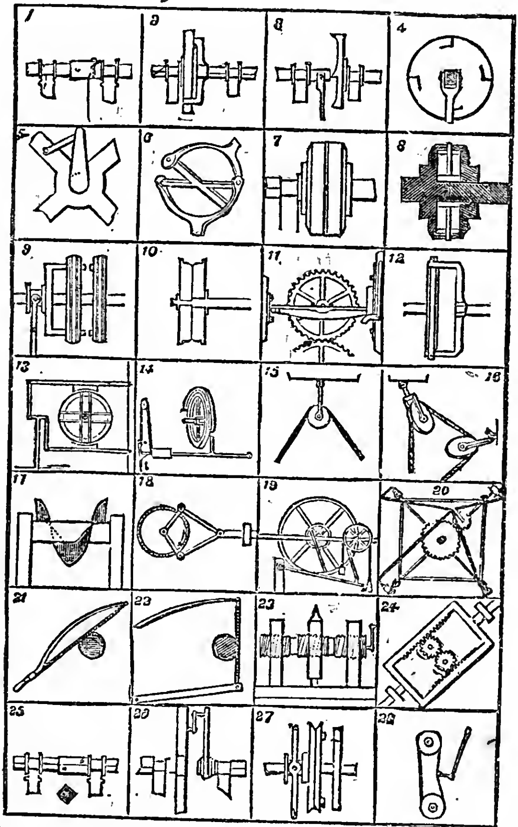
IN the construction of models, or machinery, the skilful mechanic and inventor will study to avoid clumsiness in the arrangement of parts, and will naturally take pride in selecting, as far as possible, the simplest and best forms of mechanical movements. As suggestive for this purpose we have brought together and condensed an extensive series of mechanical movements. Here the mechanic may find at a glance the movement suited for his purpose, and may see the separate parts best adapted to any special combination of mechanism.

The following is a brief description of the various movements as numbered:

1. Shaft coupling. 2. Claw coupling. 3. 4. Lever couplings. On the driving shaft, a disk with spurs is mounted, and to the shaft to be driven a lever is hinged. By causing this lever to catch in the spurs of the disk

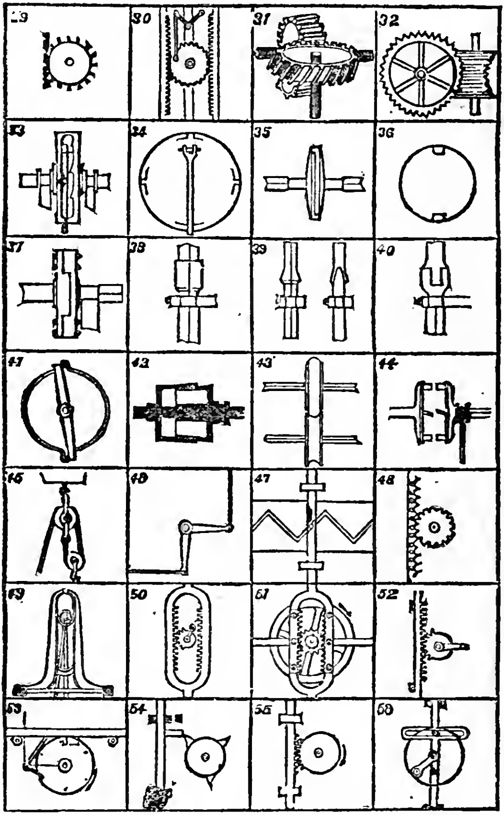
the coupling is effected. 5. Knee or rose coupling, of which 26 is a side view.

6. Universal joint. 7. 8. Disk and spur coupling. 9. Prong and spur lever coupling.



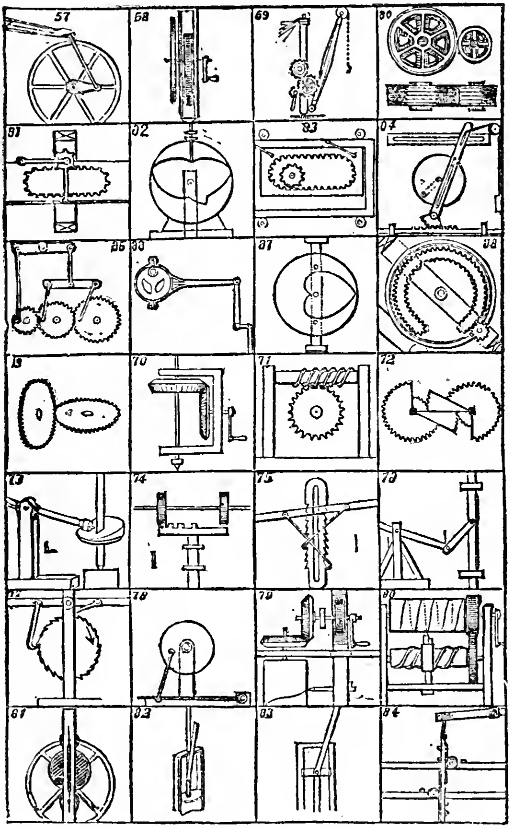
10. Fast and loose pulley. 11. Sliding gear, the journal boxes of one of the wheels being movable. 12. Friction clutch. By tightening or releasing a steel band, encircling a pulley on the shaft, the machinery is thrown in or out of gear. 13. 14. Shoe and lever brakes. 15. 16. Change of motion by sheaves. 17. Spiral flanged shaft. 18. Connected with the rod are pawl links, catching into ratchet-teeth in the wheel to which rotary motion is to be imparted. When the rod moves in one direction, one of the pawls acts ; and when the rod moves in the opposite direction,

the other pawl acts in the same direction as the first. 19. The reciprocating motion of a rod is converted into rotary motion of the fly-wheel by a weight suspended from a cord, which passes over a small pulley that connects with a treadle, from which the motion is transmitted to the fly-wheel.



20. "Flying horse," used in fairs for amusement. By pulling the cords radiating from the crank, the persons occupying the seats or horses on the ends of tne arms are enabled to keep the apparatus in motion. 21. 22. Bow-string arrangements to connect reciprocating into rotary motion. 23. Same purpose by differential screw. 24. The same by double rack and wheels. 25. Coupling for square shafts. 26. Side view of Fig. 5. 27. Sliding-spur pulley coupling. 28. Lever with bearing roller to tighten pulley bands. 29. Chain wheel.

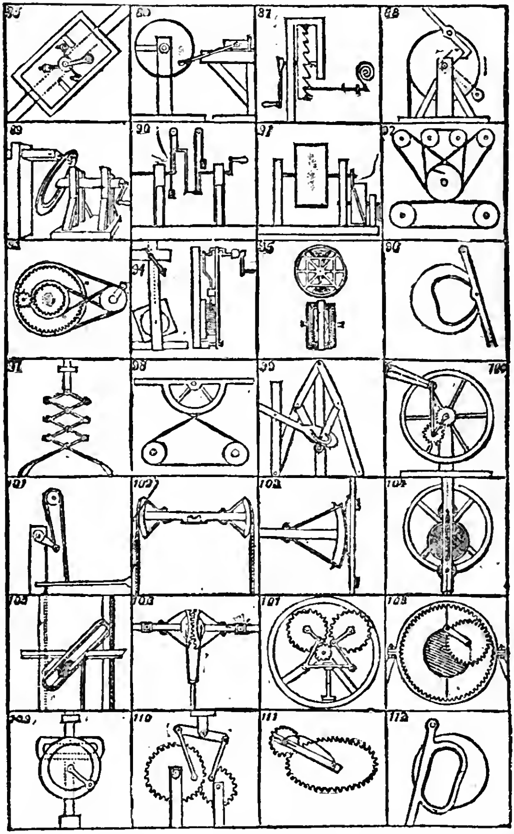
30. Reciprocating rectilinear into reciprocating rotary motion by two racks and cog-wheel. 31. Oblique-toothed wheels. 32. Worm and worm-wheel. 33. 34. Claw coupling with hinged lever. 35. 36. Disk couplings, with lugs and cavities. 37. Disk coupling with screw bolts. 38. 39. 40. Shaft couplings.



41. Face view of Fig. 12. 42. Friction cones. 43. Friction pulleys. 44. Self-releasing coupling. Disks with oblique teeth. If the resistance to the driven shaft increases beyond a certain point, the disks separate. 45. Hoisting blocks. 46. Elbow crank, for changing motion. 47. Reciprocating into rotary motion by zigzag groove on cylinder. 48. Another form of Fig. 29. 49. Reciprocating into a rotary motion.

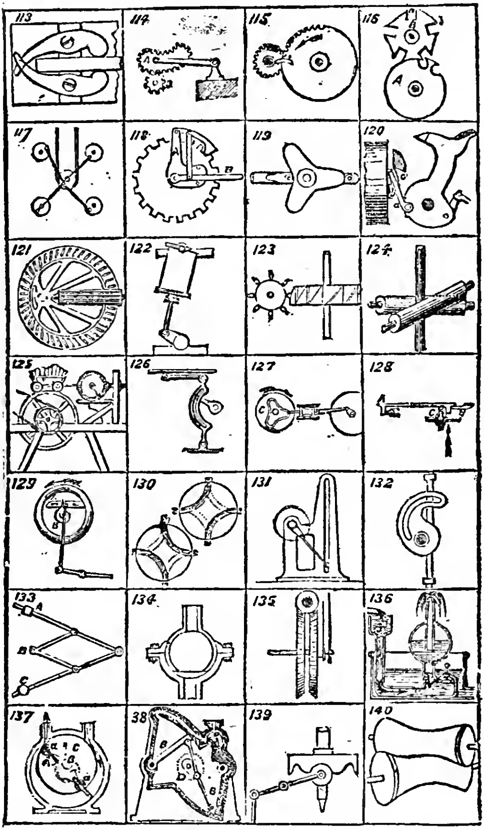
50. Same purpose. 51. Same purpose, by double rack and two ratchet pinions. When the double rack moves in one direction, one

pinion is rigid with the shaft: when the rack moves in the opposite direction, the other pinion is rigid, and a continuous rotary motion is imparted to the fly-wheel shaft. 52. Reciprocating into oscillating. 53. Rotary into reciprocating. By the action of the wheel-pins the carriage



is moved in one direction, and by the action of said pins on an elbow-lever, it is moved in the opposite direction. 54. Stamp rod and lifting cam. 55. For giving reciprocating motion to rack. 56. Same motion to a bar with slot, by means of an eccentric pin, projecting from a revolving disk, and catching in the slot. 57. Walking-beam and fly-wheel. 58. Reciprocating motion to pump or other rod by means of eccentric disk and friction rollers. See 81 and 104. 59. Hoisting crane.

60. Friction gears. See 43. 61. Rotary into reciprocating by rising and falling pinion acting on endless rack. 62. By the revolving cam, a rising and falling or a reciprocating rectilinear motion is imparted to a drum. 63. Reciprocating motion to a frame by means of endless rack and pinion. 64. Reciprocating rectilinear motion to a toothed rack by a



toothed segment on a lever-arm, which is subjected to the action of a weight, and of an eccentric wrist-pin, projecting from a revolving disk. 65. Reciprocating motion to a rod. The wheels are of different diameters, and consequently the rod has to rise and fall as the wheels revolve. (See 110.) 66. Cam and elbow-lever. 67. Rod reciprocates by means of cam. 68. Revolving into reciprocating motion, by an endless segmental rack and pinion, the axle of which revolves and slides in a slot toward and from the rack. This rack is secured to a disk, and a rope round said disk extends to the body to which a reciprocating motion is to be imparted. 69. Elliptic gears.

70. Bevel gear. 71. Worm and worm-wheel. 72. Transmitting motion from one axle to another, with three different velocities, by means of toothed segments of unequal diameters. 73. Continuous revolving into reciprocating, by a cam-disk acting on an oscillating lever. 74. Intermittent revolving motion to a shaft with two pinions, and segment gear-wheel on end of shaft. 75. Oscillating lever, carrying pawls which engage teeth in the edges of a bar to which rectilinear motion is imparted. 76. Oscillating lever, connects by a link with a rod to which a rectilinear motion is imparted. 77. Oscillating lever and pawls, which gear in the ratchet-wheel. 78. Common treadle. 79. Describing on a revolving cylinder a spiral line of a certain given pitch which depends upon the comparative sizes of the pinion and bevel-wheels.

80. Marking a spiral line, the graver moved by a screw. 81. (See Fig. 58.) 82. Plunger and rods. 83. Crosshead and rods. 84. Reciprocating rod guided by friction rollers. 85. Revolving into reciprocating motion, by means of roller-arms, extending from a revolving shaft, and acting on lugs projecting from a reciprocating frame. 86. Crank motion. 87. Reciprocating motion by toothed wheel and spring bar. 88. The shaft carries a taper, which catches against a hook hinged to the drum, so as to carry said drum along and raise the weight on the rope. When the tappet has reached its highest position, the hook strikes a pin, the hook disengages from the tappet, and the weight drops. 89. Reciprocating motion to a rod by means of a groove in an oblique ring secured to a revolving shaft.

90. Double crank. 91. Cam groove in a drum, to produce reciprocating motion. 92. Belts and pulleys. 93. Pulleys, belts, and internal gear. 94. As the rod moves up and down, the teeth of the cog-wheel come in contact with a pawl, and an intermittent rotary motion is imparted to said wheel. 95. By turning the horizontal axles with different velocities, the middle wheel is caused to revolve with the mean velocity. 96. Oscillating lever and cam groove in a disk. 97. Lazy tongs. 98. Oscillating segment and belt over pulleys. 99. Converting oscillating into a reciprocating motion by a cam-slot in the end of the oscillating lever which catches over a pin projecting from one of the sides of a parallelogram which is connected to the rod to which reciprocating motion is imparted.

100. Oscillating motion of a beam into rotary motion. 101. Motion of a treadle into rotary motion. 102. Double-acting beam. 103. Single-acting beam. 104. (See Figures 58 and 81.) 105. Device to steady a piston by a slotted guide-piece, operated by an eccentric on the driving-shaft. 106. Rod operated by two toothed segments. 107. Two cog-wheels of equal diameter, provided with a crank of the same length, and connected by links with a cross-bar to which the piston-rod is secured. 108. Device for a rectilinear motion of a piston-rod based on the hypocycloidal motion of a pinion in a stationary wheel with internal gear. If the diameter of the pinion is exactly equal to one half the diameter of the internal gear, the hypocycloid becomes a sight line. 109. Same purpose as 56.

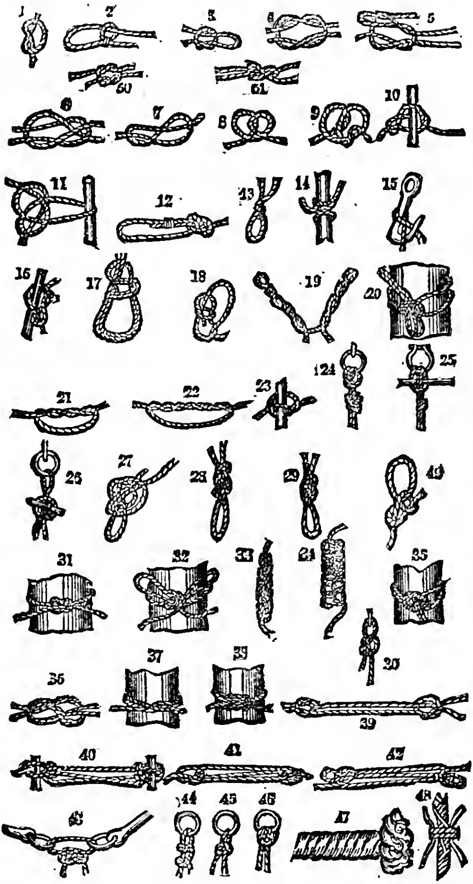
110. Action similar to 65. 111. Revolving motion by a circular sliding pinion gearing in an elliptical cog-wheel. 112. Similar to 96. 113. Carpenter's clamp. The jaws turn on their pivot-screws, and clamp the board. 114. An irregular vibratory motion is given to the arm carrying the wheel A, by the rotation of the pinion B. 115. Intermittent rotary

motion of the pinion-shaft, by the continuous rotary motion of the large wheel. The part of the pinion shown next the wheel is cut on the same curve as the plain portion of the circumference, and, therefore, serves as a lock whilst the wheel makes a part of a revolution, and until the pin upon the wheel strikes the guide-piece upon the pinion, when the pinion-shaft commences another revolution. 116. Stop-motion used in watches to limit the number of revolutions in winding up. The convex curved part, *a*, *b*, of the wheel B, serving as the stop. 117. Several wheels, by connecting-rods, driven from one pulley. 118. Intermittent circular motion is imparted to the toothed wheel by vibrating the arm B. When the arm B is lifted, the pawl is raised from between the teeth of the wheel, and travelling backward over the circumference again, drops between two teeth on lowering the arm, and draws with it the wheel. 119. Reciprocating rectilinear motion is given to the bar by the continuous motion of the cam. The cam is of equal diameter in every direction measured across its centre.

120. Mechanism for revolving the cylinder in Colt's fire-arms. When the hammer is drawn back the dog, *a*, attached to the tumbler, acts on the ratchet, *b*, on the back of the cylinder, and is held up to the ratchet by a spring, *c*. 121. Alternate increasing and diminishing motion, by means of eccentric toothed wheel and toothed cylinder. 122. Oscillating or pendulum engine. The cylinder swings between trunnions like a pendulum. The piston-rod connects directly with crank. 123. Intermittent rotary motion. The small wheel is driven, and the friction rollers on its studs move the larger wheel by working against the faces of oblique grooves or projections across the face thereof. 124. Longitudinal and rotary motion of the rod is produced by its arrangement between two rotating rollers, the axles of which are oblique to each other. 125. Friction indicator of Roberts. Upon the periphery of the belt-pulley a loaded carriage is placed, its tongue connected with an indicator. With a given load the indicating pointer remains in a given position, no matter what velocity is imparted to the pulley. When the load is changed the indicator changes, thus proving that the friction of wheels is in proportion to load, not velocity. 126. Circular intermittent rectilinear reciprocating motion. Used on sewing-machines for driving the shuttle; also on three-revolution cylinder printing-presses. 127. Continuous circular into intermittent circular motion. The cam is the driver. 128. Sewing-machine, four-motion feed. The bar B carries the feeding-points or spurs, and is pivoted to slide A. B is lifted by a radial projection on cam C, which at the same time also carries A and B forward. A spring produces the return stroke, and the bar, B, drops by gravity. 129. Patent crank motion, to obviate dead centres. Pressure on the treadle moves the slotted slide A forward until the wrist passes the centre, when the spring B forces the slide against the stops until next forward movement.

130. Four-way cock. 131. One stroke of the piston gives a complete revolution to the crank. 132. Rectilinear motion of variable velocity is given to the vertical bar by rotation of the shaft of the curved arm. 133. Pantagraph for copying, enlarging, and reducing plans, etc. C, fixed point. B, ivory tracing point. A, pencil trace, the lines to be copied with, and B, the pencil, will reproduce it double size. Shift the slide to which C is attached, also the pencil slide, and size of the copy will be varied. 134. Ball-and-socket joint for tubing. 135. Numerical registering device. The teeth of the worm shaft-gear with a pair of worm-wheels of equal diameter, one having one tooth more than the other. If the first wheel has 100 teeth and the second 101, the pointers will indicate respectively 101 and 10,100 revolutions. 136. Montgolfier's

hydraulic ram. The right hand valve being kept open by a weight or spring, the current flowing through the pipe in the direction of the arrow, escapes thereby. When the pressure of the water current



overcomes the weight of the right valve, the momentum of the water opens the other valve, and the water passes into the air-chamber. On equilibrium taking place, the left valve shuts and the right valve opens. By this alternate action of the valves, water is raised into the air-chamber at every stroke. 137. Rotary engine. Shaft B and hub C are arranged eccentric to the case. Sliding radial pistons, *a*, *a*, move in and out of hub, C. The pistons slide through rolling packings in the hub C. 138. Quadrant engine. Two single-acting pistons, B, B, connect with crank D. Steam is admitted to act on the outer sides of the pistons alternately through valve *a*, and the exhaust is between the pistons. 139. Circular into rectilinear motion. The scolloped wheel communicates motion to the horizontal oscillating rod, and imparts rectilinear movement to the upright bar. 140. Rotary motion transmitted by rolling contact between two obliquely arranged shafts. *Scientific American Reference Book.*

SPECIAL NOTE TO INVENTORS.—For full and complete information relating to the obtaining of Patents, Inventors, and others interested, are referred to *the Scientific American Hand-Book*, forwarded free by mail on application to Munn & Co., 37 Park Row, New York.

Information can also be obtained by addressing Coyne & Co., office *Western Manufacturers* Chicago, Ills.

THE knots represented on the preceeding page of engravings are as follows :

KNOTS, AND HOW TO TIE THEM.

1. Simple overhand knot.
2. Slip-knot seized.
3. Single bow-knot.
4. Square or ruf-knot.
5. Square bow-knot.
6. Weaver's knot.
7. German or figure-of-8 knot.
8. Two half-hitches, or artificer's knot.
9. Double artificer's knot.
10. Simple galley knot.
11. Capstan or prolonged knot.
12. Bowline-knot.
13. Rolling-hitch.
14. Clove-hitch.
15. Blackwall-hitch.
16. Timber hitch.
17. Bowline on a bight.
18 Running bowline.
19. Catspaw.
20. Doubled running-knot.
21. Double knot.
22. Six-fold knot.
23. Boat-knot.
24. Lark's head.
25. Lark's head.
26. Simple boat-knot.
27. Loop-knot.
28. Double Flemish knot.
29. Running-knot checked
30. Crossed running-knot.
31. Lashing knot.
32. Rosette.
33. Chain-knot.
34. Double chain-knot.
35. Double running-knot, with check-knot.
36. Double twist-knot.
37. Builders' knot.
38. Double Flemish knot.
39. English knot.
40. Shortening-knot.
41. Shortening-knot.
42. Sheep-shank.
43. Dog-shank.
44. Mooring-knot.
45. Mooring-knot.
46. Mooring-knot.
47. Pigtail worked on the end of a rope.
48. Shroud-knot.
49. A bend or knot used by sailors in making fast to a spar or a bucket-handle before casting overboard ; it will not run. Also used by horsemen for a loop around the jaw of a colt in breaking : the running end, after passing over the head of the animal and through the loop, will not jam therein.
50. A granny's knot.
51. A weaver's knot

The principle of a knot is, that no two parts which would move in the same direction if the rope were to slip, should lie alongside of and touching each other.

COST OF IRON PRODUCTION.—In Staffordshire, the making of bars marked "best, best, best," corresponds to a consumption of 5 tons of Coal per ton of Iron made from the forge pigs, which themselves require from 2 to $2\frac{1}{2}$ tons of Coal for their production. Calculating waste of iron in puddling, &c., one ton of the best brands of Staffordshire bars represent 8 to 9 tons of good coal consumed.

GARTSHERRIE IRON WORKS, SCOTLAND.—Furnaces, 16. Proportion of charges, about 32 cwts. of calcined ore are used to the ton of iron, 6 cwts. of pure limestone, or 10 cwts. of limestone containing a high percentage of alumina, which is sometimes preferred, forming a surplus of quickly melted slag. The charges are made up with the coal in quantities of about 30 cwts. each, and are hoisted to the top of the furnace by a very simple contrivance. Temperature of blast 800°. Weekly production of each furnace about 160 tons.

COLTNESS IRON WORKS:—Furnaces, 12. The calcined ironstone contains from 60 to 65 per cent. of iron, and the furnaces are charged with an addition of 12 cwts. of unburnt limestone, and 48 cwts. of coal for every ton of iron made. The make per furnace varies from 12 to 15 tons at a cast, the furnace being tapped once in every 12 hours. From 8 to 12 tuyeres are in each furnace arranged in groups of 3 in each arch formed by the square foundation. The tuyeres are usually $1\frac{1}{2}$ in. diam. at the nozzle, temperature of blast is between 600° and 700°. Power is furnished by a pair of condensing beam engines, worked with 32 lbs. steam pressure and a vacuum of 26 ins. The steam cylinders are 48 ins. diam. and the blowing cylinder 100 ins., pressure of blast in the blast main is $3\frac{1}{2}$ ins. The blowing cylinder in the lower row of furnaces is $120\frac{3}{4}$ ins.

GOVAN IRON WORKS, GLASGOW.—Furnaces, 6; height 50 ft. The charges are made up in loads of 15 cwts. of ore and limestone for every load of 10 cwts. of coal. Consumption of coal for every ton of iron made is about 50 cwts. Blowing Cylinders 2; pressure of blast $2\frac{3}{4}$ lbs. The make of each furnace is about 12 to 15 tons per cast, tapped every 12 hours. The blowing engine is supplied with steam by 7 double-flued Cornish boilers fired with coal slack, and placed below the ground level close to the engine house. The charge of gray iron for each refinery is 24 cwts., and 6 or 7 charges are made per day with ordinary coke for fuel.

BARROW-IN-FURNISS IRON WORKS:—Furnaces, 11. The charge per ton of iron is 34 cwts. of ore, $6\frac{1}{2}$ cwts. of limestone, and from 10 to 21 cwts. of coke. Ore yields 57 per cent. of iron, weekly production 4000 tons. The dimensions of the larger furnaces which form the second group, are, height 56 ft., diam. at the boshes, 7 ft., greatest inner diam. 16 ft. 6 ins., diam. at top, 11 ft. 6 ins., they are tapped every 6 hours and give about 20 tons at each cast. The blast pressure varies from 3 to $3\frac{1}{2}$ lbs., each furnace has 6 tuyeres, diam. of tuyeres is from $2\frac{1}{2}$ to $3\frac{1}{2}$ ins., temperature of blast 600° to 650°. Forty-two boilers, all fired with gas, supply the steam to the different engines; of these, 22 work up to 25 lbs., and 12 to 35 lbs. pressure. The first set of engines comprise 3 vertical beam engines: diam. of one steam cylinder is 52 ins., of the other two 48 ins., each blowing cylinder placed at one end of the corresponding beam, is 100 ins. in diam. with 9 ft. stroke.

IRON FOUNDING.—In dimensions, the McKenzie cupola, so extensively used in America, is from the drop bottom to the bottom of the charging door, 9 ft. high. The longer diameter outside is 5 ft. 4 ins., and the shorter diameter 4 ft. 4 ins. The blast is admitted through an annular tuyere or opening which extends completely round the bottom part. The blast is led into a chamber surrounding the boshes of the cupola, and from this chamber it escapes through the annular tuyere. The cupola is fitted with a drop bottom. A cupola of that kind is charged with 1400 lbs. of coal, then 4000 lbs. of iron, 400 lbs. of coal, 4000 lbs. of iron again, and the alternate charges of 400 lbs. of coal and 4000 lbs. of iron are repeated for the necessary height. The blast is supplied, when the furnace is at work, at the extremely high pressure of $2\frac{1}{2}$ lbs. per sq. inch; but when the furnace is first started the slight resistance met with by the blast does not permit a pressure of more than $\frac{1}{2}$ lb. to be obtained. The blast is applied in about 40 minutes after the fire is lighted, and the iron begins to run in about 20 minutes after the blast is turned on. When the furnace is fairly at work the melting proceeds at the rate of almost 4 tons per hour. One of the McKenzie cupolas at Morris, Tasker & Co.'s tube works, at Philadelphia, measures 7 by 4 ft., and is blown with a pillar of blast of about 24 ins. of water. The regular day's work is 23 tons of metal run down in $2\frac{1}{2}$ hours, the iron beginning to melt in 15 minutes from the time the blast is turned on, and running at the rate of 10 tons per hour. It is charged about $4\frac{1}{2}$ ft. deep with iron and anthracite coal, and about 1 ton of the latter is burned for every 9 tons of metal melted. In melting small quantities, in say, a No. 3 McKenzie cupola, a good proportion is to put in a bed about 900 lbs. coal, and charge from 4000 to 5000 lbs. of iron, then 150 to 200 lbs. coal, and charge 1000 to 2000 lbs. on the top of it. In Ireland's cupola, the furnace should be filled with coke to the top of the boshes, and four separate cwts. of iron, alternated with three cwts. of coke, should then be introduced to fill it up to the charging door. In these furnaces a ton of freely running iron has been run down by $1\frac{1}{4}$ cwt. of coke, but more usually from 2 to $2\frac{1}{2}$ cwts. are required. The furnace should be kept in careful repair and each charge well levelled off. In the Woodward cupola a steam jet is used instead of a fan, and the steam required for the jet to create the draught is only equal in quantity to the requirements of an engine for driving a fan of sufficient power to work the same size of ordinary cupola; and the consumption of coke in melting is $1\frac{1}{4}$ cwt. per ton of iron.

Blowing or Blast Engines.—Iron works at Mt. Savage, Md. For blowing 4 furnaces, 14 feet diam., each making 100 tons of pig iron per week.

Engine (*Condensing*). Diameter of cylinder, 56 in.; length of stroke, 10 ft.

Revolutions. 15 per minute. *Pressure.* 60 lbs. per square in., cut off at $\frac{1}{4}$ of the stroke.

Boilers. Six of 60 in. in diameter, and 24 ft. in length, with one 22-in. flue in each, double returned. *Grates.* 198 square ft.

Blast Cylinder. 126 in. in diameter by 10 ft. stroke. *Revolutions.* 15 per minute.

Pressure of Blast. 4 to 5 lbs. per square in.

Area of Pipes. 2300 square in., or $\frac{1}{5}$ that of the cylinder.

For Blowing Two Furnaces and Two Fineries, making 240 Tons of Forge Pig per Week.

Engine (*Non-condensing*). Diameter of cylinder, 20 in.; length of stroke, 8 ft. *Revolutions.* 28 per minute. *Pressure.* 50 to 60 lbs. per square in. (full stroke).

Boilers. Six of 36 in. in diameter, and 28 ft. in length (without flues). *Grates.* 100 square ft.

Blast Cylinders. Two of 62 in. in diameter, by 8 ft. stroke. *Revolutions.* 22 per minute. *Pressure of Blast.* $2\frac{1}{2}$ lbs. per square in.

Area of Pipes. 3 ft. or $\frac{1}{6}$ that of the cylinders.

One blast furnace has two 3-in., and one $3\frac{1}{4}$ in. tuyeres, the other has three of 3 in

One finery has six tuyeres of $1\frac{1}{8}$ in., and the other, four of $1\frac{1}{8}$ in.

The ore yields from 40 to 45 per cent. of iron. The temperature of the blast is 600°.

DOWLAIS IRON WORKS.—Furnaces 17. Weekly production about 180 tons per furnace, total annual production of pig iron about 150,000 tons, total annual consumption of coal about 1,000,000 tons. The furnaces are blown by 6 beam engines. The largest has a 55 in. steam cylinder and 13 ft. stroke of steam piston, while the blowing cylinder is 12 ft. diam., and the blast piston has a stroke of 12 ft., the great beam being divided unequally; weight of working beam 44 tons, of fly wheel 35 tons. Blast is discharged into a main 5 ft. diam. and about 140 yards long. No furnace is more than 18 ft. in diam. at the boshes, and few are as much as 50 ft. high, square at the base and assuming the circular form about half way up. They are tapped 3 times in 24 hours, are fed with raw coal, and consume 30 cwts. of coal per ton of iron made. Temperature of blast 612°, pressure of blast 3 to $3\frac{1}{2}$ lbs.

The furnaces, mines, forges, Bessemer steel works, &c., employ in all nearly 100 steam engines, 9000 work people (of which about 5500 are under ground and 3500 above), and 700 horses.

COHESIVE STRENGTH OF TIE-BARS, SUSPENSION RODS, &C.—Breaking weight in tons, equal area of section of rod in square inches, multiplied by cohesive force per square inch in tons.

Cohesive	strength of	steel	= 50	tons					tons
"	"	Wrought iron	23	"	Cohesive	Str.	of ash	=	8
"	"	Cast-iron	$7\frac{1}{2}$	"	"	"	Beech		5.5
"	"	Wr'ght copper	15	"	"	"	Oak		5.5
"	"	Cast-brass	8	"	"	"	seasoned		6
"	"	Lead	0.75	"	"	"	pitch pine		6
"	"	Boxwood	10	"	"	"	Chestnut		5
					"	"	Fir		5.5

In use, take $\frac{1}{3}$ of the above as breaking weight.

A mixture of 30 per cent. of wrought iron with cast-iron, carefully fused in a crucible, increases strength of cast-iron one third. Chilling the under side of cast iron materially increases its strength. Chilled bars of cast iron deflect more readily than unchilled. Girders cast with face up are stronger than when cast on side, as 1 to .96; also strongest when cast with bottom flange up. Cast-iron and wrought iron beams, having similar resistances, have weights, as 2.44 to 1.

TO TEST THE QUALITY OF IRON.—If fracture gives long silky fibres of leaden-gray hue, fibres cohering and twisting together before breaking, may be considered a *tough soft* iron. A medium, even grain, mixed with fibres, a good sign. A short blackish fibre indicates badly refined iron. A very fine grain denotes a *hard steely iron*, apt to be cold-short, hard to work with a file. Coarse grain, with brilliant crystallized fracture, yellow or brown spots, denote a *brittle iron*, cold-short, working easily when heated; welds easily. Cracks on the edge of bars, sign of hot-short iron. Good iron is easily heated, soft under the hammer, throws out but few sparks.

TO FIND THE WEIGHT OF TIMBER BEAMS, POSTS, AND JOISTS.—Multiply length in feet by the breadth in inches and the depth in inches, and the product by one of the following factors: For elm, 2.92; yellow pine, 2.85; white pine, 2.47; dry oak, 4.04.

WEIGHT OF TIMBER WORK, TIMBER FLOORING.—Multiply breadth in feet by length in feet by the thickness in inches and by one of the following factors, according to the material: For elm use, 3.50 lbs.; for yellow pine, 3.42; for white pine, 2.97; for dry oak, 4.85.

NICKEL PLATING WITHOUT A BATTERY.—To a solution of from 5 to 10 per cent. chloride of zinc, as pure as possible, add enough sulphate of nickel to produce a strong green color, and bring to a boil in a porcelain vessel. The piece to be plated, which must be perfectly bright and free from grease, is introduced so that it touches the vessel as little as possible. Boiling is continued from thirty to sixty minutes, water being added from time to time to replace that evaporated. During ebullition nickel is precipitated in the form of a white and brilliant coating. The boiling may be continued for hours without increasing the thickness of this coating. As soon as the object appears to be plated it is washed in water containing a little chalk in suspension, and then carefully dried. The chloride of zinc and sulphate of nickel must be free from metals precipitable by iron. If, during the precipitation, the liquid becomes colorless, sulphate of nickel should be added. The spent liquid may be used again by exposing it to the air until the iron is precipitated, filtering and adding the zinc and nickel salts as above. Cobalt also may be deposited the same way.

To Remove Iron Mould from Marble.—Take butter of antimony 1 oz., oxalic acid 1 oz.; dissolve them in 1 pt. water, add flour, and bring the composition to a proper consistence. Then lay it evenly on the stained part with a brush, and, after it has remained for a few days, wash it off, and repeat the process if the stain is not quite removed.

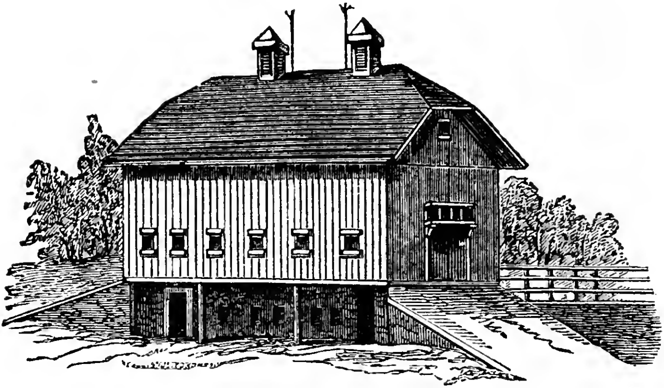
Green Transparent Varnish for Metals.—Grind a small quantity of Chinese blue with double the quantity of finely-powdered chromate of potassa (it requires the most elaborate grinding); add a sufficient quantity of copal varnish thinned with turpentine. The tone may be altered by more or less of one or the other ingredients. Green bronze liquid: One quart of strong vinegar, ½ oz. of mineral green, ½ oz. raw umber, ½ oz. sal-ammoniac, ½ oz. gum arabic, 2 oz. French berries, ½ oz. copperas; dissolve over a gentle fire, allow to cool, and then filter.

Profits of Manufacturers.—In the State Census of Massachusetts, of 1875, Col. Wright, of Boston, separates the value of the raw material from the value added by work done. Thus we have under the head of boots and shoes, not the value of the boots and shoes, but the value added to the leather by the work done to convert it into boots and shoes. This is stated to amount to $89,375,792, for which the employes received $18,727,124, or $455.05 each on an average, and the employers appropriated $70,648,668. Cotton and other industries show similar results.

Proceeds of One Ton of Cotton Seed.—A correspondent of *Leffel's News* reports cotton seed as worth now, delivered at the mills in New Orleans, $11 per ton, the mills furnishing the bags it is put up in. From that ton of seed will be gotten:

250 lbs. lint worth 5cts. per lb., or	$12.50
About 500 lbs. hull worth	2.50
About from 40 to 45 galls. oil, say 40 galls. at 50 cents	20.00
Say 800 lbs. oil cake, worth 1½ cent per lb.	12.00
Or, $11 worth of seed works to value of	$47.00

Arrangement, Proportion, Capacity, &c., of Grain Elevators.—On this subject Pallett rules that the pulleys should be at least 24 inches diameter, and about one inch thicker than the width of the belt, and nearly half an inch higher in the middle than at the sides, to make the strap keep on. These pulleys should have a motion of twenty-five revolutions per minute. The buckets should be about fifteen inches apart. One hundred and twenty-five buckets will pass per minute, carrying 162 quarts and hoisting 300 bushels per hour. If this is not fast enough, make the strap wider and the buckets larger, increase the velocity of the pulley (not above 35 revolutions), nor place more buckets than one for every twelve inches, or they will not empty.



ON FARM BUILDINGS.

The following plan for a barn appeared in the columns of the *Country Gentleman*, and is of a size suitable for about 75 acres of land under cultivation on the system of mixed husbandry; but the size may be either expanded or diminished to answer all possible requirements in any given case.

The size is 42×60 ft. Fig. 1 shows the common or principal floor, and is so constructed that a loaded wagon can be driven in at one end, unloaded, and then pass out at the other. The contrivance for this purpose, so as not to interfere with the cellar or basement, is shown in the perspective view at the head of this article, an embankment being made at each end, which would be facilitated if the building were placed between two slight knolls or in a moderate hollow, in which case ample drains should be

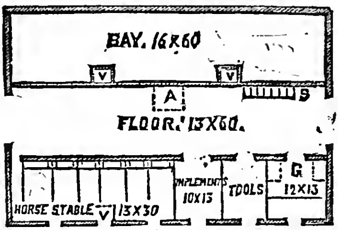


Fig. 1.

provided round the whole. In the plan fig. 1, V V represent ventilators or hay shutes; A trap door for throwing down chaff or straw, G granary, and S stairs. The bay contains 950 square feet, and will hold about 40 tons of compact hay of about 500 cubic ft. to the ton when well settled. In addition, there is room on the platforms over the floor and horse stables to hold about 20 tons more. By marking off a scale of feet on one of the ventilators, the owner may at any time gain an approximate idea of the quantity of hay on hand.

Fig. 2 represents the basements. The roots are drawn in on the barn floor and dumped down the trap A, shown in fig. 1. In fig. 2, AAAA represent calf pens, or boxes for cows in calf.

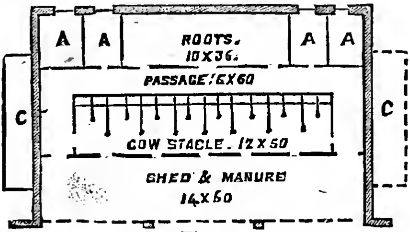


Fig. 2.

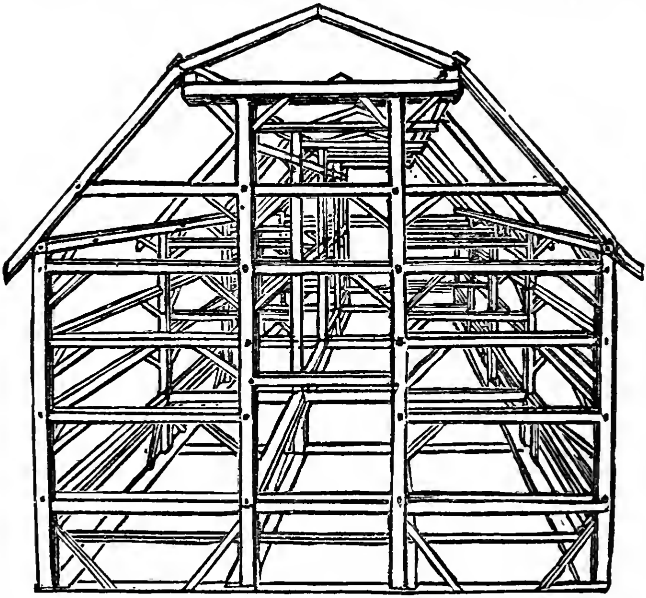
RULES FOR FARMERS.—The prime auxiliaries to good farming are: 1. Sufficient capital to buy the farm and stock it well. 2. The proper selection of a farm commensurate with these requisites. 3. The selection of good land and the rejection of barren, no matter how cheap. 4. To lay it out in good style, and provide it with good buildings, fences, and gates. 5. Stock it with the best animals and implements at a reasonable price, and provide good shelter for both. 6. Bring the soil into good heart by draining, killing of weeds, manuring, deep ploughing, and a proper rotation of crops covering every part of it. 7. Diligence and careful oversight of all operations, correct accounts in the matter of wages, buying, selling, weighing, measuring, cost of crops, animals, net returns of each, accumulation and preservation of manure, &c. 8. Early rising, remembering that "He that would thrive must rise at five. He that has thriven may lie till seven." 9. Regular and careful feeding of stock with considerate and merciful treatment of horses, cattle, &c., at all times.

Touching the rotation of crops the following courses have proved well adapted to most of the Eastern and Middle States:

I. 1st year, corn and roots, well manured. 2nd year, wheat, sown with clover seed, 15 lbs. per acre. 3rd year, clover, 1 or more years, according to fertility, and amount of manure on hand.

II. 1st year, corn and roots with all the manure. 2nd year, barley and peas. 3rd year, wheat, sown with clover. 4th year, clover one or more years.

The next illustration represents the frame of an improved stable and barn which appeared not long ago in the columns of the *Globe and Canada Farmer*, concerning which the owner furnished the following particulars to that journal: "Barn 56 x 80 feet, outside posts 20 feet high, the purline posts 33 feet; has five bents, 20 feet spans, framed according to cut. The size of timber used is from 6 to 8 inches; the sills are 3 x 12 in. plank bedded on the stone wall. The barn proper is 56 x 60, leaving 20 x 56 feet for a straw house. The driving floor is 16 feet wide, the bays on each side, loft, all floored over with double inch boards. The double doors work on rollers. There is a ventilating door in each gable end, working with a small pulley from the floor: also one on the roof, all very useful in the time of threshing to allow dust to escape. On each side of the driving floor is a ladder reaching to the top of the barn. The granary is 20 feet square. The bins are six feet deep on each side, leaving 8 x 20 feet to keep the mill in for clearing up. The barn is well lighted. If stone is scarce, the wall need be no higher than to clear the ground, as shown in the cut. No. 1 cut pine shingles are best for roof. This stable is in three parts. 1st. 25 feet is taken from one end and divided in three parts ; the centre is a feed room 20 x 25 feet ; stables 18 feet deep, with five stalls in each part. 2d. There is a yard 30 x 56 for young stock. There is a trap door at the side of the drive floor to drop down straw. If water can be had a well is preferable in this yard. There is a large door on each side to drive in and take out the manure. 3d. The cow stable is directly under the straw house, 25×56 feet, divided into three parts: the centre is the feed room, 25 x 26 feet, with trap door above to let down the chaff. The stables are 15



feet deep, with six stalls on each side. There will be sufficient light to all the stables, feed room and yard ; outer doors for stables and inner doors leading into the centre yards. Height of stables, 8½ and 9 feet. The advantages over old style of building are as follows :—Lighter and shorter timber. There are two rows of central posts run to the top of building, forming the purline work, and the whole building being framed into these posts makes a much stronger frame ; is handier for storing ; for forks working ; for threshing ; is better ventilated ; all straw inside ; all stock inside ; manure all under cover, and when a farmer has one of these barns he has all the outbuildings he requires."

WEIGHT OF HAY.—Hay, well settled in mows or stacks, fifteen cubic yards make a ton. Rule for long or square stacks : Multiply the length in yards by the width in yards, and then by half the height in yards, and divide by fifteen. Rule for circular stacks : Multiply the square of the circumference in yards by four times the height in yards, and divide by 100 ; the quotient by fifteen.

SUNDRY ITEMS OF INTEREST TO FARMERS.

A BUSHEL OF WHEAT, 60 lbs., should yield, of flour, about 48 lbs., shorts, 8 lbs., bran 4 lbs. *Wheat flour* is of the best quality from grain that has been cut before it comes to full maturity, being whiter and softer, and such flour carries a better figure in the market. Coarse or thick-husked grain will yield more bran and less flour than the kind noted above.

PROCEEDS OF GRISTS.—On this subject a correspondent of the *Country Gentleman* remarks: "The product and waste in grinding depend much upon the quality and cleanness of the wheat. I have had winter wheat turn out 40 pounds of flour and 12¾ pounds of bran, middlings, etc., to the bushel. The 'waste' in grinding clean wheat should be not more than a pound to a pound and a quarter. Spring wheat will not make as much flour. The following from a 'grist' of the last crop of spring wheat is a good average of a dozen more that I have noted.

Weight of wheat,		1,486 lbs.
" " flour,	952 lbs.	
" " bran,	240 "	
" " screenings,	32 "	
" " middlings (canaille)	88 "	
" " toll,	148 "	
" " waste,	26 "	--1,486 lbs.

Here is 24¾ bushels, and the yield of flour is 38.45 pounds per bushel, and the offal amounts to 14.54 pounds per bushel, while the waste is only 1.05 pounds per bushel. It is proper here to state that I sent a 'grist' out of the same bin, to a new mill a few weeks before, and the return was only 36 pounds in flour and the 'waste' or wheat stuck to the mill, besides the toll, 5½ pounds to the bushel. I did not repeat my experiment at that mill.

A miller, writing to the *Mill Stone*, claims that he can, on custom work, make from 38 to 42 lbs. of flour to the bushel of wheat, besides his seventh for toll, and on merchant work he can make 1 barrel of fancy flour out of 4½ bushels of wheat. This he cites as good work, and right here it may be remarked that many farmers raise an outcry against the miller, because he fails to give first class flour and ample returns from badly damaged or improperly cleaned grain. In a canticle descanting on the hard times, composed by a rural poet of the writer's acquaintance, the versifier sought to immortalize his name by a burlesque on the fair fame of every tradesman in the town. The stanza reflecting on the honest miller was as follows:

> And there's...........the miller, he grinds for his toll,
> And he ought to do right for the sake of his soul.
> But still, there, he goes, with the dish in his fist,
> He gives you the toll and he keeps the grist.

Millers, as a general rule, are fair-dealing men. From time immemorial they have been called "honest," and it is no more than fair that they should be honestly dealt with. If you wish first class returns bring first class grain to the mill.

Estimating the produce of an acre in oats at 50 bushels, they will contain 450 pounds of flesh-forming food, and 672 pounds of fat-forming food; while three tons of hay off the same acre will carry 480 pounds of flesh-formers and 2790 pounds of fat-formers. Hay is a standard food for cattle.

MEASURING HAY IN BULK.—To find the number of cubic feet in a mow, multiply the length, width and depth together. Five hundred cubic feet of ordinary clover and timothy hay, packed under ordinary circumstances, will make a ton. Generally, so many things have to be taken into consideration, in calculating the weight of hay in bulk, it makes it difficult to ascertain it precisely. For instance, fine new-mown hay, like red-top or herds grass, would probably not require quite 500 cubic feet for the ton; timothy alone, requires about 550; clover 650; coarse meadow hay 700 or more. After being stacked thirty days, the bulk would be decreased from five to ten per cent. Again, hay will vary somewhat in measurement according to the time it is cut.

The government standard for a ton is 7½ feet; this gives 422 cubic feet. To find the number of cubic feet in a stack, multiply the area of the base by one third the perpendicular height.

It is estimated that 25 cubic yds. of common meadow hay in the windrow compose a ton, and 10 cubic yds. of *baled*, or *pressed* hay, the same weight.

A truss of *new hay* is 60 lbs., of *old*, 56 lbs., a load of hay, 36 trusses; a bale, 300 lbs. A truss of straw is 40 lbs.

TABLE EXHIBITING CAPACITIES OF GRAIN BINS, &C., 10 FT. HIGH.

Width in Ft.	Bin 6 ft. Long.	Bin 7 ft. Long.	Bin 8 ft. Long.	Bin 9 ft. Long.	Bin 10 ft. Long.	Bin 11 ft. Long.	Bin 12 ft. Long.	Bin 13 ft. Long.	Bin 14 ft. Long.	Bin 15 ft. Long.	Bin 16 ft. Long.	Bin 20 ft. Long.	Bin 22 ft. Long.
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
3	145	169	192	217	241	265	289	313	338	362	386	482	530
4	193	225	257	289	321	354	386	418	450	482	514	643	708
5	241	282	321	362	402	442	482	522	563	603	643	804	884
6	290	338	386	434	482	530	579	627	675	723	771	964	1060
7	338	394	450	506	563	619	675	731	788	844	900	1125	1238
8	386	450	514	579	643	707	771	836	900	964	1029	1286	1414
9	434	507	579	651	723	796	868	940	1013	1085	1157	1446	1592
10	482	563	643	727	804	884	964	1045	1125	1205	1286	1607	1768
11	531	619	707	796	884	972	1061	1149	1238	1326	1414	1768	1944
12	579	675	771	868	964	1061	1157	1254	1350	1446	1543	1929	2122

MEASURING CORN IN THE CRIB.—Many rules are given by which the number of bushels of corn in a crib may be ascertained, but all of them must be more or less unreliable, from the fact that they assume that two bushels of ears are equal to one of shelled corn—some corn will not make it, while some will more than do it. We give several such rules, any one of which will be, probably, sufficiently accurate.

1. Measure the length, breadth and height of the crib, inside the rail; multiply them together and divide by two, the result is the number of bushels of shelled corn.

2. Level the corn so it is of equal depth throughout, multiply the length, breadth and depth together, and this product by four, and cut off one figure to the right of the product. The others will represent the number of bushels of shelled corn.

3. Multiply length by height and then by width, add two ciphers to the result and divide by 124. This gives the number of bushels of *ears*. Another rule is to proceed as above to obtain the cubic feet, and then assume that 1 1-5 cubic feet make one bushel of ears.

4. Multiply length by breadth and the product by the height, *all in inches*, divide this by 2,748, and the quotient will be the number of bushels of ears. From two-thirds to one-half of this will be the number of bushels of shelled corn, depending upon the kind and quality. The first of these rules is the one generally used as an approximate estimate.

TO MEASURE GRAIN IN THE GRANARY.—Divide the cubic feet by 56 and multiply by 45, and the result will be struck measure.

LOSS FROM SHRINKAGE.—It is said that corn loses one-fifth and wheat one-fourteenth by drying. From this estimate it seems that it would be more profitable to the farmer to sell unshelled corn in the fall at 75 cents per bushel, than to keep it until Spring and sell it at $1, and that wheat at $1.25 in December, is equal to $1.50 the succeeding June. In cases of potatoes, taking those that rot and are otherwise lost, together with the shrinkage, there is little doubt that between October and June the loss to the owner that holds them is not less than 33 per cent.

The English Quarter, at which wheat is quoted in the Eng ish reports, is 560 pounds or one-fourth of the ton gross weight of 2240 pounds. The English legal bushel is 70 pounds, and consequently 8 of those bushels is a quarter—equal to 9⅓ of our statute bushel of 60 pounds.

TABLE EXHIBITING CONTENTS OF CORN-CRIBS, CONTAINING CORN IN THE EAR, COMPUTED ON A BASIS OF 3,840 CUBIC INS. PER BUSH. HEIGHT OF CRIB, 10 FT.

Lgth	10	11	12	13	14	15	16	18	20	22	24	26	28	30
Breadth in Ft. 3	135	149	162	175	189	202	216	243	270	297	324	351	378	405
3½	158	173	189	205	221	236	258	284	315	347	378	410	441	473
4	180	198	216	234	252	270	288	324	360	396	432	468	504	540
4½	203	223	243	263	283	304	324	365	405	446	486	527	567	608
5	225	218	270	292	315	337	360	405	450	495	540	585	630	675
5½	218	272	297	322	347	371	396	446	495	545	594	644	693	743
6	270	297	324	351	378	405	432	486	540	594	648	702	756	810
6½	293	322	351	380	410	439	468	527	585	644	702	761	819	878
7	315	317	378	409	441	472	504	567	630	693	756	819	882	945
7½	338	371	405	439	473	506	540	608	675	743	810	878	945	1013
8	360	396	432	468	504	540	576	648	720	792	864	936	1008	1080
8½	383	421	459	497	536	574	612	689	765	842	918	995	1071	1148
9	405	446	486	526	567	607	618	729	810	891	972	1053	1134	1215
10	450	495	540	585	539	675	720	810	900	990	1080	1170	1260	1350
11	495	545	594	643	693	742	792	891	990	1089	1188	1287	1386	1485
12	540	594	648	702	756	810	861	972	1080	1188	1296	1404	1512	1620

EXAMPLE.—Under 28 and opposite 8 is 1,008, representing the number of bushels of corn in the ear contained in a crib 28 ft. long, 8 ft. wide, and 10 ft. high. This space would contain 1,800 bushels of shelled corn.

RULE WHEN THE CRIB IS FLARED AT THE SIDES.—Multiply half the sum of the bottom breadths in *feet* by the perpendicular height in feet, and the same again by the length in feet, multiply the last product by ·63 for heaped bushels of ears, and by ·42 for the number of bushels in shelled corn. This rule is based on the generally accepted estimate that 3 heaped half bushels of ears, or 4 even full, form 1 of shelled corn.

ANOTHER RULE WITH EQUAL SIDED CRIBS.—Multiply the length in feet by width in feet, and this last by the height in feet, multiply the resulting product by ·63 and the proceeds will show the heaped bushels of ears. To get the number of bushels in shelled corn multiply by ·42.

MEMORANDA.—A barrel of corn is 5 bushels shelled. By this latter measure crops are estimated, and corn bought and sold throughout most of the Southern and Western States. At New Orleans a barrel of corn is a flour barrel full of ears. In some parts of the west it is common to count 100 ears to the bushel.

ANOTHER WAY TO MEASURE CORN IN THE CRIB.—Multiply the length, breadth, and height together in feet, to obtain the cubic feet; multiply this product by 4 and strike off the right figure, and the result will be shelled bushels, nearly.

TO FIND THE CONTENTS OF A BARREL OR CASK.—Multiply the square of the mean diameter (in inches) by the length of the barrel (also in inches), divide this product by 29.5 and point off one figure to the right; the result will be the answer in *wine* gallons.

It may be necessary to add that to find the *mean diameter*, we add together the *greatest* and *least* diameters and divide by 2.

To Find the Number of Bushels of Apples, Potatoes, &c., in a Box or Bin.—Multiply the length, breadth and depth together (all in feet), and this product by 8, pointing off one figure in the product for decimal.

Storage of Roots in Cellars, &c.—It will require about 15 cubic feet of space to hold 10 bushels of roots. At this rate the following table will serve to estimate the dimensions of a root house or cellar required for the storage of various quantities of roots.

1,000 Bushels	of roots	will require	1,500	cub. ft., or	20 x 8.4 x 9 high,	or, 20 x 9.4 x 8 high.
1,500 "	"	"	2,250	"	20 x 12.6 x 9 high,	or, 20 x 14.0 x 8 high.
2,000 "	"	"	3,000	"	20 x 16.8 x 9 high,	or, 20 x 18.9 x 8 high.
3,000 "	"	"	4,500	"	20 x 25.0 x 9 high,	or, 20 x 28.0 x 8 high.
4,000 "	"	"	6,000	"	20 x 33.4 x 9 high,	or, 20 x 37.6 x 8 high.
7,000 "	"	"	10,500	"	20 x 58.4 x 9 high,	or, 20 x 65.7 x 8 high.
10,000 "	"	"	15,000	"	20 x 83.4 x 9 high,	or, 20 x 93.9 x 8 high.

Capacity of Wagon-Beds.—*Rule* 1.—If the opposite sides are parallel, multiply the length inside in inches by the breadth inside in inches, and that again by the depth inside in inches, and divide the product by 2,150.42 (the number of cubic inches in a bushel), and the quotient will be the capacity in bushels.

Example.—What is the capacity of a wagon-bed 10 ft. long, 4 ft. wide, and 15 inches deep.

Work.—120 inches, length, x 48 inches, width, x 15 inches, depth, = 86,400 ÷ 2,150.42 = 40 bushels. *Ans.*

Rule 2.—Should the head and tail boards, or either of them, be set in bevelling, add the top and bottom lengths together and divide by 2 for the mean length, and proceed by the foregoing rule. Should the sides be sloping add the top and bottom widths, and divide by 2 for the mean width, and proceed by the foregoing rule.

Should the contents be required in cubic feet, divide the product by 1,728 (the number of cubic inches in a cubic foot), instead of 2,154.42, and the quotient will be the contents in cubic feet.

Gross and Net Weight and Price of Hogs.—A short and simple method for finding the net weight or price of hogs, when the gross weight or price is given, and *vice versa.*

Note.—It is generally assumed that the gross weight of hogs, *diminished* by one-fifth or 20 per cent. of itself gives the net weight, and the net weight *increased* by one-fourth or 25 per cent. of itself equals the gross weight.

To find the net weight, or gross price: *Multiply the given number by* ·8 (tenths).

Example.—A hog weighing 365 lbs. gross, will weigh 292 lbs. net, and pork at $3.65 net, is equal to $2.92 gross.

$$\begin{array}{r} 365 \\ .8 \\ \hline 292.0 \end{array}$$

To find the gross weight, or net price: *Divide the given number by* ·8 (tenths).

Example.—A hog weighing 348 lbs. net, weighs 435 lbs. gross; and pork at $3.48 gross, is equal to $4.35 net.

$$\begin{array}{r} .8)348.0 \\ \hline 435 \end{array}$$

To Find the Number of Shingles Required in a Roof.—*Rule.* —Multiply the number of square feet by 8, if the shingles are exposed $4\frac{1}{2}$ ins., or by 7 1-5 if exposed 5 ins. To find the number of square feet, multiply the length of the roof by twice the length of the rafters.

To find the length of the rafters at one fourth pitch, multiply the width of the building by .56 (hundredths); at one-third pitch, multiply it by ·6 (tenths); at two-fifths pitch, by ·64 (hundredths.) This gives the length of the rafters from the apex to the end of the wall, and whatever projects must be taken into consideration.

Note.—By $\frac{1}{4}$ or $\frac{1}{3}$ pitch is meant that the apex or comb of the roof is to be $\frac{1}{4}$ or $\frac{1}{3}$ the width of the building *higher* than the walls or base of the rafters.

Example.—How many shingles are required to cover a building 42 feet long and 30 feet wide; the roof to have $\frac{1}{3}$ pitch, and to project 1 foot on each end, and 1 foot on each side for the eaves—the shingles to lie $4\frac{1}{2}$ inches to the weather.

For $\frac{1}{3}$ pitch, $30 \times .6 = 18$.
With 1 foot projection $= 19$
2 times $19 = 38$
42 and $2 = 44$

1672 sq. feet.
8

Ans. 13,376

Capacities of Cisterns.

For a circular cistern, take the diam. in feet, square that (see table on page 612), and multiply by ·785398; that gives the area in feet; multiply this by 1.728 and divide by 231, and you will have the number of gallons capacity of one foot in depth of the cistern; from this calculate the depth.

If for a Square Cistern, multiply length by breadth, and proceed to multiply the result by 1,728 and to divide by 231, as before. Calculated in this way we find that each foot in depth of a

Circular Cistern.						Square Cistern.							
5 feet	in diam.	holds	4.66	bbls.		5 feet	by	5 feet	holds	5.92	bbls.		
6 "	"	"	6.71	"		6 "		6 "	"	8.54	"		
7 "	"	"	9.13	"		7 "		7 "	"	11.63	"		
8 "	"	"	11.93	"		8 "		8 "	"	15.19	"		
9 "	"	"	15.10	"		9 "		9 "	"	19.39	"		
10 "	"	"	18.65	"		10 "		10 "	"	23.74	"		

In calculating the capacity of cisterns, &c., $31\frac{1}{2}$ gals. are estimated to 1 barrel, and 63 gals. to 1 hogshead.

To Compute the Weight of Live Cattle. For cattle of a girth of from 5 to 7 feet, allow 23 lbs. to the superficial foot. For a girth of from 7 to 9 ft., allow 31 lbs. to the superficial foot. For small cattle and calves of a girth of from 3 to 6 ft. allow 16 lbs. to the cubic foot. For pigs, sheep, and animals measuring less than 3 ft. girth, allow 11 lbs. to the superficial foot.

Rule.—Measure the girth in inches back of the shoulder, and the length in inches from the square of the buttock to a point even with the point of the shoulder blade. Multiply the girth by the length, and divide the product by 144 for the superficial feet, and then multiply the superficial feet by the number of lbs. allowed as above for cattle of various girths, and the product will be the number of pounds of beef, veal, or pork in the four quarters of the animal. To find the number of stone, divide the number of lbs. by 14.

Example.—What is the estimated weight of beef in a steer, whose girth is 6 ft. 4 ins., and length 5 ft. 3 ins.

Work.—76 ins. girth, $\times$ 63 ins. length, $= 4788 \div 144 = 33\frac{1}{4}$ square feet, $\times 23 = 764\frac{3}{4}$ lbs., or $54\frac{5}{8}$ stone. *Ans.*

When the animal is but half fattened, a deduction of 14 lbs. in every 280, or 1 stone in every 20 must be made ; and if very fat, 1 stone for every 20 must be added. See other rules on page 558.

These rules are a very close approximation to the truth, subject to very slight variations owing to the condition, breed, &c., of various animals. The following Table is compiled from two English authorities on the subject :

Girth. ft. in.	Length. ft. in.	Renton's Table. stone lb.	Cary's Table. stone lb.
5 0	3 6	21 0	21 00
5 0	4 0	24 0	24 00
5 6	3 9	27 1	27 00
5 6	4 0	34 4	34 07
6 0	4 6	38 8	38 11
6 0	5 0	43 1	43 00
6 6	4 6	45 9	45 07
6 6	4 9	48 0	48 00
7 0	5 6	64 6	64 07
7 0	6 0	70 5	70 03
8 0	6 6	99 8	99 1'
8 0	7 0	107 5	107 0

In reference to the very important item of Sheep Husbandry, the fol lowing valuable Table presents the results of numerous experiments by De Raumer :

TABLE SHOWING THE EFFECTS PRODUCED BY AN EQUAL QUANTITY OF THE FOLLOWING SUBSTANCES AS FOOD FOR SHEEP.

Lbs.	Designation.	Increased weight of living animal in Lbs.	Produced Wool Lbs.	Produced Tallow Lbs.
1000	potatoes raw with salt..	46½	6½	12½
"	" " without salt	44	6½	11½
"	mangel-wurtzel, raw....	38½	5¼	6½
"	wheat..................	155	14	59½
"	oats....................	146	10	42½
"	barley..................	136	11½	60
"	peas....................	134	14½	41
"	rye, with salt...........	133	14	35
"	" without salt.......	90	12	43
"	corn meal, wet..........	129	13½	17½
"	buckwheat............	120	10	33

The following Table, from *Delisser's Horseman's Guide*, exhibits the percentage of different nutritive elements in the various kinds of food supplied to horses in this and other countries :

Description of Food.	Wood Fibre.	Sugar and Starch.	Fibrine and Albumen.	Fatty Matter.	Saline Matters.	Water.
Black Butter Corn.	none.	53.5	15.5	10.5	9.2	11.2
Oats.	30.0	43.0	11.4	0.6	2.5	12.5
Indian Corn.	8.0	53.0	14.0	6.0	5.0	14.0
Linseed.	19.0	35.0	20.0	8.0	6.0	12.0
Beans.	14 5	40.0	26.0	2.5	3.0	14.0
Peas.	9.0	48.0	24.0	2.0	3.0	14.0
Barley.	14.0	52.0	13.5	2.5	3.0	15.0
Old Hay.	30.0	40.0	7.0	2.0	7.0	14.0
Clover.	25.0	40.0	9.0	3.0	9.0	14.0
Barley Straw.	46.0	34 0	1.5	none.	6.5	12.0
Oat Straw.	50.0	31.0	1.0	a trace.	5.5	12.5
Wheat Straw.	55.0	27.0	0.5	none.	5.5	12.0
Bran.	54.0	2.0	20.0	4.0	7.0	13.0
Carrots.	3.0	10.0	1.5	none.	1.5	84.0

1 pt. of Black Butter-Corn as imported from the Indies, and sold in many of the feed stores, is considered equivalent to 12 qts. of oats for nourishing qualities when fed to a horse. Hard working horses can be

kept in prime order by feeding them, 1st, *At Night after work*, ½ peck oats, and ½ pt. black butter corn, with 8 to 10 lbs. good hay. 2d, *In the Morning*, ¼ peck oats, 1 pt. Indian meal, with say, 2 lbs. hay. 3d, *During the day*, ¼ peck of oats with a little hay. 4th, *On Saturday Night* a good warm bran mash. 5th, *On Sunday*, an extra allowance of hay.

These rules followed out, will ensure to a horse a weekly allowance of, Fibrine and Albumen, 22 lbs.; Fat, 5½ lbs.; starch and sugar, 85 lbs, so that the relative proportion of nitrogenous to carbonaceous food is as 1 to 4; while for a fattening animal it is as 1 to 5. Horses should be watered before feeding.

TABLE, SHOWING THE RESULTS OF EXPERIMENTS IN THE FEEDING OF GOOD HAY AND OTHER SUBSTANCES, AS FOOD FOR STOCK.

10 lbs of hay are equal to		10 lbs. of hay are equal to	
8 to 10 lbs.	clover hay.	30 to 35 lbs.	mangold wurtzel.
45 to 50 "	green clover.	45 to 50 "	turnips.
40 to 50 "	wheat straw.	20 to 30 "	cabbage.
20 to 40 "	barley straw.	3 to 5 "	peas and beans.
20 to 40 "	oat straw.	5 to 6 "	wheat.
10 to 15 "	pea straw.	5 to 6 "	barley.
20 to 25 "	potatoes.	4 to 7 "	oats.
25 to 30 "	carrots (red).	5 to 7 "	Indian corn.
40 to 45 "	" (white).	2 to 4 "	oil cake.

NOTE.—In calculations of this kind, due allowance must be made for variations caused by the condition, age, digestion, breed, &c., of the animal, and the variety or mixture of the food dispensed. The same remarks are eminently true of the following.

TABLE, SHOWING THE DIFFERENCE BETWEEN GOOD HAY AND THE SUBSTANCES NOTED BELOW, AS FOOD FOR STOCK, BEING THE MEAN OF EXPERIMENT AND THEORY.

100 lbs. of hay are equal to		100 lbs of hay are equal to	
275 lbs.	green Indian corn.	54 lbs.	rye.
442 "	rye straw.	46 "	wheat.
360 "	wheat "	59 "	oats.
164 "	oat "	45 "	peas and beans mixed.
180 "	barley "	64 "	buckwheat.
153 "	pea "	57 "	Indian corn.
200 "	buckwheat straw.	68 "	acorns.
201 "	raw potatoes.	105 "	wheat bran.
175 "	boiled potatoes.	109 "	rye "
339 "	mangold wurtzel.	167 "	wheat, pea, and oat chaff.
504 "	turnips.	179 "	rye and barley, mixed.
300 "	carrots.		

The following Table shows the amount of hay or its equivalent per day, required by each 100 lbs. of live weight of various animals:

Working Horses	3.08 lbs.
" Oxen	2.40 "
Fatting Oxen	5.00 "
" " when fat	4.00 "
Milch Cows	from 2.25 to 2.40 "
Dry "	2.42 "
Young growing cattle	3.08 "
Steers	2.84 "
Pigs	3.00 "
Sheep	3.00 "

WINTER TREATMENT OF HENS.—Hens will produce an abundance of eggs during winter if they are provided with a warm comfortable roost during the night, and a sheltered sunny exposure during the day. Give them plenty of dry ashes, gravel, and sand to roll in; a box of slacked or old lime to nibble at, with an allowance of finely chopped meat every other day, and plenty of corn and oats, boiled soft, and spiced with cayenne pepper. Add the table crumbs, potato parings, &c., with plenty of lukewarm water, and they will render ample returns. No living thing kept on a farm pays better than hens if they are only well used.

NUTRITIVE VALUE OF VARIOUS CROPS, AS TO STARCH, GUM, GLUTEN, ALBUMEN, CASEIN, OIL, SALINE MATTER, &C.

DESIGNATION.	Bushels.	lbs.	Husk or woody fibre	Starch, Sugar, and gum.	Gluten, Albumen, and casein.	Oil.	Saline matter.
Wheat	25	1500	225	825	180	45	30
Barley	35	1800	270	1080	230	50	50
Oats	50	2100	420	1050	300	100	75
Peas	25	1600	130	900	380	34	48
Beans	25	1600	160	640	420	40	50
Indian Corn	30	1800	100	1260	220	130	30
Potatoes	12 tons	27000	1080	4800	540	45	240
Turnips	30 "	67000	1340	6000	1000	200	450
Wheat Straw	1⅓ "	3000	1500	900	40	80	150
Meadow Hay	1½ "	3400	1020	1360	240	120	220
Clover Hay	2 "	4500	1120	1800	420	200	400
Cabbage	20 "	45000	430	2300	1300	130	600

Johnston.

In the following table, by Sprengel, the grain, leaves, peas, straw, and hay, are estimated after they have been dried in the air, the roots after they have been taken from the field. The potato loses in drying 69 per cent. of water; the turnip, 91; the carrot, 87; the turnip leaf, 86; the carrot leaf, parsnip, and parsnip leaf, each 87, and the cabbage 93.

TABLE SHOWING THE QUANTITY AND KINDS OF INORGANIC MATTER REMOVED FROM THE SOIL IN 1000 LBS. EACH OF THE FOLLOWING CROPS.

	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Silica.	Sulphuric Acid.	Phosphoric Acid.	Chlorine	Oxide of Iron.	Oxide of Manganese.	Total in every 1000 lbs.
Wheat—Grain.	2.25	2.40	0.96	0.90	0.26	4.00	0.50	0.40	0.10	trace		11.77
" Straw.	0.20	0.29	2.40	0.32	0.90	28.70	0.37	1.70	0.30			35.18
Barley—Grain.	2.78	2.90	1.06	1.80	0.25	11.82	.59	2.10	0.19	trace		23.49
" Straw.	1.80	0.48	5.54	0.76	1.46	38.56	1.18	1.60	0.70	0.14	0.20	52.42
Oats—Grain	1.50	1.32	0.86	0.67	0.14	19.76	0.35	0.70	0.10	0.40		25.80
" Straw	8.70	0.02	1.52	0.22	0.06	45.88	0.79	0.12	0.05	0.02	0.02	57.40
Rye—Grain	5.32		1.22	0.44	0.24	1.64	0.23	0.46	0.09	0.42	0.34	10.40
" Straw	0.32	0.11	1.78	0.12	0.25	22.97	1.70	0.51	0.17			27.93
Field Bean } Bean	4.15	8.16	1.65	1.58	0.34	1.26	0.89	2.92	0.41			21.36
Field Bean } Straw	16.56	0.50	6.24	2.09	0.10	2.20	0.34	2.26	0.80	0.07	0.05	31.21
Field Pea } Pea	8 10	7.39	0.58	1.36	0.20	4.10	0.53	1.90	0.38	0.10		24.64
Field Pea } Straw	2.35		27.30	3.42	0.60	9.96	3.37	2.40	0.04	0.20	0.07	49.71
Pota's { Roots	4.028	2.334	.331	.324	.050	.084	.540	.401	.160	.032		8.284
Pota's { Tops	8.19	.09	12.97	1.70	.04	4.94	.42	1.97	.50	.02		30.84
Tur. { Roots	2.386	1.048	.752	.254	.036	.388	.801	.367	.239	.032		6.303
Tur. { Leaves.	3.23	2.22	6.20	.59	.03	1.28	2.52	.98	.87	.17		18.09
Carrots	3.533	.922	.657	.384	.039	.137	.276	.514	.070	.033	.060	6.619
Parsnips	2.079	.702	.468	.270	.024	.162	.192	.100	.178	.005	?	4.180
Rye Grass	8.81	3.94	7.34	0.90	0.31	27.72	3.53	0.25	0.06			52.86
Red Clover	19.95	5.29	27.80	3.33	0.14	3.61	4.47	6.57	3.62			74.78
White Clover	31.05	5.79	33.48	3.05	1.90	14.73	3.53	5.05	2.11	0.63		91.32
Lucerne	13.40	6.15	48.31	3.48	0.30	3.30	4.04	13.07	3.18	0.30		95.52
Sainfoin	20.57	4.37	21.95	2.88	0.66	5.00	3.41	9.16	1.57			69.57

As a means of enabling the farmer to form an approximate estimate of the amount removed from the soil by his crops, we append the following valuable tables by Prof. Johnston :—

TABLE SHOWING THE AMOUNT OF ORGANIC SUBSTANCES REMOVED FROM THE SOIL IN 1000 LBS. EACH OF THE FOLLOWING CROPS WHEN PERFECTLY DRY.

	Carbon. Lbs.	Hydrogen. Lbs.	Oxygen. Lbs.	Nitrogen. Lbs.	Ash. Lbs.
Hay, about..	458	50	387	15	90
Red Clover Hay..	474	50	378	21	77
Potatoes..........	440	58	447	15	40
Wheat............	461	58	434	23	23
Wheat Straw	484	53	389½	33½	70
Oats	507	64	367	22	40
Oat Straw........	501	54	390	4	51

TABLE SHOWING INORGANIC MATTER REMOVED FROM THE SOIL IN 1000 LBS. EACH OF THE FOLLOWING CROPS IN THEIR ORDINARY STATE OF DRYNESS.

Wheat ....about	20 lbs.	Beans ....about	30 lbs.
Wheat straw.......... "	50 "	Peas.................. "	30 "
Barley .... "	30 "	Pea straw. .... "	50 "
Barley straw.......... "	50 "	Meadow Hay.......... "	50 to 100
Oats.................. "	40 "	Clover Hay............ "	90 lbs.
Oat straw.............. "	60 "	Rye Grass Hay........ "	95 "
Rye.................... "	20 "	Potatoes.............. "	8 to 15
Rye straw............. "	40 "	Turnips............... "	5 to 8
Indian Corn........... "	15 "	Carrots .... "	15 to 20
Indian Corn Stalk.... "	50 "		

GRAND IDEA FOR FARMERS ; BEST FODDER AT $1.00 PER TON—Mr. Francis Morris of Howard Co., Ind., thus recounts a very unusual experience in preparing and using corn fodder. The system, if carried out to its ultimate results, would render almost any farm a fair equivalent to a gold mine, so far as profit is concerned.

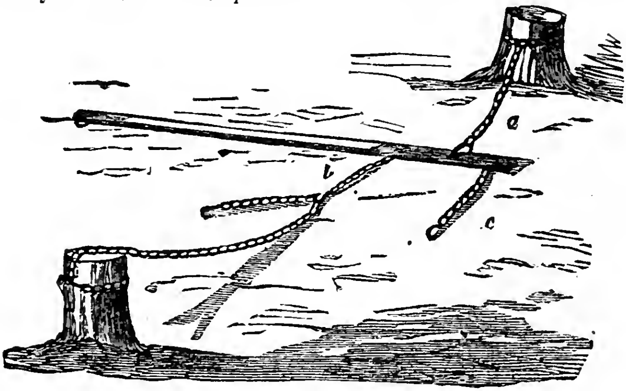
"About the 1st of last August, I planted five acres of ordinary wheat land in Indian corn, and I allowed it to grow until the 1st of October, when it was in tassel. I then had it cut down with a reaper and passed through the ordinary process of chopping, using for that purpose an ordinary feed-cutter. The fodder thus produced was mixed with straw in proportion of four-fifths corn fodder to one fifth straw. It was then put in trenches, trampled down, and covered with earth. The fodder remained in this state until last Christmas day, when the trenches were opened and the fodder taken out and fed to the cattle. The fodder was found to be in as perfect a state of preservation as when it was first put in, and the cattle seemed to relish it from the first, and now prefer it to any other kind of food. The cost of producing this fodder was only $1 a ton, which is only one-twentieth as much as the cost of timothy hay, which is not equal to it in any respect. If the land is planted early in the spring, 20 or 30 tons can be raised to the acre, but in France the land is highly manured and the corn is sowed only two feet apart, which often makes the yield as high as 80 tons to the acre. The same land can afterwards be planted in barley, and loses none of its strength by the planting of the corn, as it is a principle in agriculture that the strength of the land is only lost in the formation of the grain. By the use of this fodder every farm of 100 acres, planted with 10 acres of this fodder, would be able to fatten 100 head of cattle during the winter, which would yield a profit of 50 per cent., besides the immense advantage of having such an amount of stable manure, which in itself, if utilized, would pay for the fodder thus used."

The advantages of this method, Mr. Morris states, are best shown by a comparison between the cost of production of this fodder and the cost of timothy hay.

Phosphate, 10 acres, at $16	$160
Team and plow for 30 days	60
Man to tend the team	15
Cutting	15
Hauling and preserving	250
Total cost	$500

"A fair estimate of the crop of these ten acres would be 500 tons. Five hundred tons of timothy hay would cost $10,900, and as this 500 tons of chopped fodder will answer the same purpose as the timothy hay, it is easily seen that every community can thus raise its own meat at about half the cost to import it."

Of all the vegetable products used as food, it is to be noted that in their *dry state*, *carbon* forms almost ½ the weight, *oxygen* a little over ⅓, hydrogen a little more than 5 per cent, nitrogen from 1½ to 4 per cent, and earthy matter from 1 to 20 per cent.



A SIMPLE STUMP PULLER.

The above cut represents a simple stump machine illustrated in the columns of the *American Agriculturist*. It is worked by a lever, moved preferably by a stout yoke of oxen. The end of the lever is supplied with a strong clevis, sufficiently long to pass around so as to be used on either side. The fulcrum of the lever consists of a chain which is to be fastened to the largest stump near (*a*); on each side of this is a clevis, with a short chain and hook attached. To work the machine, fix a chain to the stump to be pulled, hook on to one of the short chains of the machine (*b*), draw up the oxen until that chain is tight; hook on the other chain (*c*), turn the team, and draw up as far as they can go; hook the chain (*b*), turn and draw again, and so repeat until the stump is drawn out. Then fasten on to another, and repeat the process until all the stumps are out within reach of the one the machine is anchored to. The machine will then have to be moved to another anchoring place, and so on until the field is cleared. The last stump left must be grubbed out. It will be necessary to remember that the power of this lever is very great; and stump pulling requires stout implements and chains. A breakage may not only cause delay, but a blow from a snapping chain may very easily be fatal ; it is therefore absolutely necessary for safety that the chains be made of the best iron, with the best workmanship, and strong enough to hold against all the resistance they may meet. The lever should be strengthened with iron plates in those parts where the holes are bored for the clevis bolts.

DYNAMITE VS. STUMPS AND ROCKS.—Late experiments by John O'Donnell, of Jamacia, L. I., before an invited party of farmers, prove conclusively that stumps and rocks can be sent flying by means of dynamite at a very low cost. The stronger and fresher the stump is the further it flies. Five stumps were attacked. The first was of oak, partly decayed. The men employed punched a hole with a crowbar between two projecting roots, but not being experts, did not insert the instrument fully under the stump. Consequently, only two-thirds of it was blown out. The partial decay of the wood was another hindrance. It did not offer the necessary resistance. A partially rotted chestnut stump was blown to fragments. The crowbar was badly inserted under an apple-tree stump, and that, like the oak, was shattered to the extent of two-thirds. With a sound and sturdy oak stump, however, the dynamite was fully triumphant. The stump was blown out utterly.

A charge was place under a rock weighing about two tons. It was thrown from its bed and shattered to pieces. A rock half its size was thrown twenty feet, but not broken. A hole about a foot deep was then drilled into a well-embedded rock, and charged with four ounces of dynamite. It was much broken, and the pieces not dislodged were easily pried out with the crowbar.

About two inches of a cartridge an inch in diameter had hitherto been used upon the stumps, but the closing experiment was made with an entire cartridge eighteen inches long upon a fresh oak stump twenty inches in diameter. Many of the fragments were thrown 125 feet.

The dynamite is put up in packages of oiled muslin, shaped like a candle, and impervious to water. One end is opened, and a hole is made in the powder with a stick for the insertion of the percussion cap, which is an inch long, and loaded for half its length with fulminate of mercury. A fuse is inserted in the cap, which is squeezed with nippers that it may fit tightly. The little interstices must be filled with soap, to render the cap waterproof. After the cap is in position in the powder, the top of the cartridge must be tied tight around the fuse, so that no water may enter. On the cartridge being placed against the stump, water must be poured into the hole and the ground around thoroughly soaked and pressed that it may offer a strong resistance. A little semi-circular dam should then be heaped around, within which more water should be poured, by way of adding to the resistance. The fuse, which should project outside of the dam, is then lighted. It reaches the cap in less than two minutes, which affords ample time for the operators to reach a safe distance. The explosion makes little noise, and after viewing a dance in the air of a myriad of fragments, spectators find a large hole, with a few loose roots around and the ground ready for the plough.

COCKROACH DESTROYER.—To destroy cockroaches, mix finely powdered borax and fine sugar, half-and-half, and spread around where the roaches are most troublesome. For a few days it may seem that the remedy is doing no good, but soon the roaches will begin to die, and in a short time you will be rid of them. This is said to be an infallible remedy. Cayenne pepper will keep the pantry and storeroom free from cockroaches and ants.

QUANTITIES OF SEED REQUIRED TO THE ACRE, &c.

Table showing the Quantity of Garden Seed for a given Space.

Designation.	Space and quantity of seeds.
Asparagus	1 oz. produces 1000 plants and requires a bed 12 ft. sq.
" Roots.	1000, plant a bed 4 feet wide, 225 long.
Eng.Dwarf Beans	1 quart plants, from 100 to 225 of row.
French " "	" " " from 100 to 150 feet of row.
Beans, Pole, large	" " " 100 hills.
" " small	" " " 300 hills, or 250 feet of row.
Beets............	10 lbs. to the acre ; 1 oz. plants 150 feet of row.
Broccoli and Kale	1 oz. plants 2500 plants, and requires 40 sq. ft. of ground.
Cabbage..........	Early sorts same as broccoli, and require 60 sq. ft. ground.
Cauliflower......	The same as cabbage.
Carrot...........	1 oz. to 150 of row.
Celery...........	1 oz. gives 7000 plants, and requires 8 sq. feet of ground.
Cucumber........	1 oz. for 150 hills.
Cress	1 oz. sows a bed 16 feet square.
Egg Plant........	1 oz. gives 2000 plants.
Endive...........	1 oz. gives 3000 plants, and requires 80 feet of ground.
Leek.............	1 oz. gives 2000 plants and requires 60 feet of ground.
Lettuce..........	1 oz. " 7000 " and requires seed bed of 120 feet.
Melon............	1 oz. for 120 hills.
Nasturtium	1 oz. sows 25 feet of row.
Onion............	1 oz. " 200 " "
Okra.............	1 oz. " 200 " "
Parsley.........	1 oz. " 200 " "
Parsnip..........	1 oz. " 250 " "
Peppers..........	1 oz. gives 2500 plants.
Peas	1 quart sows 120 feet of row.
Pumpkin........	1 oz. to 50 hills.
Radish...........	1 oz. to 100 feet.
Salsify..........	1 oz. to 150 feet of row.
Spinage..........	1 oz. to 200 feet of row.
Squash...........	1 oz. to 75 hills.....
Tomato..	1 oz. gives 2500 plants, requiring seed bed of 80 feet.
Turnip...........	1 oz. to 2000 feet.
Water Melon....	1 oz. to 50 hills.

Table showing the Quantity of Seed required to the Acre.

Designation.	Quantity of seed.		Designation.	Quantity of seed.	
Wheat	1¼ to 2	bush.	Broom Corn..........	1 to 1½	bush.
Barley	1½ to 2½	"	Potatoes	5 to 10	"
Oats	2 to 4	"	Timothy	12 to 24	quarts.
Rye...	1 to 2	"	Mustard.........	8 to 20	"
Buckwheat	¾ to 1⅓	"	Herd Grass..........	12 to 16	"
Millet	1 to 1½	"	Flat Turnip.........	2 to 3	lbs.
Corn..........	¼ to 1	"	Red Clover..........	10 to 16	"
Beans	1 to 2	"	White Clover........	3 to 4	"
Peas....................	2½ to 3½	"	Blue Grass..........	10 to 15	"
Hemp.................	1 to 1½	"	Orchard Grass.......	20 to 30	"
Flax..................	½ to 2	"	Carrots	4 to 5	"
Rice..................	2 to 2½	"	Parnsnips	6 to 8	"

Table showing the Quantity per Acre when planted in Rows or Drills.

Broom Corn...........	1 to 1½	bush.	Onions....................	4 to 5	lbs.
Beans........	1½ to 2	"	Carrots	2 to 2½	"
Peas..................	1½ to 2	"	Parnsnips.................	4 to 5	"
			Beets	4 to 6	"

To Estimate the Quantity of Peat.—Peat, as ordinarily in the bed, will weigh 2,100 to 2,400 lbs. per cubic yard, if drained in the bed, 1,340 to 1,490 ; when air-dried, 320 to 380 lbs., when it will shrink to ¼ or 1-6 its original bulk.

Vitality of Seeds.—Beans will retain vitality for 2 years, beet 7, cabbage 4, carrot 2, sweet corn 2, cucumber 10, lettuce 3, melon 10, onion 1, peas 2, parsnip 1, radish 3, squash 10, tomato 7, turnip 4.

TABLE SHOWING GERMINATION OF WHEAT SOWED AT VARIOUS DEPTHS.

	Appeared above ground in	No. of plants that came up.
Seeds sown to the depth of............½ inch.	11 days	⅞
" " " " .... 1 "	12 "	all.
" " " " .... 2 "	18 "	⅞
" " " " .... 3 "	"	6/8
" " " " .... 4 "	"	½
" " " " .... 5 "	"	⅜
" " " " .... 6 "	23 "	⅛

In sowing wheat the rule is to give it a thinner covering in a close heavy soil, than in one that is light, gravelly, and sandy.

TABLE, SHOWING THE PERIOD OF REPRODUCTION AND GESTATION OF DOMESTIC ANIMALS.

DESIGNATION.	Proper age for reproduction.	Period of the power of reproduction in years.	No. of Females for one Male.	PERIOD OF GESTATION AND INCUBATION. Shortest period, days.	Mean period, days.	Longest period, dys.
Mare...........	4 years.	10 to 12		322	347	419
Stallion,.......	5 "	12 to 13	20 to 30			
Cow,...........	3 "	10 to 14		240	283	321
Bull,...........	3 "	8 to 10	30 to 45			
Ewe,...........	2 "	6		146	154	161
Ram,...........	2 "	7	40 to 50			
Sow,...........	1 "	6		109	115	143
Boar,...........	1 "	6	6 to 10			
She Goat,.......	2 "	6		150	156	163
He Goat,.......	2 "	5	20 to 40			
She Ass,.......	4 "	10 to 12		365	380	391
He Ass.........	5 "	12 to 15				
She Buffalo,...	"	8		281	308	335
Bitch,.........	2 "	8 to 9		55	60	63
Dog,...........	2 "	8 to 9				
She Cat,......	1 "	5 to 6		48	50	56
He Cat,........	1 "	9 to 10	5 to 6			
Doe Rabbit,....	6 months	5 to 6		20	28	35
Buck Rabbit,..	6 "	5 to 6	30			
Cock,..........	6 "	5 to 6	12 to 15			
Hen,...........		3 to 5		19	21	24
Turkey,........				24	26	30
Duck,..........				28	30	32
Goose,..........				27	30	33
Pigeon,........				16	18	20
Pea Hen,......				25	28	30
Guinea Hen,...				20	33	25
Swan,........				40	42	45

GROWTH AND LIFE OF ANIMALS.

Man	grows	for	20	years,	and	lives	90 or 100	years.
The Camel	"	"	8	"	"	"	40	"
The Horse	"	"	5	"	"	"	25	"
The Ox	"	"	4	"	"	"	15 to 20	"
The Lion	"	"	4	"	"	"	20	"
The Dog	"	"	2	"	"	"	12 to 14	"
The Cat	"	"	1½	"	"	"	9 or 10	"
The Hare	"	"	1	"	"	"	8	"
The Guinea pig		"	7 months,	and		lives	6 or 7	"

TO RID A HOUSE OF RATS.—Wet a few pounds of unslacked lime with strong lye made from potash; let it be quite soft; spread it around the holes so that the rats cannot avoid treading in it; let it remain a week or so, and if it gets dry scrape it off and moisten again. The mixture burns their feet, and they will not be likely to make a second visit. Do not let it come in contact with oil cloth or paint.

ON LAND MEASUREMENT.

To aid farmers in arriving at accurate results in the measurement of an acre, we append the following table. A field of any of these dimensions contains one acre:

5 yards wide	by	968	long.		10 yards wide	by	483	long.	
20	"	"	242	"	40	"	"	121	"
80	"	"	$60\frac{1}{2}$	"	70	"	"	69	"
30	"	"	161	"	55	"	"	88	"
50	"	"	97	"	47	"	"	103	"
16	"	"	303	"	59	"	"	82	"

THE SIDE OF A SQUARE TO CONTAIN

One acre,	208.71 feet;	12.65 rods;	64 paces.
$\frac{1}{2}$ acre,	147.58 feet;	8.94 rods;	45 paces.
$\frac{1}{3}$ acre,	120.50 feet;	7.30 rods;	37 paces.
$\frac{1}{4}$ acre,	104.36 feet;	6.32 rods;	32 paces.
$\frac{1}{8}$ acre,	73.79 feet;	4.47 rods;	$22\frac{1}{2}$ paces.

TABLE FOR FARMERS, SURVEYORS, &c., GIVING EXACT PROPORTIONS OF AN ACRE IN SQUARE FEET IN A LOT LESS THAN AN ACRE.

Square Feet.	100ths of acre.	Square Feet.	100ths of acre.	Square Feet.	100ths of acre.	Square Feet.	100ths of acre.
436	.01	11326	.26	22216	.51	33106	.76
871	.02	11761	.27	22651	.52	33541	.77
1307	.03	12197	.28	23087	.53	33977	.78
1742	.04	12632	.29	23522	.54	34412	.79
2178	.05	13068	.30	23958	.55	34848	.80
2614	.06	13504	.31	24394	.56	35384	.81
3049	.07	13939	.32	24829	.57	35819	.82
3485	.08	14375	.33	25265	.58	36255	.83
3920	.09	14810	.34	25700	.59	36690	.84
4356	.10	15246	.35	26136	.60	37026	.85
4792	.11	15682	.36	26572	.61	37462	.86
5227	.12	16117	.37	27007	.62	37897	.87
5663	.13	16558	.38	27443	.63	38333	.88
6098	.14	16988	.39	27878	.64	38768	.89
6534	.15	17424	.40	28314	.65	39204	.90
6970	.16	17860	.41	28750	.66	39640	.91
7405	.17	18295	.42	20185	.67	40075	.92
7841	.18	18731	.43	29621	.68	40511	.93
8276	.19	19166	.44	30056	.69	40946	.94
8712	.20	19602	.45	30492	.70	41381	.95
9148	.21	20038	.46	30928	.71	41818	.96
9583	.22	20473	.47	31363	.72	42253	.97
10019	.23	20909	.48	31799	.73	42689	.98
10154	.24	21344	.49	32234	.74	43124	.99
10890	.25	21780	.50	32670	.75	43560	1.00

SMALL LOTS.—In laying off small lots the following admeasurements will be found to be both accurate and useful :—

$52\frac{1}{5}$	feet square,	or	$2,722\frac{1}{2}$	square feet,	$= \frac{1}{16}$	of an acre.
$73\frac{2}{3}$	"	"	5,445	"	$= \frac{1}{8}$	"
$104\frac{1}{3}$	"	"	10,890	"	$= \frac{1}{4}$	"
$120\frac{1}{2}$	"	"	14,520	"	$= \frac{1}{3}$	"
$147\frac{7}{12}$	"	"	21,780	"	$= \frac{1}{2}$	"
$208\frac{2}{3}$	"	"	43,560	"	$= 1$	acre.

TO FIND THE NUMBER OF ACRES IN A BODY OF LAND.—*Rule.*—Multiply the length by the width (in rods), and divide the product by 160 : the result will be the answer in acres and hundredths.

When the opposite sides of a piece of land are of unequal length, add them together and take one-half for the mean length or width. Multiply this by the depth, and divide by $31\frac{1}{2}$. This will give the result required.

SURVEYOR'S LONG MEASURE FOR MEASURING DISTANCES, BOUNDARIES, AREAS, RAILWAYS, &C.

$7\frac{92}{100}$ inches	1 link.	4 rods	1 chain.
25 links	1 rod..	80 chains	1 mile.

EQUIVALENTS.

Mile.		Chains.		Rods.		Links.		Inches.
1	=	80	=	320	=	8,000	=	63,360
		1	=	4	=	100	=	792
					=	25	=	198
						1	=	7.92

Surveyor's long measure, scale of units, 7.92, 25, 4, 80. ,

TABLE OF MISCELLANEOUS LINEAR MEASURE.

3 inches	1 palm.	
4 inches	1 hand.	Used in measuring the height of horses at the shoulder.
9 inches	1 span.	
3 feet	1 pace or step.	
3.28 feet	1 metre.	
6 feet	1 fathom.	Used in measuring depths at sea.
880 fathoms	1 mile.	
3 geographical miles	1 league.	
60 " "	1 degree.	Of latitude:
$69\frac{1}{4}$ statute "		Of longitude on the equator.

SURVEYOR'S SQUARE MEASURE, FOR MEASURING THE CONTENTS OF FARMS, FIELDS, &C.

625 square links (*sq. l.*)	1 pole, *P.*
16 poles	1 square chain, *sq. ch.*
10 square chains	1 acre, *A.*
640 acres	1 square mile, *sq. mi.*
36 square miles (6 miles square)	1 township, *Tp.*

EQUIVALENTS.

Tp.		Sq. Mi.		A.		Sq. Ch.		P.		Sq. Links.
1	=	36	=	2304	=	230,400	=	3,686,400	=	2,304,000,000
		1	=	640	=	6,400	=	102,400	=	64,000,000
						10	=	160	=	10,000
						1	=	16	=	1,000
								1	=	625

Surveyor's square measure, scale of units, 625, 16, 10, 640, 36.

An ACRE is the unit of land measure, and is 10 square chains (10,000 links), or a piece of land 3 chains $16\frac{1}{4}$ links (or about $69\frac{1}{2}$ yds.), on each of the four sides, or, if of a different shape, as much land as is embraced in that compass.

A ROOD is a quarter of an acre, or 40 perches, and contains 25,000 square links; if square, it should measure 1 chain and 58 links, or about $34\frac{3}{4}$ yds. on each side.

A PERCH (sometimes called a pole or rod) is the 160th of an acre, and contains $30\frac{1}{4}$ square yds., or 625 square links, and embraces $5\frac{1}{2}$ yds., or 25 running links of the chain, on each of the four sides.

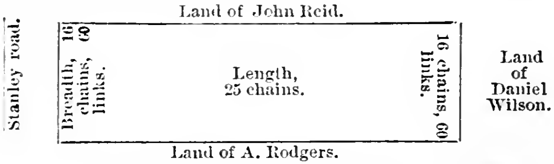
GUNTER'S CHAIN, the unit of measure used by surveyors, is a metallic chain 22 yds. in length, and is divided into 100 links of $7\frac{92}{100}$ inches each. Measurements are calculated in chains and hundredths. As a substitute for the chain, some engineers use a steel measuring tape 100 feet long, with each foot divided into tenths. It takes 10,000 links to make 1 square chain, as 100 times 100 is 10,000. An acre embraces 10 square chains, or 100,000 square links. The outside measurements of land is estimated by *running* chains and links, the contents by *square* chains and links (being a regular system of decimals), the latter being a multiple of the former. In land measurement, the chain is drawn straight over hills and hollows. Correctness in the measurement is ensured by the use of a compass (sustained by a tripod) resembling a quadrant.

Farmers and others not possessed of a Gunter's chain or metallic measuring tape, may effect correct measurements by the use of a notched pole 16½ feet long, containing 25 divisions, formed by 24 notches, each of them a trifle over 7⅞ inches apart. The 25 spaces will represent 25 links, and the pole ¼ of a chain; be careful to get the spaces correctly laid off and accurately numbered on the pole with pen and ink.

In the United States Government Land measurement a township consists of 36 sections, each 1 mile square, a section contains 640 acres, a quarter section, ½ mile square—160 acres, an eighth section, ½ a mile long, north and south, and ¼ mile wide—80 acres, and a sixteenth section, ¼ mile square—40 acres. In the surveys of the Public Lands of the United States they are laid out in ranges of townships which run longitudinally, and are numbered on the maps in Roman characters, or capital letters, according to their proximity to the northern border of a State. The ranges of townships run from west to east, the extreme northern line of townships in any State would be all number 1, the next number 11 and so on down. In a township the sections are all numbered 1 to 36, beginning at the north-east corner, as shown in the diagram.

6	5	4	3	2	NW | NE	SW | SE
7	8	9	10	11	12	
18	17	16*	15	14	13	
19	20	21	22	23	24	
30	29	28	27	26	25	
31	32	33	34	35	36	

In drawing out deeds the area or contents of the land is described in acres, roods, and perches, the extent of each boundary is expressed by chains and links; if the land is of extra value, the odd yards and links are noted in describing the contents. In laying off arms, less than half a perch is not reckoned, while a half perch or more is counted a full perch. The description of landed property as detailed in deeds should be definite and explicit as to contents and boundaries. Illustration—The diagram exhibits a piece of land, embracing, say 20 acres fronting on the west of Stanley road,



the land of John Reid is on the south side; that of Alex. Rodgers on the north side; that of Daniel Wilson on the west side; and the Stanley road on the east side. In the Deed the lot should be described as follows: "Beginning at a post, stake, or tree, on the west side of the Stanley road at the north-east corner of land owned by John Reid, running westerly, parallel with the land of said Reid, twenty-five chains, to land belonging to Daniel Wilson, thence northerly, parallel with the land of said Wilson, sixteen chains and sixty links, to land of Alex. Rodgers, then easterly, parallel with the land of said Rodgers, twenty-five chains to the Stanley road, then southerly, along said road, sixteen chains and sixty links to the place of beginning,—containing twenty acres of land, be the same more or less."

An English acre is a square of about 70 yds. each way; a Scotch of 77½ yds.; and an Irish of 88⅓ yds. Every mile of mere hedge and ditch is about an acre. Roads and fences, 1 rod wide, occupy 1 acre for every mile of length.

NOTE.—An English acre comprises 4,840 square yds.; the Scotch, 6,150; the Irish, 7,840; the French (hectare), 11,950; the Dutch, 9,722; the Prussian (morgen), 3,053; the Dantzic, 6,650; that of Amsterdam, 9,722; that of the United States is English measure.

FOR TABLE OF SURFACE MEASUREMENTS, SEE PAGE 128.

EQUIVALENTS.

Sq. Mi.		A.		Sq. Rod.		Sq. Yd.		Sq. Ft.		Sq. Ins.
1	=	640	=	102,400	=	3,097,600	=	27,878,400	=	4,014,489,600
		1	=	160	=	4,840	=	43,560	=	6,272,640
				1	=	30¼	=	272¼	=	39,204
						1	=	9	=	1,296
								1	=	144

TABLE OF AVOIRDUPOIS POUNDS IN A BUSHEL, AS PRESCRIBED BY STATUTE IN THE SEVERAL STATES NAMED.

The letter m signifies sold by measure.

COMMODITIES.	Cal.	Conn.	Ill.	Ind.	Iowa.	Ky.	La.	Maine.	Mass.	Mich.	Minn.	Mo.	N. J.	N. Y.	Ohio.	Oregon.	Penn.	R. I.	Ver.	Wis.
Barley	50	..	48	48	48	48	32	..	46	48	48	48	48	48	48	46	47	..	46	48
Beans	..	..	60	60	60	60	..	..	..	..	..	60	..	26	..	..	..	..	..	..
Blue Grass Seed	..	..	14	14	14	14	..	..	..	..	..	14	..	.	..	..	..	..	..	..
Buckwheat	40	45	40	50	52	52	..	..	46	42	42	52	50	48	..	42	58	..	46	42
Castor Beans	..	..	46	46	46	..	..	..	..	..	..	46	..	..	..	..	..	..	..	..
Clover Seed	..	..	60	60	60	60	..	..	..	60	60	60	44	60	60	60	..	..	..	60
Dried Apples	..	..	24	25	24	..	..	..	..	28	28	24	..	..	..	28	..	..	..	28
Dried Peaches	..	..	33	33	33	..	..	..	..	28	28	33	..	..	..	28	..	..	..	28
Flax Seed	..	..	56	56	56	56	..	..	m	m	..	56	55	55	56	..	..	..	..	56
Hemp Seed	..	..	44	44	44	44	..	..	..	..	..	14	..	..	..	..	..		..	..
Indian Corn	52	56	52	56	56	56	56	..	56	56	56	52	56	58	56	56	56	..	56	56
Indian Corn in ear	..	..	70	68	68	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..
Indian Corn meal	..	..	48	50	.	50	..	50	50	..	..	..	..	..	..	..	..	50	..	..
Oats	32	28	32	32	35	33⅓	32	30	30	32	32	35	30	32	32	34	32	.	32	32
Onions	..	..	57	48	57	57	..	..	52	..	..	57	..	..	..	..	..	50	..	..
Potatoes	..	60	60	60	60	60	..	60	..	..	..	60	60	60	..	60	..	60	60	60
Rye	54	56	54	56	56	56	32	..	56	56	56	56	56	56	56	56	56	..	56	56
Rye Meal	..	..	..	..	..	..	..	50	50	..	..	..	..	..	..	..	..	50	..	..
Salt	..	..	..	50	50	50	..	..	.	..	..	50	..	56	..	..	..	..	..	..
Timothy Seed	..	..	45	45	45	45	..	..	m	m	..	45	..	44	.	..	..	..	..	46
Wheat	60	56	60	60	60	60	60	..	60	60	60	60	60	60	60	60	60	..	60	60
Wheat Bran	..	..	20	..	20	20	..	..	..	..	..	20	..	..	..	..	..	..	..	..

In Pennsylvania 80 lbs. coarse, 70 lbs. ground, or 62 lbs. fine salt make 1 bushel, and in Illinois, 50 lbs. common, or 55 lbs. fine salt make 1 bushel. In Tennessee 100 ears of corn are a bushel. A heaping bushel contains 2815 cubic inches.

In Maine 64 lbs. of ruta baga turnips or beets make 1 bushel.

A cask of lime is 240 lbs. Lime in slacking absorbs 2½ times its volume, and 2¼ times its weight in water.

The United States Standard bushel contains 2150.42 cubic inches. A cubic foot contains 1728 cubic inches, so that a bushel is to a cubic foot, as, say 2150 to 1728, or about the proportion of 4 to 5; hence to convert cubic feet to bushels, multiply by ⅘.

TO FIND THE CONTENTS OF A BIN IN CUBIC FEET.—Abate the contents one-fifth, and the result will be the contents in bushels.

ON FENCES.

As the maintenance of fences is a most important consideration on every farm, we present the following

TABLE SHOWING THE NUMBER OF RAILS, RIDERS, AND STAKES REQUIRED FOR EVERY TEN RODS OF ZIG-ZAG FENCE.

Length of rail.	Deflection from right line.	Length of panel.	Number of panels.	No. of rails for each 10 rods			Number of stakes.	Number of riders (single).
Feet.	Feet.	Feet.	Feet.	5 rails high.	6 rails high.	7 rails high.		
12	6	8	20⅝	103	123	144	42	21
14	7	10	16½	83	99	116	34	17
16½	8	12	13¾	69	84	95	28	14

For longer distances than 10 rods, the proper number of rails, &c., may be computed by multiplying. For instance: If for 50 rods of fence, multiply the above number by 5; if for 100, multiply by 10, &c. The like rule will apply to the next

TABLE, SHOWING THE NUMBER OF RAILS AND POSTS REQUIRED FOR EACH TEN RODS OF POST AND RAIL STRAIGHT FENCE.

Length of rail—feet.	Length of panel—feet.	Number of panels.	Number of posts.	Number of rails for each 10 rods.			
				5 rails high.	6 rails high.	7 rails high.	8 rails high.
10	8	20⅝	21	103	123	144	165
12	10	16½	17	83	99	116	133
14	12	13¾	14	69	84	95	109
16½	14½	11⅓	12	57	69	81	93

APPROXIMATE COMPARATIVE COST OF ZIG-ZAG AND STRAIGHT RAIL FENCES.

Zig-zag rail fence—

Twelve rails, at $25 per thousand .... 30 cents.
Ground covered by fence, with total worm from stake to stake, in alternate panels of six feet, at $50 per acre .... 78 "
Two stakes, at two cents apiece .... 4 "

$1.12 per 12 ft.

Straight rail fence—

Eight rails, at $25 per thousand .... 20 cents.
Ground covered by fence, two feet wide .... 26 "
Two stakes .... 4 "
Wire .... 2 ".

$0 52 per 12 ft.

A board fence, 4 ft. 6 ins. high, with cedar posts 6 ft. apart, 4 boards, respectively, 6 inches, 6 inches, 9 inches, and 12 inches broad, with a coping board and vertical board covering the joints against the posts, may be constructed, when lumber costs not over $16 per 1000, at a cost of not more than $1 for every 12 ft. in length, without counting labor.

The cheapest, and everything considered, the most efficient fence a farmer can construct, is one made of wire; such fences vary in cost according to the number of wires used, the number of posts, size of wire, &c. The following table exhibits the length of wire of each number that a given weight will make, from which may be computed the cost of a wire fence.

63 lbs. of No. 6 runs 223 yards, and costs $3 45 or 8½ cents per rod.
" 7 " 229 " " 3 55 or 7¼ "
" 8 " 322 " " 3 65 or 6¼ "

Cost of materials of a wire fence, posts eight feet apart, with a bottom board twelve inches wide, and a scantling three by four on top:

1½ posts, at 5 cents............................	7½ cents.
12 feet of inch board, at $16.00 per thousand feet.	19 "
Scantling, 12 feet, at $16.00 per thousand feet....	19 "
5 wires=60 ft. of No. 6, at 8½ cents per rod.......	30 "
	75½ cents per 12 ft.

In view of the increasing scarcity of timber in many parts of the country, it would be well for farmers to exercise greater care for the preservation of their standing trees, and as occasion offers, plant out more. Nature never fails to respond generously to all such investments. For interesting facts regarding the growth of forest trees, consult pp. 84 and 118. This subject reminds the writer of the advice given by a Scotch laird to his son and heir on his death bed. The laird's ruling passion during a long life had been to set out trees, and when the closing scene arrived, the son was called to his father's bed-side, and while standing there anticipating salutary counsel befitting the solemnities of the occasion, the dying laird exclaimed ; "Now Jock, mind what I'm gaun to tell ye, when I'm gane be aye stickin' in a tree, for it'll grow when you'r sleepin'!"

THE CHEMICAL INGREDIENTS OF PLANT FOOD, IN POUNDS AVOIRDUPOIS, CONTAINED IN ONE TON OF THE FOLLOWING MANURES.

Manures.	Chlorine.	Sulphuric Acid.	Phosphoric Acid.	Soda.	Magnesia.	Potash	Ammonia.
	lb. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
Farm Yard Manure...	1 9	1 4	5 1	1 10	18 3	2 4	13 5¾
Night Soil...........	3 0	2 3	120 0	4 10	2 7	6 7	47 15¼
Fresh Bones.........	....	....	580 0	....	......	......	145 5
Dry Blood...........	....	....	....	....	......	......	444 3
Guano...............	62 0	93 8	283 9	36 15	......	66 8	221 9½
Soot................	22 9½	194 3¼	5 12¾	2 11¾	8 11¼	7 1¼	50 2
Salt, Common.........	1344 0	....	....	833 0	......	......	....
Gypsum..............	....	1317 0	....	....	......	......	....
Mxd. Urine p. 100 gals.	1 6	3 8	2 6	5 9	......	2 0	18 3¼
Nitrate of Soda......	....	....	....	8 3	......	......	364 0
Sulp. of Arniea......	....	1357 0	....	....	......	......	470 0

A dragoon-horse kept in a box-stall with 1 hour's exercise each day for a week, was fed as follows :—

Oats each day 10 lbs. = 70 lbs. per week
Hay " " 12 " = 84 " " "
Straw " " 8 " = 56 " " "

He drank within the week 27 gals. of water ; during the time of his exercise the loss of manure is supposed to be 4 lbs. daily, or 28 lbs. per week, yet although the

Total forage consumed amounted to 210 lbs.,
The manure and litter produced was 327½ lbs.

Thus if lost manure be added, yielding with the addition of the moisture imparted to the litter by urine, an increase of two-thirds beyond the weight of the food consumed. Experiments prove that a cow of average size voids about 60 lbs. of manure, or about 1⅓ cubic feet per day, or more than 3 cords, weighing over 10 tons, per year. Composted with peat or swamp muck, three parts to one of manure, it would form 12 cords of excellent compost. It is further estimated that the liquid manure is equally valuable with the solid, and if this also is utilized by the peat absorbents, either under the stable or in it, 24 cords of an excellent fertilizer is secured. This, applied to 2 acres of worn-out meadow, producing say, 1 ton of hay or less per acre, would increase the crop to 3 tons to the acre the first year, besides greatly increasing the crops for 5 years longer. In every case never fail to save your liquid manure, for it is well worth every effort that can be made.

TABLE SHOWING THE COMPARATIVE INCREASE OF CORN BY VARIOUS FERTILIZERS.

No. experiment	QUANTITY OF FERTILIZER.	Yield per acre in bushels.	Increase in bus.	Cost of manure.	Increase of corn for each dollar's worth of manure.	
				$	bus	qrts
1	No Manure	28				
2	500 lbs. Superphosphate of Lime	46	18	12 50	1	14¾
3	690 " Guano	50½	22½	19 00	1	6
4	300 " Superphosphate Lime & 640 lbs. Guano	58	30	25 10	1	6¾
5	320 " Guano and 640 lbs. dissolved Bones	51	23	18 40	1	8
6	1040 " Guano and 400 lbs. Superphosphate Lime	74¾	46¾	38 60	1	6¾
7	16 loads Stable Manure	35½	7½	16 00		15
8	32 " "	42¾	14¾	32 00		14¾
9	16 " " & 200 bus. leached Ashes	44	8	12 00*		22¾
10	16 " " & 640 lbs. Super P Lime	49½	14½	17 80*		28
11	32 " " & 320 lbs. Guano & 1320 lbs. Superphosphate Lime	60	17¼	16 80*	1	¾
12	Hog manure from 108 bus. corn	43	15	16 20		30

* Only the increase over the experiments 7 and 8 with stable manure alone.

TABLE EXHIBITING THE NUMBER OF LOADS OF MANURE AND THE NUMBER OF HEAPS IN EACH LOAD REQUIRED TO AN ACRE, THE HEAPS AT GIVEN DISTANCES APART.

Distance of heaps apart, in yards.	NUMBER OF HEAPS IN A LOAD.									
	1	2	3	4	5	6	7	8	9	10
3	538	269	179	134	108	89½	77	67	60	54
3½	395	168	132	99	79	66	56½	49½	44	39½
4	203	151	101	75½	60½	50½	43¼	37¾	33½	30¼
4½	239	120	79½	60	47¾	39¾	34¼	30	26½	24
5	194	97	64½	48½	38¾	32¼	27¾	24¼	21½	19¼
5½	160	80	53½	40	32	26¾	22¾	20	17¾	16
6	131	67	44¾	33½	27	22½	19¼	16¾	15	13½
6½	115	57½	38¼	28¾	23	19	16¼	14¼	12¾	11½
7	99	49½	33	24¾	19¾	16½	14	12¼	11	10
7½	86	43	28¾	21½	17¼	14¼	12¼	10¾	9½	8½
8	75½	37½	25¼	19	15¾	12½	10¾	9½	8½	7½
8½	67	33½	22¼	16½	13½	11¼	9½	8½	7½	6¾
9	60	30	20	15	12	10	8½	7¾	6⅔	6
9½	53½	26¾	18	13½	10¾	9	7¾	6¾	6	5¼
10	48½	24¼	16¼	12	9¾	8	7	6	5½	4¾

EXPLANATION.—The left hand column gives the distance in yards between the heaps each way in each row ; at the top of the columns are indicated the number of heaps in each load, and the number of loads required per acre will be found at the point where the two lines meet.

MEMORANDA.—1 cubic ft. of half rotten stable manure will weigh 56 lbs.; if coarse or dry, 48 lbs. A *load of manure* is about 36 cubic ft., and if of the first quality will weigh 2,016 lbs.; if of the second, 1728 lbs. 8 loads of the first kind spread over an acre will give 108 lbs. to each square rod, and about 3½ lbs. to each square yard.

To apply guano, mix it thoroughly for a few days with 5 times its bulk of vegetable mould or loam, and some charcoal or gypsum, after breaking the lumps and sifting in alternate layers. Avoid the use of ashes or lime, as they tend to expel the ammonia, and keep under cover, dry, until used. It may then be scattered broadcast upon meadows or grain, or placed near the seeds of young plants in the hill. Use from 200 to 500 lbs. guano to the acre, the latter quantity to the more barren soils.

The following Table shows the composition of Bone dust. In 100 parts, there are of

Lime	55.5	Carbonate of lime	3.75
Phosphate of Magnesia	2.	Fluoride of calcium	3.
Soda, and Common salt	2.5	Gelatine (the substance of horn)	33.25

Analysis of a manure heap in the condition usually applied to a field.

Fresh.		Dried at 212°.	
Water	64.96	Carbon	37.40
Organic matter	24.71	Hydrogen	5.27
Inorganic salts	10.33	Oxygen	25.52
		Nitrogen	1.76
		Ashes (inorganic matter)	30.05

The urine voided from a cow during one year contains 900 lbs. solid matter, and compared with Peruvian guano at $50 per ton is worth $20. It will manure 1¼ acres of land, and is more valuable than its dung, in the ratio, by bulk, of 7 to 6, and in intrinsic value as 2 to 1.—*Dana.*

The Urine of the Cow contains of water	92.6	per cent.
" " Horse " "	94.	"
" " Sheep " "	96.	"
" " Hog " "	92.6	"
" " Human " "	93.3	"

The remainder is composed of salts and rich food for vegetables.—*Sprengel.*

ANALYSIS OF BOLIVIAN GUANO BY PROF. JOHNSTON.

Water	6.91
Organic Matter, containing Ammonia	55.52
Common Salt and Sulphate of Soda	6.31
Carbonate of Lime	3.87
Phosphate of Lime and Magnesia	25.68
Silicious Matter or Sand	1.71

ANALYSIS OF PERUVIAN GUANO BY PROF. JOHNSTON.

Water	13.09
Organic Matter, containing Ammonia	53.17
Common Salt and Sulphate of Soda	4.63
Carbonate of Lime	4.18
Phosphate of Lime and Magnesia	23.54
Silicious Matter or Sand	1.39

PROF. JOHNSTON'S TESTS FOR GOOD GUANO.—The drier the better, there is less water to pay for and transport. The lighter the color the better, it is the less completely dissolved. If it has not a strong ammoniacal smell it ought to give off such a smell when a spoonful of it is mixed with a spoonful of lime in a wine-glass. When put into a tumbler of water and stirred well, and the water and fine matter poured off, it ought to leave but little sand or stones. When heated to redness over a fire or a bright flame, until the animal matter is burnt away, the ash should nearly all dissolve in dilute muriatic acid.

ANALYSIS OF FISH GUANO.

Water expelled by 212° heat	8.06	Sulphate of Magnesia	0.71
Sand	0.33	" Potash	2.05
Oil	2.40	" Soda	2.42
Organic Matter	50.72	Chloride of Sodium	1.12
Super-Phosphate of Lime	9.85	Sulphate of Ammonia	2.72
Sulphate of Lime, Hydrated	19.62		

Dr. Apjohn.

TABLE, SHOWING THE EFFECT PRODUCED UPON THE QUANTITY OF THE CROP BY EQUAL QUANTITIES OF DIFFERENT MANURES APPLIED TO THE SAME SOIL, SOWN WITH AN EQUAL QUANTITY OF SEED.

Manure applied.	Return in Bushels for each Bushel of Seed. Wheat.	Barley.	Rye.	Oats.
Blood	14	16	14	12½
Night Soil	14	..	13½	14½
Sheep Manure	12	16	13	14
Horse "	10	13	11	14
Pigeon "	..	10	9	12
Cow "	7	11	9	16
Vegetable "	3	7	6	13
Without Manure	..	4	4	5

Analysis of fresh farm-yard manure, composed of horse, cow, and pig excreta, about 14 days old, by Dr. Augustus Voelcker, Professor of Chemistry in the Royal Agricultural College, Cirencester, England. According to this analysis one ton (2,000 lbs.) farm-yard manure contains—

Soluble silica (silicic acid)	24	lbs.
Ammonia (actual or potential)	15¾	"
Phosphate of lime	13$\frac{7}{10}$	"
Lime	23$\frac{7}{10}$	"
Magnesia	3$\frac{1}{10}$	"
Potash	13½	"
Soda	1$\frac{2}{5}$	"
Common salt	$\frac{6}{10}$	"
Sulphuric acid	2⅓	"
Water	1323$\frac{2}{5}$	"
Woody fibre, &c	579	"

Of course no two samples of farm-yard manure are exactly of the same composition. That analyzed by Dr. Voelcker was selected with much care, as representing a fair average.

Note.—In estimating the value of barn-yard manure the value of the different excreta will always range in value according to the kind of food provided for the stock. See last column of Table on page 716.

TABLE SHOWING THE COMPARATIVE VALUE OF ANIMAL MANURES, WITH FARM-YARD MANURE AS THE STANDARD.

100 lbs. farm-yard manure are equal to	
125 lbs. solid excrement of the Cow	3 lbs. Dry Flesh.
73 " " " " Horse	5 " Pigeon Dung.
91 " liquid " " Cow.	15 " Liquid Blood.
16 " " " " Horse.	4 " Dry Blood.
98 " Mixed " " Cow.	3 " Feathers.
54 " " " " Horse.	3 " Cow Hair.
36 " " " " Sheep.	3 " Hair Shavings.
64 " " " " Pig.	3½ " Dry Woollen rags.

Johnston.

TABLE SHOWING THE RELATIVE VALUE OF DECOMPOSED VEGETABLE MANURES, FROM THE INORGANIC MATTER THEY CONTAIN.

	Inorganic Matter. lbs. lbs.
1 ton Wheat Straw made into manure returns to the soil	70 to 360
1 " Oat " " " " "	100 to 180
1 " Hay " " " " "	100 to 200
1 " Barley " " " " "	100 to 120
1 " Pea " " " " "	100 to 110
1 " Bean " " " " "	100 to 130
1 " Rye " " " " "	50 to 100
1 " Dry Potato-tops " " " "	400
1 " Dry Turnip-tops " " " "	370
1 " Rape Cake " " " "	120
1 " Malt Dust " " " "	180
1 " Dried Seaweed " " " "	560

Johnston.

TABLE SHOWING THE RELATIVE VALUES OF DECOMPOSED VEGETABLES AS MANURES, FROM THE NITROGEN THEY CONTAIN.

100 lbs. of farm-yard manure is equal to

130 lbs.	Wheat Straw Manure.	80 lbs.	Fresh Seaweed Manure.
150 "	Oat " "	20 "	Dried " "
180 "	Barley " "	26 "	Bran of Wheat or Corn "
85 "	B'kwh't " "	13 "	Malt Dust "
45 "	Pea " "	8 "	Rape Cake "
50 "	Wheat Chaff "	250 "	Pine Sawdust "
80 "	Green Grass "	180 "	Oak " "
75 "	Potato Tops "	25 "	Coal Soot "

Boussingault.

MOISTURE ABSORBED BY VARIOUS MANURES.

1000 parts horse-manure, dried at a temperature of 100° Fahr., absorbed by exposure to the air at a temperature of 62° Fahr.:

Moisture	145 parts.
1000 parts cow-manure, under same circumstances	130 "
" pig-dung, " " "	120 "
" sheep-dung, " " "	81 "
" pigeon-dung, " " "	50 "
" rich alluvial soil, " "	14 "
" fresh tanners' bark, " "	115 "
" putrified, " " "	145 "
" refuse marine salt, " "	49½ "
" soot, " "	36 "
" burnt clay, " "	29 "
" coal ashes, " "	14 "
" lime, " "	11 "
" sediment from salt-pans, "	10 "
" crushed rock-salt, " "	10 "
" gypsum, " "	9 "
" chalk, " "	4 "

Everything on a farm should be utilized, even the outflow of the kitchen slops should be discharged on a bed of swamp muck. Good wood ashes weigh about 60 lbs. to the bushel ; of this 6¾ lbs. are soluble in warm water. They are worth to the farmer from 60 to 70c. per bushel as a fertilizer, if leached, they are worth perhaps a quarter of that sum. They are excellent for all crops, altogether unequalled for fruit trees, and in a most unfavorable season 250 bushels of potatoes have been raised from 1 acre dressed with them.

The products of the water closet, both liquid and solid, should be deodorized and composted by mixture with dried peat, ashes, or dry earth of a loamy nature. The privy vault or box should be easily accessible at all times, and ought to be kept well supplied with a mixture of these absorbents. No better fertilizer than this exists under the sun; about 10 bushels of the compost will be a good dressing for an acre. In China no other fertilizer is used, and about 400,000,000 of people exist on the crops nourished by it. The dry earth closet introduced into England by the Rev. Mr. Moule, and the Wakefield closet in the United States, are most powerful auxiliaries of the agriculturist, and deserve the highest commendation.

TABLE SHOWING AMOUNT OF SEED POTATOES REQUIRED, WHEN CUT OR UNCUT, AND WHEN SET AT DIFFERENT DISTANCES APART, IN DRILLS TWENTY-EIGHT INCHES FROM CROWN TO CROWN.

Whole, and planted........	6 inches apart	77 bushels per acre.
" "	9 " "	50 " "
" "	12 " "	38 " "
" "	18 " "	26 " "
" "	24 " "	19 " "
Cut into two sets "	6 " "	38 " "
" "	9 " "	25 " "
" "	12 " "	19 " "
" "	18 " "	13 " "
Cut into four sets "	6 " "	19 " "
" "	9 " "	13 " "
" "	12 " "	10 " "
Cut into five sets "	6 " "	15 " "
" "	9 " "	10 " "
Cut into six sets "	6 " "	13 " "

TABLE SHOWING THE QUANTITY OF LAND, IN ACRES AND TENTHS, PLOUGHED BY A TEAM AND PLOUGH MOVING AT THE RATE OF TWO MILES PER HOUR, PER DAY OF 10 HOURS.

Width of furrow in inches.	Acres and tenths.	Width of furrow in inches.	Acres and tenths.	Width of furrow in feet.	Acres and tenths.	Width of furrow in feet.	Acres and tenths.
5	1.0	12	2.4	2	4.8	5½	13.2
6	1.2	14	2.8	2½	6.0	6	14.4
7	1.4	16	3.2	3	7.2	6½	15.6
8	1.6	18	3.6	3½	8.4	7	16.8
9	1.8	20	4.0	4	9.6	7½	18.0
10	2.0	22	4.4	4½	10.8	8	19.2
11	2.2			5	12.0		

ARGUMENTS IN FAVOR OF SOILING CATTLE.—By soiling is understood the feeding of cattle in yards or in stables, with grass or other green fodder cut in the fields, and hauled to them. The Hon. Josiah Quincy, a high authority, states the following as the main advantages of the system: 1st. The saving of land. 2nd. The saving of fencing. 3rd. The economizing of food. 4th. The better condition and greater comfort of the cattle. 5th. The greater product of milk. 6th. The attainment of manure. See page 47.

In reference to the 3rd item, the economy of food, he says: "There are six ways by which beasts destroy the article destined for their food—1. By eating; 2. By walking; 3. By dunging; 4. By staling; 5. By lying down; 6. By breathing on it. Of these six, the first only is useful. All the others are wasteful." He asserts that a milch cow may be kept by this method during the ordinary pasturing season on the product of ½ acre of land, while at least 2 acres of the same land would be necessary on the pasturage system, and some place the proportion in favor of soiling as high as 1 to 7. By this system interior fences may be abolished in every case, weedy head-lands got rid of, and the plough performs its healthy work from one side of the farm to the other, without let or hindrance.

The system recommended by Mr. Quincy is as follows :—

"1. As early in April as the state of the land will permit, which is usually between the 5th and the 10th, on properly prepared land, sow oats at the rate of 4 bushels to the acre.

"2. About the 20th of the same month, sow oats or barley, at the same rate per acre, in like quantity and proportions.

"3. Early in May, sow, in like manner, either of the above grains.

"4. Between the 10th and 15th of May, sow Indian corn (the flat Southern being the best) in drills, 3 bushels to the acre, in like quantity and proportions.

"5. About the 5th of June repeat the sowing of corn.

"7. After the last mentioned sowing barley should be sown in the above-mentioned quantity and proportions, in succession, on the 15th and 25th of June, and on the 1st of, or early in July ; barley being the best qualified to resist the frosts."

Mr. Quincy relied on the mowing of his best grass land to carry his stock through the month of June, or from the earliest pasturing season to the 1st of July, when he anticipated fodder from his first sowing of oats, and after the first severe frost he relied on the tops of 12 acres of root crops for the supply of 15 cows.

The plan adopted by Geo. E. Waring, Jr., another eminent agriculturist, for 12 Cows, is as follows :—

"1. Early in the autumn sow 3 acres of winter rye to be cut from May 15th to June 15th.

"2. Early in April, 3 acres oats, to be cut from June 15th to July 1st.

"3. Late in April, 2 acres oats or barley, to be cut from July 1st to July 15th.

"4. Early in May, 2 acres oats or barley, to be cut from July 15th to August 10th.

"5. Middle of May, 2 acres corn, to be cut from August 10th to September 1st.

"6. Middle of June, the 3 acres from which rye has been cut to be sown with corn, to be cut from September 1st to September 20th.

"7. Early in July, the first three acres sown with oats to be re-sown with barley, to be cut from September 20th until the harvest of roots and cabbages furnish a stock of green refuse, which will suffice until winter feeding commences.

"8. In September, 3 acres of the 4 comprising Nos. 4 and 5, should be sown with rye for the following spring's use, and the rotation should follow in regular order. The latter end of the season should be helped out with root crops. The reason alleged by Mr. Waring for this apportioning 12 acres for 12 cows, is the bad condition of the land, but he is satisfied, that if all the manure made in the soiling season were to be applied to the ground year after year, that they might be made in time to support, during the whole of the usual pasturing season, 30 milch cows, or 5 cows to each acre. He urges that in the Northern States the *earliest* abundant food will be secured by the use of winter rye, and that the *best* and most abundant food for the late summer and earlier autumn will be secured by the use of Indian corn.

To Construct an Ice-House.—This indispensable appendage to the farm-house and dairy may be constructed at a small cost. One writer remarks : " Last January I drew 1 large load of sawdust and spread it on the ground on the north side of my horse-barn, then drew the ice (sawed in square cakes) and built up a square pile some 8×10 ft. and 7 or 8 ft. high, filling up the spaces between the cakes with pounded ice. I then set up scantling and built a board house around it 2 feet larger each way than the ice ; then filled in sawdust around and 2 to 3 ft. on top, and covered with boards and slabs. We have used freely through the season, sold to pic-nic parties, given away to sick neighbors, and have plenty of ice yet."

Another writer reports his method as follows: "I set posts in the ground, so as to make a house 12 ft. square (three posts on each side), then board or plank it up 8 ft. high, on the inside. The surface earth is now dug out 6 ins. deep, and sawdust filled in 1 ft. deep, making it 6 ins. above the level of the earth. The ice is carefully packed, 9 ft. square and 6 ft. high, leaving a space of 18 ins. between ice and boards, closely packed with sawdust, and the same thickness of sawdust placed on top. I have an old fashioned board roof over this ice-house. The space above the sawdust is left open, so that the air can circulate through and the sun shine in. The result is that we have used ice daily and have a plenty yet. As to the cost, four men with one team, cut, hauled and packed the ice, and filled in the sawdust in less than 2 days, notwithstanding we had to haul the ice over ½ mile."

AVERAGE COMPOSITION, PER CENT. AND PER TON, OF VARIOUS KINDS OF AGRICULTURAL PRODUCE, &C., BY JOHN B. LAWES, OF ROTHAMPSTEAD, ENGLAND.

	PER CENT.					LBS. PER (LONG) TON.					Value of manure in $ and cts. from 1 ton (2,000 lbs.) of food.
	Total dry matter.	Total mineral matter (ash).	Phosphoric acid reckoned as phosphate of lime.	Potash.	Nitrogen.	Total dry matter.	Total mineral matter (ash).	Phosphoric acid reckoned as phosphate of lime.	Potash.	Nitrogen.	
Linseed cake......	88.0	7.00	4.92	1.65	4.75	1971	156.8	110.2	37.0	106.4	19.72
Cotton seed cake..	89.0	8.00	7.00	1.12	6.50	1994	179.2	156.8	70.0	145.6	27.86
Rape cake........ .	89.0	7.00	5.75	3.76	5.00	1994	179.2	128.8	39.4	112.0	21.01
Linseed...........	90.0	8·00	3.38	1.37	3·80	2016	89.6	75.7	30·7	85.1	15.65
Beans.............	84.0	4.00	2.20	1.27	4.00	1882	67.2	49.3	28.4	89.6	15.75
Peas....	84.5	3.00	1.84	0.96	3.40	1893	53.8	41.2	21.5	76.2	13.38
Tares.............	84.0	2.40	1.63	0.66	4.20	1892	44.8	36.5	14.8	94.1	16.75
Lentils....	88.0	2.00	1.89	0.96	4.30	1971	67.2	42.3	21.5	96.3	16.51
Malt dust.........	94.0	3.00	5.23	2.12	4.20	2106	190.4	117.1	47.5	94 1	18.21
Locust beans.......	85.0	8.50	....	....	1.25	1904	39.2	.. ..	.. .	28.0	4.81
Indian meal........	88.0	1.75	1.13	0.35	1.80	1971	29.1	25.3	7.8	40.3	6.65
Wheat.............	85.0	1.30	1.87	0.50	1.80	1904	38.1	42.0	11.2	40.3	7.08
Barley............	84.0	2.20	1.35	0.55	1.65	1882	49.3	30.2	12.3	37.0	6.32
Malt..............	95.0	2.60	1.60	0.65	1.70	2128	58.2	35.8	14.6	38.1	6.65
Oats..............	86.0	2.85	1.17	0.50	2.00	1926	63.8	26.2	11.2	44.8	7.70
Fine pollard*.. ...	86.0	5.60	6.44	1.46	2.60	1926	125.4	144.2	32.7	58.2	13.53
Coarse pollard†....	86.0	6.20	7.52	1.49	2.58	1926	138.9	168.4	33.4	57.8	14.36
Wheat bran........	86.0	6.60	7.95	1.45	2.55	1926	147.8	178.1	32.5	57.1	14.59
Clover hay........	84.0	7.50	1.25	1.30	2.50	1882	168.0	28.0	29.1	56.0	9.64
Meadow hay.......	84.0	6.00	0.88	1.50	1.50	1882	134.4	19.7	33.6	33.6	6.43
Bean straw........	82.5	5.55	0.90	1.11	0.90	1848	124.3	20.2	24.9	20.2	3.87
Pea straw.........	82.0	5.95	0.85	0.89	....	1837	133.3	19.0	19.9	20.2	3.74
Wheat straw.......	84.0	5.00	0.55	0.65	0.60	1882	112.0	12.3	14.6	13.4	2.68
Barley straw.......	85.0	4.50	0.37	0.63	0.50	1904	100.8	8.3	14.1	11.2	2.25
Oat straw..........	83.0	5.50	0.48	0.93	0.60	1859	123.2	10.7	20.8	13.4	2.90
Mangel wurtzel....	12.5	1.00	0.09	0.25	0.25	280	22.4	2.0	5.6	5.6	1.07
Swedish turnips ..	11.0	0.68	0.13	0.18	0.22	246	13.4	2.9	4.0	4.6	0.91
Common turnips...	8.0	0.68	0.11	0.29	0.18	179	15.2	2.5	6.5	4.0	0.86
Potatoes...........	24·0	1.00	0.32	0.43	0.35	537	22.4	7.2	9.6	7.8	1.50
Carrots...........	13.5	0.70	0.13	0.23	0.20	302	15.7	2.9	5.1	4.5	0.80
Parsnips	15.0	1.00	0.42	0.36	0.22	336	22.4	9.4	8.1	4.9	1.14

* Middlings, Canielle. † Shipstuff.

TABEL SHOWING NUTRITIVE EQUIVALENTS OF VARIOUS FOODS.

FOOD.	Amount of flesh-forming matter in 100 lbs.	Amount of fat-forming matter in 100 lbs.	Total nutritive matter in 100 lbs.	Nutritive equivalents of 100 lbs. best English hay.
Irish potatoes	1.4	18.9	20.3	245.3
Carrots	0.6	6.6	7.2	691.6
Parsnips	1.2	7.0	8.2	607.3
Jerusalem artichoke	1.0	18.8	19.8	251.5
Sugar beet	0.9	13.6	14.5	336.5
Turnips (Swede)	1.0	5.2	6.2	803.2
Common white turnip	0.9	3.3	4.2	1185.7
Mangel wurtzel	1.0	12.6	13.6	367.6
Green pea straw	0.9	7.9	8.8	565.9
Spurrey (green	2.7	2.3	5.0	960.0
Green buckwheat stalks	0.2	4.7	4.9	1016.6
Common vetch (green)	1.9	2.6	4.5	1106.6
French vetch (green)	0.7	4.7	5.4	922.2
Green stalks white lupin.	1.8	2.3	4.1	1212.1
Green stalks white bean.	1.0	2.7	3.7	1345.9
Green oats (fodder)	1.0	8.5	9.5	524.2
Timothy grass (green)	4.0	9.7	13.7	363.4
Red top " "	3.3	8.7	12.0	415.0
Superior English hay	13.5	36.3	49.8	100.0
Red clover (green)	2.0	3.6	5.6	907.1
White clover (green)	1.5	2.7	4.2	1185.7
Lucerne (green)	1.9	3.6	5.5	905.4
Red clover (hay)	22.5	18.7	41.2	120.8
White clover (hay)	18.7	40.0	58.7	84.6
Lucerne (hay)	12.7	38.0	50.7	98.2
Wheat flour	14.7	66.4	81.1	61.4
Indian corn	11.0	66.7	77.7	64.2
Rye meal	14.3	55.8	70.1	71.0
Barley meal	13.0	52.0	65.0	76.0
Oatmeal	18.0	51.1	69.1	72.0
Buckwheat meal	9.0	52.1	61.1	81.5
Peas	23.1	41.9	65.0	76.0
Kidney beans	23.9	39.3	63.2	78.7
White field beans	24.0	39.7	63.7	78.2
Lentils	25.7	38.9	64.6	77.0
English linseed cake	22.1	51.0	73.1	68.0
American linseed cake.	22.2	48.6	70.8	70.3

BEE FLOWERS.—The following select list of bee-flowers, plants, trees, &c., is commended to the attention of bee keepers on the high authority of Mr. King, Editor of the *Bee Keepers' Magazine*, New York, as one of the most accurate and reliable ever published. Those plants marked with an asterisk are prime favorites of the bees, and yield large quantities of honey.

Bee keepers would almost double the product of their hives by taking advantage of the grand modern discovery of artificial comb foundations. These foundations are made of wax, or other suitable materials, by means of a machine, are sold at a very reasonable price by the pound, and, when placed in hives, are the means of saving the bees a vast amount of time and work in the construction of comb, every pound of which, estimated in honest bee labor represents at least 20 lbs. of honey. Another notable discovery is the use of salicylic acid for curing foul brood and other useful purposes. The mixture is compounded as follows: Mix together 128 grs. salicylic acid, 128 grs. of soda borax, and 16 ozs. of distilled water. To use, uncap the brood in all the frames that show any diseased cells, and thoroughly spray the bees, brood, comb, and all, with an atomizer filled with the solution.

Spring.

Erica Carnea*	Almond	Turnip*
Winter aconite*	Wallflower* (single)	Cabbage, &c.*
Rosemary*	Borage*	Strawberry
Laurustinus	Onion	Tulip*
Hazel*	Gooseberry	Hawthorn.
Snow-drop.	Apricot	Gorse or furze
Crocus*	Peach	Columbine
Willow*	Apple*	Laburnum
Osier*	Gooseberry*	Barberry*
Primrose	Currant*	Ribes Sanguineum
Hepatica	Laurel*	Dutch clover*
Violet	Linden or basswood	Sycamore maple*

Summer.

Alsike clover*	White clover*	Lucerne clover*
Silverleaf buckwheat*	Catnip	Spanish needle
Syringa	Mignionette*	Yellow vetch
Helianthemum	Blackberry	Sainbois
Annual poppy*	Chesnut	Broom
Sea-kale	Mallow	Wheat
French willow*	Lime*	Viper's bugloss*
Sweet-briar	Hyssop	Raspberry*
Bean	Teazle*	Symphora
Yellow lupin	Nasturtium	Racemosa

Autumn.

Michaelmas daisy	French buckwheat* sowed at midsummer	Heath*
Winter savory		Sunflower
Purple houseleek		Lemon thyme*
Ivy	Spanish broom*	St. John's wort
Honeysuckle	Hollyhock*	Melilotus leucantha*

CUCUMBER PICKLES.—Select nice, firm cucumbers ; pour on them, for three successive mornings, boiling water enough to cover ; add a handful of coarse salt. The night before pickling throw on cold water and drain ; put into jars with ground spices in a bag, sugar and salt enough to taste, alum size of an English walnut to each jar ; pour vinegar hot in each jar, and cover tight while hot.

TO FIND THE SIZE OF A BIN TO HOLD A CERTAIN NUMBER OF BUSHELS. Augment the number of bushels ¼, and the result will exhibit the number of cubic feet the bin will comprise. Then, when two dimensions of the bin are known, divide the last result by their product, and the quotient will be the other size.

PER CENTAGE OF OIL IN SEEDS, GRAIN, &C.

	Oil per cent.		Oil per cent.
Linseed	11 to 22 say 17	Oats	5 to 8 say 6½
Hempseed	14 " 25 " 19	Indian Corn	5 " 9 " 7
Rapeseed	40 " 70 " 15	Wheat Bran	3 " 5 " 4
White Mustard	36 " 38 " 37	Potatoes, turnips and cabbage	1½
Sweet Almond	40 " 54 " 47	Wheat Straw	2 " 3½ " 3
Bitter Almond	28 " 46 " 37	Oat Straw	4
Turnip Seed	40 " 50 " 45	Meadow Hay	2 " 5 " 3½
Wheat Flour	2 " 4 " 3	Clover Hay	3 " 5 " 5
Barley	2 " 3 " 2½		

TABLE SHOWING THE AMOUNT OF BUTTER AND CHEESE OBTAINABLE FROM MILK.

100 lbs.	milk contains about	3 lbs.	pure butter.
100 "	" " "	7.8 lbs.	cheese.
100 "	" averages "	3.5 lbs.	common butter.
100 "	" " "	11.7 lbs.	common cheese.
100 "	skim milk yields "	13.5 lbs.	skim milk cheese.

TABLE SHOWING THE INGREDIENTS CONTAINED IN VARIOUS KINDS OF MILK. IN 100 PARTS THERE ARE OF—

	Woman.	Cow.	Ass.	Goat.	Ewe
Water,	87.9	87.0	91.7	86.7	85.6
Milk Sugar,	6.5	4.8	6.1	5.3	5.0
Butter,	3.6	3.1	0.1	3.3	4.2
Casein,	1.5	4.5	1.8	4.1	4.5

The quantity and quality of cows' milk varies according to the food supplied, breeds, &c.

IN EVERY 1000 PARTS OF MILK THERE ARE OF—

Water,	840 parts.
Milk-Sugar,	45 "
Butter, or oil,	40 "
Casein,	40 "
Phosphate of lime,	17 "
Chloride of potassium,	9 parts.
Phosphate of magnesia,	4 "
Free soda,	3 "
Common salt,	3 "

The time required for the full amount of cream to rise to the surface of new milk at different temperatures may be seen from the following table :—

10 to 12 hours if the temperature of the air is	77° Fahr.
18 to 20 " " " "	68° "
24 " " " "	55° "
36 " " " "	50° "

1 gal, of milk weighs 10 lbs. 4 ozs ; being heavier than water in the proportion of 103 to 100. The best temperature at which to churn *cream* is from 55° to 60° Fahr. ; for *milk* 65° Fahr. Milk will produce scarcely any cream even in the space of a month if it is kept at 33° to 38° Fahr. Milk turns sour by the fermentation of the sugar, and its transformation into lactic acid, thus causing the milk to curdle ; vinegar or rennet will produce the same effect. Good cream will produce about $\frac{1}{4}$ of its weight of butter ; cheese made from good milk contains nearly 33 per cent. of water; that from skim-milk about 60 per cent.

The perfection of milk keeping is attained when a stream of pure spring water flows through the room where it is kept, where fresh air circulates freely through slatted windows or doors uncontaminated by the odor of decaying vegetables or animal matter, and when the temperature ranges from 55° to 65° Fahr. During winter great profit would result from bringing the temperature of the milk to about 120° Fahr. previous to setting, and during all seasons the greatest amount of cream will be collected when the milk in the pans is not over 2 inches in depth. During warm weather the milk, after being drawn from the cow, should, as soon as possible, be cooled down to 62°. This may be done by setting the pail in cold water, or by putting a little pulverized ice in the pail previous to straining. A small piece of crystallized soda about the size of a marble, dissolved in a little water and added to a pail of freshly drawn milk, will increase the amount of cream, improve the butter, and correct acidity. Milk vessels, strainers, churns, &c., should be kept scrupulously clean and free from taint of every kind by frequent scaldings with boiling water. During very hot weather the milk room may be cooled by hanging wet linen sheets near the doors and windows, with the lower parts of the sheets immersed in cold water, and during cold weather the temperature may be raised by means of a fire in a stove, on which a vessel of water may be placed to prevent too much dryness of air.

In skimming the milk, deposit the cream in clean stone crocks, or tin pails, and after sprinkling a handful of fine salt over the surface, set away in a cool place, to remain until churned. In filling the churn leave out whatever milk may be found at the bottom of the cream crock as its sour taste will be sure to promote acidity in the butter. Churning should occupy from ½ to ¾ of an hour; rapid churning should be avoided, as it affects the quality and lessens the quantity of the butter; if it should be hard and granular, refusing to come together well, throw in a little warm water, churning all the while, and the butter will be gathered and ready to take up.

As the question of correct temperature is all important in the manufacture of butter and cheese, frequent use should be made of a good thermometer. Great loss is certain to result if this useful instrument is dispensed with.

In churning, use care to keep the cream well washed down, so that the whole will granulate with regularity; and when the butter has formed in small lumps, pour off the buttermilk, leaving the butter in the churn; pour in a pailful of pure cold water and well wash the butter in it, gathering it into a solid compact mass and working it to squeeze out the buttermilk. Next, remove it to the butter dish and again well wash, at a temperature not higher than 55° or 58°, until the milk is utterly removed from the butter and the water quite clear, then salt, with the best Ashton salt, at the rate of ½ lb. to 10 lbs. butter: work the salt well in and use every effort to rid the butter of water and milky brine, for depend upon it, the product will not be first class unless this is done.

In packing butter use neat firkins, tubs, or pails made of white oak; purify each by filling with a strong solution of bicarbonate of soda boiling hot, allowing the water to stand for 24 hours. Avoid packing butter in vessels containing undissolved salt at the bottom; unless covered with a cloth the butter will be damaged by coming in contact with it. Take great precautions to remove all rancid or suspicious butter from firkins that are to be refilled. All butter made during the early part of the summer should be shipped and sold without loss of time, as it will only keep sweet for a short period. Butter made during warm weather should be packed in firkins and kept in a dry cool place. To preserve it from the air, cover the butter to the depth of half an inch (or deep enough to exclude the air) with strong brine containing in solution 2 tablespoonfuls of white sugar and a piece of saltpetre double the size of a pea. In the fall the butter may be repacked in pails and tubs, to market as fresh butter.

If butter is too soft while being worked and salted, allow it to stiffen for 3 or 4 hours in a cool place, then begin again and finish the work. In packing never mix even the smallest amount of poor butter with good ; it is certain to taint and ruin the whole package. The rancidity of butter may be prevented by thoroughly washing and salting before the cheesy particles and milky matter is acidified by exposure to the air, and by using due caution to exclude air from the package by a covering of water well saturated with salt.

The *oil* of butter is a substance of peculiar richness, unlike any other known oil, and the *fat* of butter, when compacted by expressing the oil, is identical with the solid fat of the human body. Chemical analysis and numerous experiments prove that the butter in cow's milk comes direct from the fat of the animal. The fatty globules are carried into the circulation, deprived of stearine by respiratory combustion, and the oil is then sent to the udders, where, under the influence of mammary pepsin it is changed into the components of butter. It is on this principle that the oleomargarine, now being vended in such immense quantities in the United States and Europe, is manufactured from cow's fat or beef suet.

First class butter is free from every trace of a rancid taste or smell. When cut with a knife it should neither soil the blade, exude any dew or milky brine, should be neither sticky nor greasy, but should, in summer, possess a rich yellow color, with a granular, waxy composition; in winter the color should be of whitish cast or of a pale yellow tint. A plentiful clover pasture surpasses all other food for producing the best quality of milk and butter.

On Cheese Manufacture.—The following practical directions are by an experienced manufacturer:

"When two milkings are united, strain the evening's milk and cool by means of pieces of ice dropped into the pails before straining. In the morning take off all the cream, mix it with twice the quantity of new milk. Add warm water enough to raise it to the temperature of 98°. Rub annatto through a silk cloth sufficient to make the curd the color of rich cream. Into this put rennet sufficient to curd in 35 minutes. Stir the whole into the milk previously raised to the temperature of 85°. The milk should be warmed by means of a pail of hot water set into it, but never by putting it over the fire, for the least burning of the milk will spoil the cheese. While the curd is setting, cover with a cloth to prevent the surface from cooling. The method of cutting, scalding, and pressing depends upon the varieties of cheese to be manufactured. About ¾ of a pound of the best Ashton salt is sufficient for 20 lbs. of curd. Care should be taken that the whey be entirely expressed."

Calves may be raised in first class order at a cost of not more than one-tenth of the value of the butter made from the milk saved, by the use of oil meal, the cheapest molasses, and skim milk. The right quantity for a young calf, is a tablespoonful of oil meal (oil cake) and the same of molasses, divided into 3 parts, for 2 days' feed, added to the skim milk. At the end of the first week each may be increased, and at 10 days a spoonful of molasses and the same of oil meal may be given at each feed. At the commencement of the third week a spoonful of oat or barley meal may be added to each feed, but this should be cooked. The oil meal should be scalded and allowed to form a thick mucilage before being mixed with the skim milk, the molasses may be added direct, and the whole given milk warm. Calves raised on this food have weighed 125 lbs. at 4 weeks old. Hay tea is sometimes used to bring up a calf; this is the soluble constituents of the hay, obtained by cooking.

At the noted agricultural college of Hohenheim, Germany, probably the best conducted institution of the kind in the world, they raise calves entirely by hand, and the daily allowance of food is as follows :

	MILK. lbs.	OATMEAL. lbs.	FINE HAY. lbs.
1st week	12	0	0
2nd "	16	0	0
3rd "	20	0	0
4th "	22	0	0
5th, 6th, and 7th weeks	22	½	½
8th week	21	½	½
9th "	20	1	1
10th "	16	2	3
11th "	12	2	6
12th "	8	— 2	10
13th "	4	3	10

In the ninth week the milk is first mixed with water, and a little fine oatmeal is stirred in. The meal is afterwards mixed with the dry fodder

After three months the milk is withheld, and then the young animals receive daily, till two and one-half years old, from twenty to twenty-two pounds of hay or its equivalent. But the calves never after receive, even in summer, any dry food till they are nine months old. The average feeding is so divided that the younger portion receives less, the older more, till two and one-half years, when they begin to receive the regular rations of the older cattle, including the grain fodder as indicated above. The growth with this treatment is such that these animals (not Shorthorns) attain the following weights at various ages :—

	HEIFERS.	BULLS.
Average weight of calves at three months	233 lbs.	353 lbs.
" " " " six months	351 "	472 "
" " " " twelve months	640 "	750 "
" " " " two years	1184 "	1300 "
Daily increase of calves	1.5 "	1.8 "
" " in second year	1.4 "	1.5 "

FATTENING POWER OF FOODS, PRODUCTION OF PORK, BEEF, &c.—Carefully conducted experiments prove that 1 bushel of corn, weighing 56 lbs., will produce 10½ lbs. of pork. Throwing off ⅕ to come at the net weight, gives 8 2-5 lbs. of pork as the proceeds of 1 bush. corn, or 1 lb. of pork as the product of 6⅔ lbs. of corn. 1 lb. of pork is made by 3 4-5 lbs. of *cooked* corn meal. Experiments made by C. M. Clay, of Kentucky, showed that one bushel of *dry* corn made 5 lbs.10 ozs. of pork ; of *boiled* corn, 14 lbs. 7 ozs., and *boiled* meal, 16 to 18 lbs. The following Table shows the relation which the price of corn bears to that of pork on the assumption that it requires 6⅔ lbs. of corn to produce 1 lb. of pork.

TABLE SHOWING THE PRICE OF PORK PER POUND AT DIFFERENT PRICES PER BUSHEL FOR CORN.

Corn per bush. Cents.	Pork per pound. Cents.	Corn per bush. Cents.	Pork per pound. Cents.
12½	1.50	38	4.52
15	1.78	40	4.76
17	2.00	42	5.00
20	2.38	45	5.35
22	2.62	50	5.95
25	2.96	55	6.54
30	3.57	60	7.14
33	3·92	65	7.74
35	4.00	70	8.57

By reversing the preceding Table we obtain the price of corn at different prices per lb. for pork. The utility of the Table is apparent. For instance, if corn is selling at 50c. per bushel and pork for only 6c. per lb., it would be most profitable to sell the corn ; but should corn be selling at 40c. per bushel and pork for 6c. per lb., it would be the most profitable to sell the latter. The Table must be regarded as an approximation merely, as the results will vary according to the sample of grain, breed, constitution, age, digestion, condition, habits, health, &c., of the animal.

In fattening pigs, peas to begin with are the most valuable food to fill up the flesh on the bones; this well accomplished, corn is the most efficient in the formation of fat. A mixture of peas and corn, or peas and barley, will give better results than either of these grains fed separately. Peas contain in 1,000 parts—

	264	parts	gluten,	and	496	of starch,	gum and	sugar.
Corn................	123	"	"	"	716	"	"	"
Barley..............	64	"	"	"	684	"	"	"

Gluten and albumen are *flesh*-forming, starch, gum, and sugar, are *fat*-forming elements. From numerous experiments, Mr. Harris, in his work on the pig, deduces the following : that

A moderately fat	heifer or steer	will	dress	$59\frac{1}{3}$	per cent.	meat.
"	" mutton sheep	"	"	$59\frac{3}{4}$	"	"
"	" pig	"	"	$82\frac{1}{2}$	"	"

The preponderance in favor of the pig is immense. It is remarked by an eminent cattle feeder, Mr. Glyde, "that an ox requires two per cent of his live weight per day : if he works, $2\frac{1}{2}$ per cent ; a milch cow 3 per cent; a fattening ox, 5 per cent at first, and $4\frac{1}{2}$ per cent when half fat, and 4 per cent when fat ; grown sheep, $3\frac{1}{2}$ per cent to keep them in their store condition." An ox, to replace the daily loss of muscular fibre, requires from 20 to 24 ozs. of dry gluten or vegetable albumen daily. This would be supplied by—

120	lbs. of	turnips or 17 lbs. clover hay.
115	"	wheat straw or 12 lbs. peas.
75	"	carrots or 12 lbs. barley.
67	"	potatoes or 10 lbs. oats.
20	"	meadow hay or 5 lbs. beans.

The Society of Shakers, at Lebanon, N. Y., noted for pork raising, say : "For fattening animals, swine particularly, we consider three of cooked, equal to four of raw meal."

"Unless food be thoroughly deprived of its vegetative powers before it enters the stomach, the whole nourishment which it is capable of affording cannot be derived from it. The most effectual mode of destroying the living principle is by the *application of heat*, by steaming or boiling." —*Louden's Encyclopedia of Agriculture.*

"As to the steaming of food for cattle, there is abundant experience to recommend it. The process of cooking renders soluble that which would otherwise be imperfectly digested. It removes, in some cases, what would otherwise be unwholesome, and it renders savory what would otherwise be distasteful."—*Morton's Cyclopedia of Agriculture.*

If 30 lbs. of hay is required per day to keep 1 cow in passable order during a Canadian winter, numerous experiments establish the fact that 22 lbs. of *steamed* hay will answer the same purpose equally well. This, with 20 head of cattle, will effect a saving of 160 lbs. per day, or \$150 during 5 winter months, with hay at \$10 per ton.

Augustus Whitman, in the *Country Gentleman*, writes : "While 28 lbs. per day of good hay are required to keep dry cows (weighing from 1,150 lbs. to 1,450 lbs.) in an even condition of flesh, upon 20 lbs. of steamed food a handsome gain is made. The trial that furnished the data for the statement was made a year since, when six dry cows, in condition as nearly alike as could be found, were divided into three pairs, and each pair fed differently from the others for 3 weeks; note was then made of the result, and the trial continued another 3 weeks, giving to each pair what another pair had previously been allowed. The result was, that upon 28 lbs. per day of good dry hay, two cows weighing 1,184 lbs. and 1,456 lbs. respectively, just about held their own; while another pair weighing 1,362 lbs. and 1,120 lbs. respectively, upon 20 lbs. per day of steamed feed, gained 54 lbs. and 36 lbs. Reversing the feed for the second three weeks, the last named barely held their own, while the first gained 40 lbs. and 30 lbs. respectively.

"I should say that the cattle on long hay had all they would eat at the three regular feeds, and the quantity consumed was found to be at the close of the trial equal to 28 lbs. per day, as above stated. You will very properly ask, what is the mixture made of?

"My steam box (in three divisions) holds enough to fill 200 feed boxes of about one bushel each, and requires to pack it well 900 lbs. of dry fodder. This is made up of 300 lbs. good hay and 600 lbs. of corn stover, dried fodder, corn or oat or barley straw. This is cut tolerably fine and well mixed, and when packed in layers for steaming is thoroughly wet and seasoned with 180 quarts wheat shorts, 60 quarts cotton seed meal, and 60 quarts corn meal.

"The rule for feeding now observed, and that has been used for the past winter, is somewhat changed from previous years, and is a boxful of steamed feed morning and noon, and 5 lbs, dry hay at night. The two boxes of feed contain 3 lbs. good hay, 6 lbs. straw (or its equivalent), 1 lb. shorts, and $1\frac{3}{4}$ lbs. meal (half each cotton seed and corn), and upon this good gain is made, as the monthly record shows."

A cheap and serviceable steamer may be improvised by making a box of well jointed 2 in. pine, about 7 or 8 feet long by $2\frac{1}{2}$ ft. wide, with a bottom of No. 16 sheet iron, nailed securely on to the lower edge of the sides and ends, and turned up a little outside of them, say, $\frac{1}{2}$ an inch. Place a false bottom perforated with numerous holes, about 3 ins. above the fast bottom, and arrange a tight fitting cover for the top. Set the box on brick work over a suitable fireplace, so that the wooden edges of the box will be safe from the fire, and give a proper draught by a suitable chimney erected at the opposite end from fireplace.

The space between the lower and false bottom being partly filled with water, the cut hay or other provender is packed tightly in above the false bottom, the cover is shut tight, the fire is lighted, and the steam enters the perforations in the false bottom and cooks the contents of the box.

Hon. G. Geddes, of Syracuse, N.Y., says:—"That there is no branch of farming that was *less understood* and promised *more advantages*, than the preparation of food. He had thoroughly proved years ago that *cookng*, independent of grinding, at least DOUBLED THE VALUE OF FOOD."

Geo. A. Moore, of Erie Co., said he had fed 200 sheep on *cooked food*, and he had fully satisfied himself that the value of food was TRIPLED BY COOKING.

Professor Mapes says (*Transactions American Institute*, 1864, p. 373): "The experiment, often tried, has proved that eighteen or nineteen pounds of cooked corn is equal to fifty pounds of raw corn for hog feed. Mr. Mason, of New Jersey, found that pork fed with raw grain cost $12\frac{1}{2}$ cents per pound, and that from cooked $4\frac{7}{8}$ cents. Cooked corn stalks are as soft and almost as nutritious as green stalks. Cattle can be fattened at about half the expense upon cooked food as upon uncooked."

Experiments made by Mr. Owen Merchant, of Warsaw, N.Y., proved that a yoke of poor oxen, valued at about $40, were fatted on cooked potatoes and bran in five weeks and three days, and made extra beef, which was sold in the market for first quality.

JAMES BUCKINGHAM gave in the *Prairie Farmer* an experiment with raw and cooked meal, and found that a hog fed on 1¼ bushels raw meal gained 19 pounds, and another fed on one bushel cooked meal gained 22 pounds.

S. H. CLAY, of Kentucky, found by experiment that a bushel of raw corn makes 5½ pounds of pork, whilst a bushel of cooked meal makes 17½ pounds.

Mr. A. AVERY, of Syracuse, N.Y., says, after two years' trial :—"I think I have saved $10 per head on keeping (say $600 on the stock feed), besides having the milch cows in better condition than ever before." He says again, in April, 1869, "This you see gives me a clear profit of $537.25 on 4½ months' feed.

Messrs. DEWEY and STEWART, ot Owosso, Mich., says:—We have fed 64 head of cattle, 7 horses,and 340 sheep, fattened 22 head of cattle and 70 sheep. We think we have saved one-third the expense in wintering this stock.

By Professor VOELCKER's analysis, 1 ton of wheat straw contains:—

35 lbs. of oil,	26 lbs. albumen,
390 " digestible,	85 " mucilage.

Experiments by E. W. STEWART, of New York, proved a bushel of wheat straw with two quarts middlings or meal was equal to the same weight of *cut* hay, and was worth 25 per cent. more than uncut hay. It was also found that the animals would eat 25 per cent. more hay uncut than cut. The same experiment was then made with corn meal, and 1½ pints was found to make a bushel of straw equal to hay.

Mr. SKINNER, of New York, says he "fed 44 head of milch cows on steamed straw and shippings, and 26 head on hay not steamed. The straw was cut and steamed with the shippings. Each cow received 10 lbs. of straw and 8 lbs. of shippings, and the expense, including labor and fuel, was 29 cents per head, daily. The 26 cows on hay cost 35 cents per head, daily, showing a balance of 6 cents per day each in favor of the straw and shippings. Those fed on the straw were full and plump, were gaining flesh, and doing better than those fed on hay."

In Alcsath, Hungary, similar trials were made about the year 1839 on a very large scale, resulting in a decided success. The trials were made

208 draught oxen,	108 days—daily profit of steaming		$13 00
2,000 old wethers,	120 "	" "	12 50
34 stud horses	180 "	" "	1 42

The profit on 180 days' winter feeding on the above animals being $4,850, an amount quite worth saving. Cooking largely increases the bulk of the grain, a great advantage in preparing it for feeding cattle.

4 measures of	corn	have been increased to	13
4 "	barley	" "	10
4 "	bran	" "	14

THOMAS J. EDGE writes to the *Practical Farmer:*—"I found that 5 bushels of whole corn made 47¾ lbs. of pork. Five bushels (*less miller's toll*) of corn ground and made into thick slop with *cold water*, made 54½ lbs of pork. The same amount of meal well boiled and fed cold, made 83½ lbs. of pork. The corn cost $1.30 per bushel; the pork made from the *whole corn barely paid for the corn*, while the same amount of ground corn *cooked*, paid the whole cost of the cooking and a little more than $1 per bushel over." In this instance the pork sold at $14 per cwt. In a second experiment 10 bushels of corn on the cob, fed in the usual way, on the ground, made 29½ lbs. of pork, while the same amount of shelled, ground by horse-power and well boiled, made 64 lbs. of pork.

J. D. Isett reports in the *Practical Farmer*, that "he formerly fed his team horses 70 lbs. of chop for each horse per week, besides the hay they would eat, and that by cooking his chop he found that his horses did better, and looked better, kept in better spirits, and in every way were better, fed on 50 lbs. per week than on the large amount uncooked, making a saving, as he claims, on 8 weeks, of $57.60.

Note.—In steaming hay, chaff, straw, &c., the fodder should first be cut and then moistened by a large sprinkling pot or hose, adding water at the rate of at least 3 gals. to 5 bushels of feed while it is being stirred up with a fork; then, if bran, meal, or other more concentrated food is to be fed with it, it should be sifted on evenly, and mixed. Sift in a little salt at the same time. Food thus prepared and fed to horses affected with the heaves will often effect a thorough cure. The steaming process has also a wonderful transforming power in rendering mildewed, musty, smutty, and rusted straw, hay, corn, fodder, &c., into first-class, nourishing fodder. Every offensive odor and repulsive taint is completely dissipated by the steaming process.

In the *Practical Farmer* for Dec., 1868, "Agricola" writes, "I have demonstrated to my own satisfaction, with the use of the Prindle Steamer * and careful weighing, that while 5 bushels of boiled mush will make 84 lbs. of pork, 3 bushels of meal and 5 bushels of potatoes will make 72 lbs. of pork."

PRINDLE'S AGRICULTURAL BOILER.

In doing business on a large scale, it is much the best way to use an Agricultural Boiler, like that of Prindle's, represented in the cut, which illustrates the method by which the steam is transmitted to the barrel or box containing the fodder to be cooked. The uses of such a contrivance are manifold. It may be used to great advantage as a small still for dis-

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* *Note*—Farmers will be pleased to learn that this unequalled Agricultural Steamer and Farmer's Boiler, is the invention of Daniel R. Prindle, himself a practical farmer, of East Bethany, N.Y. It was victorious at the World's Exhibition at Philadelphia in 1876. Full information, circulars, &c., obtained free, by addressing the inventor as above, or the manufacturers, Barrows, Savery & Co., Philadelphia, Pa.

tilling essential oils, refining coal oil, boiling clothes, warming bath tubs, heating small rooms, scalding hogs, &c. These boilers, made by Savery & Co., Philadelphia, are provided with safety valves, flexible pipes, &c., and may be procured in the United States from Robert C. Reeves, dealer in Agricultural implements, &c., 185 and 187 Water Street, New York. Another Boiler, somewhat similar, is sold by William Rennie, Toronto, Ont.

NUMBER OF FEET IN LENGTH OF THE FOLLOWING DIMENSIONS OF TIMBER REQUIRED TO MAKE 1000 FEET OF BOARD AND CUBIC MEASURE RESPECTIVELY.

Size.	No. of ft. in length to make 1000 ft. cubic m.	Size.	No. of ft. in length to make 1000 feet board m.	Size.	No. of ft. in length to make 1000 feet, board m.
5 x 5	5,760	2 x 6	1,000	6 x 10	200
5 x 6	4,800	2 x 7	857.2	6 x 11	181.10
5 x 7	4,114.3	2 x 8	750	6 x 12	166.8
5 x 8	3,600	2 x 9	666.8	7 x 7	244.11
5 x 9	3,200	2 x 10	600	7 x 8	214.3
5 x 10	2,880	2 x 11	545.6	7 x 9	190.6
5 x 11	2,618.2	2 x 12	500	7 x 10	171.5
5 x 12	2,400	2½ x 5	960	7 x 11	155.10
6 x 6	4,000	2½ x 6	800	7 x 12	142.10
6 x 7	3,428.7	2½ x 7	685.9	8 x 8	187.6
6 x 8	3,000	2½ x 8	600	8 x 9	166.8
6 x 9	2,666.8	2½ x 9	533.4	8 x 10	150
6 x 10	2,400	2½ x 10	480	8 x 11	136.4
6 x 11	2,181.8	3 x 5	800	8 x 12	125
6 x 12	2,000	3 x 6	666.8	9 x 9	148.2
7 x 7	2,938.9	3 x 7	571.5	9 x 10	133.4
7 x 8	2,571.4	3 x 8	500	9 x 11	121.3
7 x 9	2,285.8	3 x 9	444.4	9 x 12	111.2
7 x 10	2,057.3	3 x 10	400	10 x 10	120
7 x 11	1,870.1	3 x 11	363.7	10 x 11	109.1
7 x 12	1,714.3	3 x 12	333.4	10 x 12	100
8 x 8	2,550	4 x 5	600	11 x 11	99.2
8 x 9	2,000	4 x 6	500	11 x 12	90.9
8 x 10	1,800	4 x 7	428.7	12 x 12	83.4
8 x 11	1,636.4	4 x 8	375	12 x 14	71.5
8 x 12	1,500	4 x 9	333.4	12 x 16	62.5
9 x 9	1,777.9	4 x 10	300	12 x 18	55.6
10 x 10	1,600	4 x 11	272.8	12 x 20	50
9 x 11	1,455.5	4 x 12	250	16 x 18	41.8
9 x 12	1,333.4	5 x 6	400	20 x 20	30
10 x 10	1,440	5 x 7	342.10	20 x 24	25
10 x 12	1,200	5 x 8	300	22 x 24	22.8
11 x 11	1,190	5 x 9	266.8	18 x 24	27.10
11 x 12	1,091	5 x 10	540	18 x 20	33.4
12 x 12	1,000	5 x 11	218.2	14 x 16	53.7
14 x 16	642.10	5 x 12	200	15 x 18	44.5
16 x 18	500	6 x 6	333.4	16 x 20	37.6
18 x 20	400	6 x 7	285.8	13 x 14	66.11
20 x 22	327.3	6 x 8	250	30 x 40	10
22 x 24	272.8	6 x 9	222.2	36 x 36	9.3

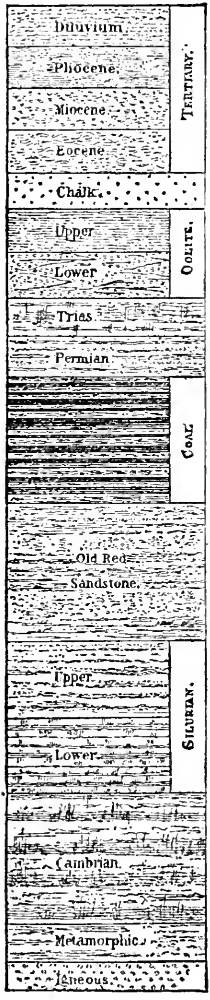
TO MEASURE LUMBER BY THE BOARD RULE.—Place the rule *across* the board to be measured, with the far end flush with the off side of the board, and note the width in inches; then measure the length of board and turn the rule to same length, examining the section or column of that length, and the contents will be found indented on the rule just over the nigh edge of the board.

RULE TO MEASURE LOGS OR ROUND TIMBER.—Multiply the length, taken in ft., by the square of one quarter of the mean girth, measured in inches, and this product divided by 144 will give the required contents in cubic ft. In measuring tapering timber take the girth about one-third the distance from the large to the small end.

RULE FOR ANY SIZE.—Multiply the number of ft. in the face of the timber to be measured, by the thickness in inches, and the result will be the contents in ft. of board measure.

The foregoing table will be found extremely useful to every timber merchant, mill owner, lumberman, and farmer. For other tables relating to Timber measurement, the reader is referred to the series commencing with page 617.

GEOLOGICAL FACTS; AGE, ORIGIN AND ULTIMATE DURATION OF THE EARTH.



Geology is a noble science of but recent origin; it treats of the structure and mineral construction of the earth's crust, the varied strata which compose it, the fossils they contain, and the tremendous forces employed in their formation. The diagram displays the order in which the different strata are super-imposed on each other; they extend to an estimated depth of 82,600 feet or upwards of 15 miles, from the surface down to the granite. The granite, styled by geologists, the *primitive*, *crystalline*, or *igneous* rocks, owing to their evident origin from the action of fire, forms the foundation of the stratified rocks, and at one period the surface of the globe was entirely composed of these rocks in an incandescent condition like molten iron. Gradually cooling during the lapse of ages, a crust was formed, water was condensed from the atmosphere, and the formation of the stratified or *aqueous* rocks began. As an instrumentality in creation, water seems to have been endowed with absolute power, for its irresistible potency appears to be omnipresent in the formation of everything terrestrial. Each stratified layer bears manifest proof of having at one time composed the surface of the earth on which we dwell, and a duration of time, estimated by Prof. Agassiz to be not less than 15,000,000 of years have been required to produce the different strata that have been formed since first the dry land appeared. The substances of which the stratified rocks consist have all been deposited by the action of water; each imbeds in its rocky prison enormous quantities of the fossil remains of organized forms of animal and vegetable life, which at one time, although at periods inconceivably remote, flourished in the sunshine, on the blooming surface of the earth.

The following table shows the relative position in which these various strata exist with respect to each other, computing from the granite upwards together with the estimated thickness of each, but it must not be imagined that they can all be found in any one particular part of the earth. Some will always be found missing, the existence and absence of such deposits being caused by the alternate submersions and dessications which have existed at different times on every part of the earth's surface. All land and stratified rocks have been formed by tidal and sub-marine action, and whatever the strata may be in any given place, *the order of their succession is always the same.* The PRIMARY comprises the Azoic and Cambrian or bottom rocks, the Silurian, the Devonian or Old Red Sandstone, the Carboniferous or Coal System, and the Permian. The SECONDARY, which succeeds, comprises the Trias and Oolite, and the cretaceous or Chalk formation. The TERTIARY consists of the Eocene, Miocene, Pliocene and the Pleistocene, or superficial deposits.

		FEET.
PRIMARY	Azoic (lifeless) and Cambrian rocks	26,000
	Silurian, Lower and Upper	30,000
	Devonian, or Old Red Sandstone	9,000
	Carboniferous, or Coal	10,000
	Permian	2,000
SECONDARY	Trias and Oolite	2,500
	Cretaceous, or Chalk	1,100
TERTIARY	Eocene, or lower tertiary Miocene, or middle tertiary Pliocene, or upper tertiary Diluvium, or superficial deposits	2,000
		86,600

1st. The *primitive or igneous rocks* (granite) contain no organic remains, they bear evidence of having existed at one time in a molten state by reason of intense heat. These rocks protrude through the earth in many places, forming mountains, &c., in numerous localities, the upheaval, as many suppose, being caused by volcanic forces operating from beneath.

2d. The Cambrian, *Azoic*, *metamorphic or transition* rocks are partly crystalline. but manifestly stratified, and composed in great part of the disintegrated material of the underlying granite, with slight deposits of sea shells. The "Azoic" rocks denote those devoid of all traces of organic life.

3d. The Silurian formation resting on the Cambrian, contains remains of Zoophytes, Mollusks, and Crustaceans, all of them submarine *invertebrate* animals of a very low order. The *Zoophite* is a sort of starfish fixed on the top of a slender stalk, rising from, and adhering to the bottom of the water, supplied with long tentacles or fingers, armed with suckers stretching forth on all sides to seize their prey and convey it to a stomach of a simple organism with one orifice. The *mollusks* are pulpy, boneless creatures with or without shells, like the modern oyster, muscle, snail or slug. Of the Crustaceans the most highly developed were the *trilobites*, now quite extinct, but at this time existing in great profusion and variety; the nearest existing resemblance to the trilobites is to be found in the lobster, crab, shrimp, or crayfish families. Of the vegetable creation no traces are to be found in this formation beyond the casts of some specimens of Fucoids or sea-weeds. In the Silurian formation *no vertebrated animals have been anywhere discovered.* To this class belong all those animals furnished with a vertical spine or backbone, with connecting skeleton, as Fishes, Reptiles, Birds, Mammals and the Human race. No dry land, or land vegetation existed during this epoch.

4th. The Devonian or Old Red Sandstone formation, resting on the Silurian, contains the fossil remains of nearly 200 varieties of vertebrate fishes. All these fishes were cartilaginous, clad in strong integuments of bone composed of enamelled plates, instead of the scales which cover the existing races of the deep. Owing to the intense internal heat of the globe, the water composing the seas during this period were in a tepid or warm condition, hence the need of this defensive exterior on the finny tribes. As the globe cooled down and the alternations of summer heat and winter cold set in (as evidenced by the appearance of annual season rings in the fossil trees)these fishes disappeared and others came into existence. The dawn of the Old Red Sandstone epoch was heralded by tremendous and wide spread volcanic explosions causing the upheaval of the underlying granite, lifting with it the super-imposed Cambrian and Silurian strata, thereby forming mountains and dry land above the surface of the waters. Land vegetation soon followed. Vertebrate fishes were created, their armored condition attesting a very high temperature on the earth during the whole period. This formation contains 67 species of Zoophytes, 48 of crustacea, 88 of conchifera, 82 of mollusca, &c., but no quadrupeds.

5th. The *carboniferous system*, resting on that of the Old Red Sandstone, contains deposits of Shale, Sandstone and Limestone, interspersed with Ironstone and coal. The internal heat of the earth was still of a high temperature during this epoch, vast volumes of carbonic acid gas were emitted from the ground, hot, hazy, damp vapors filled the atmosphere, the conditions of shade, heat and humidity, extending even into the frigid zones, generated a growth of Ferns, Calamites, Lepidodendra, Sigillaria and Stigmaria of prodigious extent and the most astonishing dimensions. These different growths, compared with which the most luxuriant tropical vegetation of modern times are but as a howling wilderness or a barren desert, existed at widely different periods; each underwent a complete submersion under water, sand and gravel, and it is to the great masses of vegetable matter which composed these primeval forests that the coal measures owe their origin. The transmutation of the vegetable into the mineral substance of coal has occupied incalculable ages, but on close inspection the vegetable structure is plainly visible, and no doubt can exist of its organic origin.

The fossil remains imbedded in the limestone sections which alternate with coal seams mainly resemble those of the preceding ages. Reptiles of the Batrachian or frog species, and terrestrial animals in the forms of insects of a low order, chiefly of the Scorpion, Cockroach, Cricket and Beetle tribes; now first appear. The festering heat was unsuitable to higher organisms, no sunbeam could penetrate the dense mists, silence held universal sway, while a profuse, flowerless and almost fruitless vegetation, unparalleled in immensity by anything ever known in the history of this planet, tenanted the sombre and death-like solitudes. These forests grew with amazing rapidity until the soft and pulpy masses fell beneath their own weight and succeeding forests sprang from their prostrate trunks. A terrible revulsion of nature takes place; these precious materials are destined for the future use of man. Water, the main-spring of all terrestrial activity, the irresistible agent of creative power, comes upon the scene with overwhelming force, these forests are submerged, and covered with strata of sand and gravel, long since transmuted into sections of rock. Thus the bosom of the earth was made the store-house of those vast treasures of coal and iron which daily minister to the wants of man.

6th. The PERMIAN system is superimposed on the Carboniferous formation. Violent subterranean convulsions appear to have dislocated the coal beds about the commencement of this epoch, and on the broken masses the Permian system of sedimentary rocks were deposited. The ancient order of fishes occur in this formation for the last time, the Trilobite disappears from existence, and undoubted traces of an air-breathing oviparous reptile of the Saurian (lizard) family appear. Fossil footsteps of four-footed animals, apparently those of tortoises, exist, and for the first time we discover the annual season rings in the fossil woods, thus attesting that the unclouded sunbeam had free access to vegetation. This formation comprises, 1st. The red conglomerate. 2d. The magnesian limestone. 3d. The variegated sandstone. 4th. Muschelkalk; and 5th. Uppermost, Variegated marl. The petrifactions of the vegetables, zoophytes, crustacea, fishes and fresh water-shells are numerous. With the Permian system closes the Primary or Palæozoic class of rocks which form the earth's crust, and the primeval forms of organized animal life disappear.

7th. THE SECONDARY PERIOD.—The *Trias* and *Oolite system* rests on the Permian formation. The Trias is a deposit of shelly limestone and variegated sandstones. The Oolite, which rests on it is also a series of calcareous or limestone beds principally composed of conglomerate, or collections of small round grains or spheroids resembling a cluster of minute eggs, or the roe of a fish. This epoch has been styled "*The Age of Reptiles*," from the enormous number of fossil remains visible in this formation. One species of frog seems to have equalled a large hog in size. The *Icthyosaurus*, an amphibious animal, often exceeded 30 feet in length, with a head and teeth resembling those of a crocodile, and eyes as large as a man's head, with a huge voracious stomach, and four fins like the paddles of a whale. The half digested remains of fishes and other reptiles found in its stomach attest its carnivorous habits, terrible ferocity, and tremendous strength. The *Plesiosaurus* "united to the head of a lizard the teeth of a crocodile, a neck of vast length resembling the body of a serpent, a trunk and tail having the proportions of an ordinary quadruped, the ribs of a chameleon, and the paddles of a whale." The structure would permit it to plunge downwards at the fishes below it or seize birds on the wing above it. The *Megilosaurus* was an enormous reptile, measuring from 40 to 50 feet in length, resembling the crocodile of the present day. The Iguanodon was still larger, attaining a length of from 60 to 70 feet. The Saurian monsters, the *Pterodactyles*, resembled a gigantic bat or vampire, with strange dragon-like wings, extending in some cases, 27 feet, by means of which it could soar aloft, but per Cuvier, it must be classed in the Saurian or Lizard tribe, inasmuch as the beaks are armed with teeth." Most of them had the nose elongated like the snout of a crocodile, and armed with conical teeth. From their wings projected fingers terminated by long hooks, forming a powerful paw, and their eyes were of vast size, enabling them to fly by night. In the lower Oolite, fossil remains of small animals of the Marsupial family have been found. Of this class are the Kangaroo and Opossum species, forming the connecting link between the reptile and mammal tribes. The footprints of birds of vast size have been found in quarries of laminated flagstones, the foot of the largest measured 18 inches in length, distance between the footsteps was from 4 to 6 feet, indicating legs about 7 feet long. Remains of reptiles in immense numbers are everywhere abundant; butterflies, dragon-flies, ants, &c., existed in swarms, trees of Cypress, Palm and Pine species flourished with the ferns, conifers and calamites of the coal period, and flowering shrubs and fruit-bearing plants grew in profusion. The extensive coal beds existing throughout the Oolite system afford evidence of a rank vegetation.

8th. The *Chalk* or *Cretaceous system*, formed by deposits in deep seas, constitutes the last bed of the SECONDARY period. It is largely composed of organic remains, calcareous shells of animals so minute that a cubic inch would embrace ten millions of them. The fossils embrace Birds, Reptiles, Fishes, Mollusks, Zoophytes, Crustaceans and marine substances from the sponge to the alligator. The existing classes of fishes are found for the first time in this formation, and the ancient races disappear.

9th. THE TERTIARY SYSTEM, resting on the chalk formation, has been divided into three eras, viz: The Eocene or *Lower Tertiary*, The Miocene, or *Middle Tertiary*, and the Pliocene, or *Upper Tertiary*. Sometimes a fourth era is added named the Pleistocene, embracing the superficial deposits. The *Eocene*, or lowest layer marks the origin of the recent or now existing races of quadruped Mammals. The Palætherium, now extinct, is described as partaking of the various character of the Rhinoceros, the Horse, and the Tapir: the *Anaplotherium*, evidently a marine animal, resembled an Ass in form, and embraced several species. The Adapis resembled an enormous Hedgehog, and the Cheiropotamus a Peccary. The *Miocene* or middle deposit contains the remains of the extinct *Dinotherium Giganteum*, an enormous herbivorous animal, which must have been 18 ft. in length, furnished with a trunk like an elephant, and tusks like those of a walrus. In ascending to the Pliocene or upper deposit, we find the organic remains of the *Mammoth*, *Mastodon*, *Megalonyx*, and *Megatherium*, all of immense dimensions and quite superior as regards size and strength to the Elephant, the Rhinoceros, the Hippopotamus, and the Sloth, which represent them at the present day. Besides these, bears, tigers, hyenas, and other flesh eating animals, some of them extinct, abounded in vast numbers, and the Whale, Seal, and Morse species now appear for the first time. For a distance of 10 or 12 miles around Charleston, S.C., there exists in the post pliocene beds of the tertiary formation, about 8 or 10 feet below the surface, and in the beds of rivers, such enormous quantities of the bones of animals that 800 to 1,000 tons can be excavated from a single acre. Over 300,000 tons were shipped from that locality in 1876.

According to Lyell, there are now 50,000 species of fossils recognized, but they are believed to be of very distant epochs. The *fossil* species *distinct* from living species, are mammalia, 120, birds, 25, amphibia, 50, fishes, 400, and mollusca 3,100, in all 4795, besides vegetables ; the number is constantly being increased by new discoveries, miners are conversant with an immense number of fossilized vegetables, none of them resembling the plants of present growth. If coals are cut into thin slices their vegetable structure can be detected with the microscope, and numerous cells perceived that are filled with a yellow bituminous liquid that causes the flame seen in common fires, and whose gaseous products form illuminating gas. The trunk of a tree, measuring 60 feet, was lately found in a quarry in Lothian. It penetrated through 10 or 12 strata of white sandstone, but its back had become pure coal, and forests of standing trees have been discovered in Yorkshire and in Ireland; in stone.

In the English coal measures, 300 species have been detected, comprising ferns, palms, calamites, reeds, cactæ, lepidodendrons, &c., at least 50,000 years old ; the last named, which now grow no higher than 3 ft., were in the lowest coal measures, great trees, whose fragments are 45 feet. In the magnesian limestone, over the coal, only 8 species of fuci, or marine plants, have been found. A fossil forest has been discovered under the banks of the Tiber, petrified with calcsinter, mixed with volcanic dust. Below the coal beds a large tree has been found 3 ft. in diam., and 36 ft. long, and in many cases the entire trunks of fossilized trees form roofs over the coal strata. As submersions destroyed the primeval forests, so we have the resulting strata ; but myriads of ages have failed to render all of them perfect coal, hence the different varieties of that product.

The coral reefs furnish evidence of an antiquity of the globe far exceeding any received estimate. The formations are of very slow growth, not exceeding 6 inches in a century, and are composed of the remains of dead polypes united with gluten, forming rocks of great density and cohesion. The great coral reef of New Holland is 350 miles, continuously, and then in parts 1,000 miles, and from 20 to 50 in depth. East of New South Wales is a reef 500 miles long, and more than 200 fathoms perpendicular, yet these mountain masses of limestone in the ocean are formed by polypes, insignificant in size, but infinite in numbers, composed of simple gelatinous bodies, or small stomachs in shells of carbonate of lime, which cohere together with great tenacity after death. Within half a mile of many coral reefs there are no soundings to the depth of several hundred fathoms. The Ammonites, a fossil shell in a spiral form, curved like a ram's horn, existed in various shapes during the secondary and transition periods, but became extinct, perhaps, 100,000 years ago. The nummulite, a fossil Cephalapod, resembling a coin, were so numerous as to form immense mountains of limestone, and yet so ancient that they are abundant in the stones of the pyramids and sphinx, yet even then as embedded fossils. 1234 species of fossil shells have been described in France and England, mostly extinct species : other thousands have been found in other countries, mostly extinct.

The Geological Society of London has a slab 2 ft. square in which is embedded 250 fishes. Fossil sea turtles have shells 8 ft. long. There are beds of sea shells 2,000 ft. high on Mount Etna, and strata of grey clay, filled with shells, much higher. Shells and organic remains abound in Chili, from 9 to 1,400 ft. above the sea level. Workmen near Eureka, Nevada, while blasting in the solid rock, 40 ft. below the surface, found imbedded in a piece of it a petrified wasp's nest, the texture of which, though turned to stone, was plainly visible. On breaking it open, some cells, larva, and two perfectly formed wasps were found, also petrified. The rock is of a granite sandstone of sedimentary formation. The *Atlantosaurus*, an enormous monster from Colorado, is per Prof. Marsh, the largest land animal as yet discovered. It was some 50 or 60 ft. in length, and, when erect, at least 30 ft. high. It doubtless browsed upon the foliage of the mountain forests, portions of which are preserved with its remains.

The islands of the Icy Sea, per Pallas, are full of elephants and rhinoceros' bones, and the islands opposite the Lena are almost composed of them and fossil wood. A mammoth, a carnivorous animal, much larger than an elephant, was found in Siberia in the ice, perfect in its eyes, flesh, hair, skin, &c., with long mane and tail of stout black bristles ; many others, together with elephants, have been found in Siberia, and Hudson's Bay, a positive proof that the temperature of the Tropics existed at one time in these regions. The bones of the *Mastodon* of North America, as arranged in Peale's Museum, form a skeleton 18 ft. long, 11 ft. 5 ins. high, with tusks, 10 ft. 7 ins. The *Iguamadon*, an enormous herbivorous reptile, discovered by Mantell, is 70 ft. long, the body is 4 ft. 9 ins. in diam., with a horn of bone, and a tail 52½ ft. The bones of the *Mammoth* are quite numerous in the United States ; the molar tooth weighs 8 lbs., and the joint of the bone of the leg is a foot in diam.

The Era of Superficial Deposits.—This may be called the modern age of geology, but what human being will presume to say when it began? The formations of gravel, sand, clay, peat, marl, coral reefs, &c., have been formed since this epoch commenced, and vast changes caused by submersions and convulsions have taken place all over the globe. These silent but irresistible forces, the tools of creative power, are incessantly at work rendering the world a fit habitation for *man*, and as we approach this momentous period of the world's history we also discover for the first time, evidences of the existence of those plants and cereals which furnish his daily bread. Agassiz has recorded his opinion, that the order of the Rosaceæ to which belong the apple, pear, the plum, and the various fruits of that description, as well as the raspberries, strawberries, brambleberries, and roses in all their varieties, were introduced, contemporaneously with, or only a short time before, the first appearance of the human race. The gradual transformation of varieties since the ferns of the coal period, is indeed immense.

During the glacial period, in which the climate of Greenland extended as far south as New York, the world was covered with immense moving masses of ice, which in their progress from north to south moved rocks hundreds of miles and remodelled the topography of various countries. The effects of these glacial movements were the pulverization of the various rocks, thus forming sand from sandstone, calcareous soil from limestone, and clay from granite and gneiss, transforming barren rock into fertile soil.

The alluvial deposits contain remains which indicate a vast antiquity. The skeleton of a whale was dug up in the vicinity of Niagara a few years ago, a sure indication that that region formed at one time the bed of an ocean. All the land about the Clyde rests upon beds of shells, bones of stags, elephants, &c., and at Yealm Bridge, and Ketley, near Plymouth, there are caves containing bones of rhinoceroses, elephants, hyenas, bears, foxes, wolves, dogs, horses, oxen, sheep, &c. Agassiz describes 300 new species of fossil fish found in England, of which 50 exists in London clay. A bed of oyster shells 9 miles long and 18 feet thick exists in the interior of Norfolk; a pair of stags' horns have been found on the shores of the Mersey, near Liverpool, at 30 feet, and pieces of timber at 40 feet. Palms and cocoa nuts have been found imbedded in the London clay, clearly indicating the existence at one time of a tropical climate in what is now the temperate zone. An old Roman port off Romney marsh is now several miles out at sea, and proofs are abundant that Great Britain was at one time united to the continent.

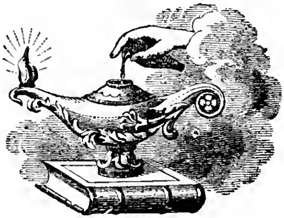
No doubt exists that the Falls of Niagara were at one time precipitated into an ocean over Queenston Heights, and Sir Charles Lyell computes that a period of at least 30,000 to 35,000 years have elapsed while the falls have been cutting their way through seven miles of rock to their present position ; the retrograde movement is still going on, slowly but surely, every day.

A volcano now extinct, near Mount D'Orr in the interior of France, emitted a flow of lava at a comparatively recent period, which filled up the channel of a river in its course. The water rose, passing over the impediment in its course, and has up to this time cut a channel 50 feet deep through the lava bed. From the remains of an old Roman bridge known to have been constructed about 2000 years ago, it appears that the erosion of the water into the lava has been considerably less than six inches during that period, which would indicate that it has required over 200,000 years to cut the channel to its present depth of 50 feet.

Myriads of ages have elapsed while the rushing waters have been cutting out those tremendous ravines in the hard rock, known as the Canyons of Mexico, Texas, Colorado, and the Rocky Mountains. The great Canyon of the Colorado river is 298 miles long and the sides rise perpendicularly above the water to a height of 5000 or 6000 feet.

On Oak Orchard creek and the Genesee river, between Rochester and Lake Ontario, are enormous chasms, worn by the water, 7 miles long. On the Genesee, south of Rochester, a cut exists from Mount Morris to Portage, sometimes 400 feet deep. In the Rocky Mountains, near the source of the Missouri river, there is a gorge 6 miles long and 1200 feet deep. In the Mississippi, at St. Anthony's Falls, the river has eroded a passage through limestone rock 7 miles long, to which distance the cataract has receded. In the passage of the Connecticut river at Brattleboro and Bellows Falls, it can be proved that the river was once at least 700 feet above its present level.

From these and thousands of other proofs which might be cited, the inference is unavoidable that vast periods have elapsed since the beginning of the present geographical distribution of sea and land, but step by step, during the slow but majestic march of Time, we can always see that every instrumentality employed by creative power has been in the continual effort to bring order out of chaos and fit the earth as a habitation for *man*.



FIAT LUX.

GREAT LIGHT ON A DARK SUBJECT.

AGE, ORIGIN, AND ULTIMATE DURATION OF THE EARTH.—More than 140 years have elapsed since Emanuel Swedenborg penned the startling announcement, the first of the kind ever made, that our earth, together with her sisterhood of planets, derived their origin from matters and substances evolved from the atmospheres and solar energy of the sun of our system. In his *Principia*, written in 1734, and again in his *Worship and Love of God*, in 1745, he remarks that the sun is the centre of a vortex; that it rotates upon its axis; that the solar matter concentrated itself into a belt, zone, or ring, at the equator, or rather ecliptic; that by the attenuation of the ring it became disrupted; that upon the disruption, part of the matter collected into globes, and part of the matter subsided into the sun forming solar spots; that the globes of solar matter were projected into space; that consequently they described a spiral orbit; that in proportion as the igneous matter thus projected receded from the sun it gradually experienced refrigeration and consequent condensation; that hence followed the formation of the elements of ether, air, aqueous vapor, &c., until the planets finally reached their present orbit; that during this period the earth experienced a succession of geological changes which originated all the varieties in the mineral kingdom, and laid as it were the basis of the vegetable, and afterwards of the animal, kingdom.

These were alarming propositions to propound at a time when it was almost universally accepted as a literal truth that the world was created out of *nothing* in the space of six natural days about 6000 years ago, yet since Swedenborg's time scientists have abundantly demonstrated the truth of what he taught, and this so clearly that at this day no enlightened mind will dispute the facts.

Swedenborg asserted that the whole starry heavens was one vast sphere, and its suns or stars, including their systems, to be parts of a sphere connected with each other. He writes, "Possibly there may be innumerable other spheres, and innumerable other heavens, similar to those we behold, so many indeed and so mighty, that our own may be respectively only a point." The Essay in his immortal *Principia*, expressly called "The Theory of the Siderial Heavens," giving full details of the system, was published in 1733, long before the advent of monster telescopes, twenty-two years before Kant, twenty-four years before Lambert, twenty-six years before Boscovitch, thirty-four years before Mitchell, and forty-four years before Herschel gave the result of their confirmatory discoveries to the world.

The grandest and latest discovery of modern astronomy is the motion of the so-called fixed stars, yet long before this discovery was announced, Swedenborg asserted that the whole universe was in motion, and that the paths which the countless suns with their systems were traversing was the Milky-Way, and that the point at which they entered was at the south, and that at which they emerged was at the north. The truth of this theory has been demonstrated and accepted within the last thirty years by Humboldt, Herschel, and other eminent observers. The knowledge of these movements enable astronomers to predict, with absolute certainty, the different changes the various constellations will undergo during the lapse of ages to come, and define the reasons and causes of such changes.

The fact is well attested that our sun is only one of a million which traverse the Milky Way. In the crowded part of the Milky Way, Sir W. Herschel, the prince of astronomers, had fields of view in which, during a quarter of an hour, he saw 116,000 stars pass through the field of view of a telescope of only 15′ aperture; and at another time, in 41 minutes, he saw 258,000 stars pass through the field. It consists mostly of stars of the 10th or 12th magnitude, but too numerous to be seen by the naked eye, which can only discriminate stars of the 6th or 7th magnitude; powerful telescopes reach even to a 16th magnitude. He calculated the length of the *visual ray* of the telescope he used. It reached stars 497 times the distance of Sirius; now Sirius cannot be nearer than 100,000 × 190,-000,000 miles, therefore Dr. Herchel's telescope, at least, reached to 100,-000 + 190,000,000 + 497 miles = 9941 billions miles. He saw stars 42,000 times more distant that Sirius; and a cluster 11 trillions of miles distant. He says there are nebulæ from which light is 48,000 years travelling! Light travels 192,000 miles in a second, or $6\frac{1}{3}$ trillions of miles per annum, then in 48,000 years this would be 304,000,000,000 of millions of millions of miles distant; if the cluster ceased to exist we should not know it for 48,000 years! Such distances can indeed be written, but can never be conceived by the mind of man.

It is a trifling matter to reduce these figures to writing, but quite another thing to realize their full significance.

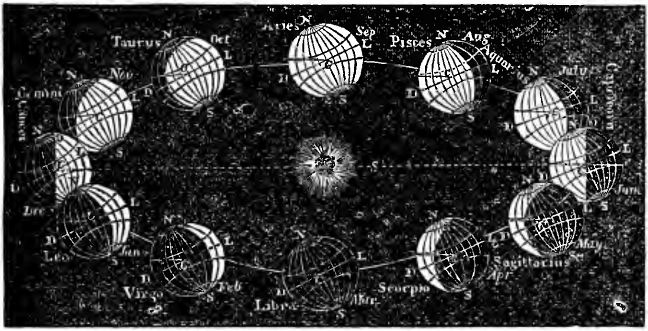
To assist our conception of what constitutes a "billion," we will take as a unit a second of time, of which 60 flit away in a minute, or 86,000 in a day. Not the one-sixteenth part of that number have come and gone since the commencement of the Christian era to the beginning of 1878, for it takes exactly 31,687 years, 17 days, 22 hours, 45 minutes, and 5 seconds to constitute a billion of seconds of time.

The immensity and grandeur of the Heavens penetrates every enlightened mind with indescribable emotions of awe and reverence for the Almighty energies of that Adorable Intelligence who created and sustains the whole.

Touching the stability of the solar system, it was feared by many, eminent for their attainments and acquirements in every branch of human learning, that owing to the mighty changes and apparent derangements which were occurring in the planetary orbits, that impending ruin and destruction would ultimately render the earth uninhabitable for man. At a time when the belief was prevalent that certain destruction awaited the whole universe, Swedenborg announced to the world his theory that: "As the solar system is carried along through the Milky-Way, and afterwards compelled to diverge therefrom, the planetary orbits will change their form and eccentricity to a certain amount, and then return to their original condition, when they will again change and again return, and so on to eternity." This beautiful and harmonious theory, so well calculated to terminate every groundless fear, has since been proved and demonstrated by La Grange, and this doctrine of a cyclar return of the solar system is now known among the learned as La Grange's theory of the stability of the solar system; nevertheless this doctrine was expounded in Swedenborg's *Principia* forty-four years before La Grange put his forth, seventy-one years before Mayer, and ninety-one years before Bessel.

Irregularities in planetary motions correct themselves, because every motion, included in the motion of the Sun, is itself subordinate, and therefore must ultimately conform. The planets being acted upon by the common force of the sun, they often interfere on the same side with the sun's force on that side, and this begets irregularity or disturbance. oddly called their own attractions.

La Grange proved that the mass of each planet into the square-root of the line of apsides, and into the square of the eccentricity, give sums that are invariable. It will be seen from the preceding article that the work of creation has been progressing during incalculable myriads of ages, and we may rest satisfied that it forms no part of the Divine economy to destroy what it has been millions of years in building up. The agencies employed in the creation of the universe are identical with those which now exisit for its preservation. Harmony and perfection are everywhere real entities; derangement and disorder are apparent only. That the sun's *apparent* path through the ecliptic is really caused by the motion of the earth in its orbit around the sun, may be seen from the globes in the figure, representing the earth in twelve different positions, corresponding



to the twelve months. In the various globes, N is the north pole, DCL the equator, S the place of the Sun, and C S and all lines from C *parallel* to this the direction of the plane of the ecliptic. The inclination of the earth's axis to the plane of its orbit is 23° 28′, and this, with its annual revolution around the Sun, causes the change of seasons known as Spring, Summer, Autumn and Winter. Besides the diurnal and annual movements of the earth, there is also an onward movement of the whole solar system through space, in an orbit of its own, at the rate of 154,000,000 miles per annum.

Swedenborg asserts that there is an internal or spiritual sense concealed within the letter, or natural sense of the Word, comparable to the soul or spirit of man, which fills the human body just as the hand fills a glove. This sense he unfolds by means of the science of correspondences, the knowledge of which he claims was revealed to him. For instance, wherever the end of the World is foretold or predicted in the Word, he says that by this we are not to understand the end of the natural world, but the church or dispensation existing in the world, the latter being used in a symbolic sense to represent the former. If after this statement any one persists in adhering to a literal interpretation, let him take a good concordance and examine under the words "ever" and "forever"; he will find to his amazement that there are just as many proofs to sustain the theory of the everlasting duration of the earth as there are to prove its destruction! In this case what can a man gain by refusing his assent to the truth as unfolded by Swedenborg?

In his work descriptive of the Last Judgment, which Swedenborg avers has already taken place, not in this, but in the spiritual world, during the year 1757, the following passage occurs:

"That the procreations of the human race will continue to eternity, is plain from many considerations, and of which the following are the principal:—I. That the human race is the basis on which heaven is founded. II. That the human race is the seminary of heaven. III. That the extension of heaven, which is for angels, is so immense that it cannot be filled to Eternity. IV. That they are but few respectively, of whom heaven at present is formed. V. That the perfection of heaven increases according to plurality. VI. And that every Divine work has respect to Infinity and Eternity. The angelic heaven is the end for which all things in the universe were created, for it is the end on account of which mankind exists, and mankind is the end regarded in the creation of the visible heaven, and the earths included in it; wherefore that Divine work, namely, the angelic heaven, primarily has respect to Infinity and Eternity, and therefore to its multiplication, without end, for the Divine Himself dwells within it. Hence also it is clear, that the human race will never cease, for were it to cease, the Divine work would be limited to a certain number, and thus its respectiveness to Infinity would perish. The Lord did not create the universe for His own sake, but for the sake of those with whom He will be in Heaven; for spiritual love is such, that it wishes to give its own to another; and as far as it can do this it is in its being, in its peace, and in its blessedness: spiritual love derives this from the Divine Love of the Lord, which is infinitely such; from hence it follows that the Divine Love, and hence the Divine Providence, has for its end a heaven, which may consist of men made angels, to whom He can give all the blessed and happy things which are of love and wisdom, and give them from Himself in them." *L. J.* 6.

It will console and comfort many honest but simple-minded thinkers who believe otherwise, to be told that although these startling facts seem to jar with terrific force against their cherished articles of faith, and even to oppose revealed truth, it is nevertheless most true, that they do not, even in the slightest degree, enter into conflict with revelation. There is a science of spiritual truth and there is a science of natural truth; there is the Book of Revelation and there is the Book of Nature; the same Omnipotent Hand has written both, each must be understood in a *sense peculiar to itself*, and when so understood, there can be no contradiction between them. Wherever contrariety or discordance appears, the error, if any exists, is in man himself and in his natural proneness to receive appearances as truths. During a depth of time not to be penetrated, mankind inferred, from the apparent motion of the sun, planets, and stars, that they revolved around the earth once in 24 hours, but now every school-boy knows that this idea is a fallacy, and an outrage on natural truth, the real truth being that in every passing hour we are moved by the earth's rotation on its axis 1,037 miles, and in its orbit 66,092 miles, the diurnal motion causing the *apparent* motion of the heavenly bodies around the earth. Many readers infer, from a perusal of the first chapter of Genesis, that it is simply a narrative of the creation of the world on which we dwell, yet still it must be said, that although this belief is all but universal among the great masses of society, it is nevertheless as gross an outrage on spiritual truth as the first noted fallacy is on natural truth. The sublime narration recorded in Genesis does not treat of natural creation, for being Divinely composed it is to be understood in a sense entirely different from merely human writings. This style is such that it describes spiritual things by means of pure correspondences, similitudes, types, and symbolic imagery drawn from earthly things. The subject treated of is indeed concerning a new creation, but one more momentous by far than even the creation of a world. Many modern theologians are afraid to enter on an interpretation of this chapter on account of its alleged conflict with the known facts of science, but the theology that could be endangered by such an investigation is worthy of no man's acceptance. Understood naturally, what reflecting mind could conceive of the existence of light, evening and morning, day and night, and grass, before the creation of the Sun; in such case what *could* exist but universal darkness and Arctic desolation! In the first chapter, v. 21, "every living thing that moveth" is described as being created and "brought forth abundantly after their kind," by the waters; in chap. ii. v. 19, "every beast of the field and fowl of the air" is described as being "made out of the ground." Understood literally, or in the sense of the letter, these statements are contradictory to every rational idea, but when interpreted according to the law of correspondences they are divinely true even as to their minutest details.

At this day, amidst the crash of creeds framed by self-derived intelligence, when many are announcing from the pulpit the impending ruin of our planet, when brazen infidelity proclaims from the platform to applauding audiences that there is no hereafter, and scoffs at sacred things, it must gratify every lover of truth to learn that there exists in Swedenborg's theological writings a system of doctrine and scriptural interpretation absolutely impregnable against every assault of the enemy. From the wonderful story of Genesis to the sublime visions of the Apocalypse, the searcher after truth will find the veil of mystery lifted from a thousand questions which have for ages puzzled the wisest commentators. The system of interpretation is unerring in its logic, inflexible in its allegiance to truth, and astonishing in its minuteness of detail. In an article in a recent number of the *Galaxy*, in relation to the contest between science and religion, the writer says: "The modern school of Free Thought has found its one serious opponent, and its only one, in Emanuel Swedenborg, whose writings, first issued more than a century since, have had an effect on the whole tone of thought and metaphysics, such as few people suspect, and hardly any realize.

"It must be remembered that Swedenborg published his first (theological) book in 1749, and that his theological activity covered the very period wherein the French and English school of scientific inquiry, skepticism, and free thought, was beginning to be most active.

"In the midst of this period of intellectual bustle and activity, the Seer of the North, secluded in his lonely study among the Swedish forests, with nothing before him but a Hebrew Bible and Greek Testament, was calmly writing those wonderful books which he asserts to be the result of direct revelations from the Deity.

"The only system that remains able to-day freely to admit the most uncompromising results of scientific inquiry without fear or question, and at the same time to hold to the absolute truth of Holy Writ in every jot and tittle, appears to be that proclaimed by Swedenborg.

"The system of theology it propounds is purely and uncompromisingly monotheistic. An Arab could not quarrel with it on that score. It is, at the same time, so purely Christian that the most zealous evangelical of the extremest type can find no fault with it, making as it does the Saviour and Redeemer its grand central figure.

"Finally, it is able to concede to the boldest of materialists, the most acute of historical critics, the most ardent evolutionist, the most dogmatic of palæontologists, the most abstruse of metaphysicians, everything which they can possibly claim to have proved, every truth, however contrary to current theological opinion, which they can establish, while at the same time it holds to the absolute truth of every word of Holy Scripture.

"Nothing seems to shake its faith in the slightest; it shuns no inquiry and needs no explanation of any fact, everything being plain, the Bible its only standard."

In the Cyclopædia of Biography, by Parke Godwin, we read: "Swedenborg was no impostor, but a learned and pious man, and his books richly repay the most careful study."

The *Nonconformist* (English) assures us that: "He (Swedenborg) is received by all thinkers courteously, and by very many cordially. The storm of violent denunciation or angry ridicule which was launched against him by theologians a generation ago, is scarcely remembered now, and is not likely to be revived. All are agreed that he was a genuine and sincere man, who believed his own words, and did not wilfully deceive or invent."

Hon. Theophilus Parsons, late Professor in the Cambridge Law School, says: "I regard him (Swedenborg) as a man of remarkable ability, and great and varied culture; taught, as no other man ever was taught, truths which no other man ever learned; and thus instructed that he might introduce among men a new system of truth or doctrine, excelling in character and exceeding in value any system of truth before known."

Speaking of Swedenborg and his writings, Henry James, the author of "Substance and Shadow," says: "Such sincere books, it seems to me, were never before written."

Bishop Hurd (author of Lectures on Prophecies) says: "It has been said by some, and received implicitly without further examination by others, that Swedenborg, after receiving his extraordinary commission, was mad, and became totally deprived of his natural senses; but this insinuation is such a palpable contradiction of truth, and such an insult to common sense—being overruled by every page of his writings as well as by every act of his life after that period—that we should have thought it altogether unworthy of notice were we not aware that it operates powerfully with many, even at this day, to prejudice them against a character which otherwise they would revere, and against writings from which they would otherwise receive the most welcome instruction."

The venerable Thomas Carlyle, having looked upon the great seer all his life as a visionary lunatic, now says that he stands rebuked. He looks upon Swedenborg as one of the loftiest minds in the realm of mind, one of the spiritual suns that will shine brighter as the years go on; and that more truths are compassed in his writings than that of any other man. His great prescience with regard to modern scientific discoveries, since made known, is astonishing.

George Dawson, M. A. writes: "Emanuel Swedenborg had the privilege which belongs to all men who devote their lives to thought, that as the world grows older, they get more reverenced, better known, and better loved. If I were going to be shut up in prison three years, Swedenborg's books would be my choice, and at the end of three years it would be six more before I should find them uninteresting, strange, or dry."

Dr Porteous writes: "The incomparable depth, splendor, and vastness of Swedenborg's genius are shown in this, that he alone has ever dared to tread the threefold realm of natural, mental, and spiritual philosophy. Few men have approached the hem of his garment in respect to moral purity, his teaching and example are calculated to make men meek, gentle, and charitable, and his followers catholic, intelligent and pious. Examine all the philosophical systems extant and take all the religious literature of the last century, and place them in one scale, and take the voluminous works of Swedenborg, and place them in the other scale, and the philosophy and libraries of the world will kick the beam." R. M. Patterson, late Professor in the university of Pennsylvania, says respecting Swedenborg's Principia: "It is an extraordinary production of one of the most extraordinary men that has ever lived, many of the experiments and observations presented in this work are *believed to be of much more modern date, and are unjustly ascribed to much more recent authors.*"

"There is in Swedenborg's writings a marvellous insight, a vision of the higher truths of philosophy and religion, to which few men have attained."—*N. Y. Independent.*

"The majority think and speak of Emanuel Swedenborg as a mystic and dreamer, when in fact, he was a practical man, an inventor, and public benefactor. The metrical system, now under discussion, was first suggested by him, and the Dutch are indebted to him for important improvements in their docks and dykes."—*Literary World.*

"Swedenborg's writings teem with the grandest and profoundest truths."—*North American.*

Count Von Hopken, for forty years an intimate friend of Swedenborg's, and for many years Prime Minister of Sweden, advised the king "that no religion could be better, as the prevailing and established one, than that deduced by Swedenborg from the Sacred Scriptures, and this on the two following accounts: 1st. This religion in preference to, and in a higher degree than any other, must produce the most honest and industrious subjects; for this religion places properly *the worship of God in uses.* 2d. It causes *the least fear of death*, as this religion regards death merely as a transition from one state into another, from a worse to a better situation; nay, upon his principles, I look upon death as being of hardly any greater moment than drinking a glass of water."

T. S. Arthur, the world renowned author, writes: "Only in the revelations made for the New Church, in which the plenary inspiration and inner and Divine Sense of the Word, and the true doctrine of the Lord and his Providence, are fully explained and made known for the salvation of mankind, can be seen in rational light, the truths on which Christian unity and harmony can be established, and by which the growth of naturalism, skepticism, and irreverent infidelity can be arrested and destroyed."

The Rev. Prof. Von Gœrres (Roman Catholic) writes:—"Swedenborg was not a man to be carried away by an unbridled imagination, still less did he ever manifest, during his whole life, the slightest symptoms of mental aberration. Throughout the entire course of his learned researches and activity, we everywhere discover the pious and religious man, who, in all his sayings and doings, was intent upon good."

Edwin Paxton Hood, in the preface to his *Life of Swedenborg*, writes: "That he conceives he has derived much benefit from the study of the works of Swedenborg, and has much reason to be grateful to that illustrious, venerable and much misunderstood, and comparatively unknown man."

Design and Work (English) says of the *Apocalypse Revealed:* "A careful perusal of many of its 900 and odd pages has led us to cease wondering at the favor with which this modern edition has been received, and to recommend others to follow our example. Many a sermon have we listened to on the Revelations. Several works, dealing with the gorgeous panorama unfolded before the internal vision of the Seer of Patmos, how we travelled through, wondering at the inventive faculty as displayed by commentator and preacher, but too often feeling that a stone had been given us instead of bread. Whoever takes earnestly to the consideration of the pages of the 'Swedish Seer,' will find that there is more in his text-book than he has given it credit for; that it contains truths illimitable; that in their expounding no meretricious aids are required; that it appeals, not to the eye or the ear, but to the deepest depths of the human heart and mind. Whosoever will read it patiently and carefully must rise up from its perusal a wiser, a more charitable, altogether a better man."

The *Chicago Advance* writes: "We confess to having read for years some portion of his works with intellectual and spiritual profit, and we imagine at least that we can trace his influence in the conceptions and reasoning of many modern authors of distinction, who do not always give Swedenborg the credit he deserves."

The writer of this book has no pecuniary interest whatever in the sale of Swedenborg's writings, but conceives it to be his duty to present these testimonials in vindication of a most deserving and worthy man, whose writings have been greatly misrepresented and misunderstood. A hundred years hence such a vindication will be unnecessary. It is a veritable truth that Swedenborg has rendered greater services to mankind than any other man ever did or ever can render, and this fact is becoming better known every day. When he began to write and promulgate his system of doctrines, a noted Lutheran bishop and doctor got up a complaint against him. The doctor, whose name was Ekebom, had the honesty to say of himself, that he was very careful not to examine Swedenborg's works. Swedenborg, however, was a man of good character and connections, and led such a blameless, quiet, calm, and peaceful life, that it was found impossible to arouse popular sentiment against him.

Since Swedenborg's day, two men, who have all the animosity, but lack the honesty, of Dr. Ekebom, viz: Dr. Pike, of Derby, Eng., and Enoch Pond, of Bangor, Me., Theological Seminary, have rendered themselves notorious by the publication of pamphlets containing the most horrible libels on Swedenborg and his writings. These detestable publications, which have been answered and refuted time and again, present a combination of reckless assertion, downright lies, malignity, and ignorance, which is perfectly amazing. Each publication may be described in the expressive language of Edwin Paxton Hood, as "a fountain of mud," and both combined are highly flavored with the peculiar sanctity which pervades the devotional exercises of Holy Willie.

We have still another notable detractor in Mr. William White, who many years ago wrote a Life of Swedenborg, in which he rendered full justice to the subject of the memoir. Of late years he resumed his task by dipping his pen in ink (or rather in venom), and dashing off a vast amount of trash in the shape of baseless absurdities regarding Swedenborg and his followers, which he styled a "Life of Swedenborg." In order to understand the animus which pervades this work, it is necessary to know that Mr. White was at one time agent for the London Swedenborg Society, and while thus occupied he engaged in the sale of the so-called spiritist publications. The sale of these books is held by the Swedenborg Society to be utterly incompatible with the objects which it has in view, but Mr. White resisted the efforts of the Society's Committee to remove him from office, and compelled them to bring a suit in Chancery to effect their purpose. The final judgment was decisive against him, and it was while smarting under this reverse that his two-volume Life of Swedenborg was written. The work in question is composed throughout in a vindictive spirit, and the malevolent production owes its origin to a malicious feeling of the worst kind, nevertheless it is most true that slander has greater swiftness than truth, and the groundless assertions of a defamer are frequently accorded greater credence than the veritable assertions of a truthful man.

In an elaborate article which appeared some time ago in the columns of the *English Mechanic*, the editor of that journal presented a list of Swedenborg's inventions, which, including a notice of his mechanical and philosophical works, occupied nearly two quarto pages. The following is a partial list of the latter:—1. An Introduction to Algebra. 2. Attempts to find the Longitudes of places by Lunar Observations. 3. A proposal for a Decimal System of Money and Measures. 4. A Treatise on the Motion of the Earth and the Planets. 5. Proofs, derived from Appearances in Sweden, of the Depths of the Sea, and the Greater force of the Tides in the Ancient World. 6. On Docks, Sluices, and Salt Works. 7. Some Specimens of Work on the Principles of Natural Philosophy, comprising New Attempts to explain the Phenomena of Chemistry and Physics by Geometry. 8. New Observations and Discoveries respecting Iron and Fire, and particularly respecting the Elemental Nature of Fire; together with a New Construction of Stoves. 9. A New Method of Finding the Longitude of Places on Land or Sea by Lunar Observations. 10. A New Mechanical Plan of Constructing Docks and Dykes. 11. A Mode of Discovering the Powers of Vessels by the Application of Mechanical Principles. 12. Miscellaneous Observations connected with the Physical Sciences—Parts 1-3. 13. Part 4. Principally on Minerals, Iron, and Stalactites in Baman's Cavern. 14. On the Depreciation and Rise of the Swedish Currency. These were some of his works published between 1722—1733.

These were succeeded by, 1. The Principia: or, the First Principles of Natural Things, in 3 folio Vols. with Plates. 2. The Economy of the Animal Kingdom considered Anatomically, Physically, and Philosophically, 2 Vols., with Plates. 3. The Animal Kingdom, Parts i., ii., iii., 2 Vols. 4. The Animal Kingdom, Parts v., vi. 5. Outlines of a Philosophical Argument on the Infinite and the Final Cause of Creation. 6. Some Specimens of a Work on the Principles of Chemistry, with other Treatises, 8vo, 21 Plates, comprising 159 figures. 7. Miscellaneous Observations Connected with the Physical Sciences. 8vo, 9 Plates, comprising 86 Figures. 8. Posthumous tracts on various subjects.

In 1785, the Commissioners appointed by the King of France, for the examination of the subject of animal magnetism, affirmed that there did not exist any theory of the magnet; and the Count de Buffon, in his work on Natural History, affirmed that nothing had been written on the formation of the planets. Both these errors were refuted in a most scholarly and elegant letter addressed to the Commissioners by the Marquis de Thomé, in which he directed public notice to Swedenborg's elaborate and profound works on these subjects, concluding his letter as follows, "This, gentlemen, is what I thought it my duty to make public for the benefit of society, from a regard for truth, and in gratitude to him, to whom I am indebted for the major part of the little I know; though before I met with his writings, I had sought for knowledge amongst almost all the writers, ancient and modern, who enjoyed any reputation for possessing it. I have the honor to be, &c.,

"Paris, Aug. 4, 1785. MARQUIS DE THOMÉ."

Ralph Waldo Emerson writes:—"Swedenborg's writings would be a sufficient library for a lonely and athletic student. Not every man can read them, but they will richly reward him who can. The grandeur of the topics makes the grandeur of the style. One of the missourians and mastodons of literature, he is not to be measured by whole colleges of ordinary scholars. He anticipated in astronomy the discovery of the seventh planet; anticipated the views of modern astronomy in regard to the generation of earths by the sun; in magnetism some important experiments and conclusions of later students; in chemistry, the atomic theory, in anatomy the discoveries of Schlienting, Monro, and Wilson, and first demonstrated the office of the lungs."

The celebrated Berzilius writes:—"I have looked through the *Animal Kingdom*, and am surprised at the great knowledge displayed by Swedenborg in a subject that a professed metallurgist would not have been supposed to make an object of study, *and in which, as in all he undertook, he was in advance of his age.*"

To sum up, it may be stated that his mechanical and philosophical works would be equivalent to about 25 volumes of 500 pages each. This generation is most deeply indebted to the incomparable genius of this extraordinary man for very important improvements in the construction of docks, blast furnaces, stoves, the smelting of metals, and a host of inventions which are usually credited to others.

The reader may infer, from a perusal of the foregoing list of books, that the labor involved in their production might well entitle the writer to rank as a first class literary giant in any age or nation, but wonderful to say, the most extraordinary performances of this most remarkable man are still to be recounted.

In the year 1743, Swedenborg was 54 years of age, and here we find him relinquishing his philosophical pursuits, and devoting himself exclusively to theology and to the unfolding of the new doctrines which he now declares were first revealed to him. His *Worship and Love of God*, published in 1745, seems to mark the commencement of this new era in his Life. The following is a list of his theological works arranged according to the order in which the original books were written and published by the Author.

1. 1749-56. *Arcana Cœlestia, The Heavenly Arcana which are contained in the Holy Scriptures, or Word of the Lord; unfolded: beginning with the Book of Genesis; together with the Wonderful things seen in the World of Spirits and in the Heaven of Angels.* English Ed. 12 vols. 8 vo. £2 8*s*., any vol. separate, 4*s*. American Ed. 10 vols. $1.50 per vol. 2. 1758. *Concerning Heaven and its Wonders; and concerning Hell, being a Relation of things heard and seen.* English Ed. 3*s*. American do. $1.25. 3. 1758. *An account of the Last Judgment and the Destruction of Babylon; showing that all the Predictions in the Apocalypse are at this day fulfilled, being a relation of things heard and seen*, 8 vo. Eng. Ed. 8*d*. American do. 75c. 4. 1758. *On the White Horse mentioned in the Apocalypse, chap. xix., with References to the Arcana Cœlestia on the subject of the Word, and its Spiritual or Internal Sense. With an Appendix.* English Ed. 4*d*. American do. 10*c*. 5. 1758. *On the Earths in our Solar System, and on the Earths in the Starry Heavens; with an account of their inhabitants, and also of the Spirits and Angels there, from what has been seen and heard.* Eng. Ed. 8 vo., 8*d*. American Ed. 60c. 6. 1758. *On the New Jerusalem and its Heavenly Doctrine, as revealed from Heaven, to which are prefixed some Observations concerning the New Heaven and the New Earth.* Eng. Ed. 8 vo. 1*s*. American do. paper, 10*c*. 7. 1763. *Angelic Wisdom concerning the Divine Love and the Divine Wisdom* Eng. Ed. Demy 8 vo., 2*s*. American do. $1. 8. 1763. *The Four lead-*

ing Doctrines of the New Church, signified in Rev. xxi. *by the New Jerusalem; being these respecting the Lord. His Divine and Human Natures, and the Divine Trinity; the Sacred Scripture; Faith; and Life.* Eng. Ed. 8 vo. 2*s*. American do. $1. 9. 1764. *Angelic Wisdom concerning the Divine Providence.* Eng. Ed. 8 vo. 3*s*. American do. $1.50. 10. 1765. *The Apocalypse Revealed; in which are disclosed the Arcana therein foretold; and which have hitherto remained concealed.* 2 vols. Eng. Ed. 8*s*. American do. $3. 11. 1768. *Conjugal Love and its Chaste Delights; also Adulterous Love and its Insane Pleasures* Eng. Ed. 4*s*. American do. $1.25. 12. 1769. *A Brief Exposition of the Doctrines of the New Church meant by the New Jerusalem in the Apocalypse.* Eng. Ed. 10*d*. American do. 40c. 13. *The Intercourse between the Soul and the Body, which is supposed to take place either by Physical Influx, or by Spiritual Influx, or by Pre-established Harmony.* Eng. Ed. 4*d*. American do. 10*c*. 14. 1771. *The True Christian Religion; or, the Universal Theology of the New Church, foretold by the Lord in Dan.* vii, 13, 14, *and in the Apocalypse* xxi, 1, 2. Eng. Ed. 7s. American do. $2.50.

These prices include postage to destination. The books may be obtained by addressing the Publishing Society's Manager, E. H. SWINNEY, No. 20 Cooper Union, New York, or the London Society's Agent, JAMES SPIERS, 36 Bloomsbury St., London, W. C., Eng.

Swedenborg's "*True Christian Religion*" and the "*Apocalypse Revealed*," may be obtained absolutely free by any Protestant clergyman or student who may enclose the postage for same to the celebrated publishing house of J. B. Lippincott & Co., of Philadelphia. The requisite funds for this purpose are supplied by a retired Philadelphia merchant of princely means and large-hearted liberality, who takes an ardent interest in the work, and has made ample provision for its permanent continuance even after his hands have laid it down. No clergyman or student need hesitate to enclose the postage and send for these books, for they will be sent without fail. The New Church Tract and Publication Society, T. S. Arthur (the well-known author), President, George Burnham (of the Baldwin Locomotive works), Treasurer, offer Swedenborg's "Heaven and Hell," through J. B. Lippincott & Co., to clergymen on the same terms. In ordering these books in this way, enclose 30*c*. for postage on the first named, 18*c*. for the second, and 13*c*. for the last noted work, and forward all orders to J. B. Lippincott & Co., 715 and 717 Market St., Philadelphia.

Up to Jan. 1, 1878, this well-known firm have received and filled requests from clergymen for 14,000 copies of the "*True Christian Religion*," 8,000 copies of the "*Apocalypse Revealed*," and 12,000 copies of "*Heaven and Hell*." Requests are still coming in, books are still going out, and hundreds of letters have been received attesting the lively gratitude of the recipients to the donors of these books for their inestimable gifts. In addition to this unusual traffic of supplying costly books free of charge, J. B. LIPPINCOTT & Co. publish elegant editions of many of Swedenborg's theological writings, which they supply to purchasers in the usual way of business. Lists and prices furnished by addressing or applying as above.

IMPORTANT RULES, TABLES, &c., FOR PRINTERS.

A THOUSAND EMS, MEASURING TYPE OR MATTER.—This is done by multiplying the number of solid ems contained in the *length* of any quantity of type, by the number contained in the width of the measure. The gauge for measurement is an em of the type in which the matter calculated is set. A thousand ems is the space that so many letter m's would occupy. It takes over 2,000 average letters to occupy the space of 1,000 ems. In Britain the matter is measured by ens. To determine the number of ens in a line, lay as many of the letter m flat wise in the stick as will make the measure. The following Table shows the number of ems contained in a pound of each of the following sizes of type.

1 lb. of	Pica	contains	130	ems.	1 lb. Minion	contains	356	ems.
" "	S. Pica	"	170	"	" Nonpareil	"	520	"
" "	L. Primer	"	200	"	" Agate	"	690	"
" "	Bourgeois	"	270	"	" Pearl	"	800	"
" "	Brevier	"	290	"				

Table showing number of ems in 100 square inches of the sizes of type from Pica to Agate inclusive.

Pica	3,600	Nonpareil	14,400	Minion	10,404
Long Primer	5,625	Small Pica	4,900	Agate	19,600
Brevier	8,836	Bourgeois	6,889		

The above list is based on the supposition that lines of the length of 6 ems pica, 7 ems small pica, 7.5 ems long primer, 8.3 ems bourgeois, 9.4 ems brevier, 10.2 ems minion, 12 ems nonpareil, and 14 agate, are equal to an inch. This is not strictly true, but the variation is so little that it will not make a difference of 1,000 ems in 100 ordinary sized pages.

In one square inch there are—

36 ems Pica.	72¼ ems Bourgeois.	144 ems Nonpareil.
50 " Small Pica.	87 " Brevier.	200½ " Agate.
56¼ " Long Primer	113¾ " Minion.	225 " Pearl.

The above is an approximation merely, as different type founders slightly vary the size of their type.

METAL FOR BACKING ELECTROTYPE PLATES.—Lead 91 parts, tin 4, antimony 1.

TO MAKE WRITING INK INERASEABLE EVEN BY ACIDS.—To good gall ink add a strong solution of Prussian blue in distilled water. The ink writes greenish blue but afterwards turns black, and cannot be erased without destroying the pape

ARRANGEMENT OF TYPE IN AMERICAN UPPER CASE.

*	†	‡	§	‖	¶	☞	℔	℞	@		●	´	°
¼	½	¾	⅛	⅜	⅝	⅞	$	£	˜	3 ˜	˘	ˆ	¯
⅓	⅔	⅙	Æ	Œ	æ	œ	-	—	——	3 ——	&	Æ	Œ
A	B	C	D	E	F	G	A	B	C	D	E	F	G
H	I	K	L	M	N	O	H	I	K	L	M	N	O
P	Q	R	S	T	V	W	P	Q	R	S	T	V	W
X	Y	Z	J	U	]	)	X	Y	Z	J	U	ffi	ffl

ARRANGEMENT OF TYPE IN AMERICAN LOWER CASE.

&	fl	5em sp.	4em sp.	'	k	e	1	2	3	4	5	6	7	8
j / ?	b .	c		d		e	i		s		f	g	ff / fi	9 / 0
! / z	l	m		n		h	o		y	p	w	,	en qds.	em qds.
x / q	v	u		t		3 em spaces.	a		r		; / .	: / -	2 & 3 em quadrats.	

Weight of leads required for any work. These calculations apply to any measure, and are based on the use of six-to-pica leads. The first Table is for SOLID MATTER which requires to be leaded.

1,000 ems	Pearl	require	7½	ozs. leads.	1,000 ems	Bourgeois,	13½	ozs.	leads.
1,000 "	Agate	"	8½	" "	1,000 "	L. Primer,	15½	"	"
1,000 "	Nonpareil		9½	" "	1,000 "	S. Pica,	16½	"	"
1,000 "	Minion	"	11½	" "	1,000 "	Pica,	19	"	"
1,000 "	Brevier	"	13	" "					

EXAMPLE.—It is estimated that the matter to be set will make 20,000 ems Small Pica solid. Required, the weight of leads necessary to lead this matter. 1,000 ems of solid Small Pica require 16½ ounces of leads. 16½ × 20 = 330 ozs. = 20 lbs, 10 ozs.

The second Table gives the weight of the leads contained in 1,000 ems of *leaded* MATTER.

1,000 ems	Pearl	contains	5½	ozs. leads.	1,000 ems	Bourgeois	contains	11	ozs. lds
1,000 "	Agate	"	6	" "	1,000 "	L. Primer	"	12½	"
1,000 "	Nonpareil	"	7½	" "	1,000 "	S. Pica	"	14	"
1,000 "	Minion	"	9	" "	1,000 "	Pica	"	16½	"
1,000 "	Brevier	"	10½	" "					

EXAMPLE.—A page of leaded Long Primer contains 2,000 ems. Required, the weight of leads necessary to lead thirty-two pages. 1,000 ems of leaded Long Primer contain 12½ ounces of leads. 12½ × 2 = 25 ozs. per page. 25 × 32 = 800 ozs. = 50 lbs.

Or, a column of Nonpareil contains 8,000 ems. Required the weight of leads necessary to lead six columns. 1,000 ems of leaded Nonpareil contain 7½ ounces of leads. 7½ × 8 = 60 ozs. per column. 60 × 6 = 360 ozs. = 22 lbs. 8 ozs.

An allowance must of course be made for additional leads used for blanking out and in standing matter.

The following table gives the weight of leads in 1000 ems of leaded matter :—

LEADED MATTER—

1000	ems	Pearl..............	contains..............	$5\frac{1}{2}$	ozs. leads.
1000	"	Agate..............	"	6	" "
1000	"	Nonpareil..............	"	$7\frac{1}{2}$	" "
1000	"	Minion..............	"	9	" "
1000	"	Brevier..............	"	$10\frac{1}{2}$	" "
1000	"	Bourgeois..............	"	11	" "
1000	"	Long Primer..............	"	$12\frac{1}{2}$	" "
1000	"	Small Pica..............	"	14	" "
1000	"	Pica..............	"	$16\frac{1}{2}$	" "

TABLE SHOWING THE QUANTITY OF PAPER REQUIRED FOR ANY JOB FROM 50 TO 10,000 COPIES.—No allowance for waste or surplus copies. For any number not noted in Table, say 36 to the sheet, use double the quantity given in column headed 18.

No. of Copies Required.	2 to sht	3 to sht	4 to sht	6 to sht	8 to sht	9 to sht	12 to sht	15 to sht	16 to sht	18 to sht	20 to sht	24 to sht	32 to sht.
	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts	qrs shts
50	1— 1	0—17	0—13	0— 9	0— 7	0— 6	0— 5	0— 4	0— 4	0— 3	0— 3	0— 3	0— 2
100	2— 2	1—10	1— 1	0—17	0—13	0—12	0— 9	0— 7	0— 7	0— 6	0— 5	0— 5	0— 4
200	4— 4	2—19	2— 2	1—10	1— 1	0—23	0—17	0—14	0—13	0—12	0—10	0— 9	0— 7
250	5— 5	3—12	2—15	1—18	1— 8	1— 4	0—21	0—17	0—16	0—14	0—13	0—11	0— 8
300	6— 6	4— 4	3— 3	2— 2	1—14	1—10	1— 1	0—20	0—19	0—17	0—15	0—13	0—10
400	8— 8	5—14	4— 4	2—19	2— 2	1—21	1—10	1— 3	1— 1	0—23	0—20	0—17	0—13
500	10—10	6—23	5— 5	3—12	2—15	2— 8	1—18	1—10	1— 8	1— 4	1— 1	0—21	0—16
600	12—12	8— 8	6— 6	4— 4	3— 3	2—19	2— 2	1—16	1—14	1—10	1— 6	1— 1	0—19
700	14—14	9—18	7— 7	4—21	3—16	3— 6	2—11	1—23	1—20	1—15	1—11	1— 6	0—22
750	15—15	10—10	7—20	5— 5	3—22	3—12	2—15	2— 3	1—23	1—18	1—14	1— 8	1— 0
800	16—16	11— 3	8— 8	5—14	4— 4	3—17	2—19	2— 6	2— 2	1—21	1—15	1—10	1— 1
900	18—18	12—12	9— 9	6— 6	4—17	4— 4	3— 3	2—12	2— 9	2— 2	1—21	1—14	1— 5
1000	20—20	13—22	10—10	6—23	5— 5	4—16	3—12	2—19	2—15	2— 8	2— 2	1—18	1— 8
1250	26— 1	17— 9	13— 1	8—17	6—13	5—19	4— 9	3—12	3— 7	2—22	2—15	2— 5	1—16
1500	31— 6	20—20	15—15	10—16	7—20	6—23	5— 5	4— 5	3—22	3—12	3— 3	2—15	1—23
1750	36—11	24— 8	18— 6	12— 4	9— 3	8— 3	6— 2	4—22	4—14	4— 2	3—16	3— 1	2— 8
2000	41—16	27—19	20—20	13—22	10—10	9— 7	6—23	5—14	5— 5	4—16	4— 4	3—17	2—15
2500	52— 2	34—18	26— 1	17—10	13— 1	11—15	8—17	7— 0	6—13	5—20	5— 5	4— 9	3— 7
3000	62—12	41—16	31— 6	20—20	15—15	13—22	10—10	8— 8	7—20	6—23	6— 6	5— 5	3—22
4000	83— 8	55—14	41—16	27—19	20—20	18—13	13—22	11— 3	10—10	0— 7	8— 8	6—23	5— 5
5000	104— 4	69—11	52— 2	34—18	26— 1	23— 4	17— 9	13—22	13— 1	10—14	10—10	8—17	6—13
10000	208— 8	138—22	104— 4	69—11	52— 2	46— 8	34—18	27—19	26— 1	22— 4	20—10	17— 9	13— 1

NAMES AND SIZES OF BOOKS AS CLASSIFED BY PUBLISHERS.—The number of folds and pages in a single sheet when manufactured.

Name of book.	When a sheet is folded into leaves.	Contain.
Folio....	2 leaves..............................	4 pages.
Quarto or 4 to...	4 "	8 "
Octavo or 8vo..............................	8 "	16 "
Duodecimo or 12 mo..............................	12 "	24 "
16 mo *..............................	16 "	32 "
18 "	18 "	36 "
24 "	24 "	48 "
32 "	32 "	64 "

BEST PRINTERS' INK.—Boil 3 gallons best clear old linseed oil down to a thick varnish ; add while hot 12 lbs. of powdered rosin, $3\frac{1}{2}$ lbs. dry brown soap shavings, 5 ozs. indigo ; 5 ozs. Prussian blue, and 10 lbs. best lampblack ; stir all well together, let it stand a week and grind.

For other inks, roller compositions, &c., see pages 545-6 and 579. For paper tables see page 577.

* *Note.*—This book is a 16 mo., there being 32 pages to the sheet. The terms *folio, quarto, octavo, etc.,* denote the number of leaves in which a sheet of paper is folded.

The marks A, B, C ; 1, 2, 3 ; 1A, 2A ; 1*, 2*, etc., occasionally found at the bottom of pages, are what printers term *signature marks*, thus, 3*, being printed for the direction of binders in folding the sheets.

One pound of leads or slugs covers four square inches. Hence, when the space to be filled by leads or slugs is known, it is only necessary to divide the number of square inches by four, and the result will give the required weight in pounds.—*Proof Sheet.*

HOW TO ESTIMATE.---To ascertain the quantity of plain type required for a newspaper or magazine, or any other work, find the number of square inches and divide the same by four, the quotient will be the approximate weight of matter; but as it is impossible to set the cases clear, it is necessary to add 25 per cent. to large fonts, to allow for dead letter.

SCHEME FOR ENGLISH WOOD TYPE.—The following table will be useful in ordering wood type. Wood type should always be ordered by the "a," if for large Poster letters. A "3 A," font is generally sufficient, while for smaller letters it is always advisable to order at least a "5 A" font. Of condensed letters especially there should always be a large font.

	3 A, caps.	3 a, l. c.	4 A, caps.	4 a, l. c.	5 A, caps.	5 a, l. c.
A	3	3	4	4	5	5
B	2	2	3	3	3	3
C	2	2	3	3	4	4
D	2	2	3	3	4	4
E	4	4	5	5	6	6
F	2	2	3	3	3	3
G	2	2	3	3	3	3
H	2	2	3	3	4	4
I	4	3	4	4	5	5
J	2	1	3	2	3	2
K	1	1	2	2	2	2
L	4	4	5	5	6	6
M	2	2	3	3	4	4
N	3	3	4	4	5	5
O	3	3	4	4	5	5
P	2	2	3	3	3	3
Q	1	1	2	2	2	2
R	3	3	4	4	5	5
S	4	4	5	5	6	6
T	3	4	4	4	5	5
U	2	2	3	3	4	4
V	2	2	3	3	3	3
W	2	2	3	3	3	3
X	1	1	2	2	2	2
Y	2	2	3	3	3	3
Z	1	1	2	2	2	2
&	1		2		2	
,	3		4		4	
;	1		2		2	
:	1		2		2	
.	3		4		4	
-	1		1		1	
'	2		2		2	
!	2		3		3	
fi		1		1		1
ff		1		1		1
fl		1		1		1
ffi		1		1		1
ffl		1		1		1

Figures,	$	0	9	8	7	6	5	4	3	2	1
No. of each,	2	5	2	2	2	2	2	2	2	2	3

} 26 in all.

Figures are usually put up with Fonts of 4 A and upwards, and always with Lower Case, so that when a Font of 4 A is ordered the Lower Case, and Figures will always be sent unless otherwise ordered.

BILL OF TYPE.—English type founders call 3,000 lower case m's a bill, and proportion all other sorts by them; so that a bill of pica, including accents and italic, weighs 800 lbs. For every lb. of italic there are 10 lbs. of Roman. From the annexed table an idea can be obtained of the number of letters contained in 800 lbs. pica.

a	8,500	,	4,500	A	600	*A*	300
b	1,600	;	800	B	400	*B*	200
c	3,000	:	600	C	500	*C*	250
d	4,400	.	2,000	D	500	*D*	250
e	12,000	-	1,000	E	600	*E*	300
f	2,500	?	200	F	400	*F*	200
g	1,700	!	150	G	400	*G*	200
h	6,400	'	700	H	400	*H*	200
i	8,000	)	300	I	800	*I*	400
j	400	]	150	J	300	*J*	150
k	800	*	100	K	300	*K*	150
l	4,000	†	100	L	500	*L*	250
m	3,000	‡	100	M	400	*M*	200
n	8,000	§	100	N	400	*N*	300
o	8,000	‖	100	O	400	*O*	200
p	1,700	¶	60	P	400	*P*	200
q	500			Q	180	*Q*	90
r	6,200	1	1,300	R	400	*R*	200
s	8,000	2	1,200	S	500	*S*	250
t	9,000	3	1,100	T	650	*T*	326
u	3,400	4	1,000	U	300	*U*	150
v	1,200	5	1,000	V	300	*V*	150
w	2,000	6	1,000	W	400	*W*	200
x	400	7	1,000	X	180	*X*	90
y	2,000	8	1,000	Y	300	*Y*	150
z	200	9	1,000	Z	80	*Z*	40
&	200	0	1,300	Æ	40		
ff	400			Œ	30		
fi	500	Accents average 150 each.		3 em spaces	18,000		
ffi	150			4 " "	12,000		
ffl	100			5 " "	8,000		
æ	100			Hair "	3,000		
œ	60			em Quads	2,500		
—	150			en Quads	5,000		
——	90			Large Quadrats 80 lbs.			
———	60						

NAMES AND SIZES OF TYPE.

GREAT PRIMER.—In conversation, study purity of language: avoid vulgar dialects like the following samples:

ENGLISH. — *English Rustic.* Measter Goddin used to zay as how children costed a sight o' money to breng um oop, and 'twas all very well whilst um was leetle, and zucked the mother, but when um begind to zuck the vather, 'twas nation akkerd!

PICA.—*Rector.* "These pigs of yours are in excellent condition." *Jarvis.* "E'as, sur, they be. Ah! sur, if we was all on us only as fit to die as them are sur, it would be good for we."

SMALL PICA.—*Scotch Elder.* "O! Sandy, if ye wad only tak' soond advice, an' drink watter instead o' whiskey, it wad be better for your puir wife an' bonnie bairns; d'ye no ken whaur a' the drunkards gang tae?" *Confirmed Sot.* "Yes, Maister Tamson, richt weel I ken that, they aye gang whaur they get the best whiskey."

LONG PRIMER.—*Cockney Hair-Dresser.* "They say, sir, that the cholera is in the Hair, sir!" *Gent.* (very uneasy) "Indeed! ahem! then I hope you are very careful about the brushes you use." *Hair-Dresser:* "Oh, I see you don't *h*understand me, sir; I don't mean the 'air of the 'ed, but the *h*air *h*of the *h*atmosphere!"—*Punch.*

Cockney Servant Girl. "Well mam—Heverythink considered, I'm afraid you won't suit me. I've always been brought up genteel; and I couldn't go nowheres where there aint no footman kep'." *Servant Man, Thompson* (who is very refined), "Ho yes, mum, I don't find no fault with you, mum, nor yet with master—but the truth *his* mum, the *hother* servants is so *orrid* vulgar and *hignorant*, and speaks so *hungrammatical*, that I reely cannot live in the same 'ouse with 'em, and I should like to go this day month, if so be has it won't illconwenience you! "—*Punch.*

Bourgeois.—*Mrs. Brown* (an Aberdeen widow on the north side of forty). "Hoo's a' wi' ye this mornin', Mester Miller; come in an' sit doon, I was just thinkin' o' ye; some lang-tongued hizzies were sayin' that it was a perfec' shame that a man like you, wi' grey hair, an' a long fite beard should mak' a feel o' yersel' getting married fan ye should be thinkin' o' deein'. Its a peer world to live in if a man canna tak' a wife fanever he likes. Na, na, I ken plenty, some o' them no far aff, that wad be prood to get ye. Eh, sirs, the life o' a peer, lone woman, or a lone man is a weary, sair dree o' dool an' sorrow; dinna ye think sae, Mester Miller?" *Miller;* (a widower on the look out for another wife.) "In my long pilgrimage through this vale o' tears, my experience has been, that a man is muckle the better o' a woman, and a woman is muckle the better o' a man!"

Brevier.—*Wilkins.* "Well Tummas, did you 'ear as how Measter Smith hurted hisself on the leg just above the hancle." *Tummas,* "O did um, that be very bad for he, and I be very zarry to 'ear it. Las' week my son Jan war a drivin' a nail, an' the 'ammer, he flew out'n 'is 'and an' struck I very 'ard on the nose, the blood comed, an' if it 'ad struck much 'arder it would 'ave killed I on the spot sure."

Blarney. *Yankee* (just arrived). "Guess your legal fare is just Sixpence." *Dublin Carman:* "Shure, me Lord, we take some chape-Jacks at that—but its meself wouldn't dishgrace a gintleman a' your Lordship's quality by dhrivin' 'm at a mane pace through the public shtreets, so I tuk it upon myself to give your lordship a *shillin's* worth both of shtyle and whip cord."

Minion.—*Vermont Tombstone Agent to Smith, in the backwoods:*— "Good morning', Mister; I was told over tew .... that you had lost your wife, and I have jest cum ten miles over meowntains, woods, an' swamps to get an order for a tewmstun' for her. Was awful sorry to hear of your great loss, but I can sell you the cheapest an' best tewmstun' in the hull creation." *Smith.* "Waal, stranger, I reckon I can stand my loss if she can stand her'n; but you see as how the critter isn't ready for a tombstone yet, she's only *scooted* with another man."

Nonpareil.—*English Rustics. Sam:* I zay, Jack, be you a politicianer? *Jack.*—"E'as I be." *Sam.*—"Wall I zay, Jack, what be a politicianer? *Jack.*—"Zounds, Sam! doant'ee knaw nothink about un?" *Sam.*—Naw I doan't." *Jack.*—Wall, I doan't knaw as I can tell'ee, Sam, fur I doan't exackerly knaw mysel'!"

Pearl.—*English Showman.* Walk in to the show my hearties, walk in and see the great Hafriean lions, rhinoceros and helephants as was caught in the desert about 15 miles from either sea or land, and the great 'ippopotamus and catterwallapus as lives in the hocean. Them as don't go in can't win, and them as stays out there harn't in here, and can't see the great Hindian tiger, leopard, the hanacondas from Brazil, the grizzly bear, the buffalo that swings his vast preposterous over the Rocky Mountings and Western prarers, and the great dens of performing hanimals from hall hover the world!

Do yees raily think, Squire, that there is anny chancee of war wid this country an' Roosha? *Squire.* Well things did look a little queer lately; but why do you ask? Well, me raison for axin' is, d'ye moind now, wan o' these days I'll have to be afther sellin' me pig, and if there's goin' to be anny war, bacon 'ill roise to a foine price as thrue's me name's Tim O'Farrell!

1 a/ Though a variety of opinions exist as to the individual by whom the art of printing was 2 ∂ first discovered; yet all authorities concur in admitting Peter Schoeffer to be the person 3 Caps. who invented *cast metal types*, having learned
4 ∂ the art ~~of~~ of *cutting* the letters from the Gut-
5 :/ tembergs/ he is also supposed to have been
6 # the first whoengraved on copper plates. The 7 /-/ following testimony is preseved in the family, 8 r/
9 by Jo. Fred. Faustus, of Ascheffenburg: < # 6
10 > 'Peter Schoeffer, of Gernsheim, perceiving S. Caps.
11 his master Fausts design, and being himself
12 tr. desirous ardently to improve the art, found out (by the good providence of God) the method of cutting (~~incidendi~~) the characters 13 stet. in a *matrix*, that the letters might easily be
5 ;/ singly *cast* instead of bieng *cut*. He pri- 12 ei/
14 ⊥ vately *cut matrices* for the whole alphabet: 15 Faust was so pleased with the contrivance, that he promised Peter to give him his only 17 wf.
16 daughter Christina in marriage a promise 3 Ital. which he soon after performed.
19 as/ But there were many difficulties at first 18 no ¶ with these *letters*, as there had been before 3 Rom.
20 + with wooden ones, the metal being too soft 3 Ital. to support the force of the impression: but 9 this defect was soon remedied, by mixing a substance with the metal which sufficiently tr. 12
5 ⊙ hardened it/

and when he showed his master the letters cast from these matrices,

The designated errors being corrected, the foregoing matter will read as follows:

Though a variety of opinions exist as to the individual by whom printing was first discovered; yet all authorities concur in admitting PETER SCHOEFFER to be the person who invented *cast metal types*, having learned the art of *cutting* the letters from the Guttembergs: he is also supposed to have been the first who engraved on copper-plates. The following testimony is preserved in the family, by Jo. Fred. Faustus, of Ascheffenburg:

'PETER SCHOEFFER, of Gernsheim, perceiving his master Faust's design, and being himself ardently desirous to improve the art, found out (by the good providence of God) the method of cutting (*incidendi*) the characters in a *matrix*, that the letters might easily be singly *cast*, instead of being *cut*. He privately *cut matrices* for the whole alphabet: and when he showed his master the letters cast from these matrices, Faust was so pleased with the contrivance, that he promised Peter to give him his only daughter *Christina* in marriage, a promise which he soon after performed. But there were as many difficulties at first with these letters, as there had been before with *wooden ones*, the metal being too soft to support the force of the impression; but this defect was soon remedied, by mixing the metal with a substance which sufficiently hardened it.'

EXPLANATIONS OF THE CORRECTIONS.

The following rules, from Mackellar's *American Printer* (a most reliable work), will be found of inestimable value to typographical men and all who write for the press:

A wrong letter in a word is noted by drawing a short perpendicular line through it, and making another short line in the margin, before which the right letter is placed. (See No. 1.) In this manner whole words are corrected, by drawing a line across the wrong word and making the right one in the margin opposite.

A turned letter is noted by drawing a line through it, and writing the mark No. 2 in the margin.

If letters or words require to be altered from one character to another, a parallel line or lines must be made underneath the word or letter,—viz. for capitals, three lines; small capitals, two lines; and Italic, one line; and, in the margin opposite the line where the alteration occurs, *Caps*, *Small Caps*, or *Ital.* must be written. (See No. 3.)

When letters or words are set double, or are required to be taken out, a line is drawn through the superfluous word or letter, and the mark No. 4 placed opposite in the margin.

Where the punctuation requires to be altered, the correct point, marked in the margin, should be encircled. (See No. 5.)

When a space is omitted between two words or letters which should be separated, a caret must be made where the separation ought to be, and the sign No. 6 placed opposite in the margin.

No. 7 describes the manner in which the hyphen and ellipsis line are marked.

When a letter has been omitted, a caret is put at the place of omission, and the letter marked as No. 8.

Where letters that should be joined are separated, or where a line is too widely spaced, the mark No. 9 must be placed under them, and the correction denoted by the marks in the margin.

Where a new paragraph is required, a quadrangle is drawn in the margin, and a caret placed at the beginning of the sentence. (See No. 10.)

No. 11 shows the way in which the apostrophe, inverted commas, the star and other references, and superior letters and figures, are marked.

Where two words are transposed, a line is drawn over one word and below the other, and the mark No. 12 placed in the margin; but where several words require to be transposed, their right order is signified by a figure placed over each word, and the mark No. 12 in the margin.

Where words have been struck out that have afterward been approved of, dots should be marked under them, and *Stet* written in the margin. (See No. 13.)

Where a space sticks up between two words, a horizontal line is drawn under it, and the mark No. 14 placed opposite. in the margin.

Where several words have been left out, they are transcribed at the bottom of the page, and a line drawn from the place of omission to the written words (see No. 15) ; but if the omitted matter be too extensive to be copied at the foot of the page, *Out, see copy*, is written in the margin, and the missing lines are enclosed between brackets, and the word *Out* is inserted in the margin of the copy.

Where letters stand crooked, they are noted by a line (see No. 16); but, where a page hangs, lines are drawn across the entire part affected.

When a smaller or larger letter, of a different fount, is improperly introduced into the page, it is noted by the mark No. 17, which signifies wrong fount.

If a paragraph be improperly made, a line is drawn from the broken-off matter to the next paragraph, and *No* ¶ written in the margin. (See No. 18.)

Where a word has been left out or is to be added, a caret must be made in the place where it should come in, and the word written in the margin. (See No. 19.)

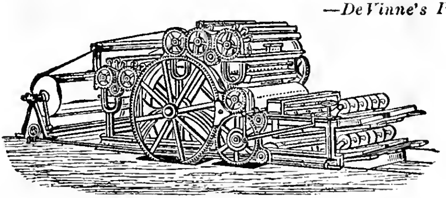
Where a faulty letter appears, it is marked by making a cross under it, and placing a similar one in the margin (see No. 20); though some prefer to draw a perpendicular line through it, as in the case of a wrong letter.

PAPER VARNISH.—All varnished gums composing the same, and dissolved in turpentine, have a greasy nature. Paper must be first sized, or if dissolved by any other spirit, 8 oz. of gum sandarach, 2 oz. of Venice turpentine, 32 oz. of alcohol. Dissolve by gentle heat. Or a harder varnish, reddish cast, 5 oz. of shellac, and 1 oz. of turpentine, 32 oz. of alcohol, or Canada balsam dissolved in turps.

Average Daily Performance of Presses.— The estimates of the following Tables are for miscellaneous work, done in the usual manner, with little making ready and under the favorable conditions of a busy season. It is supposed that the presses are at work full 10 hours; that feeders and pressmen are expert and diligent: that paper, rollers, steam power, ink, etc., are in perfect order, and that there are no detentions or accidents.

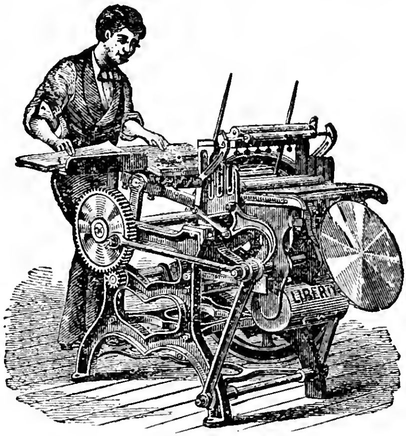
Make Ready Time.	Style of Press.—No. of Forms.	Time of Press Work.	Rate per Hour.	Daily Performance.
Hours.		Hours.		Impr.
	Card Press.			
1	1 form of 7,500 impressions.	9	833	7,500
4	4 " 1,000 "	6	666	4,000
6	8 " 250 "	4	500	2,000
	Small Machine Press.			
1	1 form of 6,000 impressions.	9	666	6,000
5	5 " 500 "	5	500	2,500
8	8 " 100 "	2	400	800
	Hand Press.			
1	1 form of 1,500 impressions.	9	156	1,500
4	" 250 "	6	166	1,000
	Medium Cylinder.			
1	1 form of 7,500 impressions.	9	833	7,500
5	5 " 750 "	5	750	3,750
7	8 " 250 "	3	666	2,000
	Double Medium Cylinder.			
2	1 form of 5,000 impressions.	8	666	5,000
5	3 " 1,000 "	5	600	3,000
7	6 " 250 "	3	500	1,500
	Mammoth Cylinder.			
3	1 form of 4,000 impressions.	7	570	4,000
5	2 " 1,250 "	5	500	2,500
7	4 " 250 "	3	333	1,000

—*De Vinne's Price List.*

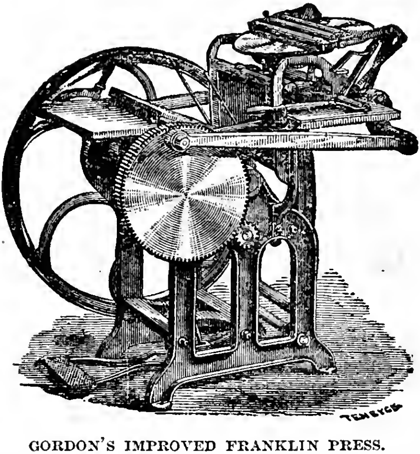


THE BULLOCK SELF-FEEDING PERFECTING PRESS.

The press represented by the cut is one of the most wonderful inventions of modern times in the department of printing machinery. The space occupied by the Bullock Perfecting Press is about 12 feet long 5½ ft. high. As indicated by the name, it is a self-feeder, drawing its supplies from a large cylindrical roll, or web of paper, placed either on the press itself, or near it, drawn in by tension, passing in, first, between an impression and a type cylinder, where it is printed on its first side; and, then, secondly, passing immediately to a second set of type and impression cylinders, where it is printed on the other side. Passing onwards the paper is severed by a knife into sheets of the desired size, and delivered in perfect condition (with the most astonishing rapidity) by means of a fly, upon the receiving board, with no other aid than that furnished by the machine itself.



WEILER'S PRINTING PRESS.



GORDON'S IMPROVED FRANKLIN PRESS.

Concentrated Ink Pastes to Write with Water.—1. *Black Ink.* Take 4 parts of bichromate of potash, pulverized, and mixed with 25 parts of acetic acid, 50 parts of liquid extract of logwood, $\frac{1}{4}$ part of picric acid, 10 parts of pulverized sal sorrel, 10 parts of mucilage, and ¼ part of citrate of iron, and mix well. The liquid extract of logwood is prepared by mixing 3 parts of an extract of common commercial qzality with two parts of water. 2. *Red Ink.* Take 1 part of red aniline mixed with 10 parts of acetic acid, 5 parts of citric acid, and 25 parts of mucilage, all well mixed. For use, mix 1 part of the paste with 16 parts of water. 3. *Blue Ink.* Take 2 parts of aniline blue mixed with 10 parts of acetic acid, 5 parts of citric acid, and 40 parts of mucilage, all well mixed. For use, mix 1 part of the paste with 8 parts of water. 4. *Violet Ink.* Use the same ingredients in the same proportions, as blue, with the difference, that violet aniline is used instead of blue aniline. 5. *Green Ink.* Take 1 part of aniline blue, 3 parts of picric acid mixed with 10 parts of acetic acid, 3 parts of citric acid, and 80 parts of mucilage. For use, 1 part of this paste is mixed with 8 parts of water. 6. *Copying Ink.* Take 6 parts of pulverized bichromate of potash, mixed with 10 parts of acetic acid, and 240 parts of liquid extract of logwood, and add a pulverized mixture of 35 parts of alum, 20 parts of sal sorrel, and 20 parts of mucilage. Mix well. For use, 1 part of this paste is mixed with 4 parts of hot water.

These inks are described as leaving no sediment, as drying quicker on paper than the ordinary inks, and as being non-corrosive.

Colored Inks for Rubber and other Stamps.—*Red.* Dissolve ¼ oz. of carmine in 2 ozs. strong water of ammonia, and add 1 dr. of glycerine and ¾ oz. dextrin. *Blue.* Rub 1 oz. Prussian blue with enough water to make a perfectly smooth paste; then add 1 oz. dextrin, incorporate it well and finally add sufficient water to bring it to the proper consistence. *Violet.* Alcohol 15 ozs., glycerine 15 ozs., aniline violet 2 to 4 drs.; mix, dissolve, pour the solution on the cushion and dab on with a brush.

The following estimates relating to the consumption of ink, &c., are selected from *De Vinne's Price List,* a work of incomparable utility to printers, published by Francis Hart & Co., New York.

Black Inks.—On common news and rough book work, the value of black ink at 40 cents, used and wasted in printing a wet-down sheet of size 24 × 38 inches, or thereabouts, is a little less than 17 cents per 1000 impressions, or about 4 cents * a token of 250 impressions. If the sheet is over-colored, it will cost 6 cents; if it is under-colored, or if printed on damp calendered paper (an unusual quality of this class of work), it will not cost 3 cents per token.

For ordinary book work, using ink at 60 cents, on smooth paper of size 24 × 38 inches, the average cost of ink used and wasted will be about 6 cents per token; on dry and rough paper, it will reach 10 or 13 cents.

Fine book or pamphlet Presswork on damp sheets of calendered paper, of size 24 × 38, using ink at $1.00, should have its average value rated at 10 cents per token for an ordinary edition. Upon a short edition, for which ink is specially put in the fountain, and of which much is wasted, the cost will be from 15 to 25 cents per token. If the paper is a soft and spongy Book, cost for either quantity will be still higher.

Illustrated Catalogues, printed on medium sheets, 19 × 24 inches, on dry calendered paper, with cuts of large size and blackness, will use

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* It is a popular belief that the ink used for this class of work, on this size does not exceed 3 cents per token. This is the ordinary reckoning, which is for use only. But the waste of this quality of ink is rarely ever less than one-fifth, and it often approximates more closely to one-third of the amount purchased.

of wood-cut ink at \$2.50 per pound, on an edition of 1000, at the rate of 60 cents to \$1.00 per token. If the edition is of 5000 impressions, the value of ink used will range from 40 cents to 70 cents per token. If cuts are very large or black, they may consume ink, on an edition of 1000 copies, at the rate of \$1.50 per token. If ink at \$3.00 or \$5.00 is used, in place of ink at \$2.50, the price will increase, but not in true proportion—the more expensive color is finer, and has more extending capacity. These are prices for cuts of machinery. The amount of color on this work is largely under the control of the pressman. He can use it freely or sparingly, at will, but with a corresponding effect of strength or weakness in the work.

Book Illustrations.—The ordinary illustrations of books and newspapers, when not too frequent, or too black, do not sensibly increase the consumption of ink. It is not usual to make account of the value of ordinary ink on this class of work. But when the cuts are numerous and are black, and fine inks are used, the value of color used cannot be overlooked. On a large edition of work of this class, the average value of ink at \$2.00, on a sheet 24 × 38 inches, will be 50 cents per token. Upon an edition of 1000, the cost of the same ink would be more than \$1.00 per token. A Double Royal sheet 29 × 43 inches, on an edition of 20,000, with ink at \$3.00, with many cuts, has been worked at a cost of 53 cents per token for ink; but this is a rare result, the economy being due as much to the skill of the pressman as to the length of the edition. If the edition had been 1000, the value of the black ink used and wasted would have been at the rate of \$1.50 per token.

Posters.—An ordinary poster, 12 × 19 inches, will consume of black ink at 25 cents per pound, at the rate of 30 and 40 cents per 1000 impressions, the quantity used depending upon the size of the type and the quality of the paper. Under the same conditions, a poster 19 × 24 inches, will consume black ink of same quality at the rate of 75 cents and \$1.00 per 1000 impressions; a poster 24 × 38 inches, from \$1.25 to \$2,00 per 1000 impressions. The value of the color used increases with the size of the sheet, and for this work, in greater proportion. The larger form has larger type, and the larger press wastes more color.

Tint Blocks.—A solid tint Block cut on pine, for a sheet 24 × 38 inches, with a few white lines, will use of 25 cent ink, at the rate of \$3.00 per 1000 impressions. If finer inks are used, the advance in price will be nearly in strict proportion. For a sheet 24 × 38, of smooth, thick paper, dry, printed on a metal tint-plate, with ink at \$1.00 per pound, the cost of ink will be \$10.00 per 1000 impressions. For this class of work, a pound of fine ink will do more work than a pound of cheap ink. On common flat work, a good black ink will permit a liberal reduction of body with varnish.

Blue Inks.—Many qualities of this color are used. The leading varieties are best known to printers as light, dark, ultramarine and bronze blues. The light has a limited use for flat surfaces and tints; the ultramarine, for flat surfaces, tints, posters, and to some extent, in its finer qualities, on fine type; the dark and bronze blues are most used for fine and light work, for which they are well adapted, having strong body, and in extending property being nearly equal to fine black ink.

Ultramarine is the favoring color for bright showy work. It is very bulky for its weight, and works well upon all flat surfaces. It is not a finely-ground color. The best colors only are used for type, but they do not work with the freedom and smoothness of dark or bronze blues. The prices range from 50 to \$3.00 per pound.

Flat Surfaces.—A flat-faced label, 9 × 14 inches, will consume of pure ultramarine blue at \$1.00 per pound at the rate of \$3.00 per 1000 impressions. A flat tint block, 18 × 22 inches, on fair paper, will use of this color, when somewhat reduced with varnish, at the rate of $9.00 per 1000 impressions. A flat tint block of pine wood, made for paper 24 × 38 inches, will use of ultramarine at 75 cents, largely reduced with varnish, at the rate of $15.00 per 1000 impressions.

Posters.—For a poster, 12 × 19 inches, on ordinary News, the value used of ultramarine ink at $1.00 will be at the rate of $2.00 per 1000 impressions; for a poster, 19 × 24 inches, on ultramarine blue at 75 cents, $3.05 per 1000 impressions ; for a poster, 24 × 38 inches, on ultramarine blue at 75 cents, at the rate of $6.00 to $8.00 per 1000 impressions. Ink at 50 cents per pound would diminish the value of the color used, but not in ratio with the reduced price. The cheaper color is thinner, not so well ground, and is consumed more freely. If it is used on any but the largest type, it will not prove of marked economy.

Dark blue and bronze blue are little used for posters or flat tints. If used in bulk, without reducing, they will be much more expensive than ultramarine. When used on this kind of work, they are usually thinned with white ink, varnish, turpentine, benzine, etc., and sometimes with magnesia. When used on light, open and fine work, the value of dark or bronze blues, may be rated as about double that of the same quality as black ink.

Red Inks.—Under this heading may be classified many qualities of scarlet and crimson color. The leading qualities are vermilion, lake and carmine.

Vermilion red, a pure scarlet, is the basis of the better qualities of the cheap reds in greatest use. Commoner qualities, such as are sold at 75 cents and $1.00 per pound, are largely mixed with cheaper colors. In its pure state, vermilion is the densest, and, in extending property, the weakest of all colors. A pound of vermilion red at $3.00 per pound is about half the bulk of fine black at $1.00 per pound. Where the black will yield color for 1000 impressions, the vermilion red will be used up with about 350 impressions. The value of the red color, extending capacity considered, is about ten times as great as that of fine black.

Lake red, a deep crimson, is inferior to black in extension, but will give treble the service of ordinary vermilion. It is too expensive for most bold work, or for flat surfaces, nor does it produce as good an effect as pure vermillion. It is largely used for fine work, for which it is well fitted.

Carmine, an intense and glowing crimson, is but little inferior to the finest black in extending properties. It is one of the most expensive colors, and can be used to profit and with effect only on light and open work. For flat and solid work, the effect produced is but little superior to that of the finer lakes, and is seldom worth the extra cost.

Posters.—The value of red ink at $1.00 per pound, that will be used and wasted in printing 1000 posters, 12 × 19 inches, may be rated at $3.00 ; on 1000 posters, 19 × 24 inches, the value of color may be estimated at $5.00 and $6.00 per 1000 ; on a poster, 24 × 38 inches, at $9.00 and $12.00 per 1000. The color is weak, and the use of light or bold-faced type will make serious differences in the consumption of color. On double-medium posters, the value of the color may be averaged at $1.00 per 100 impressions.

Flat Surfaces.—A flat label 9 × 14 inches, with ordinary amount and size of lettering cut for white, such as is used for soap boxes, etc., will consume of pure red ink at $1.00 per pound, at the rate of $4.50 and $5.00 per 1000 impressions. If the plate is flat, without lettering, at the rate of $6.00 per 1000 impressions. A flat tint poster for paper 19 × 24 inches, with letters cut in white as above, will use of red ink at $1.00 per pound, that has been somewhat thinned with varnish, at the rate of $9.00 and $10.00 per 1000 impressions. If pure color is used, it will consume color to the amount of $14.00 or $15.00. A flat tint poster for paper 24 × 38 inches, cut on pine, with lettering as above, will consume of red ink at $1.00 per pound, thinned with varnish, at the rate of $18,00 and $25.00 per 1000 impressions. If dry paper is used, as is necessary for registered work it could not be rated at less than $20.00 ; for damp paper, carefully managed, it may be less than $18.00, but this is unusual.

COLORING OF PAPER.—*Gray* is usually obtained by mixing mineral or vegetable black with the bleached pulp, but the tones produced by these primitive means are generally dull. Vegetable black made from the chestnut tree gives the best result. Chestnut black can be made from the bark of the young sprouts of this tree, generally cultivated to make hoops for casks ; after taking off the bark it is dried, ground, and made into a decoction for coloring paper, and which can be made either gray or black. Logwood also may be used. *Iron Gray* is made with chestnut or logwood. For two cwt. of paper, 4 lbs. of ext. of chestnut, 4 lbs. sulphate of iron, dissolved in 9 gals. of boiling water, then stirred and mixed with the pulp, adding a small quantity of red lake and ultramarine. The size is mixed with 8 per cent. of sulphate of aluminum, this may be much varied. With small quanities of ext. of logwood and sulphate of iron a *light gray* is obtained; by adding yellow and Prussian blue, a *greenish slate* color ; by adding white, suppressing the blue, and keeping the lake, a *chamois* tone ; by adding to this last formula a little umber, bistre. Logwood is used with all colors when it is wished to darken the shades. With fine pulp il is best to replace the ext. of logwood by the product obtained from the tree noted at the beginning of this notice.

SOLVENTS FOR RUBBER.—These are bisulphide of carbon, coal naptha, rectified oil of turpentine, chloroform, and ether, which must be free from alcohol.

INFORMATION CONCERNING PATENTS.

UNITED STATES PATENTS AND FEES.—No patent will be granted if the whole or any part of what is claimed has been patented or described in any printed publication in this or a foreign country, or been invented or discovered in this country.

Prior Invention abroad will not prevent issue of a patent, unless the invention has been there patented or described in some printed publication.

To prevent a subsequent inventor from obtaining a patent, an invention must have been reduced to a practical form, either by construction of a model or machine, or drawing, by which a mechanic could make the same.

Merely conceiving an idea of an invention is not a discovery, and patentable.

Foreign Patents.—The taking out of a patent in a foreign country does not prejudice a patent previously granted here; nor does it prevent obtaining a patent here subsequently. When a patent is granted here it will extend only seventeen years from date of foreign patent.

Every foreign inventor must have in use, or for sale in the United States, a copy of their patentable article, within eighteen months from date of patent.

Duration of Patent is seventeen years. Extensions are prohibited on all patents granted since 1861. Applications for extension must be filed, and requisite fee paid, ninety days before expiration of the patent.

Granting of Patents.—Patents, on payment of same official fee, are granted to all persons, including women and minors, unless inhabitants of countries which discriminate against the inhabitants of the United States.

Application for a patent must be made in the name of the *inventor*, who can *alone* sign the papers ; an attorney for inventor *can not* do so.

Heirs of an Inventor can obtain a patent, papers to be signed by executor or administrator of inventor.

Joint Inventors are entitled to a joint patent.

An Inventor can assign his entire right, before a patent is obtained, so as to enable the assignee to take out a patent in his own name; but the assignment must be first recorded, and specification sworn to by the inventor.

Oaths may be taken, in this country, before any one authorized by law to administer oaths ; in a foreign country before any minister plenipotentiary, charge d'affairs, consul, commercial agent or notary public of the country in which oath is taken, being in all cases properly attested by official seal of such notary.

Stamps.—A stamp of value of fifty cents is required for each power of attorney, each sheet of an assignment to be stamped *five cents*, each certificate of magistrate *five cents*.

Drawings to be in duplicate, one on stiff paper, one on tracing cloth, to be 20 inches top to bottom, 15 inches wide ; tracing to have 1 inch margin on right hand side, for binding.

Models to be of hard wood, or metal, not more than 12 inches in any dimension ; name of the inventor to be engraved or painted conspicuously on it.

For an Improvement, only model of part to be patented is required, to show nature and operation of invention.

Designs, no models required ; either drawings or photographs, both in duplicate, with *negative* of photograph.

New Articles of manufacture, sample of article ; medicines, or medical compounds, sample of same, and minute statement of exact proportions and ingredients.

CAVEATS.—The filing of a caveat prevents, during its existence, the issue of a patent, without the knowledge of the caveator, to any person for a similar device. The caveator is entitled to receive official notice during one year, for any petition for similar or interfering invention filed during that time. The caveator, when so notified, must complete his own application within three months from date of notice.

A caveat runs one year : can be extended by paying $10 a year.

Caveats can only be filed by citizens of the United States, or aliens who have resided here one year and declared their intention of becoming citizens.

UNITED STATES PATENT FEES.

On filing each caveat	$10 00
On filing each original application for a patent, except for a design.	15 00
On issuing each original patent	20 00
On every appeal from Examiners-in-Chief	20 00
On application for a reissue	30 00
On application for extension	50 00
Granting an extension	50 00
Filing each disclaimer	10 00
Certified copies of patents and other papers, 10 cents per 100 words.	
Recording every assignment, agreement, power of attorney, and other papers, of 300 words or under	1 00
If over 300 and under 1,000 words	2 00
If over 1,000 words	3 00
Drawings, cost of making same	
Patents for designs—for three and one-half years	10 00
" " for seven years	15 00
" " for fourteen years	30 00

In addition to the above, Messrs. MUNN & Co., Patent Solicitors, N.Y., charge for written report of special examination at Patent office,if invention has been patented in this country, $5 ; for general information of infringements, reissues, claims, assignments, joint ownership, contracts, licences, name in which patent is recorded, abstracts of deeds of transfer, sketch of a drawing of patent, license made out, transfer of do., recording do.. $5 for each case ; for procuring a patent, $25 to $35, or more ; for procuring a caveat, $10 to $15 ; for copies of patents or assignments, or drawings of any existing patents, $5 to $10 ; copy of any claim, $1.

FOREIGN PATENTS.—*Great Britain.*—Duration, fourteen years, to first inventor or importer, cost, $350, of which $100 due at time of making application, balance in four months ; three years from date of patent, a further sum of £50 must be paid ; end of seven years, £100 additional. For designs to protect shape of article, three years, $100.

France.—Term of patent, fifteen years, annual fee, $20.

Belgium.—Term of patent, twenty years ; small annual fees.

EXPENSE OF FOREIGN PATENTS, INCLUSIVE OF ALL FEES.

Austria	$250	Netherlands	$150
Bavaria	150	Portugal	250
Belgium	150	Prussia	200
Cuba	450	Russia	550
France	150	Saxony	250
Great Britain	350	Spain	400
India	400	Sweden and Norway	600
Italy	250		

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FACTS RELATING TO HUMAN LIFE.

The following table exhibits the recent mortality statistics, showing the average duration of life among persons of various classes in the State of Massachusetts :

	Years.		Years.		Years.
Men unemployed	68	Blacksmiths	51	Bakers	43
Judges	65	Merchants	51	Painters	43
Farmers	64	Calico Printers	51	Shoemakers	43
Bank Officers	64	Physicians	51	Mechanics	43
Coopers	58	Butchers	50	Editors	40
Public Officers	57	Carpenters	49	Musicians	39
Clergymen	56	Masons	48	Printers	38
Shipwrights	55	Traders	46	Machinists	36
Hatters	54	Tailors	44	Teachers	34
Lawyers	54	Jewellers	44	Clerks	34
Rope Makers	54	Manufacturers	43	Operatives	32

The average death rate in Europe is 1 out of every 42 inhabitants, or 2.38 per cent. The principal European countries exhibit the following annual bills of mortality :—

England	1 death to every	46	Austria	1 death to every	40
Denmark	1 " "	45	Prussia	1 " "	39
Belgium	1 " "	43	France	1 " "	32
Norway and Sweden	1 " "	41			

The death rate in the United States varies much from the above, from the highest, Arkansas, where the annual mortality is one death to every 49 inhabitants, a trifle over 2 per cent of the population, to the lowest, Oregon, where the death rate is less than half of one per cent., or one to every 200 inhabitants. The average yearly mortality in proportion to population is exhibited in the following table :—

New England States	1 in 68	Pacific States	1 in 115
Middle States	1 " 88	Atlantic States	1 " 80
Southern States	1 " 70	Gulf States	1 " 63
Western States	1 " 81	Mississippi Valley States	1 " 80
North-Western States	1 "120		

According to the Carlisle table of mortality, largely used as an authority in life insurance calculations in America and Europe, of 10,000 children born—

3,540	die in	10	years.	5,603	die in	50	years.	9,848	die in	90	years.
3,910	"	20	"	6,357	"	60	"	9,991	"	100	"
4,358	"	30	"	7,599	"	70	"	9,999	"	104	"
4,915	"	40	"	9,047	"	80	"				

Leaving only one living at the age of 104 years.

The tables of the British Government annuities are constructed on the principle that women live longer than men. Thus, a male of 15 can purchase an annuity of £15 per annum for £411 5s. 10d., but a female of the same age must pay £438 11s. 4d. And, at 50, a man would pay £272 17s. 1d. ; but a woman £312 14s. 10d.

Long life, as a general rule, awaits the man who is gifted with prudence, a good constitution, and the mental potency to banish corroding anxiety. These are inestimable gifts. Dr. Heberden, an illustrious London physician of the last century, whose practise lay chiefly among the wealthy classes, asserted that nine out of ten of his patients died of a broken heart. Cornaro, the noted dietist, who by prudent care of himself, lived to 104, wrote, "I am likewise greatly indebted for the excellent health I enjoy to that calm and temperate state in which I have been careful to keep my passions. The influence of the passions on the nerves and health of our bodies is so great that none can be ignorant of it. He, therefore, who seriously wishes to enjoy good health, must learn to keep his passions in subjection to reason. Otherwise, all temperance will go for little." The man endowed by nature with the best prospect for long life is thus described by the famous Hufeland, in his work on longevity, published during the last century : "He has a well-proportioned stature, without, however, being too tall. He is rather of the middle size, and somewhat thickset. His complexion is not too florid ; at any rate, too much ruddiness in youth is seldom a sign of longevity. Hair approaches rather to the fair than to the black. His skin is strong, but not rough. His head is not too big. He has large veins at the extremities, and his shoulders are rather round than flat. His neck is not too long. His belly does not project, and his hands are large, but not too deeply cleft. His foot is rather thick than long, and his legs are firm and round. He has also a broad chest and strong voice, and the faculty of retaining his breath a long time without difficulty. In general there is complete harmony in all his parts. His senses are good, but not too delicate. His pulse is slow and regular. His appetite is good, and his digestion easy. He has not too much thirst, which is always a sign of rapid self-consumption. His passions never become too violent or destructive. If he gives way to anger he experiences a glow of warmth, without an overflowing of the gall. He likes employment, particularly calm meditation and agreeable speculations ; is an optimist, a friend to nature and domestic felicity—has no thirst after either honors or riches, and banishes all thought of to-morrow."

Mr. John Q. Adams was in excellent health, when, in his ninetieth year, he was visited by Charles Mackay, who thus explains the cause :

"Men and women," he says, "scarcely ever allow the fresh air of heaven to touch any part of their bodies, except their hands and face, and even to these the ladies are systematically unjust by wearing gloves and veils. The surface of the beautiful human form requires to be for a certain period of every day exposed to the action of the atmosphere. I take my air bath regularly every morning, and walk in my bed-room *in puris naturalibus*, with all the windows open, for half an hour. I also take a water bath daily. I read and write for eight hours a day. I sleep eight hours, and devote another eight to exercise, conversation, and meals. I feel within myself a reserve of bodily strength, which, I think, will carry me to a hundred years, unless I die by accident, or am shot or hanged."

Between 1840 and 1871 the annual mortality on the Cheviot Hills, in Scotland, was at an average of 15 per 1,000. In the hamlet of Harbottle, with 120 inhabitants there has been no death of a child for 20 years. A farmer and his three shepherds, who have occupied their present situation nearly 30 years, have among them 47 children, and not a single death has occurred in these families. In Alwinton, a parish on the southern slopes of the hills, the birth-rate in 1871, when it contained a population of 1,205, was 32.4 per cent., and the death-rate only 7.5. An abundance of good food, good water, good houses, and regular but not severe work, have brought about this orderly state of existence.

Of a man who died near London at the advanced age of 110 years, it is reported that he had never been ill, and that he had maintained through life a cheerful happy temperament. He was uniformly kind and obliging to everybody; he quarrelled with no one; he ate and drank merely that he might not suffer from hunger and thirst, and never beyond what necessity required. From his earliest youth he never allowed himself to be unemployed. These were the only means he ever used.

Of a woman who died near Stockholm at the advanced age of 115 years, it is on record that she passed her long life free from illness, always contented and happy, a devoted lover of cleanliness, had a daily habit of washing her face, hands, and feet in cold water, and as often as opportunity afforded, bathed in the same; she never ate or drank any delicacies or sweet-meats; seldom tea or coffee, and never wine.

Another noted instance of long life was that of a man who died near St Petersburg, and had enjoyed good health until he was 120 years old. He was an early riser, and never slept more than seven hours at a time; he was never idle; he worked and employed himself chiefly in the open air, and particularly in his garden. Whether he walked or sat in his chair he always maintained an erect position, never tolerating a stooping, leaning, or distorted attitude.

Unquestionably, a properly selected vegetable diet is the best fitted for the maintenance of health. A great percentage of the diseases which afflict humanity are generated by the use of pork, veal, and other meats in immoderate quantities, and prepared in preposterous forms with lard, rich sauces, seasoning, &c. Of all animal food in common use pork is decidedly the worst. Its use as food frequently engenders an extremely painful disease, by many pronounced incurable, caused by a filthy parasite which exists naturally in the muscles of swine. See *Trichina*, page 149. A farmer writing from Freeport to the Chicago INTER-OCEAN denounces pork in the most trenchant style. He says "Pork grease will ruin a wagon axle, much more the human stomach, and the farmer who uses pork alone as a meat diet and pork grease as *shortening*, ruins not only his own constitution but that of his family as well. This is the experience of a farmer who has tried the use of pork for over fifteen years, with as many years of sickness in his family, and two years on beef diet and perfect health." "Vegetable aliment, as neither distending the vessels, nor loading the system, never interrupts the stronger action of the mind; while the heat, fulness and weight of animal food is adverse to its efforts."—*Cullen.*

The following table shows the number of grains of warmth and strength evolved per lb., from various articles of food. The carbon and nitrogen taken into the system form fat and flesh, the fat being consumed makes the body stout, while the flesh represents strength or the muscles which yield it.

Grains of Strength yielded by one pound of 7000 grains.	GRAINS.	Grains of Warmth yielded by one pound of 7000 grains.	GRAINS.
Beer or Porter	1	Whey	150
Parsnips	12	Turnips	238
Turnips	12	Beer and Porter	315
Whey	13	Buttermilk	335
Greens	14	Skimmed Milk	351
Potatoes	24	New Milk	378
Skimmed Milk	34	Carrots	390
New Milk	35	Parsnips	425
Buttermilk	35	Potatoes	770
Barley	70	Fresh Fish	980
Rice	70	Beef Liver	1,220
Bacon	78	Red Herrings	1,455
Rye Bread	89	Baker's Bread	1,990
Baker's Bread	90	Fresh Beef	2,300
Pearl Barley	91	Molasses	2,300
Fresh Pork	108	Skim. Milk Cheese	2,350
Seconds Flour	120	Cheddar Cheese	2,550
Corn Meal	125	Seconds Flour	2,700
Fresh Fish	129	Rye Bread	2,700
Cocoa	130	Rice	2,750
Oatmeal	140	Barley Meal	2,780
Mutton	140	Indian Meal	2,800
Fresh Beef	172	Sugar	2,900
Beef Liver	200	Fresh Pork	3,100
Split Peas	250	Bacon	4,200
Cheddar Cheese	310	Butter	4,700
Skim. Milk Cheese	360	Lard	4,800
		Drippings	5,500

In cookery 4 lbs. of beef lose 1 lb. by boiling, 1 lb. 5 ozs. by roasting, and 1 lb. 3 ozs. by baking; 4 lbs. of mutton lose 14 ozs. by boiling, 1 lb. 6 ozs. by roasting, and 1 lb. 4 ozs. by baking. As to the drinking customs of society, statistics prove that every year in the United Kingdom, 70,000, and in the United States, about 75,000 deaths result directly and indirectly from the use of spirituous liquors. The benefits derived from their use are in a great measure merely imaginary, and their persistent use can only have one result, viz., premature death. An intemperate person of twenty years has a probability of life extending 15.6; one of 30 to 11·6 years, while temperate persons would have a like probability of living 42 and 35 respectively. Comment is useless, if you wish health and long life, abstain. Liebig, the celebrated chemist, recommends the persistent use of a purely vegetable diet as a cure for this abominable vice, especially in its earlier stages, and Charles Napier, the noted English scientist, has reported, as the result of experiments, 27 cases, in which the exclusive use of vegetables as food, had created repugnance for alcoholic stimulants. Another remedy highly commended is to steep equal parts of the herbs valerian and wormwood together, and drink the liquid three times a day when the desire is felt. Still another remedy is tincture of cinchona (Peruvian bark) taken in 1 drachm (teaspoonful) doses every two hours. The dose may be increased to six teaspoonfuls and taken in that proportion 4 to 10 times per day. It will not destroy appetite for food, but in a few days the anti-periodic properties of the cinchona begin to tell, and the patient not only loses all taste for the tincture, but also all desire for everything in the shape of alcohol.

THE LATEST CENSUS OF ALL THE COUNTRIES OF THE WORLD.

Behm and Wagner estimate the total number of all men 1,423,919,000. They are distributed over the five parts of the world as follows,

		Number of inhabitants per square mile.	
Africa	199,921,600	13	Average all over the earth, 28.
America	85,519,800	6	
Asia	824,548,300	49	
Australia	4,748,600	$1\frac{1}{2}$	
Europe	309,178,500	82	

Reliable figures are exhibited for Europe, save Turkey. They show:

Andorra	12,000	Montenegro	190,000
Austria, 1876	37,700,000	Netherlands, 1875	3,809,527
Belgium, 1874	5,336,634	Norway, 1875	1,802,882
Denmark, 1876	1,903,000	Portugal, 1874	4,298,831
France, 1873	36,102,921	Roumania, 1873	5,073,000
Germany, 1875	42,723,242	Russia, (Europe) 1870	71,730,980
Great Britain, 1876	33,450,000	Servia, 1875	1,377,068
Greece, 1870	1,457,349	Spain, 1870	16,551,647
Italy, 1875	27,432,174	Sweden, 1875	4,383,291
Luxemburgh, 1875	205,158	Switzerland, 1870	2,669,147
Monaco, 1873	5,741	Turkey (Europe)	3,500,000

Another estimate of the population and area of the Globe is as follows:—

Divisions.	Area.	Population.	Pop. to Sq. M.
Europe	3,800,000	296,713,500	80
Asia	15,000,000	699.863,000	46
Africa	10,800,000	67,414,000	5
America	14,700,000	88,061,148	6
Oceanica	1,500,000	25,924,000	5
Total	48,800.000	1,177,975,688	24

It is estimated that this aggregate of humanity speak 3,064 languages, and profess to believe in 1,000 various forms of religion.

Of this vast multitude, 33,333,333 are estimated to pass into eternity every year, 91,954 every day, 3,730 every hour, 60 every minute, and 1 every second. The number of births is larger than the number of deaths.

Still another estimate of the earth's population, classified according to race and religion, is as follows:

Races.		Religions.	
Whites	550,000,000	Pagans	676,000,000
Mongolians	550,000,000	Christians	320,000,000
Blacks	173,000.000	Mohammedans	140,000,000
Copper-Colored.	12,000,000	Jews	14,000,000

The Christians are classified as follows:

Church of Rome.	Protestants.	Greek and East Church.
170,000,000.	90,000,000.	60,000,000.

AREA OF OCEANS AND SEAS—APPROXIMATE ESTIMATES.

Oceans.	Sq. miles.	Seas	Sq. miles.
Pacific about	78,000,000	Mediterranean	1,000,000
Atlantic "	25,000,000	Black Sea	170,000
Indian "	14,000,000	Baltic	175,000
Southern Ocean to 30° about	25,000,000	North Sea	160,000
Northern about	5,000,000		

In the British expedition under Capt. Nares, with the two steamers Alert and Discovery, to the Polar Sea, it was determined that the depth of that sea, at one point, was abont 70 fathoms, that the ice was from 80 to 120, and in many places 200, feet thick, and probably a century old; that a powerful tide sets in from the Pacific under this ice and extends down the long channel as far as the northern part of Smith's Sound. A sledge party advanced over the ice to lat. 83° 20′ 26″ N., the most northerly point as yet ever trod by man. No traces of human life exists north of lat. 81° 52′, where the Esquimaux appear to have crossed the water, here only 15 miles wide, into Greenland, from the large islands which fringe the North American continent on the north. On the Alert, mercury was frozen 47 days in all, and, in still weather, the minimum temp. was more than 70° below zero and the auroras were neither brilliant nor of frequent occurrence during the long Arctic winter, with its unparalleled intensity and duration of darkness produced by the absence of sunlight for 142 days. Birds do not migrate beyond Cape Joseph Henry, on the American coast of the Polar Sea, in lat. 82° 52′ north, and the northern limits of the haunts of wild animals is about 82°. Dwarf oaks, sorrel, poppies, saxifrage, and between 20 and 30 species of flowering plants were found growing in the vicinity of lat. 82° north, together with fossil corals, a workable seam of good coal, and evidences of the former existence of an evergreen forest in lat. 82° 44′.

Between the Tropics the temperature of the Ocean is from 77° to 84°, it diminishes to 45 5° at 1,000 fathoms depth. In the Arctic Sea the temperature rises from 8° to 10° at 700 fathoms, and 6° at 200 fathoms. Divers report an entire absence of motion in the Ocean at a depth of 30 ft., and the Solar rays penetrate 200 or 300 ft. Sea water is salt and bitter at the surface, but salt only at profound depths. The component parts, with slight variations, are water, muriatic acid, sulphuric acid, mineral alkali, lime, and magnesia. The deepest soundings on record is 9 miles. Young estimates the Atlantic at 3 miles, and the Pacific at 4 deep. Copper globes are compressed at 800 fathoms. Parry sounded in lat. 57° N. long. 24° W. but found no bottom at 1,020 fathoms.

ESTIMATED LENGTH OF SEAS, &C.

Seas.	Miles	Seas.	Miles.	Seas.	Miles.
Mediterranean	2,000	Black	930	Aral	250
Carribean	1,800	Caspian	640	Hudson's Bay	1,200
China	1,700	Baltic	600	Baffin's Bay	600
Red	1,400	Othotsk	600	Chesapeake Bay	250
Japan	1,000	White	450		

ESTIMATED SIZE OF NOTED LAKES.

Lakes.	Length Miles.	Width Miles.	Lakes.	Length Miles.	Width Miles.
Superior	380	120	Maracaybo	150	60
Baikal	360	·35	Ladoga	125	75
Michigan	330	60	Great Bear	150	40
Great Slave	300	45	Nicaragua	120	40
Huron	250	90	Champlain	123	12
Winnipeg	240	40	L. of the Woods	70	25
Erie	270	50	Geneva	50	10
Ontario	180	40	Constance	45	10
Arthabaska	200	20	Cayuga	36	4

Many of the above lakes are very deep, and it is owing to this cause that they never freeze.

LENGTH OF NOTED RIVERS ON THE GLOBE.

Rivers.	Locality.	Miles.	Rivers.	Locality.	Miles.
Amazon	Brazil	3200	St. Lawrence	Canada	1960
La Plata	S. America	2215	St. John	N. Brunswick	450
Aronoco	"	1500	Murray	Australia	3000
Mississippi	N. America	3200	Mackenzie	Brit. Ter.	2500
Missouri	"	4500	Obi	Siberia	2800
Arkansas	"	2500	Danube	Austria & Turkey	1790
Red River	"	2500	Don	Russia	1000
Columbia	"	1090	Dneiper	"	1000
Ohio	"	1000	Euphrates	from Ararat	2020
Colorado	"	1000	Rhine	Germany	800
Susquehanna	"	400	Wolga	from the Waldais	2100
James	"	500	Lena	Siberia	2500
Potomac	"	400	Maykiang	Siam	1700
Hudson	"	325	Hoang-Ho	China	3000
Nile	Egypt and Nubia	2690	Yang-tse-kia	"	2500
Niger	Africa	2300	Ganges	India	1650
Jumna	Hindostan	680	Brahmapootra	"	1600
Gogra	"	500	Indus	"	1770

The Ganges, in India, derives its origin from a Himalayan glacier, it has a fall of 4 inches to the mile, and rises from April till August 32 ft. creating a flood 100 miles wide. The Delta of the Ganges is 200 miles long, consisting of woods called Sunderbunds. It pours down from 80 to 400-000 cubic ft. in a second. The force of the tides, which rise from 13 to 16 ft. high, with the floods, frequently form and destroy islands 25 miles in diam. The Nile has advanced 16 ft. per annum since the time of Herodotus, and raises the soil of Egypt 4 ins. in a century. The prodigious quantities of mud brought down by large rivers enlarges continents at their estuaries, and form deltas of alluvial land which eventually form plains of immense fertility. The Mississippi, the Amazon, the Nile, the Danube, the Po, the Ganges, and the Niger are striking examples of the truth of this statement. The Yellow River, in China, is said to carry down 2,000,000 cubic ft. of alluvium every day. The Euphrates covers the Babylonian plains to a depth of 12 ft. between March and June.

THE HIGHEST MOUNTAINS ON THE GLOBE.

	Feet.	Miles.		Feet.	Miles.
Kunchainyunga, Himalayas	28,178	5½	Miltsin, Morocco	12,000	2½
Sorata, Andes, highest in America	25,380	5	Mount Hood, Oregon	11,570	2¼
Illimani, Bolivia	21,780	4⅛	Simplon, Alps	11,542	2⅛
Chimborazo, Ecuador	21,444	4⅛	Mount Lebanon, Syria	11,000	2⅛
Hindoo-Koosh, Afghanistan	20,600	3¾	Mount Perdu, France	10,950	2
Cotopaxi, Ecuador	19,408	3½	Mount St. Helen's, Oregon	10,158	1⅞
Antisana, "	19,150	3½	Mount Etna, Sicily	10,050	1½
St. Elias, British America	18,000	3½	Olympus, Greece	9,754	1¾
Popocatapetl volcano, Mexico	17,735	3⅜	St Gothard, Alps	9,080	1¾
Mt. Roa, Hawaii	16,000	5	Pilate, Alps	9,050	1¾
Mt. Brown, highest Rocky Mt. pk	15,900	3	Mount Sinai, Arabia	8,000	1½
Mont Blanc, highest in Europe	15,776	5	Pindus Greece	7,677	1⅜
Mowna Roas, Owhyhee	15,700	5	Black Mountain, New Caledonia	6,476	1¼
Mount Rosa, Alps, Sardinia	15,550	3	Mount Washington, N. Hampshire	6,234	1¼
Pinchinca, Ecuador	15,200	2¾	Mount Marcy, New York	5.467	1
Mount Whitney, Cal	15,000	2⅞	Mount Hecla, Iceland	5,000	1
Mount Fairweather, Russ. Poss.	14,796	2¾	Ben Nevis, Scotland	4,400	¾
Mount Shasta, California	14,450	2¾	Mansfield, Vt.	4,280	¾
Pikes Peak, California	14 320	2¾	Peaks of Otter, Va.	4,260	¾
Mount Ophir, Summatra	13,800	2⅝	Ben Lawers, Scotland	4,030	¾
Fremont's Peak, R. M. Wyoming	13,570	2⅝	Parnassus, Greece	3,950	¾
Long's Peak, R. M. California	13,400	2½	Vesuvius, Naples	3,932	¾
Mount Ranier, Washington Ter.	13,000	2½	Snowdon, England	3,500	¾
Mount Ararat, Armenia	12,706	2⅜	Stromboli	3,850	¾
Peak of Teneriffe, Canaries	12,236	2¼	Ben Lomond	3,280	¾
			Mount Carmel	2,000	
			Gibraltar	1,470	

The mountains subtract no more from the globular form of the earth than the roughness on the coat of an orange. The highest elevations are within the tropics, the next in the temperate zones, the next in the frigid, and the limit of perpetual snow varies with the heat of the surface; see page 119. The Andes chain extends 4600 miles from the Gulf of Darien to the Straits of Magellan. The same chain is continued northward, through Mexico, the United States, and the British Possessions by the Rocky Mountains and other immense elevations which form the backbone of the continent. These enormous mountain masses exert a genial action on the climate, form the source of rivers, and determine the water shed of streams. The mountains of America afford incontestable proof that the New World, geologically considered, is really the oldest formation of the present distribution of land on the globe. Irresistible subterranean forces are still active on the Andes; from Cotopaxi southward, over 40 volcanoes are continually at work, causing havoc, and belching out lava, sulphur, &c. In many cases volcanic action impels mountainous waves from the sea, carrying vessels several leagues inland over cities, towns, &c. In 1746 an official account reported all the inhabitants of Callao, 4000, destroyed, 19 vessels sunk, and 4, including a frigate, were carried far inland over the city. Wafer saw 3 vessels which had been carried 5 or 6 leagues overland. A similar irruption took place on this coast only a few months ago. attended by fearful suffering and awful loss of life and property. The Andes contain no granite at a higher elevation than 8 to 10,000 ft., the tops being crowned with whinstone, and the crevices and fissures, many of them descending below the sea level, are even more astonishing than their heights.

In Asia, the Himalayian ranges extend about 1400 miles, the mountain ridges being from 50 to 60 miles wide, extending from N. W. to S. E. They form the source of all the rivers of the Eastern seas, and have furnished the materials which compose the soil. There are 5 passes over them, some as high as 15,000 ft.; at 15,500 ft., beds of fossil shells exist. The European and Asiatic mountains are topped with granite. Regarding the Alps, and the various snow levels over the globe, see pp. 118-19.

In Scotland, the Grampian range includes Cairngorm, 4095 ft.; Macdui, 4,327 ; Shehallion, 3,550; Benmore, 3,870 ; Ben Lawers, 4,030; Cairntoul, 4,225; Ben Avon, 3,967; Ben Nevis, the highest, 4,400 ft., has a precipice of 1,500 ft., and is always capped with ice and snow; north of the Caledonian canal is another range of great altitude, all vast masses of barren granite. In all there are about 45 elevations north of the Tweed, exceeding 2,000 ft.

HEIGHT OF NOTED MONUMENTS, TOWERS, &C.

	Feet.		Feet.
Pyramid of Cheops, Egypt	543	Notre Dame Cathedral, Munich	348
Antwerp Cathedral, Belgium	476	Dome of the Invalides, Paris	347
Strasburg Cathedral, France	474	Magdeburg Cathedral	337
Tower of Utrecht, Holland	464	St. Mark's Church, Venice	328
Steeple of St. Stephen's, Vienna	460	Assinelli Tower, Bologna	314
Pyramid of Cephenes, Egypt	456	Trinity Church, New York	283
St. Martin's Church, Bavaria	456	Column at Delhi, India	262
St. Peter's, Rome	448	Porcelain Tower, China	242
Salisbury Spire, England	410	Canterbury Tower, England	235
St. Paul's, London, England	404	Notre Dame Cathedral, Paris	232
St. Peter's, at Hambro'	395	Bunker Hill, Monument	220
Cathedral at Florence, Italy	384	Leaning Tower, Pisa, Italy	202
Cremona Cathedral, Italy	372	Monument, London	202
Seville Cathedral, Spain	360	Monument, Pl. Vendome, Paris	153
Pyramid of Sakkarah, Egypt	356	Trajan's Pillar, Rome	151

Nearly 70 round towers, with cromlechs, exist in different parts of Ireland, from 30 to 135 ft. high.

For other interesting items on this subject, see page 125.

POPULATION, GROWTH, &C., OF THE UNITED STATES AND TERRITORIES.

When Admitted.	Populati'n when Admitted.	STATES.	Area sq're miles	Populat'in in 1870.	Mem. Con	Populati'n in 1875.	Miles R.R. 1862.	Miles R.R. 1872.
1819	144,317	Alabama,	50,722	996,992	8	....	805	1,671
1836	52,240	Arkansas,	52,198	484,471	4	....	38	25
1850	107,000	California,	188,981	560,247	4	....	23	1,013
Sett	led 1636	Connecticut,	4,750	537,454	4	....	630	820
Sett	led 1627	Delaware,	2,120	125,015	1	....	127	227
1845	54,477	Florida,	59,248	187,748	2	....	402	466
Sett	led 1682	Georgia,	58,000	1,184,109	9	....	1,020	2,108
1818	34,620	Illinois,	55,410	2,539,891	19	....	2,998	5,904
1816	63,867	Indiana,	33,809	1,680,637	13	....	2,175	3,529
1846	81,929	Iowa,	55,041	1,194,020	9	1,550,541	731	3,160
1859	107,206	Kansas,	81,318	364,399	3	528,349	....	1,760
1792	73,077	Kentucky,	37,630	1,321,011	10	....	567	1,123
1812	76,556	Louisiana,	41,346	726,915	6	857,039	355	539
1820	208,335	Maine,	35,000	626,915	5	....	505	871
Sett	led 1635	Maryland,	11,124	780,894	6	....	408	820
Sett	led 1620	Masachus's	7,800	1,457,351	11	1,651,912	1,285	1,606
1837	200,000	Michigan,	56,451	1,184,059	9	1,334,031	....	2,235
1859	150,042	Minnesota,	83,531	439,706	3	598,429	823	1,612
1817	75,512	Mississippi,	47,156	827,922	6	....	862	990
1821	60,586	Missouri,	65,350	1,721,295	13	....	838	2,580
1866	60,000	Nebraska,	75,995	122,993	1	246,280	....	828
1864	40,000	Nevada,	81,539	42,491	1	52,540	....	593
Sett	led 1623	N. Hamps'e,	9,280	318,300	3	....	661	790
Sett	led 1624	New Jersey,	8,320	906,096	7	1,026,502	633	1,265
Sett	led 1614	New York,	47,000	4,382,759	33	4,705,208	2,728	4,470
Sett	led 1650	N. Carolina,	50,704	1,071,361	8	....	937	1,190
1802	41,915	Ohio,	39,964	2,665,260	20	....	3,100	3,740
1859	52,465	Oregon,	95·274	90,923	1	....	4	159
Sett	led 1685	Pennsylv'na,	46,000	3,521,951	27	....	3,006	5,113
Sett	led 1637	R. Island,	1,306	217,353	2	258,239	108	136
Sett	led 1670	S. Carolina,	34,000	705,606	5	925,145	973	1,201
1796	77,262	Tennessee,	45,660	1,250,520	10	....	1,253	1,520
1848	250,000	Texas,	274,356	818,579	6	....	451	865
1791	85,539	Vermont,	10,212	330,551	3	....	562	675
Sett	led 1607	Virginia,	38,352	1,225,163	9	....	1,379	1,490
1862	376,688	W. Virginia,	23,000	442,014	3	....	361	485
1848	210,596	Wisconsin,	53,924	1,054,670	8	1,236,729	961	1,725
		Total States,	1,950,171	38,115,641	292		32,120	59,587
		TERRITORIES.						
		Arizona,	113,916	9,658	...	....	....	....
		Colorado,	104,500	39,864	...	....	....	392
		Dakota,	147,490	14,181	...	....	....	....
		District of Columbia,	60	131,700	...	....	....	....
		Idaho,	90,930	14,999	...	....	....	....
		Montana,	143,776	20,595	...	....	....	....
		New Mexico,	121,201	91,874	...	....	....	....
		Utah,	80,056	86,786	...	....	....	375
		Washington,	69,944	23,955	...	....	....	....
		Wyoming,	93,107	9,118	...	....	....	498
		Total Territories,	965,032	442,730				1,265
		Total U.S. and Ter.,	2,915,203	38,558,641			32,120	60,852

POPULATION, AREA, &c.. OF THE PRINCIPAL COUNTRIES OF THE WORLD.

Countries.	Populati'n.	Area in sq. miles.	Capitals.	Population.
China	446,500,000	3,741,846	Pekin	1,648,800
British Empire	226,817,108	4,677,432	London	3,251,800
Russia	81,925,400	8,003,788	St. Petersburg.	667,000
United States and Alaska.	38,925,600	2,603,884	Washington	109,199
France	36,469,800	204,091	Paris	1,825,300
Austria and Hungary	35,904,400	240,348	Vienna	833,900
Japan	34,785,300	149,399	Yeddo	1,554,900
Great Britain and Ireland.	31,817,100	121,315	London	3,251,800
German Empire	29,906,092	160,207	Berlin	825,400
Italy	27,439,921	118,847	Rome	244,484
Spain	16,642,000	195,755	Madrid	332,000
Brazil	10,000,000	3,253,029	Rio Janeiro	420,000
Afghanistan	6,000,000	226,000	Cabool	60,000
Turkey	16,463,000	672,624	Constantinople	1,075,000
Arabia	8,500,000	1,200,000	Mecca	60,000
Mexico	9,173,000	761,526	Mexico	210,300
Turkestan	4,800,000	414,000	Bokhara	160,000
Sweden and Norway	5,921,300	292,871	Stockholm	136,900
Aram	6,000,000	150,000	Hue	60,000
Persia	5,000,000	635,964	Teheran	120,000
Belgium	5,021,300	11,373	Brussels	314,100
Birmah	7,000,000	205,000	Monchovo	5,000
Bavaria	4,861,400	29,292	Munich	169,500
Siam	5,500,000	189,000	Bankok	150,000
Portugal	3,995,200	34,434	Lisbon	224,063
Holland	3,688,300	12,680	Hague	90,100
New Grenada	3,000,000	357,157	Bogota	45,100
Chili	2,000,000	132,616	Santiago	115,400
Laos	2,000,000	130,000	Changmai	25,000
Switzerland	2,629,100	15,992	Berne	36,000
Peru	2,500,000	471,838	Lima	160,100
Bolivia	2,000,000	497,321	Chuquisaca	25,000
Argentine Republic	1,812,000	871,848	Buenos Ayres.	177,800
Wurtemburg	1,818,000	7,533	Stuttgart	91,600
Denmark	1,784,000	14,753	Copenhagen	162,042
Venezuela	1,500,000	368,238	Caraccas	47,000
Baden	1,461,300	5,912	Carlsruhe	36,600
Greece	1,457,900	19,353	Athens	43,000
Guatemala	1,180,300	40,879	Guatemala	40,000
Ecuador	1,300,000	218,928	Quito	70,000
Paraguay	1,000,000	63,787	Asuncion	48,000
Hesse	823,138	2,969	Darmstadt	30,000
Liberia	718,000	9,576	Monrovia	3,000
San Salvador	600,000	7,335	San Salvador	15,000
Hayti	572,000	10,205	Port au Prince.	20,000
Beloochistan	500,000	162,000	Kelat	15,000
Nicaragua	350,000	58,171	Managua	10,000
Malaya, etc.	500,000	60,000	Singapore	57,000
Uraguay	300,000	66,722	Monte Video	44,500
Honduras	350,000	47,092	Camayagua	12,000
San Domingo	136,000	17,827	San Domingo	20,000
Costa Rico	165,000	21,505	San Jose	2,000
Hawaii	62,950	7,633	Honolulu	7,633

In the foregoing table the figures relating to population, give, in the majority of cases, the census of 1870-71.

In Europe the five Great Powers are the Empire and Monarchy of Gr

Britain and Ireland, the Empire of Germany, the Empire of Russia, the Empire of Austria, and the Republic of France.

The second-rate Powers are the Kingdoms of Italy, Spain, Norway and Sweden, and the Empire of Turkey in Europe. Regarding the latter it may be said that great changes are impending, owing to the adverse issue of the war with Russia, and the present threatening attitude of the Russian armies and the British fleet near Constantinople.

The third-rate Powers are the Kingdoms of Belgium, Portugal, Bavaria, Denmark, Saxony, Greece, Holland, or Netherlands, the Republic of Switzerland and the Duchies or lesser States.

AREA, POPULATION, &C., OF BRITISH AMERICA.

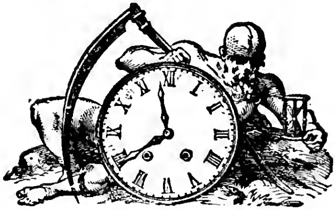
Name.	Area in Eng. sq. miles.	Population.	Capital.	Population.
Hudson Bay Ter.	1,800,000	175,000	York Factory,	
Red River,		10,000	Fort Garry,	
Brit. Columbia, &c.	344,500	50,000	New Westminst'r	4,000
Vancouver Island,	13,250	18,000	Victoria,	3,000
Newfoundland,	57,000	124,288	St. Johns,	25,000
Prince Edw. Island,	2,173	80,857	Charlottetown,	6,706
Nova Scotia & Cape B.,	19,650	330,857	Halifax	26,000
New Brunswick,	27,710	252,047	Fred'n	7,000
Quebec,	210,000	1,111,566	Quebec } Ottawa	52,140
Ontario,	125,000	1,396,091	Toronto } 15,000	44,821
	2,599,283			

CAPACITY OF NOTED CHURCHES.

	Will Contain No. persons.		Will Contain No. Persons.
St. Peter's, Rome	54,000	St. John's, Lateran	22,900
Milan Cathedral	37,000	Notre Dame, Paris	21,000
St. Paul's, Rome	32,000	Cathedral, Pisa	13,000
St. Paul's, London	25,600	St. Stephen's, Vienna	12.400
St. Petronio, Bologna	24,400	St. Dominic's, Bologna	12,000
Florence Cathedral	24,300	St. Peter's, Bologna	11,400
Antwerp Cathedral	24,000	Cathedral, Vienna	11,000
St. Sophia's, Constantinople	23,000	St. Mark's, Venice	7,500

CAPACITY OF THEATRES, OPERA HOUSES, HALLS, &C.

	Will Contain No. Persons.		Will Contain No. Persons.
Gilmore's Garden, New York	8,443	St. Charles, Th., N. Orleans	2,178
Stadt Theatre, "	3,000	Grand Opera House, New York	1,883
Academy of Music, "	2.526	Booth's Theatre, "	1,807
Academy of Music, Philadelphia.	2,865	Opera House, Detroit	1,790
Carlo Felice, Genoa	2,560	McVicar Theatre, Chicago	1,786
Opera House, Munich	2,307	Grand Opera House, "	1,786
Alexander, St. Petersburg	2,332	Ford's Opera House, Baltimore	1,720
San Carlos, Naples	2,240	Nat. Theatre, Washington	1,709
Adelphi Theatre, Chicago	2,238	De Bar's Opera House, St. Louis	1,696
Music Hall, Boston	2,585	Cal. Theatre, San Fran	1,651
Academy of Paris	2,092	Euclid Av., Op. H., Cleveland	1,650
Imperial, St. Petersburg	2,160	Opera House, Berlin	1,636
La Scala, Milan	2,113	Opera House, Albany	1,404
Covent Garden, London	2,684	Hooley's Theatre, Chicago	1,373
Boston Theatre, Boston	2,972	Coulter Op. H., Aurora, Ill	1,004
Grand Opera Hall, New Orleans,	2,052	Opera House, Montreal	928



Measurement of time, table.

60 seconds	1 minute.
60 minutes	1 hour.
24 hours	1 day.
7 days	1 week.
28 days	1 lunar month.
28, 29, 30, or 31 days	1 calendar month.
12 calendar months	1 year.
365 days	1 com. year.
366 days	1 leap year.
365¼ days	1 Julian year.
365 d., 5h., 48m., 49s	1 solar or tropical year.
365 d., 6 h., 9 m., 12 s	1 siderial year.
365 d., 6.13 m., 49.3 s	1 anomalistic year.
10 years	1 decade.
10 decades, or 100 years	1 century.

EQUIVALENTS.

Yr.		Da.		Hr.		Min.		Sec.
1	=	365¼	=	8766	=	525960	=	31557600
		1	=	24	=	1440	=	86400
				1	=	60	=	3600
						1	=	60

Scale of units:—60, 60, 24, 365¼.

The tropical (or solar year) and the sidereal years are the same, and the tropic is only an anticipated solar mark before the sidereal year is completed. The anomalistic year is an advance of the orbit as part of he solar system in space, and its excess over the sidereal year is the stellar measure of the annual advance of the whole system; the mean velocities are uniform, and the times as the spaces.

The diurnal revolution of the earth causes the difference in time, etc., illustrated in the following

LONGITUDE AND TIME TABLE.

For every	hour of time	there is	a difference	of	15° in longitude.
"	minute	"	"	"	15′ "
"	second	"	"	"	15″ "
"	degree of longitude	"		"	4m. in time.
"	minute	"	"	"	4 sec. "
"	second	"	"	"	$\frac{1}{15}$ sec. "

360° = 1 revolution of the earth, or 1 day.
1440′ = 1 " " " "
1440 ÷ 360 = 4 minutes, or 1 degree.

Add difference of time for places EAST, and *subtract* it for places WEST of any given locality. The greatest circumference of the earth's surface is 24,930 miles. 1° of that circumference is 1-360th of that number, or 69¼ miles. Hence a geographical or nautical mile is equal to 1′ of the earth's greatest circumference, or a trifle more, the 1st mile and

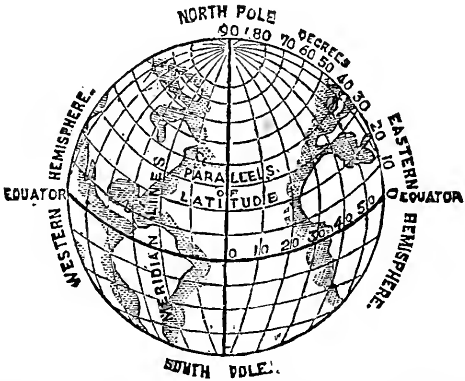
49 rods. The following table exhibits the DIVISIONS OF THE CIRCLE, as used by geographers, astronomers, surveyors, navigators, &c. :—

60 seconds (″)	make	1 minute,	marked	′
60 minutes	"	1 degree,	"	°
30 degrees	"	1 sign,	"	sig.
90 degrees	"	{ 1 quadrant, / 1 right angle,	" / "	quad. / r. a.
4 quadrants or 12 signs	"	1 { circumference or circle	"	cir.

EQUIVALENTS.

C.		S.		°		′		″
1.	=	12	=	360	=	21600	=	1296000
		1	=	60	=	1800	=	108000
				1	=	60	=	3600
						1	=	60

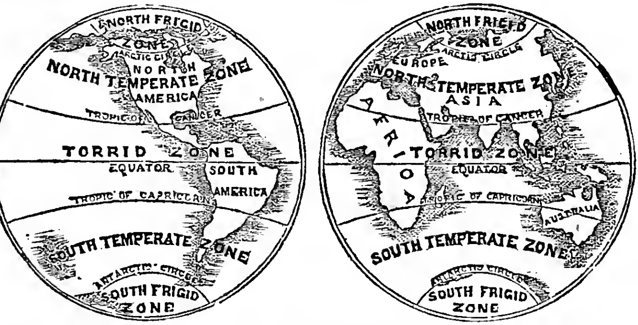
NOTE.—A full circle is 360°, ½ circle is 180°, ¼ circle is 90, ⅙ circle is 60°. The distance around a circle is called its *circumference*. The distance across its *diameter*, and any section of its circumference is called an *arc*.



The above figure displays the various imaginary lines, consisting of the great and less circles, axis, and poles of the earth. The next figure exhibits the geographical division into zones, tropics, and circles.

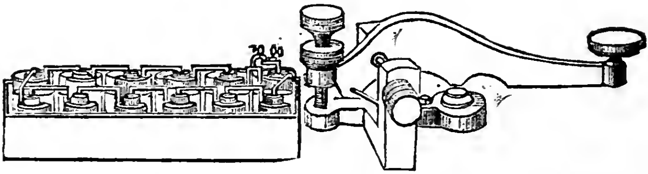
Leap year, called Bissextile, comes every 4th year and contains 366 days, by the addition of one day to February. Three leap years are omitted in 400 years, but 109 leap years in 450 years would be exact. In common business affairs, 30 days compose a month, and 52 weeks a year. The Lunar Cycle, or GOLDEN NUMBER, is a term of 19 years, after which the changes of the moon return on the same days of the month. The SOLAR CYCLE is a period of 28 years, when the days of the week again return to the same days of the month. Owing to an error in the Julian calendar it was decreed by the British Government that the day following the 2nd of September, 1752, should be called the 14th day of September, or that 11 days should be stricken from the calendar; hence, time, previous to this decree, is called *Old Style* (O. S.), and since, *New Style* (N. S). In Russia, time is still reckoned by the Old Style, hence their dates are 12 days behind ours. The legal or civil day begins and ends at

12 p.m. The astronomical day begins and ends at 12 m. As to Epochs, the Christian Era was first invented and introduced at Rome by Dionysius, a monk, in 527, adopted in France, in 750; in Spain, in 1340; and in Portugal, in 1410. It was first used in books in 748. The birth of Christ, was, however, four years earlier, that is in 1878, really 1882 since his birth; the chronology was not inquired into until the reign of Justinian. The 46 years of the Julian calendar was the first of our era. The Hegira, or Flight, took place July 16,622, and is the Mohammedan era. Their year is 12 lunar months, or 354 days, 8 hours, 48 minutes; and eleven days being lost a year must be allowed every 33, to reconcile their dates with ours. Greek Olympiads of 4 years began 776 B. C., and were continued until the 5th century. The era of the Selucidæ 311 B. C., of Alexander 323 B. C., of the siege of Troy 1209 B. C., of the founding of Rome 754 B. C., of the battle of Actium 31 B. C., of the Cæsars 38 B. C., of Tyre 125 B. C., of Abraham 2016, of Moses 1582, of Antioch 49, were also used by various early writers. The early Christians dated from the accession of Diocletian in A. D. 284.



The Vulgate fixes the Epoch of Adam at 4004 B. C., which is adopted by the Romish Church. The Samaritan Pentateuch makes it 4700; the Talmud, 5344; Hales, 5411; the Greek Church, 5508; the Septuagint, 5872; Pezron, 5872; Alphonso, King of Castile, 6934; the early Fathers, 5502 and 5592; 200 other authorities estimate it from 6984 to 3268 B. C. The controversy is a hopeless one, owing to the prevalent ignorance regarding the true meaning of the first 12 chapters of Genesis, which are grossly misunderstood, owing to the prevalent opinion that they form a mere literal historical narrative concerning natural events, when the truth is really far otherwise. Rollin, the historian, traces up the history of several ancient peoples to within 100 years of the alleged time of the flood, and is much perplexed to account for the existence of mighty nations possessing well organized armies, embracing thousands of fighting men, at that early period.

In India, the priests claim a duration of about 2,000 millions of years since the beginning, and allege that Brahma was 17 millions of years creating. They mention also those deluges and periodical submersions required by the claims of geology. Sir Wm. Jones computes the first book of Vedas to be written about 2,800 B.C. In the year 1,000 A. C. the Arabs used the pendulum as a measure of time. A second calculated by the movement of a 39-inch pendulum is one with that motion, and the movement itself is a simple deflection of the combined motions of the earth in its orbit from east to west, and on its axis from west to east.

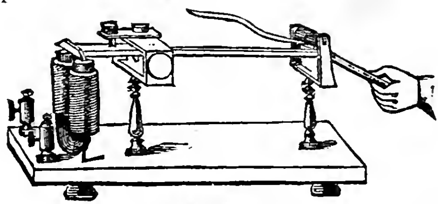


DESCRIPTION OF THE TELEGRAPH AND HINTS TO LEARNERS.

The cut represents a series of Grove's Battery, such as are generally used in telegraphs. When a plate of platina and one of zinc are placed in an acid solution a current tends to flow from the platina to the zinc, through any conductor which may be so disposed as to connect the two. In the figure the galvanic series is represented, consisting of twelve pairs; the zinc of each of which is connected with the platina of the next. It may be considered that a current is produced by each of these pairs, which has, however, to flow in the same direction, and fall in with all the others. Hence their intensity is multiplied twelve times. It is by this means that the resistance to the passage of the current through very long conductors is overcome. Each pair of the battery consists of a pint glass tumbler, a cylinder of zinc, a small porous cylindrical earthernware cell within the zinc, and a platinum strip suspended within the cell from an arm belonging to the zinc of the next pair. A solution of diluted sulphuric acid is used with the zinc outside the porous cell, and the cell itself is filled with nitric acid. The two acids are used on account of an increase of power depending on a chemical reaction. The zinc cylinder is amalgamated with mercury to prevent its being acted upon by the acid when the battery is not in use. A solution of sulphate of soda is sometimes added to the sulphuric acid to assist in accomplishing the same object. Two screw cups rise from the battery, one of which is the positive pole, or extremity of the series, the other the negative; to these the wires are attached which convey the current.

The signal key is showed in the cut. When the hand depresses the key it comes in contact with the knob and metallic strip below, making connection between the screw cups, and completing the battery circuit.

While the key is depressed a continuous current passes, but if it be depressed, and allowed to spring immediately up. only an instantaneous wave or impulse is communicated.



MORSE'S REGISTER.

The annexed cut shows the registering apparatus of Morse's Telegraph. Two screw cups are seen on the board for the insertion of the wires from the distant battery. Next the screw cup is seen a U shaped electro-magnet, with coils of wire upon it, the ends of which, passing down through the board, are connected with the screw cups · over the poles of the magnet is a little armature, or bar of soft iron, attached to the short arm of a lever, whose long arm carries a point or style nearly in contact with the grooved roller above. The action which takes place on depressing the signal key at the distant station is, a wave of electricity is transmitted through the wire of the telegraph, arrives at the electro-magnet, and circulates through the coils of wire surrounding it. The U shaped piece of soft iron immediately becomes a magnet, and attracts the little armature down to it, the long arm of the lever is thrown up, and marks the strip of paper, passing between it and the roller. When the distant operator lets the signal key fly back and the current ceases, the iron of the electro-magnet loses all its magnetism, and the armature, with the lever, is carried back by the action of a little spring, being a dot impressed on a piece of paper. Should the distant operator hold down the key a continuous current will pass, and a line be marked in place of a dot (-) on the paper which moves under the roller.

When a long circuit is used, the resistance to conduction, measured by the amount of electricity which passes, is great, and would not give sufficient force to work the Morse instruments. To overcome this, Professor Morse uses one instrument called a *Relay*, which is similar in most respects to the main instrument, but of a more delicate electrical organization; it has no work to do—simply to act as a contact maker, enabling a weak or exhausted current to bring into action and substitute for itself a fresh and powerful one from the local battery which is placed in the office with the printing instrument, and which supplies the electricity which moves the instrument.

The greatest recorded velocity of a signal through a suspended copper wire is 1,752,800 miles per second, by Mr. Hipp. The lowest velocity through a buried copper wire, 750 miles per second, by Faraday.

MORSE'S ALPHABET, NUMERALS AND PAUSES.

A - —	O - -	1 - — — -	Period - - — — - -
B — - - -	P - - - - -	2 - - — - -	Comma - — - —
C - - -	Q - - — -	3 - - - — -	Semicolon - — - — -
D — - -	R - - -	4 - - - - —	Interrogation — - - — -
E -	S - - -	5 — — —	Exclamation — — — -
F - — -	T —	6 - - - - - -	Parenthesis - — - - —
G — — -	U - - —	7 — — - -	Italics — - - - —
H - - - -	V - - - —	8 — - - - -	Paragraph — — — —
I - -	W - — —	9 — - - —	
J — - — -	X - — - -	0 ———	
K — - —	Y - - - -		
L ———	Z - - - -		
M — —	& - - - -		
N — -			

HINTS TO LEARNERS.

Compiled from Modern Practice of the Electric Telegraph, by Frank L. Pope. *

The characters of the American Morse Alphabet are formed of three elementary signals—

The *dot*, whose duration is the unit of length in this alphabet ;
The *short dash*, which is equal to *three dots* ; and
The *long dash*, which is equal to *six dots*.

The above are separated by variable intervals or *spaces*, four in number :

* D. Van Nostrand, Publisher, 23 Murray street, New York.

1st—The ordinary *space* between the elements of a letter, equal to *one dot*.
2d—The *space* employed in the *spaced letters*, equal to *two dots.*
3d—The space between the letters of a word, equal to *three dots.*
4th—The space between *two* words, equal to *six dots.*

The dot signifies a point or a current of infinitely short duration, and involves *time*, which varies according to circumstances, the length of the dot increasing with the length of the circuit.

In long submarine lines the dot has to be made longer than the dash itself on short open air lines, and the same thing occurs in working through repeaters.

In commencing to learn telegraphing, the beginner should acquire the habit of making short, firm *dashes*, instead of light, quick *dots*.

In the valuable Manual of Prof. Smith, published by L. C. Tillotson & Co., New York, six elementary principles are laid down as the basis for practicing the alphabet, viz :

1st Principle.—Dots close together:

I	S	H	P	6
- -	- - -	- - - -	- - - - -	- - - - - -

2d Principle.—Dashes close together:

M	5	¶
— —	— — —	— — — —

3d Principle.—Lone dots:

E
-

4th Principle.—Long dashes:

T	L or cipher.
—	———

5th—Principle.—A dot followed by a dash:

A
- —

6th Principle.—A dash followed by a dot:

N
— -

To send messages, place the first two fingers upon the top of the button of the key, with the thumb partly beneath it, the wrist being entirely free from the table; the motion being made by the hand and wrist, the thumb and fingers being employed merely to grasp the key. The motion up and down must be free and firm. Tapping on the key must be strenuously avoided.

The *downward* movement of the key produces *dots* and *dashes;* the upward movement, *spaces*.

The beginner should first practice the 1st principle, making *dots* at regular intervals, of definite and uniform dimensions.

2d Principle.—Make dashes, first at the rate of one per second, and slowly increase to three, the space between the dashes to be as short as possible.

3d Principle.—Letter E, formed by a quick, but firm, downward movement of the key.

4th—The usual tendency is to make T too long and L too short. The same character is used for L and the cipher, or 0; occurring by itself, or among letters, it is translated as L ; when found among figures it becomes 0.

5th—The Letter A may be timed by the pronunciation of the word *again*, strongly accenting the second syllable.

6th—The dash followed by a dot; usually the student separates the practice. The lever of the Morse instrument makes a sound at each movement, the downward motion producing the heavier one, or that representing dots and dashes; *i. e.*, the heavy stroke indicates the commencement of a dot or dash, and the lighter one its cessation. A dot makes as much noise as a dash, the only difference being in the length of time between the two sounds.

Technical Terms Used in the Telegraph Service.

Line.—The wire or wires connecting one station with another.

Circuit.—The wires, instruments, etc., through which the circuit passes from one pole of the battery to the other.

Metallic Circuit.—A circuit in which a return wire is used in place of the earth.

Local Circuit.—One which includes only the apparatus in an office, and is closed by a relay.

Local.—The battery of a local circuit.

Loop.—A wire going out and returning to the same point, as to a branch office, and forming part of a main circuit.

Binding Screws or *Terminals.*—Screws attached to instruments holding the connecting wires.

To Cross Connect Wires.—To interchange them at an intermediate station.

To Put Wires Straight.—To restore the usual arrangement of wires and instruments.

To Ground a Wire, or Put on Ground.—To make a connection between the line wire and the earth.

To Open a Wire.—To disconnect it so that no current can pass.

Reversed Batteries.—Two batteries in the same circuit, with like poles towards each other.

To Reverse a Battery.—To place its opposite pole to the line; or, in other words, interchange the ground and line wires at the poles of the battery.

Escape.—The leakage of current from the line to the ground, caused by defective insulation and contact with partial conductors.

Cross.—A metallic connection between two wires, arising from their coming in contact with each other, or from other causes.

PHOTOGRAPHIC PORTRAITURE MADE EASY

By C. J. P. Handey.

Author of "Puzzle Writing," &c., &c.

Instructions.

Pictures produced by the agency of light are called photographs, whether taken on glass or paper These are divided into two classes—negatives and positives; negatives being pictures with the lights and shades of the object reversed, while positives represent the lights and shades as in nature.

Pictures taken on glass are called positives, which are complete in themselves. The negative process is that pursued when the intention is to produce a paper proof. Paper portraits are not obtained like positives by one operation in the camera, but a negative is taken from which the copies are procured by photographic printing. To take a portrait on glass—either a negative or positive—requires five operations. First, giving the glass plate a collodion coating; second, exciting the glass plate; third, exposure in the camera· fourth, developing the latent image; fifth, fixing the picture.

APPARATUS.

A camera is the first requisite. The most convenient form consists of two portions of boxes, one sliding within the other.

The double-combination lens is used for portraiture. It consists of a set of three glasses, mounted in a brass tube, with a rack and pinion adjustment.

A camera stand is requisite, which should be from four to five feet high. A tripod stand, with a screw to fix the camera with, is the best.

A porcelain bath is required to hold the silver solution for exciting the collodionized plate.

One or two graduated glass measures, to measure the solutions, estimated by fluid measure.

A set of scales and weights for weighing the chemicals.

Two or three porcelain dishes, for holding solutions of silver, toning bath, &c.; &c.

A printing frame will be required, after taking a negative picture, to produce the paper copies.

A few packets of different-sized glass, a piece of wash-leather, and a linen cloth, will complete the requisites.

DARK ROOM.

It will be necessary for the success of the second, third, and fourth operations in producing a collodion picture, that they should be performed in a dark room. The best and easiest way will be to obtain a small room or closet with a window, and to cover the window with several sheets of yellow paper, which will exclude the chemical rays. A table or shelf should be fixed under the window, and a pail kept at the side, containing water for washing the pictures.

If a glass room cannot be had, the photographer must arrange an apartment according to his means. In selecting a room, he must bear in mind that it should not only have a good side light, but a sky-light, if possible.

In taking a portrait, the sitter should not be opposite the window, but a little behind it—a more even focus is thus secured.

A proper background is of some importance. A white wall will do very well, but something a shade darker will be better.

In focussing the lens have the stand and camera placed seven or eight ft. from the sitter. The better to observe the image, a dark cloth is thrown over the camera and head of the operator. The proper attitude of the person sitting for the portrait must be left to the taste of the operator Allow the sitter time to get seated, and accustomed to the light, before removing the cap off the lens. And now, having concluded these preliminary remarks, we will proceed to take a picture.

POSITIVE PROCESS.

Chemicals.—The most important chemical used in photography is collodion. As it is extremely volatile, it should be kept in a stoppered bottle.

Exciting Bath.—Nitrate of silver, 2 drachms; distilled water, 4 ounces; iodized collodion, 6 minims. Filter before using.

Developing Solution.—Protosulphate of iron, 2 drachms ; acetic acid, 2 drachms ; methylated alcohol, 2 drachms ; water 10 ounces.

Fixing Solution.—Cyanide of potassium, 2 drachms ; water, 6 ounces. This solution will keep for months without losing its strength.

MANIPULATION.

The Collodion Coating.—Having selected a piece of glass, entirely free from blemishes, and quite clean, hold it as level as possible by the left-hand corner, then, in the centre, form a good pool of collodion. Slant the glass so that the collodion may cover all portions, taking care that it does not touch the hands. Pour the superfluous quantity back into the bottle. The glass is now ready for immersion in the silver bath, which is called

Exciting the Plate.—The manipulation may be conducted in daylight up to this point; but as the immersion of the collodionized plate renders it sensitive to light, recourse must be had to a dark room. Having the silver solution ready, place the prepared glass on the dipper, and immerse in the solution. When the plate has remained in the bath about a minute it should be withdrawn, then immersed for half a minute longer, then drain the glass plate, place it in the dark slide of the camera, and proceed with the third operation—

Exposure in the Camera.—Assuming that the camera has been prepared, and the image properly focussed, remove the ground glass screen, and insert the slide containing the plate. Desire the sitter to keep perfectly still, and look at some dark object; then take the cap off the lens and allow the plate to be exposed for twenty or thirty seconds, then close the shutters of the dark-slide, and return to the dark room to

Develop the Picture.—Having excluded all white light from the dark room, remove the glass plate from the slide. Holding it by the left-hand corner, proceed to pour on the developing solution. Begin by pouring on at one edge, inclining the plate so as to enable the liquid to flow uniformly over the surface. The first effect will be the appearance of white lights, then the half tones, and, finally, the darker shades. When this is obtained, the plate must be thoroughly washed. It can then be passed on to the next and last operation—

Fixing the Picture.—Having well washed the picture, the door of the dark room may be opened to observe the action of the fixing agent. Pour this mixture over the plate until the creamy appearance is dissolved. When this is the case, it must be again washed and set on edge to dry. As the picture is now finished, it should be varnished with jet varnish, which should be poured on the plain side of the glass. In mounting the picture, put it into a gilt mat and preserver; and when finished, the lights and shades will be shown to perfection.

NEGATIVE PROCESS.

Chemicals.—Negative collodion differs slightly from positive in the preparation of the iodized solution.

Exciting Bath.—Nitrate of silver, 2 drachms; distilled water, 3½ ounces; iodized collodion, 3 minims.

Developing Solution.—No. 1. Protosulphate of iron, 1 drachm; acetic acid, 2 drachms; methylated alcohol, 2 drachms; water, 4 ounces. No. 2. Pyrogallic acid, 13 grains; citric acid, 15 grains; distilled water, 4 ounces.

Fixing Solution.—Cyanide of potassium, 2 drachms; water, 5 ounces.

MANIPULATION.

The Collodion Coating is applied in the same manner as for positives, and then

Sensitized, which is accomplished by immersion in the nitrate bath. The plate should remain in the bath from two to three minutes. When the collodion surface presents a nice even film, drain off the excess of silver, and lay the glass plate carefully in the dark slide, taking care not to allow any specks of dust or dirt to get near it. It is then ready for

Exposure.—After exposing the plate for the necessary time, which will be double that required for a positive, proceed to

Develop.—Having removed the dark slides in the dark room, pour the developer, No. 1, evenly over the plate. As the picture will appear suddenly, it must be watched. Continue the action of the iron developer until there is fear of the dark shadows becoming veiled. When the glass plate has been washed, pour into a measure—which must be perfectly clean—sufficient of the developer No. 2 to cover the surface of the plate, to this add ten minims of the silver bath. This mixture must be used immediately by pouring it over the plate. When sufficiently intense, the surface must be again washed. It is now ready to be

Fixed, using the cyanide solution. This is to be poured over the plate in the same manner as the developer, and the surplus rebottled. It should now be thoroughly washed to remove all traces of chemicals, which, if allowed to remain, would eventually spoil the picture. The negative will now require to be

Varnished.—The most convenient varnish for a tyro to use is amber or crystal varnish; it is simply poured on the plate, and then drained off at the lower end.

PRINTING PROCESS.

Chemicals.—Exciting bath; nitrate of silver, 120 grains; distilled water, 2 ounces.

Toning Bath.—Acetate of soda, 30 grains; carbonate of soda, 10 grains; chloride of gold, 1 grain; distilled water, 4 ounces. This solution will keep for a considerable length of time, and may be used over and over again until the gold is thoroughly exhausted, when more must be added, if again required.

Fixing Bath.—Hyposulphate of soda, 1 ounce; distilled water, 10 ounces. This solution may be made up for a fortnight before using, as it is much better for keeping. It must not, however, be used a second time, but a fresh one made for every batch of prints.

MANIPULATION.

Sensitizing.—Filter the silver solution into a shallow dish, then take a piece of albumenized paper, cut to the size, and, holding the two ends, let the centre drop until the albumenized face touches the solution; then lower the ends, and leave the paper floating. When it lies flat, and ceases to curl up, it should be removed, and, when perfectly dry, it may be passed on to the next operation.

Printing the Positive.—Take a printing frame and remove the back board; then lay the negative in the rabbits of the frame with the collodion side upwards, and cover the face with a sheet of sensitized paper, replace the back board, turn up to the frame, and expose to the light. When the desired strength of picture is obtained, remove the paper, and proceed with the

Toning Process.—Having removed the prints into a dark corner of the room, wash them in several changes of water to remove the nitrate of silver. They are now ready for the toning bath, therefore immerse them in a porcelain dish, filled with the solution. When the color of the prints change from a brown to a purple black, remove them to the last operation, the

Fixing Process.—The pictures are immersed in the hyposulphate solution for about five minutes, then washed in running water for at least ten minutes. As the fixing solution will greatly reduce the depth of the print, it should be over-printed, to allow of the reduction, else the detail of the picture will be entirely lost.

Mounting Prints.—Starch is the most suitable adhesive substance. It is prepared by mixing a small quantity with sufficient boiling water to work into a stiff paste.

Apply the starch to the back of the picture by means of a brush, then carefully lower the prints on to the card, lay a piece of blotting paper over it, and rub to expel the air bubbles. When nearly dry, place under pressure for a few hours. The picture is now finished.

CONCLUDING REMARKS.

In purchasing apparatus, it is advisable that the tyro should be accompanied by one who is experienced in such matters ; any mistakes as to the quantity and quality of the articles required is thus prevented.

The camera may be made either square, oblong, or bellows body, according to taste. The former is considered the most serviceable and the cheapest.

The lens may be had without a rack and pinion if desired. A better focus, however, is obtained by having the rack adjustment ; it is also much easier to work, and it is not liable to shift when the cap is removed. Some lenses are provided with diaphragms or stops, but as these are rather expensive, I should advise the young tyro to make his own, which he can easily do by cutting different sized holes in several pieces of stiff cardboard, and then making them to fit the interior of the lens tube. These diaphragms, it must be borne in mind, are only to be used on certain occasions, as, for instance, when the sun is shining, the light of course is much too powerful for the open aperture of a lens. It is, therefore, requisite that it should have a stop inserted in order to retard the rapid action. A diaphragm with an opening of about one inch diameter will be sufficiently large for a quarter-plate lens.

Camera stands are made of various shapes and material ; the one most recommended is the plain ash tripod, that being both light and useful, and the most portable.

The sensitizing bath should not measure less than seven by five inches, as that is the proper size for quarter plates.

The graduated measures should hold at least five and ten ounces respectively.

The funnel may be either six or eight inches in diameter, with a long, narrow neck.

The toning and fixing dishes should be as large as possible, in order to allow the prints plenty of room, and preventing them adhering to each other.

Chemicals may be purchased in small quantities, but it is not advisable to buy collodion in less quantities than five ounces, as it is extremely volatile, and soon loses its power of action.

Nitrate of silver may be bought either in crystals or blocks ; the former is preferable, as it can be obtained in smaller quantities than the latter, which is only sold in one ounce boxes.

Hyposulphate of soda, protosulphate of iron, and methylated alcohol are exceedingly cheap, as are also most of the other chemicals.

The tyro must be very careful, when using cyanide of potassium, not to allow the least drop to enter any cuts in the flesh, for, being a most deadly poison, it is likely to cause death, if the part is not immediately washed in warm water and the poison thereby removed. As cyanide possesses an odor something like peppermint, it is advisable not to place it within the reach of children.

The silver bath should be filtered at least three times before using ; this will ensure the removal of every particle of collodion.

The toning and fixing baths, after being made up, should be allowed to stand for at least four-and-twenty hours before being used. The longer these solutions are kept the better they work.

If the tyro wishes to become a first-class portrait taker, he must study the following rules, and strictly adhere to them :—

RULES.

1. Never allow any one but the sitter to be present when taking a portrait.

2. Always make it a rule to have a place for everything, and everything in its place.

3. Never open the door of the dark room when exciting or developing a plate.

4. The camera and dark slide should be dusted out every morning previous to being used.

5. Never allow any one to meddle with your apparatus, as it is very easily put out of order.

6. Do not handle your sitter more than you can help, but tell him in what position you wish him to stand, and he will pose himself much better than you can.

PHOTOGRAPHIC REQUISITES.

The following is a correct list of all articles required in photographic portraiture : Square mahogany camera, double combination lens, tripod stand, screw stand, screw top, porcelain bath and dipper, two graduated glass measures, set of scales and weights, a glass or porcelain funnel, one deep and two shallow dishes, a tent, printing frame, a packet of quarter-size glass, some filtering paper, a wash-leather, and a linen cloth, negative and positive collodion, crystalized nitrate of silver, protosulphate of iron glacial acetic acid, methylated alcohol, chloride of gold, hyposulphate carbonate, and acetate of soda, cyanide of potassium, distilled water, &c. See also page 552.

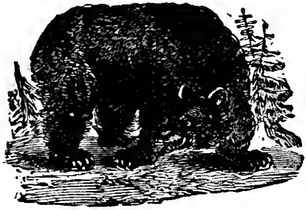
CHEMICAL NOMENCLATURE.

For an intelligent apprehension of the meaning of chemical terms we will define several relating to sulphur, which, combined with oxygen, produces an *acid.* This acid exists in two states of saturation, possessing different properties. It is necessary to designate all the *saline* components of these two acids and to trace sulphur in its various combinations with *alkalies*, *earths*, and *metals.* The five following terminations describe these five states of the same principle. 1. Sulphur*ic* acid signifies sulphur in the greatest degree of saturation with oxygen. 2. Sulphur*ous* acid signiifies sulphur combined with a smaller proportion of oxygen. 3. Sulph*ate* is the generic name of the *salts* composed by the sulphur*ic* acid. 4. Sulph*ite* is the name of the salts formed by the sulphur*ous* acid. 5. Sulphur*et* s the name of the various combinations of sulphur not acidulous.

In union with oxygen, carbon is *carbonic acid*, combined with gas, it forms carbonic acid gas. Oxydized, and composing salts with bases of iron, minerals, or alkali, it becomes carbonate of lime, iron, or potash. In union with oxygen, it forms with iron carburet of iron, &c. Salts are discriminatea by two .ames, the one denotes the *acid*, the other the *base.* For example sulph*ate* of iron is a combination of sulphuric acid and iron, sulph*ate* of soda is a union of sulphur*ic* acid and soda, muri*ate* of soda is a compound of muria*tic* acid and soda. Salts composed of acids ending in *ous*, have the termination *ite* instead of *ate*. See the following examples in sulphur.

Sulphur*ic* acid, a strong acid.
Sulhpur*ic* acid, a w eakacid.
Sulphur*et* of iron, Sulphur and iron.
Prot-oxide of sulphur is the first degree.
Deut-oxide, the second degree.
Trit-oxide the third degree.
Per-oxide many degrees.
Sulph*ate* is the salt of sulphur*ic* acid.
Sulph*ite* the salt of sulpher*ous* acid.
Bi sulphate the salt of a double dose.

Hypo-sulphurous acid,—less oxygen than sulphurous acid (1 tc 2). *Hypo* sulphuric acid—less than sulphuric.



ON HUNTING AND TRAPPING.

To Trap the Common Black Bear—Select a suitable spot for the trap between logs, trees, or hills, close to their suspected haunts, and secure it well with a short, stout chain. Bait the trap with a piece of pork, mutton, or beef, and if the bait is scented with honey it will prove a powerful attraction ; the bear will push himself forward where there is any thing to eat, being dominated more by greed and voracity, than by craft and cunning. He is a No. 1. contractor at a job for taking a fat porker from the farmer's pen off to the woods, and will squeeze himself into a deadfall or figure 4 trap, intent only on getting at the bait, but is decidedly dangerous to attack single-handed with a gun, as he is perfectly furious when wounded. On one occasion, a bear emerged from the woods and destroyed a sheep belonging to the writer. One of the farm hands, a veteran hunter and trapper, took the remains of the sheep to the woods and placed them in such a position, near some fallen trees, that the bear would be compelled to go through a passage way between two logs in order to reach the carcass. At right angles with this passage way, but back from it, he secured a Spencer rifle (loaded with slugs) in a firm position, so as to sweep the passage, and arranged a small cord extending across the narrow avenue, with one end fastened to the trigger of the rifle, and the other to the timbers opposite its muzzle. The result was a loud bang from the rifle in the evening, a lantern hunt in the woods at night, and a dead bear shot through the heart behind the fore-legs, within a few feet of the rifle. The black bear is usually less than 6 ft. in length, domiciles under the snow and in hollow logs during winter, and produces from 1 to 5 at a birth, generally in January.

The Grizzly Bear is a huge brute of vast size, sometimes as much as 8 or 9 ft. in length, and of prodigious strength. He is of massive build, has a thick stout neck, shaggy hair, coarse formidable tusks, and powerful claws of great length ; is altogether an ugly customer and requires for his capture the largest size trap that is made. In the Northwestern (British) Territory, on sighting the hunter he generally makes for his enemy, and has a curious habit when 60 or 70 yards distant of sitting up erect on his haunches and taking a survey of the field, as if calculating his chances in the coming fray, and will repeat the examination at intervals of nearly 20 yards as he approaches. The hunter will do well to reserve his fire until the bear comes within a few yards' distance, when, if he suddenly extends his arms the animal will come to a full stop and erect himself again. This is the time to take unerring aim at close quarters and make sure work, for if he fails he will never hunt another bear. In the Sierras, the Rocky Mountains, and in California, no animal roaming his native wilds surpasses the grizzly in savageness and strength. His weight is upon the average from 1000 to 1200 lbs., and one bite of his jaws or one stroke of his paw is certain death. On the Pacific coast he is often hunted by mounted *Vaqueros*, who usually go five in a company; four use the lasso, which they throw over the bear at opposite angles from each other, and while he is thus held tight from four opposite directions, it is possible for the fifth man to approach and finish him with a knife. It is extremely dangerous work, for if one or more of the ropes should slip, unless it is immediately secured by another successful throw, there is danger of instant death to the nearest man if his horse is not smart enough to carry him off in safety. The grizzly makes jumps of 10 feet, and when he has a chance to charge it requires immense agility to dodge or escape him. All of the *vaqueros* have a number of lassos, and in case of a slip make prompt action with another throw. In nearly every case the grizzly invites attack, he will run from men at an extreme distance, but never fails to make a savage charge if he comes within hailing distance.

Baits for Trappers' use.—1. *Fish Oil*, is made by mincing eels, bass, trout, or other small fish, and allowing the pieces to remain in a loosely corked bottle exposed to the rays of the sun for 2 or 3 weeks during the heat of summer, until a sort of oil is generated, which owing to its very intense odor, is perceived by wild animals at an immense distance and forms a most attractive scent. 2. *Oil of Anise*. 3. *Oil of Rhodium*. 4. *Assafœtida*. 5. *Oil of Amber*. 6. *Oil of sweet fennel*. The last noted articles (five in number) are procured in drug-stores. 7. *Muskrat-musk*, a most powerful scent, is an oil obtained from that animal, and is contained in glandular sacs situated near the anus. 8. *Castoreum*, called *Bark-stone* by the fur traders, is a fatty substance of an intensely strong odor contained in similar sacs in the back parts of the Beaver. It forms a more attractive scent for that animal than any other. 9. *Otter musk*, derived in a similar way from the otter, is very successful in attracting that animal. 10. A mixture composed of equal parts of fish-oil, assafœtida, musk-rat-musk, and oil of anise, is said by old trappers to be the most attractive scent obtainable for almost any animal. The odor reaches far and wide, forming what a Frenchman would call "one grand stink" of the first magnitude. It is used on baits for traps, and for scenting trails leading to the traps by sprinkling it in successive drops on the ground. 11. A rank codfish drawn along on the earth by means of a string, in a direction leading to the traps will also answer this last named purpose very well. 12 Musk-rat musk and skunk musk mixed. This receipt has been sold for $75. 13. Unslaked lime ½ lb., salammoniac 3 ozs., or muriate of ammonia, 3 ozs. Mix and pulverize, keep in a corked bottle a few days until a thorough admixture takes place. For mink, sprinkle on the bait around the trap. Keep in a closely stoppered bottle. This receipt has been sold for $50. In using these compounds on baits for trapping foxes and other sly game, it is often advisable to smear a little on the trap in order to overpower the human scent arising from handling them; it would be a better way to wear gloves when handling traps, and employ a slight smearing of beeswax or blood to overcome the odor of the iron.

To protect the hen roost from these depredators, saw out an aperture large enough to admit the fox on a level with the ground. Inside the roost place a box without a lid and open at one end. This open end must be placed against the aperture in the wall, on the ground, so that the fox will pass into it on his entrance into the roost and the side without the lid will be uppermost. Set your trap in the box just opposite the entrance to the roost, secure it with a chain and lightly cover with dried leaves, grass, or other material adapted to conceal it. Next, place a chicken inside a smaller box and nail slats on one side instead of a cover, and place this box with the slatted side downwards, on the top of the first box, immediately over the trap and exposed to the view of the fox. The temptation will prove too much even for a fox to resist, and he will enter only to be caught in the trap. Mink, raccoons, weasels, skunks, &c., may be caught in the same manner. Close up every entrance to the roost except the one just described.

In trapping *Mink* in the water, the trap should be set in a shallow part, not more than one or two inches deep, with the bait suspended about 18 inches above it; this compels the animal to erect itself on its hind legs, or leap upwards to get the bait, and thus to tread on the trap and get caught. Traps may also be set sunk in their beaten tracks, or at the mouths of their holes, and concealed by dried grass, leaves, &c., with excellent effect.

In trapping WOLVES or FOXES, use a trap well cleaned with weak lye; after drying, oil or grease it well, and smoke it over burning hair or feathers. In handling it use clean buckskin gloves to avoid imparting the least human odor. Make the bed for the trap about 3½ ft. in diam. so that the jaws when set will be on a level with the ground. Cover with fine dried grass, wheat, oat, or buckwheat chaff, secure it well with a chain, level all neatly to a natural appearance, and bait with fresh meat or roasted cheese. In going and coming, your chances will be increased by rubbing fish oil, or some other powerful odor on the soles of your boots, to scent the way leading to the trap. Wolves and foxes are easily destroyed by mixing a little strychnine with grease and concealing it in pieces of meat scattered around in places where they haunt. It destroys animal life in a very few minutes after it is taken, but it is injurious to the fur.

In trapping the OTTER, take a large sized steel trap, set it, hang it over a fire 2 or 3 hours, then take a stick or board, and get into your boat or canoe, go to the place most frequented by them, and place the trap about 3 inches under water and carefully cover it with leaves, light trash or grass gathered from the bottom of the stream, and chain it securely. Be very careful not to touch the bank above water, if you do, your labor is gone for nothing. The otter will leave at once for a quieter home many miles distant from the scene. In visiting your trap never go nearer than the opposite side of the stream, or go by means of a boat. When caught, the otter will point directly for his den; if the trap is not heavy enough to drown him, a weight can be attached to the chain.

RACCOONS may be caught in a steel trap set on the edge of a swamp, 1½ ins. below the surface of the water, and secured by a chain to a stake. Suspend the bait—a piece of a chicken, fish, or frog—2 ft. above the pan of the trap. The raccoon will leap for it, and when he comes down, up goes the trap and holds him a prisoner. Another plan is to set the trap on an old log in or near the swamp, then get two long poles or old limbs, set one on each side of the log over the trap, crossing it like the letter x, so that the coon will have to go under them and over the trap. Bait the trap if you wish, but the coon is certain to run the old log if he comes in the neighborhood. One of the surest ways to catch raccoons is with a good cur dog, one that will not give tongue on track, but will bark at the tree.

MUSKRATS may be taken in large numbers by sinking an old barrel with its top on a level with the ground on the edge of a stream near their haunts. Half fill it with water, put in a couple of shingles or light strips of board to float on the water, on these place small bits of sliced apples, potatoes, or carrots, and place some more in the runs of the muskrats, so as to lead them towards the barrel. The rats will leap into the barrel after their food and cannot get out. A cheaper and more effective contrivance could not be imagined. In using a trap, note a tree or old log with recent droppings on it leading from the bank into the stream. On this set your trap, say, 2 ins. under water, place a bait on a projecting stick about 6 or 8 ins. above the pan of the trap, securing the latter with a chain sufficiently long to permit access to deep water, but not to go ashore. By this means the fur is preserved in good order and the animal is safely secured. In winter it is quite common for trappers to take the muskrats by approaching quietly on the ice and driving a spear into their house. They must be approached with the greatest caution, as they take to the water at the slightest noise. Another way is to make an opening in the side of their house, set the trap in their bed, lightly covering it with moss, &c.; allow a sufficient length of chain to permit the animal to leap into the water, secure the chain by a fastening *outside* the house, plaster up the aperture with mud, retire, and await results.

SQUIRRELS may be taken by setting a steel trap on the upper rail of a fence where they frequent; set a pole with an ear of corn fastened to it so that the bait may be suspended 6 or 8 ins. over the pan of the trap, and in reaching for the bait the squirrel will get caught.

BADGERS may be caught by setting the traps, carefully covered, at the mouth of their holes, or in their tracks or resorts about cultivated fields. They may also be taken in deadfalls, using a piece of meat for a bait, and if the ground is hard frozen during early spring, they may be expelled by filling their holes with water. In summer the water would soak away through the earth, during hard frost it cannot do so, and the animal is compelled to come out of its hole or drown.

In trapping BEAVERS, the best place to set the trap is right at the entrance to their holes in the banks, a few inches under water. Get a small stick, and batter or bruise the thickest end soft, smear it with bait No. 8, and stick the small end in the bank so that the baited end will project a few inches above the water right over the pan of the trap; the beaver, in raising himself to get the bait, will get caught. Another way is to break an aperture in the dam a few inches below the surface of the water, set the trap on the upper side of the break, and the beaver will get caught when he comes to investigate and repair the damage. The trapper will usually secure his prize by placing his trap a few inches below the surface of the water at those places where they make their landings by springing from the stream onto the bank.

The PINE-MARTEN OR AMERICAN SABLE lives in the trees and preys on partridges, mice, squirrels, hares, &c. A piece of either of these may be used as bait, or the head of a fish, pheasant, or a piece of meat, and the trap may be placed in a hollow tree, in any natural or artificial enclosure, or in the track of a deer; in each case let it be well covered with light grass, decayed moss, or rotten wood, so as to present a natural appearance.

THE FISHER-MARTEN is attached to low, swampy ground, is partially web-footed, and subsists on fish, mice, rabbits, &c. It may be caught in the same manner as the last-named animal. Be careful to scent the trap and conceal it properly, also attach it to a spring pole or twitch-up contrivance, so that when caught it be elevated out of the way of becoming a prey to larger animals, and prevented from dismembering itself to get clear of the trap. The Pine-Marten and the Fisher both live and breed in hollow trees; they are by no means very cunning or difficult to trap, but are absolutely furious when caught.

The WOODCHUCK, *or Ground Hog*, as it is styled in Canada, constructs burrows in the ground, extending 20 or 30 feet, usually entering the slope of a hill, at the root of a tree or stump, under a fence, or in crevices between rocks. They are very destructive to crops in cultivated fields. Sometimes they are drowned or flooded out of their holes by means of water, at other times they are shot, but in the great majority of cases they are caught by traps set without bait, (although they will take roots, corn, or bread), and carefully covered with paper, sand, &c., at the mouths of their holes.

GOPHERS may be caught by making a slight excavation at the mouth of their hole and placing a trap so that the pan and jaws will be on a level with the surface of the ground and covered as above described.

HUNTERS' AND TRAPPERS' TABLE,

SHOWING THE VARIOUS SIZES OF NEWHOUSE TRAPS ADAPTED TO THE CAPTURE OF DIFFERENT KINDS OF GAME.

Kind of Animal.	No. of Trap.	Bait required.
Squirrel,	0	Grain, nuts, or ear of corn.
Gopher,	1	do. do. do.
Muskrat,	1	Carrots, potatoes, apples, &c.
Woodchuck,	1 or 1½	Roots, fruit, corn, or bread.
Mink,	1½	Fowl, flesh, or roasted fish.
Fisher-Marten,	1½	Meat, muskrat or deer flesh, fish.
Skunk,	1½ or 2	Mice, meat, piece of a fowl.
Fox,	2	Fowl, flesh, fish, toasted cheese.
Opossum,	2 or 3	Nuts, corn, mice, piece of fowl.
Raccoon,	2 or 3	Chicken, fish, or frog.
Badger,	3	Mice, or flesh of any kind.
Otter,	3	Fish, piece of a bird, or otter musk.
Marten,	3	Head of a fish, piece of meat, or fowl.
Beaver,	4	Fresh roots, castoreum on the end of a stick.
Wolf,	4	Waste parts of tame or wild fowl.
Common Black Bear,	5	Pork, beef, ear of corn, honey.
Grizzly Bear,	6	do. do. do. do.

NOTE.—The numbers 0, 1, and 1½, respectively, are single spring traps; No. 0 is the smallest size; all the others are double spring traps, No. 6 being the largest trap made. The above baits should be scented, where necessary, by a proper selection from the preparations previously described. Wildcats, foxes, wolves, and all the weasel tribe will take flesh and fish of all kinds, with this exception, that foxes, wolves and dogs will not eat their own kind; weasels of every kind will.

All furs are best in winter, but trapping may be done with profit from the first of October to the beginning of April. All fur-bearing animals lose the best part of their fur as the warm weather approaches, and regain it as the cold weather sets in during the fall, so that from the first of May to near the end of September trapping is but labor lost. This process is indicated in the case of the muskrat and some other animals, by the color of the inside part of the skin. Towards summer it becomes brown and dark, a sign that the best fur is gone. Afterward it grows light-colored, and in winter, when the fur is in the best order, it is altogether white. When the pelt is white it is called prime by the fur dealers. The fur is then glossy, thick, and of the richest color and the tails of such animals as the mink, marten, and fisher, are full and heavy Beavers and muskrats are not thoroughly prime till about the middle of winter; other animals are prime about the first of November. The skins of animals trapped are always valued higher than those shot, as shot not only makes holes, but frequently plow along the skin, making furrows as well as shaving off the fur. Newhouse gives the following rules to trappers as the result of much experience:

1. Be careful to visit your traps often enough, so that the skin will not have time to get tainted. 2. As soon as possible after an animal is dead and dry, attend to the skinning and curing. 3. Scrape off all superfluous

flesh and fat, and be careful not to go so deep as to cut the fibre of the skin. 4. Never dry a skin by the fire, or in the sun, but in a cool, shady place, sheltered from rain. If you use a barn door for a stretcher, as boys sometimes do, nail the skin on the inside of the door. 5. Never use "preparations" of any kind in curing skins, nor even wash them in water, but simply stretch and dry them as taken from the animal.

To Deodorize Skunk Skins, or Scented Clothing.—Hold them over a fire of red cedar boughs, and sprinkle with chloride of lime; or wrap them in green hemlock boughs when they are to be had, and in 24 hours they will be cleaned.

For arsenical soap for preserving skins, see page 124. Skulls of animals may be rapidly prepared by boiling in water for a few hours; a little potash or lye will facilitate the removal of the flesh. A mixture of equal parts of good glycerine and water, to every gallon of which is added 1 oz. of the crystals of carbolic acid, constitutes a good preserving liquid for all animal substances. The use of pure glycerine, with about ½ pt. alcohol, and ½ oz. carbolic acid, added to each gal., makes an excellent mixture for preserving the tissues of soft animals, where it is desired to preserve the color as well as the tissues.

According to M. Devergie, of the Paris School of Practical Anatomy, a mixture of 3 pts of glycerine, and one of carbolic acid, injected into dead bodies, will prevent any unpleasant odors emanating from them for several months. Another high authority, Dr. Lowell, of Brooklyn, recommends as a preservative fluid, the use of zinc chloride. The quantity used for a human subject is 5 gals. The apparatus required consists of a porcelain lined vessel, which is elevated to such a height that the solution is injected into the artery by the simple gravity of the liquid, as it descends through glass and rubber tubing. Dr. Lowell writes: "The injection may be made by either artery or vein. . . . . I prefer the brachial artery above the elbow as the point for introduction of the glass tube, for the primary incision is slighter, and consequently divides smaller and fewer veins than when I expose the femoral artery. I use the gravity method, and introduce about five gallons of the antiseptic fluid. The effects are eminently satisfactory. The color of the integument is improved."

To Preserve Insects.—After killing the insect with chloroform, paint it with a solution of carbolic acid in alcohol—4 grains to the ounce—then dry in the sun. This will keep it fresh and beautiful.

To Trap Hawks or Owls.—Take a pole 20 feet long. Set it a short distance from the house or barn, or on the poultry house. Split the top so as to admit the base of a common steel trap, which should be secured. When the trap is set the depredators will be pretty certain to alight on it and get caught, as they usually select a lofty perch from which to pounce upon their prey.

The Shooting of Birds.—The wanton shooting of harmless birds, merely for sport, is a most heartless and cruel recreation. The plea of commercial necessity and self-preservation may be urged in behalf of the shooting and trapping of wild animals, but no such excuse can be alleged for the extermination of harmless birds. Let them sing in the broad vault of heaven to their heart's content, and tenant the fields and their forest homes without molestation. A hunter narrates that he once fired at a bird which he followed up as it fluttered away. He said, "I saw a sight I never will forget. There it was, with its wings broken, and all bespattered with blood, at the nest with its young. I felt so bad that I vowed never to shoot another bird!" Again we say, spare the innocents.

To Select Furs.—A sure test of what dealers call prime fur is the length and density of the down next the skin. This can be determined by blowing a brisk current of air from the mouth against the set of the fur. If the fibres open readily, exposing the skin to the view, reject the article; but if the down is so dense that the breath cannot penetrate it, or at most shows but a small portion of the skin, it is all right.

To Clean Furs.—Strip the furs of their stuffing and binding, place them, if possible, in a flat position, and brush them briskly with a stiff clothes-brush. Cut out all moth-eaten portions, and replace by new bits of fur to match. Sable, chinchilla, squirrel, fitch, &c., should be treated by an application of hot bran (warmed in a pan), well rubbed into the fur with the hand. Repeat this two or three times, shake the fur, and give it a good brushing,to free it from dust. White furs may be cleaned by laying the furs on a table, and rubbing them with bran made moist by warm water. Rub until quite dry, then apply dry bran. The wet bran should be put on with flannel, the dry with book muslin. In addition to the above, light furs should be well rubbed with magnesia, or a piece of book muslin, after the bran process.

ON BOOK-KEEPING.

In Book-Keeping, he who buys what he does not pay for at the time, is said to go in debt for it, and is called a debtor, and he who sells the goods and gives credit for them is called a creditor. In entering accounts it is usual to abridge the terms and write Dr. for Debtor, and Cr. for Creditor. In every case the *receiver* is always the Debtor, and the *seller* is always the Creditor. In Book-Keeping, the thing received is Dr., the thing delivered is Cr.; what you owe is Cr., what owes you is Dr. The whole system of Book-Keeping rests upon *charges* and *credits*; when you sell to your neighbor, it is a *charge* against him, and you must charge him with it on the debit side of the account ; when you receive anything from him, it is a *credit*, and you must credit him with it on the credit side of the account.

The word *To*, in keeping accounts, denotes that the debtor owes for what has been sold *to* him, and the word *By*, is an indication that the debtor has made a payment *by* which he has paid a part or the whole of the debt charged to him.

There are two methods of book-keeping, Single and Double Entry ; the last is employed in extensive and complicated mercantile business, where a check is required upon each entry, to prove that it has been properly recorded. The first is generally used by persons engaged in ordinary business, as it is more simple and sufficiently correct for such purposes. It requires but three books—the Day-Book, Ledger, and Cash–Book ; to these may be added, a Bill-Book, in which all notes, received or given, are recorded, showing when drawn, by whom, in whose favor, length of time, when due, amount of note, and any explanatory remarks required ; also, a Sales-Book, in which orders for goods or the details of sales are entered, and a Receipt-Book, where receipts can be permanently kept.

DAY-BOOK.

The Day-book should contain statements of every business transaction, which gives rise to persons owing us or to our owing them, properly arranged under the head of debtor or creditor. The accounts should be entered in this book at the time they were created, or in the order in which they occurred in business.

The book should be commenced by stating the name of the owner and his residence. The day, month, and year, should then be written, and repeated at the head of each page corresponding with the date of the first transaction on the page, the subsequent dates on the page may stand above the transaction to which they belong. In making an entry the name of the person with whom we deal is written, with Dr. or Cr. at the right of the name, to show whether he becomes debtor or creditor by the transaction. Then a statement should follow of the business done, specifying the articles bought or sold, and the price of each. The total amount should be added up and entered in the dollar and cent columns. The person with whom you deal is debtor for whatever he receives of you, and creditor for whatever you receive of him, is the rule for determining how an entry must be made. The entries in the Day-book are transferred to the Ledger, where all the transactions relating to an individual are recorded on a page devoted to his account. The figure at the left of an entry indicates the page of the Ledger to which it has been carried.

If a mistake is made in an account, it should not be corrected by altering the original entry, but a new entry made debiting or crediting the amount of the error, thus, "John Smith, Cr. by [or Dr. to] error in account of Oct. 6, $1.50." This will enable a person to swear before a court that his book contains his original entries without an alteration.

LEDGER.

The Ledger is employed for collecting the scattered accounts of the Day-book. The accounts which relate to the same individual are brought together on one page, showing all the debits and credits, thus enabling the owner to tell at a glance the state of his account with any person. The Dr. accounts are placed on the left hand of the page, and the Cr. on the right. The Ledger may be ruled according to the example on page 794. Every Ledger should have an index, in which all the names it contains are alphabetically arranged, with the page of the Ledger on which the account can be found.

Posting Accounts.—Transferring accounts from the Day-book to the Ledger is called posting. Commence with the first name in the Day-book, which in our example is M. Marshall ; begin by writing his name in a fair hand at the top of the page, with his residence, if different from your own, placing Dr. on the left, and Cr. on the right of the name. As he is debtor to us we commence at the left hand, writing in the first column the year, month, and day, in the second the page of the Day-book on which the original entry can be found, in the third the name of the article, or if several articles are recorded under one date, they may be entered with the general designation of sundries or merchandise, and in the fourth column the total amount of the transaction. Against the account in the Day-book mark the page of the Ledger to which it has been posted ; a mark can also be made to show that it has been transferred to the Ledger. Now take the second transaction in the Day-book, and if it is another name take a new page in the Ledger, and proceed in the same manner as the first. In this way all the entries in the Day-book are posted to each person's account, every week or month as opportunity may occur. By subtracting one side from the other the balance which is due will be found. The specimen page represents three pages of a Ledger, to correspond with three persons who have transactions in the Day-book.

Balance Sheet.—This may be made to accomplish a double purpose, as it will exhibit the state of the owner's accounts, by determining the amounts owing him and that he may owe, and also prove that the accounts have been correctly posted and added. The method is as follows : rule a sheet of paper similar to ledger page, for debtor and creditor ; add up all the items of credit on a page of the Day-book, and enter the amount on the sheet, then add the debits in the same manner, and proceed in this way for whatever time it is wished the proof should cover, add up the two columns and subtract one total from the other, and the difference will be the balance of the Day-book. Turn to the Ledger and obtain the balance of each person's account, and place it under its proper head ; add these up, and the difference will be the Ledger balance. If the two balances agree, it proves the entries have been correctly posted.

BOOK-KEEPING.

DAY-BOOK.

ROBERT BAKER, ST. JOHN, N. B., OCTOBER 2, 1877.

			$	cts.
	M. Marshall Dr.			
× 1	To 8 yds. of muslin, at 9 cts. a yd.	$ 0.72		
	To 4 yds. of cloth, at $3 a yd.	12.00		
	To 1 scythe	1.10	$13	82
	“			
	James Brown Dr.			
× 2	To 1 pr. of shoes	$1.40		
	To 1 lb. of tea	.75	2	15
	“			
	David Moore Cr.			
× 3	By 1 yoke of oxen		115	00
	3			
	James Brown Dr.			
	To 14 lbs. nails, at 6 cts.	$0.84		
× 2	To 5 galls. molasses, at 32 cts.	1.60		
	To 12 lbs. cheese, at 10 cts.	1.20	3	64
	Cr.			
	By 8 lbs. wool, at 36 cts.		2	88
	“			
	M. Marshall Cr.			
× 1	By 1 load of hay	$6.00		
	By 12 lbs. butter, at 9 cts	1.08	7	08
	“			
	David Moore Dr.			
× 3	To Cash		50	00
	4			
	M. Marshall Dr.			
	To 1 stove	$14.00		
× 1	To 8 yds. cloth, at $3	24.00		
	To 1 horse	42.00	80	00
	“			
	David Moore Dr.			
× 3	To 1 set of harness	$20.00		
	To 1 wagon	64.00	84	00
	5			
	James Brown Dr.			
	To 28 lbs. sugar, at 8 cts.	$2.24		
× 2	To 1 barrel of flour	7.00		
	To 3 brooms at 14 cts.	.42	9	66
	“			
	David Moore Cr.			
	By 20 bushels corn, at 62 cts.	$12.40		
× 3	By Cash	30.00		
	By order on Peter Wilkins	21.00	63	40
	7			
	David Moore Dr.			
× 3	To check to balance account		44	40
	10			
	James Brown Cr.			
× 2	By Cash to balance account		12	57
	12			
	M. Marshall Cr.			
× 1	By his note at 3 months from date		75	00

BOOK-KEEPING.

LEDGER.

1 DR. **M. MARSHALL** CR. 1

			$	cts.				$	cts.
1877.					1877.				
Oct. 2	1	To Sundries.......	$ 13	82	Oct. 3	1	By hay and butter.	$ 7	03
" 4	4	" Sundries.......	80	00	" 12	1	" note at 3 mos....	75	00
							" *Balance*.........	11	74
			93	82				93	82
" 12		To Balance........	11	74					

2 DR. **JAMES BROWN.** CR.

			$	cts.				$	cts.
1877.					1877.				
Oct. 2	1	To Sundries........	$ 2	15	Oct. 3	1	By wool.............	$ 2	88
" 3	1	" Sundries........	3	64	" 10	1	" cash.............	12	57
" 5	1	" Sundries........	9	66					
			15	45				15	44

3 DR. **DAVID MOORE.** CR. 3

			$	cts.				$	cts.
1877.					1877.				
Oct. 3	1	To Cash...........	$50	00	Oct 2	1	By oxen...........	$115	00
" 4	1	" harness & wagon	84	00	" 5	1	" sundries.........	63	40
" 7	1	" check to balance	44	40					
			178	40				178	40

CASH-BOOK.

1 DR. **CASH.** CR. 1

		$	cts.			$	cts.
1877.				1877.			
Oct. 2	To cash on hand........	$150	00	Oct. 2	Paid rent of store 6 mos.	$ 75	00
" 5	Received of M. Marshall	36	00	" 3	" David Moore......	50	00
" 9	Order on I. Rose.......	21	00	" 7	" David Moore.. ...	44	40
" 5	Receipts of store.......	100	75	" 9	" expenses in store.	8	20
				" 9	*Cash on hand*..........	130	15
		307	75			$307	75
Oct. 9	To cash on hand........	$130	15				
" 10	Received of J. Brown..	12	57				

A complete balance-sheet should be made out once or twice a year, when an inventory of stock on hand is taken and added to the debtor balances of accounts, and the original capital is added to the credit balances, (or balances we owe,) these compared will give the amount of profit or loss. It will be remembered that this sheet is an account between ourselves and our books.

All the accounts in the Ledger ought to be balanced twice a year. To do this add up each column and find the difference, and make an entry of this balance on the side that is smallest (this should be made with red ink to distinguish it from other entries) ; both sides now being equal, draw a line under them to show the fact. Now place the balance on the opposite side. so that it will exhibit the true state of the account. (See M. Marshall's account of the Ledger page.)

CASH-BOOK.

The Cash-book records the payment and receipt of cash. Cash is made debtor to the cash on hand and cash received, and credited with what is paid out. At the close of each day or week, the cash on hand is counted, and the amount entered on the credit side. This should make the debits and credits equal ; the amount of cash on hand is then entered on the debtor side. If money is paid to or received from a person who has an account with us it is also entered in the Day-book ; the total receipts and expenditures are carried to the Day-book as often as the Cash-book is balanced. (See form of Cash-book.)

As a help to compute interest we append the following Table to show the time required for a given number of dollars to draw an equal number of cents at various rates of interest. The rule is to strike off the odd cents from the principal and you have the interest at the following rates:

Interest per cent.	No. Days.	Interest per cent.	No. Days.	Interest per cent.	No. Days.
4	90	7	52	10	35
4½	80	7½	48	10-40	35
5	72	7-30	50		
5-20	70	8	45		
6	60	9	40		

The next Table shows the various sums of money which draw 1 cent interest per day, calculated at different per cents. so that the number of cents will always be found equivalent to the number of days the money has been drawing interest.

Amount.	Per cent.	Amount.	Per cent.	Amount.	Per cent.
$90	4	$52	7	$36	10
80	4½	50	7-30	35	10-40
72	5	48	7½	30	12
70	5-20	45	8	24	15
60	6	40	9		

VALUABLE INTEREST RULES, BASIS 30 DAYS PER MONTH OR 360 DAYS TO THE COMMERCIAL YEAR. Multiply the principal by the required number of days, and for 4 per cent. divide by 9, and point off ; for 5 per cent. divide by 72 ; for 6 per cent. divide by 6, and point off three figures from the right; for eight per cent. divide by 45; for 9 per cent divide by four, and point off three figures from the right ; for 10 per cent. divide by 36 ; for 12 per cent. divide by 3, and point off three figures from the right; for 15 per cent. divide by 24; for eighteen per cent. divide by 2, and point off three figures from the right, for 20 per cent. divide by 18.

A new way, called " a rule for reckoning interest on odd days, at any rate per cent., which involves no subdivision whatever," is as follows:

Multiply the principal by the number of days, and for 6 per cent. divide by 60 ; for 7 per cent. by 51 ; for 8 per cent., by 45 ; for 9 per cent. by 40 ; for 10 per cent. by 36, for 6 twice over ; for 12 per cent. by 30. For further information refer to interest Tables.

INTEREST TABLE. TEN PER CENT.

TIME.	$1	$2	$3	$4	$5	$6	$7	$8	$9	$10	$40	$50	$100	$1000
4 DAYS.	0	0	0	0	1	1	1	1	1	1	4	5	11	1 11
8 "	0	0	1	1	1	1	2	2	2	2	8	11	22	2 22
12 "	0	1	1	1	2	2	2	3	3	3	12	16	33	3 33
16 "	0	1	1	2	2	3	3	4	4	4	16	22	44	4 44
20 "	1	1	2	2	3	3	4	4	5	6	24	28	56	5 56
24 "	1	1	2	3	3	4	5	5	6	7	28	33	67	6 67
28 "	1	2	2	3	4	5	5	6	7	8	32	39	78	7 78
1 MON.	1	2	3	3	4	5	6	7	8	8	32	42	83	8 33
2 "	2	3	5	7	8	10	12	13	15	17	68	83	1 67	16 67
3 "	3	5	8	10	12	15	18	20	23	25	1 00	1 25	2 50	25 00
4 "	3	7	10	13	17	20	23	27	30	33	1 32	1 65	3 33	33 33
5 "	4	8	13	17	21	25	29	33	38	42	1 68	2 08	4 17	41 67
6 "	5	10	15	20	25	30	35	40	45	50	2 00	2 50	5 00	50 00
1 YEAR.	10	20	30	40	50	60	70	80	90	$1	4 00	$5	$10	$100

TABLE, SHOWING THE NUMBER OF DAYS FROM ANY DAY IN ONE MONTH TO THE SAME DAY IN ANOTHER.

From / To	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
January	365	31	59	90	120	151	181	212	243	273	304	334
February	334	365	28	59	89	120	150	181	212	242	273	303
March	306	337	365	31	61	92	122	153	184	214	245	275
April	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
Aug	153	184	212	243	273	304	334	365	31	61	92	122
Sept	122	153	181	212	242	273	303	334	365	30	61	91
Oct	92	123	151	182	212	243	273	304	335	365	31	61
Nov	61	92	120	151	181	212	242	273	304	334	365	30
Dec	31	62	90	121	151	182	212	243	274	304	335	365

EXPLANATION.—To find the number of days from January 20 to Dec. 20, follow the horizontal line opposite January until you reach the column headed by December, when you will find 334, representing the required number of days, and so on with the other months. During leap year, if February enters into the calculation, add one day to the result.

HOW TO CONDUCT A SUCCESSFUL BUSINESS.

That short credit and small profits forms the golden rule for success in trade may be seen from the following table, exhibiting the amounts realized for $100 at various percentages during various periods.

	Am't at 3 pr. ct.	Am't at 5 per ct.	Am't at 8 pr. ct.	Am't at 10 pr. ct.
If turned over every 3 months,	$326.20	$703.99	$2172.45	$4525.92
" " " 6 "	180.61	265.32	466.09	672.75
" " " 8 "	155.79	207.89	317.21	417.72
" " " 12 "	134.39	162.88	215.89	259.37
" " " 2 years,	115.92	127.62	146.93	161.05
" " " 5 "	106.09	110.25	116.64	121.00

TARES ALLOWED BY THE JOBBERS OF NEW YORK CITY.—It is understood that if a retail merchant orders less than an original package on which the jobber gets tare that no tare is allowed by the jobber to the retailer.

ARGOLS—Actual tares.
BARLEY, &c.—Come 100 lbs. in keg—all net.
BIRD SEED—2 per ct.
BUTTER—1 lb. on tubs as soakage; 2 lbs. on firkins; pails net weight.
CALIFORNIA HONEY—cases—(weighing 70 to 75 lbs.), 14 lbs.
CARAWAY SEED—2 per ct.
CHEESE—Always net or mrkd tares.
CHICORY—Casks, marked tares, 10 per ct. additional.
CITRON, and all Peels—2½ lbs. per box.
COFFEES—1 per ct. on everything except as below.
Jamaica and St. Domingo, 2 per ct.; Savanilla, in double bags, and Laguayra, in heavy bags, 2 per ct.
Costa Rica, in heavy bags, 2 per ct.
Old Government Java, in mats, 1 per ct.
Mexican coffee—in bales, 15 lbs.
Mocha Coffee—½ bales, 6 lb.; ¼, 4 lb.; ⅛, 2½ a. 3 lbs.
CURRANTS—Bbls, 27 to 29 lbs. average; in box, 4lbs.
DATES—In frails, 9 per ct.
FIGS—Drums, 10 per ct.; in kegs, 10. Layer figs, Boxes, 12.
HOMINY—200 lbs net.
LENTILS—2 per ct.
MOLASSES AND SYRUPS—Always allow ½ gal. out.
NUTMEGS—Cases and casks marked tares.
NUTS—2 lbs. per bag.
PRUNES—German, 4 lbs. per box. French—Marked tares. Turkish, in casks, marked tares.
RAISINS—Sultana, in boxes 10 per ct.
RICE—4 lbs. per bag; tierces 10 per ct.
ROCK CANDY—In bxs marked tares.
SAL SODA—Casks, 7 per ct.
SODA—English, mrkd English tares.
SPICES—2 per ct., except Cinnamon and Cloves.
Cassia — 9 per ct. on bales and mats; and 1½ lbs. extra for bale; cases 17 lbs.
Cloves—9 lbs. per bale.
SUGAR—Hhds., 12 per ct.; Refined Sugars always *net* or marked *tares*. Boxes—15 per ct. Mats and Bags—1 per ct. Barrels—Demarara, except where marked net, 12 per ct.
The per cent for bags and mats with the trade applies only to East India sugars. On bags and mats imported from other countries the tare is according to agreement between buyer and seller.
TAPIOCA—1 per ct. SAGO—2 per ct.
TEA—Invoice weight ascertained as follows: three to four pkgs are taken out of each 50 or 60 (usually those numbered the same), the tea turned out, and the pkgs weighed; the average of the three or four is taken as the tare of the whole.
VALENCIA RAISINS—5 lbs. per box, usually.

ITEMS REGARDING FISH.—Mackerel comes in barrels, half and quarter barrels, and kits, containing full weight, respectively, 200, 100, 50, and 20 lbs. No 1 mackerel should not be less than 13 inches in length, from the extremity of the head to the fork of the tail, fat, free from rust, taint, or damage. No. 2 mackerel should not be less than 11 ins. in length, fat, and free from rust, &c. No. 3 mackerel should not be less than 10 ins. in length. No. 3, large, should not be less than 13 ins., and in quality are those that remain after the selection of No. 1. No. 4. mackerel comprise all not in the above, and should be free from taint or damage.

The above is the standard established by law in Massachusetts, and is generally accepted by the trade elsewhere. Mackerel should be kept covered with brine and not exposed to the air as they become rancid or "rusty," after a few days. Mess mackerel—the finest fish, with head and tail removed. Extra No. 1's are selected fish. Large No. 2's—Fish over 13 ins. in length, and not good enough in quality for No. 1's.

Scaled herrings should be fat fish, free from scales, and when smoked be of a bright golden color. No. 1 herring are generally small and poor fish. The complaints of short weight packages of fish are very many, some of which exceed the entire profit.

HINTS TO GROCERS.—To keep ants out of sugar, take, say, 3 ozs. gum camphor, wrap it in one thickness of tea-paper, lay it on the sugar in the barrel and they will leave at once. Keep your tea in a close chest or canister, and keep coffee by itself, as its odor affects other articles. Look after the number of oranges and lemons in a box and see if they hold out. If not, claim. Oranges and lemons keep best wrapped in soft paper, and if possible laid in a drawer. Keep bread or cake in a tin box or stone jar. Cranberries will keep all winter in a firkin of water in a cellar. September and October butter is the best for winter use.

FLAVORING EXTRACTS, 27 KINDS.—The formulæ given below represent the average standard strength, but they may be reduced if required. 1. *Extract of Lemon*, oil of lemon, 2 ozs., freshly grated lemon peel, 1 oz., alcohol, 2 pts. 2. *Ext. of Orange*, oil of orange, 12 drs., freshly grated lemon peel, 4 ozs., alcohol 2 pts. 3. *Another*, Valencia oranges, 1 doz., alcohol, 2 pts. Carefully detach the yellow portion of the rind, and macerate it for ten days in the alcohol. Owing to the difficulty of procuring fresh oil of orange, this formula is generally preferred. 4. *Ext. of Rose*. Red rose leaves, 2 ozs., oil of rose, 1 dr., alcohol, 2 pts. 5. *Ext. of Celery*, celery seed, bruised, 2 ozs., alcohol, 1 pt. 6. *Ext. of Ginger*, tincture of ginger, 1 pt., alcohol, from ½ to 1 pt. Some use the tincture without dilution. 7. *Ext. of Bitter Almonds*, oil of bitter almonds, 1 oz. alcohol, 13 ozs., water, 6 ozs. Some color it with ½oz. tincture of turmeric. 8. *Ext. of Cinnamon*. Oil of cinnamon, 2 drs., Ceylon cinnamon, bruised, 4 ozs., diluted alcohol, 2 pts. 9. *Ext. of Peppermint*. Essence of peppermint,, U. S. P., 1 pt., alcohol, from ½ to 1 pt. Some prefer the essence without dilution. 10. *Ext. of Coriander*. Powdered coriander, 4 ozs., oil of coriander, 1 dr., alcohol, 21 ozs., water, 8 ozs. 11. *Ext. of Nutmeg*. Oil of nutmeg, 2 drs., powdered mace, 1 oz., alcohol, 2 pts: 12. *Ext. of Vanilla*. Vanilla bean, 1 oz., loaf sugar, 1 oz., alcohol, 70 per cent., sufficient. Triturate the vanilla with the sugar until a No 20 powder is obtained. Introduce into a 2 pt. stone jug with two ozs. of the menstruum, cork tightly, and digest several hours at a temperature of about 150°. Allow the mixture to cool, transfer it to a percolator, pack it firmly, and pour enough alcohol on it to make the percolate measure 1 pt. 13. *Ext. of Spearmint*. Essence of spearmint, U. S. P., 1 pt., alcohol, from ½ to 1 pt. Some use the essence without dilution. 14. *Ext. of Anise*. Anise seed, 2 ozs., oil of star anise, 1 oz., alcohol, 2 pts. 15. *Ext. of Pine Apple, Artificial*. Chloroform, 1 fl. oz., aldehyde, 1 do., butyric ether, 5 fl. ozs., butyrate of amyl, 10 do., glycerine, 3 fl. ozs., alcohol, 100 do. 16. *Ext. of Sassafras*. Oil of sassafras, 1 oz., sassafras in coarse powder, 2 ozs., alcohol, 2 pts. 17. *Ext. of Peach, Artificial*. Oil of bitter almonds, 2 ozs., acetic ether, 1 oz., alcohol 3 pts. 18. *Ext. of Nectarine*. Extract of vanilla, 1 pt., extract of lemon, 1 pt., extract of pine apple, 8 ozs. 19. *Ext. of Wintergreen*. Oil of wintergreen, 1 oz., alcohol, 1 pt., cudbear, or cochineal, 10 ozs. 20. *Ext of Clove*. Powdered clove, 4 ozs., diluted alcohol, 1 pt. 21. *Ext. of Blackberry, Artificial*. Tinct. of orris root, (1-8) 1 pt., acetic ether, 30 drops, butyric ether, 60 drops. 22. *Ext. of Tonka Bean*. Tonka bean, coarsely ground, 4 ozs., diluted alcohol, 1 pt. 23. *Ext. of Allspice*. Allspice, corsely ground, 4 ozs., diluted alchohol, 1 pt. 24. *Ext of Pear, Artificial*. Acetic ether, 5 fl. ozs., acetate of amyl, 10 do., glycerine, 10 fl. ozs., alcohol, 100 do. 25. *Ext. of Apple, Artificial*. Chloroform, 1 fl. oz., nitric ether 1 do., aldehyde, 2 fl. ozs., acetic ether, 1 do., valerianate of amyl, 10 fl. ozs., oxalic acid, 2 drs., glycerine 2 fl. ozs., alcohol, 100 do. 26. *Ext. of Strawberry, Artificial*. Nitric ether, 1 fl. oz., acetic ether, 5 do., formic ether, 1 fl. oz., butyric ether, 5 do., salicylate of methyl, 1 fl. oz., acetate of amyl, 3 do., butyrate of amyl, 2 fl. ozs., glycerine, 2 do., alcohol, 100 do. 27. *Ext. of Raspberry, Artificial*. Nitric ether 1 fl. oz., aldehyde, 1 do., acetic ether, 5 fl. ozs., formic ether, 1 do., butyric ether, 1 fl. oz., benzoic ether, 1 do., œnanthylic ether, 1 fl. oz., sebasic ether, 1 do., salicylate of methyl, 1 fl. oz. acetate of amyl, 1 do, butyrate of amyl, 1 fl. oz., tartaric acid, 2 ozs., glycerine, 4 fl. ozs., alcohol, 105 do. For other receipts, consult pp. 30, 159, and 207.

The credit system has bankrupted more people than perhaps all other causes put together. The most rigid scrutiny should therefore take place in every instance where credit is solicited. A good way is to make the party sign a statement of his assets, debts, means of payment, &c., and grant a limited credit on that basis. If the result proves intentional fraud then you have your remedy at law. Cash down is the only absolutely safe rule. Curtail every possible expense. Let the profits accumulate, hold on to them, and avoid uncertain outside speculations. See table of daily savings on page 587, and profit by its suggestions. Attend to the details of your business, see that the store is opened in good time, goods dusted, floor swept, paper, twine, nails, &c., picked up and everything kept in trim order. In establishing a business it is not always the best plan to open out in a new locality where rents are low and expenses light. The result will be in many cases, that before the new locality acquires the ability to render adequate support to a respectable business (after an unavailing struggle) the funds of the merchant will gradually give out, and he will be obliged to close his doors at the very time when he should have opened them. If, however, he succeeds, the dealer will do well to confine his attention more to the supply of the necessaries than the luxuries of life, until a more general demand arises for the latter as the neighborhood grows older.

Taking everything into account, the best locality for business purposes is in a city or town in a prominent throughfare where those whose trade you desire can most easily find you. A suitable place being secured, mount a proper sign board in a prominent manner, and make sure to present an imposing display of your choicest goods in your store windows. This, of itself, is a powerful attraction to passers by, who will frequently see just the article they require and call for it at once. This accommodation, coupled with civil treatment on your part, will often secure you a permanent customer, for people are bound to go where they are well used. A notable and most successful method of attracting customers and building up a lucrative business, is to sell a few of the leading staples at low figures, and obtain a fair profit on the rest. The most sagacious and far-seeing merchants do this, with the most astonishing financial results. In fact, thousands who are independently rich would now be bankrupt but for this system of transacting business.

The following directions deserve a wide circulation :—

"Enter into a business of which you have a perfect knowledge. In your own right, or by the aid of friends on long time, have a cash capital sufficient to do at least a cash business. Never venture on a credit business at the commencement. Buy all your goods or materials for cash ; you can thus take every advantage of the market, and pick and chose where and when you will. Be careful not to overstock yourself. Rise and fall with the market on short stocks. Always stick to those whom you prove to be strictly just in their transactions, and shun all others even at a temporary disadvantage. Never take advantage of a customer's ignorance, nor equivocate nor misrepresent. Have but one price and a small profit, and you will find all the most profitable customers—the cash ones —or they will find you.

"If ever deceived in business transactions, never attempt to save yourself by putting the deception upon others ; but submit to the loss, and be more cautious in future. According to the character or success of your business, set aside a liberal percentage for printing and advertising, and do not hesitate. Never let an article, parcel, or package, go out from you without a handsomely-printed wrapper, card, or circular, and dispense them continually. Keep yourself unceasingly before the public by judiciously advertising ; and it matters not what business of utility you make choice of, for if intelligently and industriously pursued, a fortune will be the result.

"Learn to say 'No' with decision; 'yes' with caution—'No' with decision whenever it resists temptation; 'yes' with caution when it implies a promise. A promise once given is a bond inviolable. A man is already of consequence in the world when it is known that we can implicitly rely upon him. Such a one is often preferred to a long list of applicants, for some important change which lifts him at once into station and fortune merely because he has this reputation, that when he says he will know a thing he knows it, and when he says he will do a thing he will do it. Reflect over these maxims; you will find it easy enough to practice them."

Rest assured industry and economy will be sure to tell in the end. Waste not want not go hand in hand. If in early life these habits become confirmed, no doubt can exist as to the ultimate triumph of the merchant in attaining a competency.

Be self-reliant and punctual. As you gain experience in business you can form your own judgment and act on it with more safety than you could on outside advice, and let no effort be considered too great which results in fulfilling your engagements and keeping your word. A good charcter for punctuality is in itself a valuable capital, as it makes one in a large measure the master of another's purse. In expressing yourself, be frank, speak to the point; form a habit of thinking vigorously and speaking correctly; say what you mean; and do what you say.

In buying goods never take advantage of another's necessities to beat him down to a figure which leaves him little or no profit, perhaps a loss, because he must have money. There is no manhood in such transactions, it may enhance your immediate profits, but will be disastrous to you in the end, besides being most unjust to the immediate sufferer. Let all your actions in buying and selling conform to the requirements of the golden rule.

Be always alert to the acquisition of knowledge relating to your business, this may be gained by conversation with experienced merchants, by the attentive reading of practical books treating on mercantile matters, and by taking trade papers, which in these stirring times have attained great perfection, embracing as they do an immense range of subjects, treating, each in its respective sphere, subjects of immense importance, relating to the hardware, grocery, dry goods, drug, and other mercantile trades, besides full reports of the markets pertaining to each business, an item which in itself no business man can afford to lose sight of. In this place the advice of the *American Grocer* to its subscribers to COUNT, MEASURE, WEIGH, AND GAUGE EVERYTHING YOU BUY, cannot be too strongly urgued upon the notice of business men. Profits will be greatly enhanced by taking advantage of the discounts which nearly all business men offer for cash payments. Keep your credit good and use it sparingly and discreetly.

A noted merchant amassed an immense fortune by the observance of these four simple rules: 1. Obtain the earliest and fullest information possible in regard to the matter in hand. 2. Act rapidly and promptly upon it. 3. Keep your intentions and means secret. 4. Secure the best employees you can obtain, and reward them liberally. See pp 590.

Rothschild's rules were. "1. I combined three profits I made the manufacturer my customer, and the one I bought of my customer; that is, I supplied the manufacturer with the raw material and dyes; on each of which I made a profit, and took his manufactured goods, which I sold at a profit, and thus combined three profits. 2. Make a bargain at once, be an off-handed man. 3. Never have anything to do with **an** unlucky man or place. I have seen many clever men who had not shoes to their feet. I never act with them; their advice sounds very well, but fate is against them; they do not get on themselves, how can they do good to me? 4. Be cautious and bold. It requires a great deal of caution and a great deal of boldness to make a great fortune, and when you have got it, it requires ten times as much wit to keep it."

Rules of John McDonough the millionaire of New Orleans. "1. Remember always that labor is one of the conditions of our existence. 2. Time is gold; throw not one minute away but place each one to account. 3. Do unto all men as you would be done by. 4. Never put off till tomorrow what you can do to-day. 5. Never bid another do what you can do yourself. 6. Never covet what is not your own. 7. Never think any matter so trivial as not to deserve notice. 8. Never give out that which does not first come in. 9. Never spend but to produce. 10. Let the greatest order regulate all the actions of your life. 11. Study in your course of life to do the greatest amount of good. 12. Deprive yourself of nothing necessary to your comfort, but live in an honorable simplicity and frugality. Labor then, to the last moment of your existence."

Render yourself familiar with your business and books, and do not be unduly anxious to extend your trade, remembering that a small business on cash capital yields better profits than a large business conducted on credit; also remember that the goods on your shelves are much better than having them charged up in bad debts. If it happens that you run an account with a doubtful customer, prudence requires that you should close the account at once and use every possible means to collect it without delay. It frequently happens in cases of this kind that prompt action will result in the recovery of the whole debt, when a very slight delay will entail a total loss. Every populous community is infested by such a vast number of incorrigible rascals who never intend to pay their debts, that dealers are justified in rejecting every application for credit where the financial ability of the applicant is in the slightest degree doubtful.

Avoid selfishness, niggardliness and parsimoniousness in the use of money or means. True nobility of character always finds its greatest pleasure in assisting and uplifting humanity. Viewed in this light it requires but slight exertion to solve the riddle propounded by old Mr. Honest in the Pilgrim :—

"There was a man, though some did count him mad,
The more he threw away the more he had."

The world presents many notable instances of a generous policy, It is safe to say that Peter Cooper, by his generous consecration of $2,000,000 to the up-building of the Cooper Institute, not to mention his other benefactions, has conferred more substantial benefits on humanity than whole dynasties of tyrants who misgovern empires, and render themselves a terror to peaceable nations.

In mercantile matters courage is indispenable, slackness is absolute ruin. It requires courage to tell a man you will not credit him, courage to insist on prompt payments from customers, courage to speak your mind candidly at all times, courage to deny yourself the possession of many things you want. It requires courage to refuse to conform to the absurd demands of fashion, to show respect for real worth even if it appears in humble garb, and to discountenance unprincipled rascality in fine clothes. It requires courage to act justly without fear or favor, to live within your means, to pay your debts, to collect your accounts, to withstand ridicule while acting righteously; in one word, if you lack courage never go into business at all.

In mercantile circles the commercial traveller occupies a most important position and in many cases proves himself a most valuable auxiliary to the merchant. To become a successful traveller it requires prolonged service on the road, a vast amount of shrewdness, and a profound knowledge of human nature. He must possess a clear head, a good temper, a ready, easy, and natural aptitude for making profitable bargains, with a good gift for mental, off-hand calculations in all possible emergencies.

In a work treating of commercial travellers in France, we find the following description of one of them: "With his customers, as every where else, he is polite and obliging; he kisses the baby, pats the spaniel, pays a compliment to the young lady behind the counter, and offers a pinch of snuff to the master of the shop. He inquires respecting the state of the vintage, foretells the result of the season, speaks at some length on the state of the grain market, obligingly inquires after madame's health, and invites her husband to call and see him in Paris. 'We'll dine at the Rocher,' laughs the traveller, adding, in a lower key, 'and discuss a bottle of A 1, eh?' Briefly, he obtains an order, and often a very extensive one."

In marking goods it is usual with merchants to make use of a private mark, phrase, or key-word to designate the cost and selling price of their goods, the object being to conceal these points from all except their own salesmen. The following words and phrases present a choice from which to make a selection.

GAS FIXTURE.	FISH TACKLE.	BROWN SUGAR.
BLACK HORSE.	CASH PROFIT.	NOW BE SHARP.
MISFORTUNE.	SO FRIENDLY.	ELUCIDATOR.
IMPORTANCE.	GAINFUL JOB.	OF INDUSTRY.

It will be noticed that each word or phrase contains ten letters, no two alike, the object being to use letters instead of figures in marking the goods. For instance, take the phrase

G A S F I X T U R E.
1 2 3 4 5 6 7 8 9 0

In marking the cost and selling price on a ticket, we assume that the cost is \$3.25 and the selling price \$4.37: this would be represented by the dumb letters *s a i—f s t*. The cost price is generally placed uppermost on the tag, the selling price below it, thus $\frac{s\,a\,i}{f\,s\,t}$. An extra letter, styled a repeater, is used to obviate the repetition of a letter or figure as well as to prevent the disclosure of the private mark, for instance instead of writing 366 by the key-word, which would be *s x x*, use as a repeater the letter *o*, and make it read *s x o*. Fractions may be written thus: $456\frac{2}{3} = f\,i\,x\,\frac{a}{s}$. For further information on marking goods see page 210.

In advertising, let your announcements be short, spicy, attractive, and prominently displayed; study brevity, using as few words as possible to express your meaning. A long, diffuse advertisement kills its object, people will not read it. Let an advertisement be truthful, free from senseless bombast, circulate them widely, and when your new customers come in, fulfil to the letter, the promises made in your announcements; you will thus obtain their confidence, retain their custom and their efforts to obtain more customers for you. Remember, judicious advertising always pays; but it requires judgment to advertise aright. Select the channels which circulate most widely among the class of customers you desire to reach, and advertise persistently and liberally. Every dollar expended will bring tenfold profits. In advertising on printed cards or circulars, it is an important object to connect them with some matter valuable to the receiver, such as a calendar, a railway time table, an elegant picture, or any other matter that will be preserved for its inherent value. Lithographed circulars, in imitation of the handwriting, sent direct to parties, are a first class advertising media. Never quit advertising until you quit business. The most successful merchants in New York are the ones which advertise largely, and consider their outlay in this manner just as necessary as the payment of their rent or clerk hire.

Next to prominence in announcing your business is civility, politeness, and honest treatment of customers. These elements of character, which can never be ignored without serious detriment to any one engaged in public business, cost nothing, and will often enable the small dealer to outstrip his rich rival. A cheerful, civil, and polite manner is all-powerful in obtaining and retaining customers, and a grand mistake is often made by men on the road to fortune, in forgetting or neglecting to exercise this cheap and pleasant means of its ultimate attainment.

In opening an account with a bank provide yourself with a proper introduction. Never draw a check for a larger sum than the amount at your credit, and do not send your check to a remote person with the expectation of depositing funds to meet it before it gets back; the telegraph may explode that bubble. Never exchange checks with any one, or give a check under the stipulation that it is not to be used until a given time. Never take a distant check from a neighbor to pass it free through your bank, giving him your check for it. Never give your check to a stranger; it is liable to be raised, and passed, thus entailing a heavy loss on the bank. In sending a check to a distance, with the name and residence of the payee, thus; John Ramsden & Co., of Buffalo, N. Y. This will give a clue to the bank when it is presented for payment. In presenting an accommodation note for discount, tell your bank the real nature of the paper. It is much better to act in this candid, unreserved manner than otherwise. Never consider your bank arbitrary if it declines to discount an accommodation note; in any event never wrangle or contend with it, but act squarely with them by settling in full, and then go elsewhere if discourteously treated. If you wish to get a customer's note discounted to obtain funds to take up a prior note by the same customer, inform your bank fully about it. Don't waste arguments to induce your bank to discount paper which it has already declined, it may have the best of reasons for such action. In your dealings with bank officers never exhibit asperity of temper, but study politeness, civility, candor and courtesy under all circumstances.

COMMERCIAL AND LEGAL FORMS.

No. 1. *Negotiable Note.*

$400 Montreal Jan. 1, 18—.

Three months after date, I promise to pay Oliver Cromwell, or order, Four Hundred Dollars, for value received.

Note. JOHN HOWARD.

For an interest-bearing note, add "with interest" after "value received."

No. 2. *Joint Note.*

$430 $\frac{50}{100}$ St. John, N.B., Jan. 4, 18—.

Six months after date we jointly, but not severally, promise to pay Thomas Bruce, or order, Four Hundred and Thirty $\frac{50}{100}$ Dollars, for value received, with interest.

JOHN SPENCER,
DAVID THOMSON.

No. 3. *Note payable at a Bank.*

$1000 New York, Jan. 11, 18—.

Three months after date, I promise to pay to the order of Hiram Brown, the Sum of One Thousand Dollars, value received, at Park National Bank, New York.

PETER PRINGLE.

No. 4. *Note payable by Instalments.*

$100 Toronto, Feb. 10, 18—.

For value received, I promise to pay to John Fleming, or order, One Hundred Dollars, in the way and manner following, to wit : Fifty Dollars in three months from date, and Fifty Dollars in four months, with interest on the several sums as they become due.

ALEX. ARMSTRONG.

No. 5. *Note not Negotiable.*

$600 Syracuse, N.Y., July, 15, 18—.

Three months after date, for value received, I promise to pay Thomas Bonner, Five Hundred Dollars.

WILLIAM T. BELL.

No. 6. *Note on Demand.*

$300 Hamilton, March 14, 18—.

On demand I promise to pay John Rose, or order, Three Hundred Dollars, value received, with interest.

WILLIAM WALLACE.

No. 7. *Note payable in Merchandise.*

$700 Fredericton, N.B., June 1, 18—.

For value received, on or before the first day of November next, I promise to pay to A. Gibson, or Order, Seven Hundred Dollars in good merchantable Spruce Logs, at his Sawmill near this city, at the market value on the maturity of this note.

JOHN STREAMDRIVER.

No. 8. *Due Bill for money.*

London, Ont., June 20, 18—.

$140 $\frac{50}{100}$ Due to John Baxter, or order, on demand, One Hundred and forty $\frac{50}{100}$ Dollars, value received.

J. B. PERKINS.

No. 9. *Due Bill payable in Goods.*

$200 Chicago, Ill., July 14, 18—.

Due on demand, to R. Wyllie, Two Hundred Dollars, in merchandise from our store.

T. M. HUNTER & Co.

No. 10. *Check on a Bank.*

No. 16. New York, July 20. 18-

NINTH NATIONAL BANK.

Pay to Bradford & Parker or order, Three Thousand——— $\frac{00}{100}$ Dollars.

$3,000 G. BURNHAM.

No. 11. *Form of a Bank Draft.*

$6,300 BANK OF THE METROPOLIS No. 197.

New York, Aug. 5, 18—.

Pay to the order T. M. Banker Six Thousand and Three Hundred Dollars.

Duplicate unpaid.

G. A. COPELAND, Cashier.

To Eliot Nat. Bank, Boston.

No. 12. *Sight Draft.*

$600 New York, Aug. 10, 18—.
At Sight, pay to the order of R. Pitman & Co., Six Hundred dollars, value received, and charge the same to our account.

GEORGE ROOT & CO.

To JAMES ALLISON, Chicago.

No. 13. *Time Draft.*

$200 Rochester, N.Y., Aug. 11, 18—.
Thirty days after date, pay to the Order of John Hall, Two Hundred and Fifty Dollars, value received, and charge to our account,

T. BANNING & CO.

No. 14 *Set of Foreign Bills of Exchange*

Exchange for £5,000 New York, Aug. 10, 18—.
Ten days after sight of this First of Exchange (our Second and Third unpaid), pay to the Order of David Perry, Five Thousand Pounds Sterling, value received, and charge the same without further advice, to,

JOSEPH SELIGMAN & CO.

To BARING BROTHERS.

No. 220 *London, Eng*

Exchange for £5,000 New York, Aug. 10, 18—.
Ten days after Sight of this Second of Exchange (First and Third unpaid), pay to the order of David Perry, Five Thousand Pounds Sterling, value received, and charge the same without further advice, to

JOSEPH SELIGMAN & CO.

To BARING BROTHERS.

No. 220. *London, Eng.*

Exchange for £5,000 New York. Aug. 10, 18—.
Ten days after Sight of this Third of Exchange (First and Second unpaid), pay to the order of David Perry, Five Thousand Pounds Sterling, value received, and charge the same without further advice, to

JOSEPH SELIGMAN & CO.

To BARING BROTHERS.
No. 220. *London, Eng.*

No. 15. *Form of a Protest.*

$2,000 New York, Aug. 15, 1877.
Please to take notice, that a Promissory Note for Two Thousand Dollars, made by Robert Brown, May 12, 1877, and endorsed by you, having been duly presented and payment thereof demanded, which was refused, is therefore protested for non-payment, and that the holders look to you for payment, interest, costs, and damages.

To U. LOOK OUT. I. L. KETCHUM.
Notary Public.

No. 16. *Receipt for Money on Account.*

Received, New York, March 23, 1878, of Thomas Paywell, Seventy-five dollars on account.

$75 R. THANKFUL.

No. 17. *Receipt in Full.*

Fredericton, N. B., March 12, 18—.

Received of John Murray, One Hundred Dollars, in full of all demands to date.

$100. HENRY BLACKBURN.

No. 18. *Receipt for Money advanced on a Contract.*

$1,000 Woodstock, Ont., May 1, 18—.

Received of A. Campbell, One Thousand Dollars in advance, on a contract to build for him a Frame house on Dundas street.

R. TURNBULL.

No. 19. *Receipt for Rent.*

$200 Galt, Ont., June 1, 18.—

Received of A. Thomson, Two Hundred Dollars in full for one year's rent for dwelling on Water Street.

CHARLES WILSON.

No. 20. *Receipt for a Note.*

$400 New York, June 2, 18—.

Received of Hiram Edson, his note for Four Hundred Dollars at three months, in full of account.

THOMAS HARRISON.

No. 21. *Order for Money.*

Baltimore, June 5, 18—.

Mr. ROBERT HILL,

Please pay Thomas Jamison, or Bearer, Fifty dollars on my account.

DAVID HILLMAN.

No. 22. *Order for Merchandise.*

MR. R. T. BONNER.

Please deliver to the bearer, Joseph Fallett, such goods as he may desire from your store to the amount of Sixty-five dollars, and charge the same to my account.

JOHN GARDINER

No. 23. *Letter of Credit.*

Toronto, October 5, 18—.

Gentlemen:—Allow me to introduce to your firm the Bearer, Mr. J. S. Harper; should he make a selection from your stock to the amount of One Thousand Dollars, I will be answerable for that sum in case of his non-payment.

Yours, truly,

RUFUS BARLOW

To LORD & TAYLOR, New York,

No. 24. *Landlord's Agreement.*

This certifies, that I have let and rented, this first day of June, 1878, unto Robert Walker, my house and lot No. 150, Dundas street, London, Ont., and its appurtenances; he to have the free and uninterrupted occupation thereof for one year from this date, at the yearly rental of One

Thousand Dollars, to be paid monthly in advance; rent to cease if destroyed by fire, or otherwise made untenantable.

JAS. KINGMAN.

No. 25. *Tenant's agreement.*

This certifies that I have hired and taken from Joseph Kingman, his house and lot No. 150, Dundas street, London, Ont., with appurtenances thereto belonging, for one year, to commence this day at a yearly rental of One Thousand Dollars, to be paid monthly in advance, unless said house becomes untenantable from fire or other causes, in which case rent ceases; and I further agree to give and yield said premises one year from this first day of June, 1878, in as good condition as now, ordinary wear and damage by the elements excepted.

Given under my hand this day.

ROBERT WALKER.

No 26. *Notice to Quit.*

To A. B. PALMER.

Sir:—Please observe that the term of one year, for which the house and land, situated at 47 Pearl street, and now occupied by you, were rented to you, expired on the first day of June, 1878, and as I desire to repossess said premises, you are hereby requested and required to vacate the same.

Yours truly,

T. H. CARTER.

No. 27. *Tenant's Notice of leaving.*

Dear Sir: The premises I now occupy as your tenant, at No. 56, Main street, I shall vacate on the first day of May, 1878. You will please take notice accordingly.

Dated this 26th day of March, 1878.

WILLIAM GILBERT.

To JOHN LAWRENCE, Esq.

No. 28. *Common Form of Bond.*

KNOW ALL MEN by these presents, that I, David Wilson, of Fredericton, York County, Province of New Brunswick, am held and firmly bound unto John Scott of the place aforesaid, in the sum of six hundred dollars, to be paid to the said John Scott, his heirs or assigns; for which payment to be well and truly made, I bind myself, my heirs and assigns, by these presents.

Sealed with my seal, and dated this first day of August, one thousand eight hundred and seventy-eight.

The condition of this obligation is such, that if I, David Wilson, my heirs, assigns, or executors, shall promptly pay to the said John Scott, his heirs or assigns, the sum of six hundred dollars in three equal annual instalments from the date hereof, with annual interest, then the above obligation to be void; otherwise to be in full force and virtue.

DAVID WILSON, (L.S).

Sealed and delivered in
Presence of
ADAM CLARK.

No. 29. *Form of Bill of Sale.*

Know all men by these Presents, that I, Peter Denman, of the city of Boston, in the County of Middlesex, and State of Massachusetts, of the first part, for and in consideration of the sum of six hundred dollars, lawful money of the United States, to me in hand paid, at or before the ensealing and delivery of these presents, by Robert Ensign of the same place, of the second part, the receipt whereof is hereby acknowledged, have bargained and sold, and by these presents do grant and convey, unto the said party of the second part, his executors, administrators, and assigns, *one six year old dark-bay horse fifteen hands high, one black horse, one double harness, one carriage, two cows and five pigs*, TO HAVE AND TO HOLD the same unto the said party of the second part, his heirs, administrators and assigns for ever.

And I do for myself, my heirs, executors, and administrators, covenant and agree, to and with the said party of the second part, to warrant and defend the sale of the said *goods and chattels* hereby sold unto the said party of the second part, his executors, administrators, and assigns, against all and every person and persons whatsoever.

IN WITNESS WHEREOF, I have hereunto set my hand and seal, this sixth day of April one thousand eight hundred and seventy-eight.

PETER DENMAN, (L.S).

Sealed and delivered in presence of
PETER WILSON,
J. GODDARD.

No. 30. *Chattel Mortgage.*

This indenture, made this fifteenth day of April, one thousand eight hundred and seventy-eight, between David Allan of the town of Guelph, County of Wellington, Province of Ontario, party of the first part, and Alfred Baker of the same town, county and Province, party of the second part.

WITNESSETH, that the said party of the first part, for, and in consideration of the sum of six hundred dollars in hand paid, the receipt of which is hereby acknowledged, does hereby grant, sell, convey and confirm unto the said party of the second part, his heirs and assigns forever, all and singular, the following described goods and chattels, to wit:

1 Weber piano, 4 black walnut bedsteads, 1 stove, 2 mahogany bureaus, 2 sofas, 1 dozen chairs, etc., now in possession of said Allan, in his dwelling at No. —— ——— street, Guelph. TO HAVE AND TO HOLD all and singular the goods and chattels above bargained and sold, or intended so to be, unto the said party of the second part, his executors, administrators and assigns forever. AND the said party of the first part, for himself, his heirs, assigns, and administrators, all and singular the goods and chattels above bargained and sold unto the said party of the first part, and against all and every person whomsoever shall, and will, warrant and forever defend

UPON CONDITION, that if the said party of the first part shall and do well and truly pay unto the said party of the second part, his executors, administrators, or assigns, the sum of six hundred dollars lawful money of this Province, with interest thereon, one year from this date, thence these presents shall be void. AND the said party of the first part, for himself, his executors, and assigns, doth covenant and agree to and with the said party of the second part, his executors, administrators and assigns, that in case default shall be made in the payment of the said sum above mentioned, then it shall and may be lawful for, and I, the said party of the first part, do hereby authorize and empower, the said party of the second part, his executors, administrators, and assigns, with the aid and assistance of any person or persons, to enter my dwelling-house, or such other place or places as the said goods and chattels are or may be placed, and take and convey away the said goods and chattels, and to sell or dispose of the same for the best price they can obtain, and, out of the proceeds thereof, to retain and pay the said sum above mentioned, and all charges touching the same, rendering the overplus (if any) unto me, or to my executors, administrators or assigns.

AND, UNTIL DEFAULT be made in the payment of the said sum of money, I am to remain and continue in the quiet possession of the said goods and chattels, and in the full and free enjoyment of the same.

IN WITNESS WHEREOF, I, the said party of the first part, have hereunto set my hand and seal the day and year first above written.

Signed, sealed and delivered in presence of
GEORGE ROBSON,
THOMAS NEILSON.

DAVID ALLAN, (L.S.)

NOTE.—The law, both in Canada and the United States, requires that all chattel mortgages should be filed in the Clerk's, Register's, or Recorder's office of the town, city, or county where the mortgagor resides, and the property is, when mortgaged. Unless the same is renewed at or before the close of the year, its virtue expires, and every creditor will have the same right to the property as the mortgagee.

No. 31. *Claim to be filed by Lien Creditor's in Clerk's Office.*

Henry Wilson, of Buffalo, in the County of Erie, and State of New York, lumber merchant, files his claim for five hundred and sixty dollars against a certain house and lot of ground, belonging to John Rodgers, situated on the south side of Clinton street, No. 27, in the plan of said city, containing in front on Clinton street, forty feet, and in depth one hundred feet, bounded on the north by the said Clinton street, on the west by ground of John Smith, on the east ground of Thomas Nelson, and on the south by ground of Thomas Carter, for that sum due him for lumber and other materials furnished by him, in erecting the aforesaid house in October, 1877.

HENRY WILSON.

November 4, 1877.

NOTE.—The above form is applicable for any claim whatever that may be due to lumber merchants, brick-makers, carpenters, painters, masons, plumbers, or others engaged in furnishing materials or labor in erecting buildings.

No. 32. *Form of Judgment-Note.*

For value received I promise to pay to Henry Jordan of Lockport, or Order, four hundred dollars, with interest, on the first day of June next; and I hereby nominate, constitute, and appoint, any attorney-at-law of this State, my true and lawful attorney, irrevocable, for me and in my name to appear in any court of record of this State, at any time after the above promissory note becomes due, and to waive all process and service thereof, and to confess judgment in favor of the holder hereof for the sum that may be due and owing hereon, with interest and costs, waiving all errors, etc., with stay of execution until the first day of April next.

Witness my hand and seal at Lockport, N. Y., this first day of December, in the year one thousand eight hundred and seventy-seven.

Signed, sealed, and delivered in presence of
JOSEPH INMAN,
ROBERT KERR.

THOMAS WEBSTER, (L.S.)

NOTE.—The above note enables the holder, in several States, to enter up judgment thereon without suit, if not paid when due.

No. 33. *Form of Note for Indiana.*

$200. RICHMOND, IND., April 1, 18—.

On demand, for value received, I promise to pay Charles Marsh, or Order, two hundred dollars, with interest, payable without any relief whatever from valuation or appraisement.

ROBERT MILLER.

No. 34. *Form of Note of Pennsylvania.*

$500. PHILADELPHIA, PA., April 8, 18—.

Three months after date, I promise to pay to the order of Thomas Maxwell, five hundred dollars, without defalcation, for value received.

ALEXANDER REID.

No. 35. *Form of a Bill of Lading for Timber, &c.*

Shipped, in good order and condition, by Robert Godfrey & Co., on board the good ship "*Dominie Sampson*," whereof P M. Marshall is master for this present voyage, now lying in the port of St. John, N. B., and bound for Liverpool, England. To say :—

66,760 feet Mer. Spruce, all under deck.
100 M. Spruce laths, all under deck.
90 M. ft. Mer. Pine, all on deck,

being marked and numbered in the margin ; and are to be delivered, in like good order and condition, at the aforesaid port of Liverpool (the danger of the seas and fire always excepted), unto Thomas Adams & Co., or to assigns, he or they paying freight for the said timber at the rate of ten dollars per M. feet, and one dollar per M. for laths, without primage and average accustomed.

In witness whereof, the master of the said vessel hath affirmed to three bills of lading, all of this tenor and date ; one of which being accomplished, the others to stand void.

P. M. MARSHALL.

Dated at St. John, N. B.,
June the 5th, A.D. 1878.

No. 36. *Form of a Survey Bill of Lumber, &c.*

Surveyed from Alex. Gibson of Nashwaak, New Brunswick, to Schooner "Inflexible" Captain Duncan. To say :—

43,600 ft. 2 x 8, from 12 ft. long up (Mch.) Spruce.
37,300 " No. 1 Pine boards.
19,400 " 10 x 12 Mer. Pine timber.
24,500 " Hemlock boards (Mch).
159 M. No. 1 Pine Shingles.

Nashwaak, N. B.,
June 5, Anno Domini 1878.

DAVID MORRISON,
Surveyor

No. 37. *Form of Agreement and Warrant for the Sale of Horse.*

THIS AGREEMENT, made this eighth day of April, one thousand eight hundred and seventy-eight, between Robert Pringle of the village of Stanley, county of York and Province of New Brunswick, of the first part, and David Brown of said place, of the second part.

WITNESSETH, that the said Robert Pringle hereby agrees to sell to the said David Brown his *dark-bay* horse, with a white star in the forehead, and black mane and tail, and to warrant the said horse to be well broken, to be kind and gentle, both under the saddle and in single and double harness, to be sound in every respect and free from vice, for the sum of *one hundred dollars,* to be paid by the said David Brown, on the seventh day of June next.

In consideration whereof, the said David Brown agrees to purchase the said horse, and to pay therefor to the said Robert Pringle the sum of *ıe hundred dollars* on the seventh day of June next.

IN WITNESS WHEREOF, &c. (as in No. 29).

No. 38. *Agreement to Cultivate Land on Shares*

THIS AGREEMENT, &c. (as in No. 30).

WITNESSETH, that the said Robert Pringle agrees with the said David Brown, that he will properly plough, harrow, till, fit, and prepare fo sowing, all that certain field of ground belonging to the said Brown, which field lies, etc. (*here insert description of field*) containing about ten acres, and to sow the same with good fall wheat, finding one-half the seed wheat necessary therefor, on or before the fifteenth day of September next: and that he will, at the proper time, cut, harvest, and thresh, the said wheat, and winnow and clean the same, and deliver the one-half part of the said wheat to the said David Brown, at his barn, on his premises, in the village of Stanley, aforesaid, near his dwelling house, within ten days after the same shall have been cleaned; and will carefully stack the one-half of the straw on the premises of the said David Brown, near to his barn aforesaid.

And the said David Brown, in consideration of the foregoing agreement, promises and agrees, to and with the said Pringle, that he may enter in upon said field for the purpose of tilling and sowing the same, and of harvesting the crop; and free ingress and egress have and enjoy for the purpose aforesaid; and that he will furnish to the said Pringle one-half of the seed wheat necessary to sow the same, on or before the fifteenth day of September next, and permit the said Pringle to thrash and clean the wheat upon the premises of the said David Brown.

In witness whereof, &c. (as in No. 29), both parties will sign.

No. 39. *Lease of a Farm.*

THIS INDENTURE, made this first day of March, one thousand eight hundred and seventy-eight, between Peter Marshall, of the township of Dumfries, county of Waterloo, and Province of Ontario, of the first part, and Robert Walker of the said township and county of the second part.

WITNESSETH, that the said Peter Marshall, for, and in consideration of the yearly rents and covenants hereinafter mentioned, and reserved on the part and behalf of the said Peter Marshall, his heirs, executors and administrators, to be paid, kept, and performed, hath demised, set, and to farm let, and by these presents doth demise, set, and to farm let, unto the said Robert Walker, his heirs and assigns, all that certain piece, parcel or tract of land situate, lying and being in the township of Dumfries aforesaid, known as lot No. (*here describe land*) now in the possession of ——, containing one hundred acres, together with all and singular the buildings and improvements, to have and to hold the same unto the said Robert Walker, his heirs, executors and assigns, from the —— day of —— next, for, and during the term of five years, thence next ensuing, and fully to be complete, and ended, yielding and paying for the same, unto the said Peter Marshall, his heirs and assigns, the yearly rent, or sum —— dollars, on the first day of —— in each and every year, during the term aforesaid, and at the expiration of said term, or sooner if determined upon, he the said Robert Walker, his heirs or assigns, shall and will quietly and peaceably surrender and yield up the said demised premises, with the appurtenances, unto the said Peter Marshall, his heirs and assigns, in as good order and repair, as the same now are, reasonable wear, tear, and casualties, which may happen by fire, or otherwise, only excepted.

IN WITNESS WHEREOF we have, etc. (as in No. 29).

No. 40. *Warranty Deed by Husband and Wife, with Covenants.*

THIS INDENTURE, made this eighteenth day of June, in the year of our Lord one thousand eight hundred and seventy-eight, between John Wilson, of Newton, county of Sussex, State of New Jersey, and Charlotte, his wife, of the first part, and Peter Cunningham of the same place, of the second part.

WITNESSETH, that the said party of the first part, for and in consideration of the sum of two thousand dollars in hand, well and truly paid by the said party of the second part, the receipt whereof is hereby acknowledged, have granted, bargained, and sold, and by these presents do grant, bargain, and sell, unto the said party of the second part, his heirs and assigns, all the following described lot, piece, parcel or tract of land situated in the town of Newton, county of Sussex, and State of New Jersey, to wit: (*Here describe the property.*)

Together with all and singular the hereditaments and appurtenances thereunto belonging or in any wise appertaining, and the reversion and reversions, remainder and remainders, rents, issues, and profits thereof; and all the estate, right, title, interest, claim and demand whatsoever, of the said party of the first part, either in law or equity, of, in, and to, the above-bargained premises, with the hereditaments and appurtenances: TO HAVE AND TO HOLD the said premises above bargained and described, with the appurtenances, unto the said party of the second part, his heirs and assigns, for ever. And the said John Wilson, and Charlotte Wilson, his wife, parties of the first part, hereby expressly waive, release, and relinquish unto the said party of the first part, his heirs, executors, administrators and assigns, all right, title, claim, benefit, and interest whatever, in, and to the above-described premises, and each and every part thereof, which is given by or results from, all laws of this State pertaining to the exemption of homesteads.

And the said John Wilson and Charlotte Wilson, his wife, party of the first part, for themselves and their heirs, executors, and administrators, do covenant, grant, bargain, and agree, to and with the said party of the second part, his heirs and assigns, that at the time of the ensealing and delivery of these presents they were well seized of the premises above conveyed, as of a good, sure, perfect, absolute and indefeasible estate of inheritance, in law and in fee simple, and have good right, full power, and lawful authority to grant, bargain, sell, and convey the same, in manner and form aforesaid, and that the same are free and clear from all former and other grants, bargains, sales, liens, taxes, judgments, assessments, and incumbrances of what kind or nature soever; and the above-bargained premises in the quiet and peaceable possession of the said party of the second part, his heirs and assigns, against all and every or persons lawfully claiming or to claim the whole or any part thereof, the said party of the first part shall and will warrant and forever defend.

In testimony whereof, the said parties of the first part have hereunto set their hands and seals the day and year first above written.

JOHN WILSON, (L.S.)
CHARLOTTE WILSON, (L.S.)

Signed, sealed and delivered in presence of
HENRY NELSON.
ROBERT REID.

No. 41. *Acknowledgment of Deed.*

SUSSEX COUNTY, N. J.

On the eighteenth day of June, one thousand eight hundred and seventy-eight, personally appeared before me John Wilson, and Charlotte, his wife, whom I know to be the persons described in, and who executed the within instrument, and who severally acknowledged that they executed the same: the said Charlotte being by me examined separate and apart from her husband, acknowledged that she executed the same freely, and without fear or compulsion from him.

PHILIP HUNTER, J. P.

Minute of Record.

Recorded in the Clerk's office of the County of Sussex, in Liber 45, p. 81, of Mortgages, 18th June, 1878, at 30 minutes past 2 p.m.

ROBERT WATTS, *Register.*

No. 42. *Mortgage of Land to secure Payment of Money.*

THIS INDENTURE, made the tenth day of April, one thousand eight hundred and seventy-eight, between John Hunter, of Dorset, county of Bennington, State of Vermont, merchant, and Margaret, his wife, of the first part, and William West, of the same place, agent, of the second part: WHEREAS, the said John Hunter is justly indebted to the said party of the second part, in the sum of five thousand dollars, lawful money of the United States, secured to be paid by his certain bond or obligation, bearing even date with these presents, in the penal sum of ten thousand dollars, lawful money as aforesaid, conditioned for the payment of the first-mentioned sum of five thousand dollars, as by the said bond or obligation, and the condition thereof, reference being thereunto had, may more fully appear. NOW THIS INDENTURE WITNESSETH, that the said parties of the first part, for the better securing of the said sum of money mentioned in the condition of the said bond or obligation, with interest thereon, according to the true intent and meaning thereof. and also for and in consideration of the sum of one dollar to me in hand paid by the said party of the second part, at, or before the ensealing and delivery of these presents, the receipt whereof is hereby acknowledged, have granted, bargained, sold, aliened, released, conveyed, and confirmed, and by these presents do grant, bargain, sell, alien, release, convey, and confirm, unto the said party of the second part, and to his heirs and assigns for ever, ALL that certain piece, parcel, or lot of land, situate, lying, and being: (*Here describe premises.*) To have and to hold the same, together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging, or in any wise appertaining, and the reversion and reversions, remainder and remainders, rents, issues and profits thereof; *And also*, all the estate, right, title, interest, dower, property, possession, claim, and demand whatsoever, as well in law as in equity, of the said parties of the first part, of, in, and to the same, and every part and parcel thereof, with the appurtenances. To have and to hold the above granted and described premises, with the appurtenances, unto the said party of the second part, his heirs and assigns, to his and their proper use, benefit, and behoof forever. Provided always, and these presents are upon this express condition, that if the said party of the first part, his heirs, executors and assigns, shall well and truly pay or cause to be paid unto the said party of the second part, his executors, administrators or assigns, the said sum of money mentioned in the condition of the said bond or obligation, and the interest thereon, at the time, and in the manner mentioned in the said condition, according to the true intent and meaning thereof, that these presents and the estate hereby granted shall cease, determine, and become null and void. And the said John Hunter, for himself, his heirs, executors, and administrators, doth covenant and agree to pay unto the said party of the second part, his executors, administrators, or assigns, the said sum of money and interest, as mentioned above and expressed in the said condition of the said bond. And if default shall be made in the payment of the said sum of money above mentioned, or the interest that may grow due thereon, or of any part thereof, that then, and from thenceforth, it shall be lawful for the said party of the second part, his executors, administrators and assigns, to enter into and upon all and singular the premises hereby granted, or intended so to be, and to sell and dispose of the same, and all benefit and equity of redemption of the said party of the first part, his heirs, executors, administrators, or assigns, therein, at public auction, according to the act in such case made and provided: And as the attorney of the said party of the first part, for that purpose by these presents duly authorized, constituted, and appointed, to make and deliver to the purchaser or purchasers thereof, a good and sufficient deed or deeds of conveyance, in the law for the same in fee simple, and, out of the money arising from such sale, to retain the principal and interest which shall then be due on the said bond or obligation, together with the costs and charges of advertisement and sale of the premises, rendering the overplus of the purchase money (if any there shall be) unto the said John Hunter, party of the first part, his heirs, executors, administrators, or assigns, which sale so to be made shall forever be a perpetual bar, both in law and in equity, against the said party of the first part, his heirs and assigns, and all other persons claiming or to claim the premises, or any part thereof, by, from, or under, him, them, or either of them.

In witness whereof, the parties of the first part have hereunto set their hands and seals the day and year first above written.

JOHN HUNTER, (L.S.)
MARGARET HUNTER, (L.S.)

Signed, sealed, and delivered in presence of
Thomas Bates,
William Bell.

No. 43. *Form of Satisfaction Piece.*

I, William West, of Dorset, Bennington County, Vermont, do hereby certify that a certain mortgage, bearing date the tenth day of April, one thousand eight hundred and seventy-eight, made and executed by John Hunter, and Margaret, his wife, of the same place, and recorded in the office of the Clerk of the county of Bennington, in Liber 45, p. 76, of Mortgages, on 10th day of April, 1878, is paid. Dated 1st May, 1878.

WILLIAM WEST, (L.S.)

BENNINGTON COUNTY, Vermont, SS.:

On the first day of May, 1878, before me came William West, to me personally known to be the individual described in, and who executed the above certificate, and acknowledged that he executed the same.

JOHN HAMPDEN, J. P.

No. 44. *Assignment of Mortgage.*

KNOW ALL MEN BY THESE PRESENTS, that I, William West, of Dorset, county of Bennington, State of Vermont, agent, of the first part, for and in consideration of the sum of five thousand dollars, lawful money of the United States, to me in hand paid by John Howard, of the same place, farmer, of the second part, at or before the ensealing and delivery of these presents, the receipt whereof is hereby acknowledged, have granted, bargained, sold, assigned, transferred, and set over, and by these presents do grant, bargain, sell, assign, transfer, and set over, unto the said party of the second part, his heirs and assigns, a certain indenture of mortgage, bearing date the 10th day of April, one thousand eight hundred and seventy-eight, made by John Hunter, and Margaret, his wife, and recorded in the office of the Register of the county of Bennington, State of Vermont, in Liber 36, of Mortgages, p. 50, together with the bond or obligation thereto belonging, and the money due, and to become due thereon, with the interest, TO HAVE AND TO HOLD the same unto the said party of the second part, his heirs, administrators and assigns for ever, subject only to the proviso in the said Indenture of Mortgage mentioned. AND I do hereby make, constitute, and appoint the said party of the second part, my true and lawful attorney irrevocable, in my name or otherwise, but at his own proper costs and charges, to have, use and take, all lawful ways and means for the recovery of the said money, and interest, and, in case of payment, to discharge the same as fully as I might or could do if these presents were not made.

IN WITNESS WHEREOF, I have hereunto set my hand and seal, the first day of May, one thousand eight hundred and seventy-eight.

WILLIAM WEST, (L.S.)

In presence of
DUNCAN FORBES,
JOHN REID,

NOTE.—Deeds, mortgages, and assignments of mortgages should be put on record in the Register's office without delay after being executed. The foregoing forms (as well as the following) are suitable for either the United States or Canada.

No. 45. *Form of Will for Real and Personal Property.*

I, Joseph Knight, of the city of Toronto, county of York, and Province of Ontario, grocer, realizing the uncertainty of life, and being of feeble health, but of sound mind, memory, and judgment, do make and declare this to be my last will and testament in manner and form following, to wit:

First, I give, demise, and bequeath unto my eldest son, Robert Knight, the sum of four thousand dollars, now on deposit in the Bank of Montreal, together with my grocery store at No. — —— street, with all the tenements and improvements thereto belonging: to have and to hold unto my said son, his heirs and assigns forever.

Second, I give and bequeath unto my beloved wife, Charlotte, absolutely, the house in which I now reside, at No. — —— street, together with all the furniture therein, including piano, organ, linen, china, the plate, wearing apparel, etc., together with ten thousand dollars in Bank stock and Railway bonds, now lodged in my safe; the same to be in lieu of her dower at common law.

Third, I give and bequeath to my invalid mother, Ellen Knight, the income and rents from my farm in Scarboro during the term of her natural life. Said farm to revert to my sons and daughters in equal proportion upon the demise of my said mother.

Fourth, I give and bequeath unto my youngest son, Joseph Knight, three thousand dollars, also my tenement house on —— street, with all the improvements thereto belonging; to have and to hold unto my said son, his heirs and assigns forever.

Fifth, I give and bequeath the sum of one thousand dollars to my executors, to be equally divided between them, in full, for all services in the matter of the execution of this my last will and testament.

Sixth, I direct that my debts and funeral expenses be paid from moneys now on deposit to my credit in —— Savings Bank of Toronto, the balance of such money, together with all the rest and residue of my estate, to my three daughters, Mary, Ellen, and Isabella, to be equally divided between them for their use forever.

I hereby nominate and appoint David Waterson, Robert Ford, and James Thomson, the executors of this my last will and testament, and revoke all other and former wills made and executed by me.

In witness whereof I have hereunto set my hand and seal this tenth day of April, one thousand eight hundred and seventy-eight.

JOSEPH KNIGHT, (L.S.)

Signed, sealed, published, declared and acknowledged, by the above-named testator, to be his last will and testament, in our presence, and we each, at his request, and in his presence, and in the presence of each other, subscribe our names as witnesses.

Alexander Adam, 75 King St., Toronto.

Thomas Robson, 214 Yonge St., Toronto.

Adam Clark, 95 Adelaide St., Toronto.

NOTE.—The provisions of a will should, in every case, be so clearly defined that there can be no mistake about the meaning. Any person of proper age, and sound judgment may convey property by will. All legatees are debarred by law from witnessing wills in which they are interested; their signature would nullify the whole instrument, and no person can serve as executor if he be under 21 years of age, a lunatic, convict, imbecile, or an alien at the time of proving the will. The father may appoint his wife, son, brother, or any other relative as executor, and each in their turn may do likewise, as confidence may exist. An addition to the will, called a codicil, designed to modify, add to, or change previous bequests, may be executed at any time, but in every case it must be rendered as definite and precise as the will itself, witnessing included.

No. 46. *Agreement for the Sale and Purchase of Land.*

THIS AGREEMENT, made and executed the first day of May, one thousand eight hundred and seventy-eight, between Charles Giles, of Kingston, Ulster county, State of New York, farmer, of the first part, and Thomas Kingman, of the city of New York, milkman, of the second part.

WITNESSETH, that the said party of the first part, for and in consideration of the sum of three thousand dollars (to him promised to be paid), of which the sum of five hundred dollars is now paid, the receipt of which is hereby acknowledged, and the remaining twenty-five hundred dollars is hereby agreed to be paid at the time the deed hereinafter mentioned is given, hath contracted and agreed to sell to the said party of the second part, all that certain piece, parcel, or tract of land situate in the town of Kingston, county of Ulster, and State of New York, aforesaid, known and described on the map made by Thomas Adams, surveyor, and filed in the Clerk's office of the said county, October 5, 1830, [by the number (47) forty-seven,] and bounded and described as follows: (*Here describe property*). And the said party of the first part agrees to execute and deliver to the said party of the second part, a warranty deed, with full covenants, for the said described lands: PROVIDED, and upon condition nevertheless, that the said party of the second part, his heirs and assigns, pay to the said party of the first part, his heirs or assigns, for the said land, the sum of three thousand dollars, lawful money of the United States, in the way and manner following, to wit:

(*Here specify the amount and dates of payments.*)

AND the said party of the second part, for himself, his heirs, executors, and administrators, doth covenant and agree, to and with the said party of the first part, his heirs and assigns, that the said party of the second part will pay the said several sums as they become due, without any deduction for taxes or assessments whatever: And it is further agreed between the parties to these presents, that, if default be made in fulfilling this agreement, or any part thereof, on the part of the said party of the second part, then, and in such case, the said party of the first part, his heirs and assigns, shall be at liberty to consider this cancelled, and the money already paid forfeited, and to dispose of the said land to any other person in the same manner as if this contract had never been made.

IN WITNESS WHEREOF, we have hereunto set our hands and seals the day and year first above written.

CHARLES GILES, (L.S.)
THOMAS KINGMAN, (L.S.)

Signed, sealed, and delivered in presence of
STEPHEN HAMILTON.

No. 47. *Power of Attorney, General Form.*

KNOW ALL MEN BY THESE PRESENTS, that I, Robert Grant, of Brooklyn, in the county of Kings, and State of New York, merchant, have made, constituted and appointed, and by these presents do make, constitute and appoint, Thomas Bannerman, of the city of Hamilton, in the county of Wentworth, and province of Ontario, a true and lawful attorney for me, and in my name, place and stead, and in my behalf, to (here insert the duties to be performed), hereby giving and granting unto my said attorney full power and authority in the premises to use all lawful means in my name and for my sole benefit, for the purposes aforesaid. And generally to do and perform all and every act and thing whatsoever, requisite and necessary to be done in and about the premises, as fully to all intents and purposes as I might or could do if personally present, with full power of substitution and revocation, hereby ratifying and confirming all that my said attorney, or his substitute, shall lawfully do, or cause to be done, by virtue hereof.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this first day of May, one thousand eight hundred and seventy-eight.

ROBERT GRANT, (L.S.)

Signed and sealed in presence of
DAVID SCOTT.

NOTE.—In cases where the attorney is empowered to sell land and grant deeds, the power of attorney must be placed on record in the County Register's office.

No. 48. *Agreement for Building a House.*

ARTICLES OF AGREEMENT, made the first day of June, one thousand eight hundred and seventy-eight, between John Hall, of Lockport, in the county of Niagara, and State of New York, of the first part, and George Hunter of the said town, county and State, of the second part.

WITNESSETH, that the said John Hall, party of the first part, for considerations hereinafter noted, contracts, bargains, and agrees with the said George Hunter, party of the second part, his heirs, assigns, and administrators, that he the said Hall, will within four months, next following this date, in a good and workmanlike manner, and according to his best skill, well and substantially erect and finish a three-story brick dwelling house on lot No. — ——— street, which said house is to be of the following dimensions, with brick, stone, lumber, and other materials, as described in the plans and specifications hereunto annexed.

(Here describe buildings, material, plan, &c., in full.

In consideration of which, the said George Hunter does, for himself and legal representatives, promise to pay to the said John Hall, his heirs, executors, and assigns, the sum of six thousand dollars, in the way and manner following, to wit: One thousand dollars at the beginning of said work, one thousand dollars on the first day of August next, one thousand dollars on the first day of September next, and the remaining three thousand dollars on the completion of the building.

It is also agreed that the said John Hall, or his legal representatives, shall furnish, at his or their expense, all brick, stone, lime, lumber, doors, blinds, glazed sash, window frames, nails, paint, and other materials required for the building and finishing of said house.

It is further stipulated that in order to be entitled to said payments, the said John Hall, or his legal representatives, shall, according to the architect's appraisement, have expended, in labor and material, the value of said payments, on the house, at time of payment.

And for the true and faithful performance of all and every of the covenants and agreements above mentioned, the parties to these presents covenant and agree, each with the other, that the sum of one thousand dollars, as fixed, settled, and liquidated damages, shall be paid to the other by the failing party within one month from the time of so failing.

IN WITNESS WHEREOF we have hereunto set our hands the year and day first above written.

JOHN HALL,
GEORGE HUNTER.

NOTE.—Agreements should be executed in duplicate so that each party may hold a copy. If erasures or interlineations are made in agreements, contracts, deeds, mortgages, etc., the fact should be stated on the paper that they were so done before the parties signed it. Amounts and dates should always be written out, and not expressed in figures. *Fraud vitiates every contract into which it enters.* See legal brevities on page 587.

No. 49. *Assignment of a Patent-Right.*

WHEREAS I, David Ritchie, of the city of Newark, in the county of Essex, and State of New Jersey, engineer, did obtain letters-patent of the United States for improvements in steam-engine governors, which letters-patent bear date the first day of April, one thousand eight hundred and seventy-eight; and whereas Peter Jackson, of the city of Toronto, in the county of York, and Province of Ontario, is desirous of purchasing from me all the right, title, and interest, which I have in and to said invention, in consequence of the grant of letters-patent therefor:.

NOW THIS INDENTURE WITNESSETH, that for and in consideration of the sum of one thousand dollars, lawful money of the United States, to me in hand paid, the receipt of which is hereby acknowledged, I have assigned, sold, and set over, and do hereby assign, sell, and set over unto the said Peter Jackson, all the right, title and interest which I have in the said invention, as secured to me in the said letters-patent (for, to, and in the several provinces of the Dominion of Canada, and in no other place, or places.)

The same to be held and enjoyed by the said Peter Jackson, for his own use and behoof, and for the use and behoof of his legal representatives, to the full end of the term for which the said letters-patent are or may be granted, as fully and entirely as the same would have been held and enjoyed by me had this assignment and sale not been made.

IN TESTIMONY WHEREOF, I have hereunto set my hand and seal this first day of May, one thousand eight hundred and seventy-eight.

DAVID RITCHIE, (L.S.)

Signed, sealed, and delivered in presence of
ROBERT LOGAN,
JOHN A. BRUCE.

No. 50. *Form of Affidavit.*

State of Vermont,
County of Rutland. } to wit.

Robert Dawson, of the town of Whitehall, in the county aforesaid, being duly sworn, says (*here state the facts*), and further says not.

ROBERT DAWSON.

Sworn to this fifth day of October, A.D., 1877, before me.
JOHN WALLACE,
Commissioner of Deeds.

No. 51. *Partnership Agreement.*

This Agreement made this first day of January, 1878, between Thomas Murray of Toronto, York county, Province of Ontario, Dominion of Canada, of the first part, and John Campbell, of the same place, of the second part : witnesseth : That the said parties agree to associate themselves as co-partners, for a period of seven years from this date, in the business of buying and selling groceries and such other goods and commodities as belong in that line of business ; the name and style of the firm to be "Murray & Campbell." For the purpose of conducting the business of the above named partnership, the said Murray has at the date of this agreement, invested four thousand dollars as capital stock, and the said Campbell has paid in the like sum of four thousand dollars, both of which amounts are to be expended and used in common, for the mutual advantage of the parties hereto, in the management of their business. It is further agreed by both parties hereto, that they will not, while associated as co-partners, follow any avocation or trade to their own private advantage ; but will throughout the entire period of copartnership, put forth their utmost and best efforts for their mutual advantage, and the increase of the capital stock.

That the details of the business may be thoroughly understood by each other, it is agreed that during the aforesaid period, accurate and full book accounts shall be kept, in which each partner shall record, or cause to be entered and recorded, full mention of all monies received and expended, as well as every article purchased and sold belonging to, or in any wise appertaining to said partnership ; the gains, profits, expenditûres and losses being equally divided between them.

It is further agreed that once every year, or oftener, should either party desire, a full, just, and accurate exhibit shall be made to each other, or to their executors, administrators, or assigns, of the losses, receipts, profits, and increase made by reason of, or arising from, such copartnership. And after such exhibit is made, the surplus profit, if such there be, resulting from the business, shall be divided between said partners, share and share alike. Either of said parties shall be allowed to draw a sum, first year, not exceeding nine hundred dollars per annum, from the capital stock of the firm, in monthly instalments of seventy-five dollars each, which amount may be varied, more or less, by subsequent agreement. And further, should either partner desire, or should death of either of the parties, or other reasons, make it necessary, they, the said copartners, will each to the other, or, in case of death of either, the surviving partner to the executors or administrators of the party deceased, make a full, accurate, and final account of the condition of the partnership as aforesaid, and will fairly and accurately adjust the same. And, also, upon taking an inventory of the said capital stock, with increase and profit thereon, which shall appear or is found to be remaining all such remainder shall be equally apportioned and divided between them, the said copartners, their executors, or administrators, share and share alike.

It is also agreed that in case of a misunderstanding arising with the partners aforesaid, which cannot be settled between themselves, such difference of opinion shall be settled by arbitrators upon the following conditions, viz. : Each party to choose one arbitrator, which two thus elected shall choose a third ; the three thus chosen to determine the merits of the case, and adjust the basis of a settlement.

In witness whereof the parties aforesaid hereunto set their hands and seals the day and year first above written.

Signed in the presence of

John Stewart, Thomas Murray, [L. S.]
Geo. Smith. John Campbell. [L. S.]

No. 52. *Assignment for the Benefit of Creditors.*

Know all men by these presents, that I, John Currie, of the Town of Rutland, County of Rutland, and State of Vermont, for value received, have sold, and by these presents do grant, sell, assign, and convey unto John Davidson, of the same place, all the accounts, debts, dues, notes, bills, and demands enumerated and specified in the schedule hereunto annexed, and marked "Schedule A. ;" (*the schedule should state the assignment to which they belong, and be dated and signed by the parties for the purpose of identification*), to have and to hold the same, unto the said John Davidson, his heirs and assigns: In trust to collect, sue for, demand, receive, and recover all such sums of money as may be due, owing, and payable thereon; and after paying all reasonable and proper costs, charges and expenses, to pay to each and all of my creditors the full sum that may be due and owing to them from me, of whom the said John Davidson is one, and a full and complete list of whom with the true amount due to each, is contained in the schedule hereto annexed, marked "*Schedule B.*;" and if the proceeds of the said notes, accounts, bonds, and so forth, be not sufficient fully and entirely to pay off and satisfy each and all of my creditors, then to pay them *pro rata* in proportion to the amount due and owing to each. And if the proceeds as aforesaid shall be more than sufficient to pay every one of my creditors, then to pay and return to me the balance that may be left, if any, after paying all my creditors as aforesaid.

And I do hereby nominate, constitute, and appoint, the said John Davidson my true and lawful attorney, irrevocable, in my name or otherwise, for the purpose aforesaid, to ask, demand, sue for, collect, receive, and recover, all and singular, such sum or sums of money as now or hereafter may become due, upon, for, or on account of any of the property, effects, things in action, or demands above assigned; giving and granting unto my said attorney full power and authority to do and perform every act, deed, and thing, requisite and necessary in the premises; as fully, to all intents and purposes, as I might or could do if this assignment had not been made; with full power of substitution and revocation, hereby ratifying and confirming all that my said attorney or his substitute may lawfully do, or cause to be done, in the premises, by virtue hereof.

In witness whereof I have hereunto set my hand and seal this fifth day of October, 1878.

Signed, sealed, and delivered, JOHN CURRIE, [L. S.]
In the presence of
ROBERT PALMER,
PETER SHELDON.

No. 53. *Form of Composition with Creditors.*

NOTE.—The following shows the form of a contract between a debtor who is only able to pay a portion of his debts, with his creditors, whereby they agree to accept a certain sum less than the original claim; and, upon receipt thereof, not to prosecute or trouble the debtor on account of his debt.

KNOW ALL MEN BY THESE PRESENTS, that whereas John Smashwell, is justly indebted to us, Robert Rogers, Andrew J. Reid, and Henry Middleton, creditors of the said John Smashwell, in divers sums of money, which he has become unable fully to pay and discharge; therefore we, the said creditors, do consent and agree with the said John Smashwell, to demand less than the full amount of our respective claims, and to accept of ten cents for every dollar owing to each of us the said creditors of the said John Smashwell, in full satisfaction and discharge of our several claims and demands; the said sum of ten cents on a dollar, to be paid to each of us, our heirs, executors, and administrators, within the space of thirteen months from the date hereof. And we, the creditors aforesaid, do further severally and respectively covenant and agree with the said John Smashwell, that he may, within the said term of thirteen months from the date hereof, sell and dispose of his goods and chattels, wares and merchandise, at his own free will and pleasure, for the payment of the ten cents on the dollar of each of our respective debts, and that neither of us will at any time hereafter sue, arrest or attach the said John Smashwell, or his goods and chattels, for any debt now due and owing to us or any of us, provided the said John Smashwell does well and truly pay, or cause to be paid, the said ten cents for every dollar of each of our several and respective claims against him. And all and each of the covenants and agreements herein contained shall extend to and bind our several executors, administrators, and assigns.

IN WITNESS WHEREOF, we hereunto set our hands and seals this fifteenth day of November, one thousand eight hundred and seventy-eight.

Signed, sealed, and delivered,
In the presence of
THOMAS BARCLAY,
JOHN THOMPSON.

ROBERT ROGERS, [L.S.]
ANDREW J. REID, [L.S.]
HENRY MIDDLETON. [L.S.]

No. 54. *Agreement for the Hiring of a Clerk or Workman.*

This agreement made the first day of October, one thousand eight hundred and seventy-eight, between Andrew Service of Niagara Falls, in the county of Niagara and State of New York, of the first part, and Thomas Merchant, of the city of Buffalo, in the county of Erie and State aforesaid, of the second part—

WITNESSETH, that the said Andrew Service has agreed to enter the service of the said Thomas Merchant as clerk (*journeyman, mechanic or laborer, as the case may be*) in the store, (*or factory, &c.*) of the said Thomas Merchant, and faithfully, honestly, carefully, and truly obey, and to the utmost of his power serve the best interests of the said Thomas Merchant, for and during the space of one year from the date of this agreement, for the compensation of six hundred dollars per annum, payable quarterly.

And the said Thomas Merchant covenants with the said Andrew Service, that he will receive him as his clerk (*or journeyman, &c.*) for the term of one year as aforesaid, and will pay him for his services as such clerk (*or journeyman, &c.*) the sum of six hundred dollars annually in quarter yearly payments.

In witness whereof we have hereunto set our hands and seals the day and year first above written.

Signed, sealed, and delivered,
In the presence of
JOHN W. WATSON,
WILLIAM STRONG,

ANDREW SERVICE, [L. S.]
THOMAS MERCHANT. [L. S.]

NOTE.—To prevent troublesome lawsuits and quarrels, it is often desirable to fix the damages for the violation of contracts. This may be done by inserting the following, just before the witnessing clause.

AND IT IS FURTHER AGREED between the parties hereto, that the party that shall fail to perform this agreement on his part will pay to the other the full sum of *sixty* dollars, as liquidated, fixed, and settled damages.

No. 55. *Apprentices' Indentures.*

THIS INDENTURE WITNESSETH, that Robert Hill, now aged sixteen years, by and with the consent of his father, Thomas Hill, hath voluntarily, and by his own free will and accord, put and bound himself apprentice unto Moses Goldsmith, of No. — Maiden Lane, New York, jeweller, to learn the art, trade, and mystery of the business of working and manufacturing the precious metals, and as an apprentice to serve from this date, for and during, and until the full end and term of six years next ensuing, during all of which time the said apprentice his master faithfully, honestly, and industriously shall serve, his secrets keep, all lawful commands obey, and at all times protect and preserve the goods and property of his said master, and not suffer or allow any to be injured or wasted ; he shall not buy, sell, or traffic with his own goods, or the goods of others, and not be absent from his master's service day nor night without leave, and in all things behave himself as a faithful apprentice ought to do during the said term. AND the said master shall use and employ the utmost of his endeavors to teach or cause him, the said apprentice, to be taught, or instructed in the art, trade, and mystery of a jeweller as aforesaid, (*here insert conditions as to board and lodgings, rate of wages, time of payment, &c., as agreed between the parties.*)

And for the true performance of all and singular the covenants and agreements aforesaid, the said parties bind themselves firmly, each to the other firmly by these presents.

IN WITNESS WHEREOF, the parties aforesaid have hereunto set their hands and seals the twenty-fifth day of October, one thousand eight hundred and seventy-eight.

Signed, sealed and delivered, ROBERT HILL, [L. S.]
In the presence of MOSES GOLDSMITH. [L. S.]
WILLIAM GORDON,
THOMAS WORKMAN.

I do hereby consent to and approve the binding of my son, Robert Hill, as in the above indenture mentioned.

THOMAS HILL.

No. 56. *Agreement of Teacher with School Trustees.*

This agreement, made this first day of November, one thousand eight hundred and seventy-eight, between Peter Whackboy, of the village of Stanley, county of York, Province of New Brunswick, Dominion of Canada, school teacher, of the first part, and David Brown, John Sansom, and William Currie, of the village, county, province, dominion aforesaid, school trustees, of the second part.

WITNESSETH, that the said Peter Whackboy, holding a certificate from the proper authority as a duly qualified first class teacher, has agreed to enter the service of the said school trustees as teacher in the common school in said village, and that he will faithfully, honestly, and diligently render his best services in teaching and instructing the children, and all others in attendance on said school, imparting to them, according to the best of his ability, a thorough knowledge of reading, writing, arithmetic, grammar, and the other English branches usually taught in common schools, and further, that he will, by every means in his power, maintain good morals, order, and discipline, and discountenance immorality among the attendants at said school, and will faithfully obey all reasonable wishes and commands of the said trustees, for and during the space of one year from the first day of December next, for the compensation of twelve hundred dollars per annum, payable quarterly.

And the said David Brown, John Sansom, and William Currie, covenant with the said Peter Whackboy that they will engage him as teacher in said school for the term of one year as aforesaid, and will pay him for his services as such teacher the sum of twelve hundred dollars per annum, in quarter yearly payments.

IN WITNESS WHEREOF, we have hereunto set our hands and seals the day and year first above written.

Signed, sealed, and delivered,
In the presence of
DAVID R. MOORE,
DAVID POTTER.

PETER WHACKBOY, [L. S.]
DAVID BROWN, [L. S.]
JOHN SANSOM, [L. S.]
WILLIAM CURRIE, [L. S.]

No. 57. *Form of Marriage.*

In conformity to an orderly and long established custom the ceremony of marriage is usually performed either by a clergyman or civil magistrate ; the latter may be a justice of the peace, a justice of the supreme court, a judge of an inferior court, the mayor of a city, or a police justice, as the law of the land may empower and authorize them to solemnize marriage. In Canada and some of the States, a license to marry must first be procured of the city, town, or county clerk, or other agent appointed for that purpose, duly authorizing the clergyman or magistrate to marry the affianced parties. Marriage is a civil contract, and may be entered into by parties capable of consenting thereto. It cannot be entered into by idiots or lunatics. When brought about by force or fraud, it is also void. Marriage is likewise prohibited between near relations. The parties must be of the age of consent, which is generally fourteen in males, and twelve in females. No particular ceremonies are enjoined by the common law to the valid celebration of the marriage rite, but the following form is in common use by magistrates in the United States.

FORM OF MARRIAGE.

(*The man and woman standing, the justice will say to the man :*)

"Will you have this woman to be your wedded wife, to live together after GOD'S ordinance, in the holy estate of Matrimony, to love her, comfort her, honor and keep her, in sickness and in health, and forsaking all others, keep thee only unto her, so long as you both shall live ?"

(*Next, addressing the woman, the justice will say :*)

"Will you have this man to be your wedded husband, to live together after GOD'S ordinance, in the holy estate of matrimony, to love, honor, and keep him, in sickness and in health, and forsaking all others, keep thee only to him so long as you both shall live ?"

(*Each party responding in the affirmative, the justice will then direct them to join hands and say :*)

"By the act of joining hands you take upon yourselves the relation of husband and wife, and solemnly promise and engage in the presence of these witnesses, to love, honor, comfort, and cherish each other as such, so long as you both shall live ; therefore in accordance with the laws of the State of———, I do hereby pronounce you husband and wife."

No. 58. *Short Form of Marriage.*

(*On the contracting parties rising and joining hands the justice will say :*)

"By this act of joining hands you do take upon yourselves the relation of husband and wife, and solemnly promise and engage, in the presence of these witnesses, to love, honor, comfort, and cherish each other as such, as long as you both shall live ; therefore in accordance with the laws of the State of———, I do hereby pronounce you husband and wife."

The form used by clergymen varies but very slightly from the foregoing ; to all intents and purposes it is the same, although the wording may be modified according to the mode prescribed by the denomination to which the clergyman may belong. The marriage license must be returned by the clergyman or magistrate to the issuing clerk for record, who should also at the time of issue, furnish a blank marriage certificate to be filled by the magistrate or clergyman at the conclusion of the ceremony. The certificate, which should, for obvious reasons, be always most carefully preserved by both husband and wife, may be in the following form

No. 59. *Marriage Certificate.*

MARRIAGE CERTIFICATE.

STATE OF MICHIGAN, WAYNE COUNTY.

This certifies

That John Goodfellow, of Chicago, in the State of Illinois, and Sarah Lovejoy of Detroit, Wayne county, State of Michigan, were at the house of John Splicewell, in the said city and county by me joined together in

HOLY MATRIMONY,

On the tenth day of January, in the year of our LORD, one thousand eight hundred and seventy-seven.

IN THE PRESENCE OF	GAMALIEL BANGTEXT,
TIMOTHY COURTWELL,	Pastor of the First ——— Church,
THOMAS HOPEGOOD.	Detroit.

ON LEGAL ADVICE.—Lord Mansfield considered a clear understanding of the duties of men in society as the true basis of legal science. He says: "I may cite one of the ablest lawyers of this century, who, to strong natural sense, united to largest experience, for a similar opinion—my honored master, the late Mr. Tidd. I well remember the advice he gave to a pupil who was about to commence practice : 'When you are called upon for your opinion, make yourself perfectly familiar with all the facts, and then consider what is right. You may be pretty sure that is the law, without looking much into cases. When once the facts are well ascertained, few persons differ in opinion as to the result of a civil action.'"

Prayer of Dr. Samuel Johnson when he was about to commence the study of Law, September 26, 1765.

Almighty God, the Giver of Wisdom, without whose help resolutions are vain, without whose blessing study is ineffectual, enable me, if it be Thy will, to attain such knowledge as may qualify me to direct the doubtful and instruct the ignorant, to prevent wrong and terminate contention; and grant that I may use that knowledge which I shall attain to Thy glory and my own salvation, for Thy blessed Name's sake. Amen.

CURRENT COINS OF THE PRINCIPAL COMMERCIAL COUNTRIES, WITH THEIR VALUE IN U.S. DOLLARS, CENTS AND MILLS.

	D.	C.	M.
Austria, Gold, Quadruple Ducat,	9	12	0
" " Ducat,	2	27	5
" " Sovereign (for Lombardy),	6	75	0
" Silver, Rix Dollar,	0	97	0
" " Florin,	0	48	5
" " 20 Kreutzers,	0	16	0
" " Lira (for Lombardy)	0	16	0
Baden, Gold, 5 Gulden,	2	04	0
" Silver, Crown,	1	07	0
" " Gulden, or Florin,	0	39	5
Bavaria, Gold, Ducat,	2	27	0
" Silver, Crown,	1	06	5
" " Florin,	0	39	5
" " 6 Kreutzers,	0	03	0
Belgium, Gold, 20 Franc piece,	3	83	2
" " 25 Franc piece,	4	72	0
" Silver, 5 Francs,	0	93	0
" " 2½ Francs,	0	46	5
" " 2 Francs,	0	37	0
" " 1 Franc,	0	18	5
Bolivia, Gold, Doubloon,	15	58	0
" Silver, Dollar,	1	00	6
" " ½ Dollar (debased 1830).	0	37	5
" " ¼ Dollar (debased 1830),	0	18	7
Brazil, Gold, Piece of 6,400 Reis,	8	72	0
" Silver, 1,200 Reis,	0	99	0
" " 800 Reis,	0	66	0
" " 400 Reis,	0	33	0
Bremen Silver, 36 Grote,	0	35	6
Britain, Gold, Sovereign,	4	84	5
" Silver, Half Crown,	0	54	0
" " Shilling,	0	21	7
Brunswick Gold, Ten Thaler,	7	89	0
" Silver Thaler,	0	68	0
Central America, Gold, Doubloon,	14	96	0
" " Escudo,	1	67	0
" Silver, Dollar,	0	67	0
Costa Rica, Gold, Half Doubloon, 1850,	7	62	0
" Silver, New Real,	0	05	8
Chili, Gold, Doubloon (before 1835),	15	57	0
" " Doubloon (since 1835),	15	66	0
" Silver, Dollar,	1	01	0
" " ¼ Dollar,	0	22	4
" " ⅛ Dollar or Real,	0	11	2
Denmark, Gold, Doub Fred. or 10 Thal.	7	88	0
" Silver, Rigsbank Daler,	0	52	3
" " Specie Daler,	1	04	7
" " 32 Skillings,	0	17	0
Ecuador, Gold, ½ Doubloon,	7	60	0
" Silver, ¼ Dollar,	0	18	7
Egypt, Gold, 100 Piasters,	4	97	0
" Silver, 20 Piasters,	0	96	0
France, Gold, 20 Francs,	3	85	0
" Silver, 5 Francs,	0	93	0
" " Franc,	0	18	5
Frankfort, Silver, Florin,	0	39	5
Greece, Gold, 20 Drachms,	3	45	0
" Silver, Drachm,	0	16	5
Guiana, Br., Silver, Guilder,	0	26	2
Hanover, Gold, 10 Thaler,	7	89	0
" Silver, Thaler (fine silver),	0	69	2
" " Thaler (750 fine),	0	68	0
Hayti, Silver, Dollar (100 centimes),	0	25	7
Hesse Cassel, Silver Thaler,	0	67	5
" " ⅙ Thaler,	0	11	0

	D.	C.	M.
Hesse Darmstadt, Silver, Florin,	0	39	5
Hindoostan, Gold, Mohur (E. I. Co.),	7	10	0
" Silver, Rupee,	0	44	5
Mecklenberg, Gold, 10 Thaler,	7	89	0
Mexico, Gold, Doubloon, av.	15	53	0
" Silver, Dollar, av.	1	00	7
Naples, Silver, Scudo,	0	94	0
Netherland, Gold, Ducat,	2	26	5
" " 10 Guilders,	4	00	7
" Silver, 3 Guilders,	1	20	0
" " Guilder,	0	40	0
" " Twenty-five cents,	0	09	0
" " 2½ Guilders,	0	98	2
New Granada, Gold, Doubloon, 21 car.	15	61	0
" " including the silver,	15	66	0
" " 9-10ths the stand.,	15	31	0
" " including the silver,	15	36	0
" Silver, Dollar, U. S. weight,	1	02	0
" " Dollar, or 10 Reals,	0	93	0
Norway Silver, Rigsdaler,	1	05	0
Persia, Gold, Somann,	2	23	0
" Silver, Sahib Koran,	0	21	0
Peru, Gold, Doubloon, Lima, to 1833,	15	55	0
" " " Cuzco, to 1833,	15	62	0
" " Cuzco to 1837,	15	53	6
" Silver, Dollar, Lima mint,	1	0	5
" " " Cuzco,	1	0	8
" " ¼ Dol., Cuzco, debased,	0	3	
" " ½ Dol., Arequipa "	0	36	0
" " ½ Dollar Pasco,	0	49	5
Poland, Silver, Zloty,	0	11	2
Portugal, Gold, Half Joe (full weight),	8	65	0
" " Crown,	5	81	0
" Silver, Cruzado,	0	55	2
" " Crown of 1000 Reis,	1	12	0
" " Half Crown,	0	56	0
Prussia, Gold, Double Frederick,	8	0	0
" Silver, Thaler, average,	0	68	0
" " ⅙ Thaler, average,	0	11	0
" " D'ble Thal. 3½ Gulden,	1	39	0
Rome, Gold, Ten Scudi,	10	37	0
" Silver, Scudo,	1	0	5
" " Seston (3-10 Scudi),	0	30	6
Russia, Gold, 5 Roubles,	3	96	7
" Silver, Rouble,	0	75	0
" " Ten Zloty,	1	13	5
" " 30 Copecs,	0	22	0
Sardinia, Gold, 20 Lire,	3	84	5
" Silver, 5 Lire,	0	93	2
Saxony, Gold, 10 Thaler,	7	94	0
" " Ducat,	2	20	0
" Silver Species Thaler,	0	96	0
" " Thaler (XIV E. M.)	0	68	0
Siam, Silver, Tical,	0	58	5
Spain, Gold (Qr. Doubloon),	3	90	5
" Silver, Pistareen (4 Reals Vella),	0	19	5
Sweden, Silver, Species Thaler,	1	04	0
" " ½ Daler,	0	52	0
Turkey, Gold, 100 Piasters,	4	37	4
" " 20 Piasters (new),	0	82	0
" Silver, 20 Piasters, "	0	82	0
Tuscany, Gold, Sequin,	2	30	0
" Silver, Lepoldone,	1	05	0
" " Florin,	0	26	2
Wurtemburg, Silver, Gulden, 1824,	0	38	0

The quarter of wheat is equal to the quarter of a ton of 2240 lbs. or 560 lbs.; 70 lbs. in weight are an English bushel of wheat, while 60 lbs. of wheat make our bushel; so that the U. S. wheat bushel is just 6-7ths of the English or imperial, and a quarter of wheat in England is equal to 9⅓ bushels in the United States, though in capacity to only 8¼ bushels.

The barrel of flour contains 5 Winchester bushels, and weighs, net 196 lbs. The barrel of Indian corn contains 3 1-8 bushels. The weight of a gallon of molasses is usually 11 lbs. but sometimes 10 or 12.

STATE AND PROVINCIAL LAWS REGARDING LEGAL AND SPECIAL INTEREST, THE LIMIT OF TIME IN ACTIONS FOR DEBT, &c., TOGETHER WITH THE LARGEST SUMS OBTAINABLE BY LEGAL PROCESS BEFORE A JUSTICE OF THE PEACE IN VARIOUS STATES, TERRITORIES AND PROVINCES.

States and Territories.	Limit in Justice Ct. Year.	Bonds. Years.	Accounts. Years.	Notes. Years.	Judgment. Years.	Assault & Slander. Years.	Legal Int. per cent.	Special Contracts. per cent.	Penalty for Usury.
Alabama,	$100	10	3	6	20	1	8	8	Forfeit all Int.
Arkansas,	500	10	3	5	10	1	6	10	For. prin. and int.
Arizona,							10		None.
California,	300	5	2	4	5	1	10		None.
Colorado,	300	3	6	6	3	1	10		None.
Connecticut,	100	17	6	6	20	3	7	7	For. excess of int.
Dakota Ter.,	100	20	6	6	20	2	7	12	Forfeit all int.
Delaware,	100	20	3	6	20	1	6	6	Forfeit prin.
Dist. of Columbia.		12	3	3	12	1	6	10	Forfeit all int.
Florida,	50	20	4	5	20	2	8		None.
Georgia,	100	20	4	6	7	1	7	12	Forfeit all int.
Idaho Ter.,	100	5	2	4	5	2	10	24	Fine and impris't
Illinois,	200	10	5	10	20	1	6	10	Forfeit all int.
Indiana,	200	20	6	20	20	2	6	10	Forfeit ex. of int.
Iowa,	300	10	5	10	20	2	6	10	Forfeit all int.
Kansas,	300	15	3	5	5	1	8	12	For. all int. over 12,
Kentucky,	50	15	2	15	15	1	6	8	Forfeit all int.
Louisiana,	100	20	3	5	10	1	5	8	Forfeit all int.
Maine,	20	20	6	20	20	2	6		None.
Maryland,	100	12	3	3	12	1	6	6	Forfeit ex. of int.
Massachusetts,	300	20	6	20	20	2	6		None.
Michigan,	300	10	6	6	6	2	7	10	For. ex. over 7 p. c.
Minnesota,	100	6	6	6	10	2	7	12	None.
Mississippi,	150	7	3	6	7	1	6	10	For. excess of int.
Missouri,	300	10	5	10	20	2	6	10	Forfeit all int.
Montana Ter.,		10	5	10	10	2	10		None.
Nebraska,	100	10	4	5	5	1	10	12	Forfeit all int.
Nevada,	300	4	2	4	5	2	10		None.
New Brunswick	20		6	6	3	½	6		None.
New Hampshire,	13.33	20	6	6	20	2	6	6	For 3t the ex & costs
New Jersey,	100	16	6	6	20	2	7	7	Forfeit of all int.
New Mexico,	100	10	6	10	10	1	6		None.
New York,	200	20	6	6	20	2	7	7	For. of contract.
North Carolina.	200	10	3	3	10	3	6	8	Forfeit of all int.
Ohio,	300	15	6	15	15	1	6	8	For. ex. over 6 p. c.
Ontario, Can.,		20	6	6	20	2	6		None.
Oregon,	250	20	6	6	10	2	10	12	For. prin. and int.
Pennsylvania,	100	20	6	6	20	1	6	6	Forfeit ex. of int.
Quebec, Can.,		30	5	5	30	1.2	6		None.
Rhode Island,	100	20	6	6	20	1	6		None.
South Carolina,	100	20	6	6	20	2	7		None.
Tennessee,	500	6	6	6	10	1	6	10	Forfeit ex. of int.
Texas.	100	5	2	4	10	1	8	12	" " "
Utah Ter.	300	7	2	4	5	1	10		None.
Vermont,	200	8	6	14	8	2	6	6	Forfeit ex. of int.
Virginia,	50	20	5	5	10	1	6	6	Forfeit of all int.
Wash. Ter.,	100	6	3	6	6	2	10		None.
West Virginia,	100	10	5	10	10	1	6	6	Forfeit ex. of int.
Wisconsin,	300	20	6	3	20	2	7	10	Forfeit of all int.
Wyoming Ter.,	100	15	6	15	15	1	12		None.

CONDENSED SYNOPSIS OF THE LAWS PERTAINING TO THE COLLECTION OF DEBTS, THROUGHOUT THE UNITED STATES AND DOMINION OF CANADA,

Presenting a digest of the laws of each State, Territory and Province, relating to Exemptions from Forced Sale, Mechanics Lien, Arrest and Attachment for Debt, Assignments, Garnishment, Bills and Notes, Jurisdiction of Courts, Judgments, Executions, Chattel Mortgages, Deeds, Rights of Married Women, Wills, &c.

The immense utility of the following compilation will be self evident to every Mechanic, Farmer, Trader, Merchant, Business Man, Professional Gentleman and Householder, whose interests are in the slightest degree identified with, or dependent upon, the supreme rule of law and order throughout the community. The enormous losses resulting from ignorance of the law on the aforesaid subjects are absolutely incalculable, and the diffusion of information bearing upon them cannot become too general. The coercive appliances of the Law are regarded with much disfavor by scheming and dishonest debtors, for it is well settled upon sound principles and the highest authority, that every bargain to do anything which the law forbids, or the omission to do anything which the law enjoins, is null and void. No contract can be enforced which contravenes the principles of the common law, the provisions of a statute, or the general or public policy of the law. In Nellis *vs.* Clark (4 *Hill's Rep.* 424), it was held that the vendor of real estate sold for the purpose of defrauding his creditors, could not recover the price.

Business men, and all others having outlying debts to collect, are referred to an invaluable work entitled, *The Collection Compendium*, published by E. A. Smith, 516 Pine st., St. Louis. The work presents a new and original system for the collection of claims by means of local agents at all points in the United States and Canada, upon very low stipulated rates of percentages, without the intervention of third parties. With this work at hand no man need be at a loss to collect a debt in any part of the country (provided the debtor is responsible), on the most reasonable terms, and with very slight loss of time.

SPECIAL LAWS OF ALABAMA.

EXEMPTIONS.—*Home worth $2,000 and Personal Property.*—By the Constitution of Alabama (1868), The personal property of any resident of this State to the value of one thousand dollars, to be selected by such resident, shall be exempt from sale or execution, or other final process of any court issued for the collection of any debt contracted since the adoption of the present Constitution (1868). Every homestead, not exceeding eighty acres of land, the dwelling and appurtenances thereon, to be selected by the owner, and not in a city, town or village, or in lieu thereof, at the option of the owner, any lot in a city, town or village, with the dwelling and appurtenances thereon, owned and occupied by any resident of the State, and not exceeding the value of $2,000, shall be exempt from sale on execution or any other final process from a court for a debt contracted since the adoption of this Constitution. Such exemption does not extend to any mortgage lawfully obtained; but such mortgage or other alienation of such homestead, by the owner thereof, if a married man, shall not be valid without the voluntary signature and assent of the wife of the same. The homestead of a family, after the death of the owner, is exempt from the payment of debts contracted since the adoption of this Constitution in all cases during the minority of the children; or if the owner dies leaving a widow and no children, the same shall be exempt for her benefit, and the rents and profits thereof shall enure to her benefit. This exemption does not extend to cases of laborers' liens for work done and performed for the person claiming such exemption or the mechanics' lien for work done on the premises. (Constitution of 1868.)

In addition to the above, the Legislature passed an Act (approved April 23d, 1873), exempting by statue the personal property of any resident of this State to the value of $1,000, to be selected by the resident. The homestead of every resident not exceeding one hundred and sixty acres of land, and appurtenances thereon, to be selected by the owner thereof, or in lieu thereof, at the option of the owner, any lot in a city, town or village, with the dwelling and appurtenances thereon, said lot not to exceed $2,000 in value.

LIEN OF MECHANICS AND LABORERS.—By act, approved March 19th, 1775, a lien is given to laborers and employees (except officers) of railroads in this State, for work and labor done by them as such. Such extends to all the property, rights, effects and credits of every description of such railroad companies. A lien is also given to all contractors, mechanics, builders, bricklayers, plasterers, painters, and every other person whatever in the State of Alabama, for work and labor done by them as such, and for materials furnished; and such lien extends to all the rights, title and interest of the person or persons for whom the work is done, or the materials furnished, in the property upon which such work is done and for which such materials are furnished, including the land upon which such property may be situated. *Provided*, that all the liens given under this act shall all be held to be waived, unless proceedings are commenced within six months after the completion of such work, to enforce same. Such liens are enforced by process of attachment. (Act, approved 19th March, 1875.)

COLLECTION OF DEBTS.—Attachment may issue for the collection of a debt, whether due or not for any money demand, the amount of which can be certainly ascertained, to recover damages for the breach of a contract where the damages are not certain or liquidated; *and* where the action sounds in damages merely, upon an affidavit made by the creditor, or his agent or attorney, that the debtor *absconds, secretes himself, or resides out of this State*, so that process cannot be served upon him, or is about to remove his property out of this State, whereby the plaintiff may lose his debt or be compelled to sue for it in another State; or that the debtor has fraudulently disposed of, or is about fraudulently to dispose of his property; or that he has money, property or effects liable to satisfy his debts, which he fraudulently withholds; and stating the amount due, and that the attachment is not sued out for the purpose of vexing or harrassing the debtor, upon the plaintiffs executing bond payable to the defendant in double the amount sworn to be due, or when he is unable to give bond with sufficient surety, upon making affidavit to that fact, an attachment may issue against the estate of the defendant, real and personal. Attachments auxiliary to suits pending may be issued on the same grounds as in original attachments, in which case the suit proceeds as if commenced by original attachment.

Every action founded upon a contract, express or implied, must be prosecuted in the name of the party really interested, whether he have the legal title or not, subject to any defense the debtor may have against the payee or creditor previous to notice of transfer; but this does not apply to bills of exchange, or instruments payable in bank or at a designated place of payment, and commercial instruments.

Arrest in civil action or imprisonment for debt is prohibited in this State. Estates of deceased persons are subject to the payment of all debts except certain exemptions in favor of the widow and children of the deceased.

DEEDS, MORTGAGES, RIGHTS OF MARRIED WOMEN, WILLS, ETC.—Acknowledgments, and proof of conveyances may be taken by judges of the supreme and circuit courts and their clerks, chancellors and registers in chancery, judges of probate, justices of the peace and notaries public. If taken in other States of the United States, they may be taken by the judges and clerks of the federal courts, judges of any court of record in any State, notary public or commissioner appointed by the Governor of Alabama. Beyond the limits of the United States, such acknowledgements and proof may be taken by the judge of any court of record, mayor or chief magistrate of any city, town, borough or county, notary public, or any diplomatic, consular or commercial agent of the United States. No other proof or authentication of such acknowledgement is necessary than the certificate of such officer, unless such officer be a justice of the peace, when it must be certified that such officer was a justice of the peace, and that his attestation is genuine, by some judge of a court of record, or a commissioner of that State.

All conveyances of land must be written or printed on parchment or paper, and signed by the vendor, or by his agent, legally authorized in writing, and when the party cannot write, his name must be written for him, with a cross and the words as follows: "his mark;" and when so executed must be attested by two witnesses who can write, who must write their names witnesses thereto

The wife may relinquish her right to dower by joining with her husband in a conveyance of land, and acknowledging same as above provided. Husband's must join in conveyance of wife's separate property.

If the grantor is unknown, his identity may be established by witnesses sufficient to satisfy the officer before whom the acknowledgment is made.

[Acknowledgment of Husband and Wife.]

[Form.]

THE STATE OF ALABAMA, } ss.
BUTLER COUNTY, }

I (name and style of officer) hereby certify that Thomas Clark and Sarah Clark, his wife, whose names are signed to the foregoing conveyance, and who are known to me, acknowledged before me on this day, that being informed of the contents of the conveyance, they executed the same voluntarily, on the day the same bears date.

Given under my hand this the day of , A.D. 187 .

(Signature and title.)

The real and personal property of any female in this State, acquired before marriage, and all property to which she may be entitled by gift, grant, inheritance or devise, shall not be liable for any debts, obligations and engagements of her husband, and may be devised or bequeathed by her as she were a *femme sole*. (Const. of 1868). A conveyance of the wife's separate estate may be made by the husband and wife jointly, signed in the presence of two witnesses, or acknowledged before any officer authorized to take acknowledgments of deeds. The husband is not liable for the wife's debts contracted before marriage; but she may be sued alone and her separate property is liable for the satisfaction thereof.

When no officer is convenient for taking acknowledgments, a deed may be attested by two witnesses, and afterward proved in the following form:

[Form.]

THE STATE OF ALABAMA, } ss.
BENTON COUNTY. }

I (name and style of officer) hereby certify that , a subscribing witness to the foregoing conveyance, known to me, appeared before me this day, and being sworn, stated that , the grantor in the conveyance, voluntarily executed the same in his presence, and in the presence of the other subscribing witness, on the day the same bears date; that he attested the same in the presence of the grantor and of the other witness, and that such other witness subscribed his name as a witness in his presence.

Given under my hand this the day of , A.D. 187 .

(Signature and title.)

The examination of the wife *separate and apart from her husband* is necessary to convey the title to any homestead exempt by the laws of this State. (See Exemptions). This examination may be had before a circuit or supreme judge, chancellor, or judge of probate or justice of the peace, who must endorse thereon a certificate in writing in the following form:

[Form.]

STATE OF ALABAMA, } ss.
COUNTY OF MORGAN. }

I, , judge, (chancellor, notary public or justice of the peace, as the case may be), hereby certify that on the day of , A.D. 18 , came before me the within named , known (or made known) to me to be the wife of the within named , who, being by me examined separate and apart from her husband, touching the signature of the within , acknowledged that she signed the same of her own free will and accord, and without fear, constraint or persuasion of her husband.

In witness whereof, I hereunto set my hand this the day of , 187 .

A. B. (judge, chancellor, etc., as the case may be).

The widow, (if no provision is made for her by will), is entitled to one-third part of the real estate of which her husband died seized, and to which she has not relinquished the right of dower, and one-half of the personal property if there be no children or if there be but one child; if there be more than one child, and less than five, she is entitled to a child's part; if there be five children or more, she is entitled to one-fifth part in absolute right. She shall be endowed of one-half of her husband's absolute estate when he dies leaving no lineal descendants, unless the estate is insolvent. The widow may dissent from or waive provision in a will, and claim her dower, at any time within one year after the probate of the will. The widow may retain the dwelling-place, house, plantation, &c., free from rent, until her dower is assigned her.

Chattel mortgages, are legal in this State but are null and void as to creditors and purchasers without notice until recorded, unless the property is brought into this State subject to such incumbrance, in which case they must be registered within four months, and if such property be removed to a different county from that in which the grantor resides, the conveyance must be recorded within six months from the removal, or it ceases to have effect as to creditors and purchasers from the grantee without notice. All such mortgages must be recorded in the county where the grantor resides, and also where the property is.

WILLS.—Every person 21 years of age, and of sound mind, may dispose of lands by will. Wills must be signed by the testator, or by some one in his presence and at his request, and attested by three or more witnesses. Noncupative wills may be established when the testator in his last illness calls on persons to take notice that such is his will.

SPECIAL LAWS OF ARKANSAS.

EXEMPTIONS.—*Home worth* $5,000, *and personal property* $2,000, 160 acres of land, or 1 town or city lot being the residence of a householder or the head of a family, the appurtenances and improvements thereto belonging, to the value of $5,000, and personal property to the value of $2,000.

MECHANICS' LIEN.—Mechanics, material men and laborers have a lien on land and improvements to the extent of their labor. The original contractor must file his lien within three months after all the things shall have been done or furnished. Sub-contractors must give notice to owner, proprietor, agent or trustee, before or at the time he furnishes any of the things or performs services. These have precedence over all other subsequent incumbrances.

COLLECTION OF DEBTS.—Attachments may issue against a defendant's property upon the following grounds ; In actions for recovery of money where the action is against a non-resident ; one absent four months ; has left the county of his residence to avoid the service of summons ; about to remove, or has removed his property, not leaving enough to satisfy plaintiff's claim ; conceals himself ; has sold his property with fraudulent intent to cheat, hinder or delay his creditors, or is about to do so. Bond in double the amount claimed, with good securities, residents of county.

Boats running on the navigable water of the state may be attached for debts contracted by the owner, &c., on account of work or supplies furnished the boat.

No arrest is allowable for debt in any civil action or *mesne*, or final process, unless in cases of fraud.

In suits on open claims, the affidavit of plaintiff, legally taken and certified, will be deemed sufficient proof unless the defendant shall, under oath, deny the correctness of the account, either in whole or in part, in which event the plaintiff must prove the disputed portion of his account by other evidence.

Affidavits may be made out of the state before a commission appointed by the Governor of Arkansas for that purpose, or before a mayor of a city, a judge of a court, notary public, or justice of the peace, whose certificate shall be deemed proof of its execution. The affidavit must be signed by the affiant, the certificate of the officer shall be written separately, following the signature of the affiant, and all verifications must be attached to the instrument verified.

Garnishment can be issued upon judgments or attachments against any person owing the debtor, or having his property in possession.

Assignments of bonds, bills, notes, agreements, and contracts in writing, for the payment of money or property, are permissable here. Assignments for the benefit of creditors are held good. Every assignment of every instrument of writing must bear date of the true day on which it was executed.

Every protested draft or bill of exchange draws 10 per cent. interest from date of protest. If drawn upon any person in the state, it is in addition subject to 2 per cent. damages, if on any person and payable in Alabama, Louisiana, Mississippi, Tennessee, Kentucky, Ohio, Indiana, Illinois, and Missouri, or any point on the Ohio river, 4 per cent. damages, if upon any person and payable at any other place in the United States, 10 per cent. damages on amount specified in the bill. If owned by any person within this state, 2 per centum ; if without this state, but in the U. S., 6 per centum, if without the limits of the U. S., 10 per centum. The holder shall have his action against the owner, endorser, or acceptor, or either of them, and the protest is held to be evidence of demand and refusal of payment.

Judgments in circuit courts are a lien upon real estate in county for 3 years, and may be revived so as to continue lien to 10, after which no execution can issue. Judgments in justice courts can form a lien by filing transcript in circuit clerk's office.

Executions cannot issue for 10 days after judgment unless ordered by the court and when issued to the proper officer are liens upon property liable to seizure. If no goods be found the debtor and any one supposed to owe him, or have his property in possession can be made amenable to answer under oath what property or interest he has subject to execution.

Jurisdiction of justice of the peace in matter of contract is $100 exclusive of interest, for damages $100; in replevin $300; and in suits concurrent with the circuit court when amount does not exceed $300. Circuit courts have jurisdiction of all sums over $100, both at common law, and in equity.

DEEDS, MORTGAGES, AND CHATTEL MORTGAGES, RIGHTS OF MARRIED WOMEN, WILLS, &C.—Deeds must be under seal—a scrawl is a seal. Acknowledgement, if made in this State, may be made before a justice of the peace of the county where the land lies, judge of supreme or circuit court, or clerk of any court of record, or notary public; if out of the United States, before the court of any State, Kingdom or Empire having a seal, or any mayor or chief officer of any city or town having an official seal, or before any officer of any foreign country, who, by the laws of such country, is authorized to take probate of the conveyance of real estate of his own country, if such officer has, by law, an official seal. When taken out of this State, but within the United States or their territories, before any court of the United States, or any State or territory having a seal, or the clerk of any such court, or before the mayor of any city or town, or chief of any city or town having a seal of office, or before any commissioner appointed by the Governor of this State. The seal must be attached, when there is one, and the deed recorded in the county where the land lies.

The following is the form when husband and wife join in the deed, the latter releasing dower. It is necessary for husband and wife to join in, whether his own or her property:

[Form I.]

STATE OF , } *ss.*
COUNTY OF , }

Be it remembered that on this day of , one thousand eight hundred and seventy , before me, the undersigned, , came , who are personally known to me to be the same persons whose names are subscribed to the foregoing instrument of writing, as parties thereto, and severally acknowledged the same to be act and deed for the purposes and consideration therein mentioned.

And at the same time the said wife of the said having been by me first made acquainted with the contents of said instrument, on an examination separate and apart from her said husband, acknowledged that she executed the same and relinquished dower in all the property therein mentioned, freely and without compulsion, or undue influence of her said husband.

In testimony whereof I have hereunto set my hand and seal of office, the day and year first above written. (Signature.)

Married women can hold property, both real and personal, free from the debts of her husband, but a schedule, under oath, and verified by the oath of some other reputable person must be made by the husband and wife, and filed in the recorder's office of the County where the property is, and of the County where they reside. A widow shall be endowed of the third part of the property whereof her husband was seized of an estate of inheritance at any time during the marriage, unless the same was relinquished in legal form.

A Chattel mortgage is of no avail as a lien unless recorded in the County where the property is.

Wills should be executed as shown in Business Form No. 45, on pp. 815–816, and established by the disinterested evidence of at least three unimpeachable witnesses to the handwriting and signature of the testator.

SPECIAL LAWS OF CALIFORNIA.

EXEMPTIONS FROM FORCED SALE—*House worth $5,000 and personal property.* Necessary household and kitchen furniture, one sewing machine and one piano in actual use; wearing apparel and one month's provisions for the family. Farming utensils; also 2 oxen, or 2 horses, or 2 mules, and their harness, one cart or wagon, and food for such oxen, horses or mules for one month; also seed to $200 in value. Tools or implements of an artisan necessary to carry on his trade; the seal of a notary; the instruments of a physician, dentist and surveyor necessary to the exercise of their profession, with their professional libraries, and the professional libraries and furniture of lawyers, judges and ministers of the gospel. The cabin of a miner, not exceeding in value the sum of $500, also his appliances for mining, not to exceed in the aggregate the sum of $500, and 2 horses, mules or oxen, with their harness, and food for such oxen, horses or mules for one month. Four cows with their sucking calves, and 4 hogs with their sucking pigs; poultry not exceeding in value $50. The earnings of the judgment debtor for his personal services rendered at any time within 30 days next preceding the levy. The shares held by a member of a homestead association, not exceeding in value $1,000, if the person holding the shares is not the owner of a homestead under the laws of this State. All moneys, benefits or annuities growing out of any life insurance on the life of the debtor, in any company corporated under the laws of the State, if the annual premiums paid do not exceed $500. Homestead for the head of a family, not to exceed $5,000 in value.

MECHANICS' LIEN.—Mechanics and material men have a lien for labor and materials on the land and improvements to the extent of their claims. The original contractor must file his claim within 60 days, and the laborers within 30 days, after the debt accrued. This lien attaches from the commencement of the work, and has precedure over any subsequent or previous unrecorded encumbrance.

COLLECTION OF DEBTS.—Attachment may issue on affidavit and undertaking with two sureties, in a sum not less than $300, or greater than the amount claimed, in action upon a contract, express or implied, for the direct payment of money, where the contract is made or is payable in this State and is not secured, or the security becomes valueless; and in an action upon a contract, express or implied, against a defendant not residing in this State. Every species of property not exempt is subject to attachment.

Arrests in civil actions are not allowable in this State except as follows:—1. In an action for the recovery of money or damages on a cause of action arising upon a contract, express or implied, when the defendant is about to depart from the State with intent to defraud his creditors. 2. In an action for a fine or penalty, or for money or property embezzled, or fraudulently misapplied, or converted to his own use by a public officer, or an officer of a corporation, or an attorney, or factor, broker, agent or clerk, in the course of his employment as such, or by any other person in a fiduciary capacity, or for misconduct or neglect in office or in a professional employment, or for a willful violation of duty. 3. In an action to recover possession of personal property unjustly detained, when the property or any part thereof has been concealed, removed or disposed of, to prevent its being found or taken by the sheriff. 4. When defendant has been guilty of fraud in contracting the debt or incurring the obligation for which the action is brought, or in concealing or disposing of the property, for the taking, concealing or conversion of which the action is brought. 5. When the defendant has removed or disposed of his property, or is about to do so, with intent to defraud his creditors. No female can be arrested in any action.

Garnishment may be made under execution or attachment against any bailee of the debtor, and when the debtor's interest or right is acknowledged in a specified sum or article, the said sum or article may be paid over to the Sheriff under an order of court.

Judgments in all courts of record and in the justices' court, when filed in the county court, are liens from the time they are docketed, which must be within 24 hours after their rendition, on all real estate owned by the defendant not exempt and situated in the county where the judgment was rendered, for a period of 2 years, unless the defendant stay execution by an appeal bond, in which case the lien ceases. By recording a transcript of the docket in any other county the lien attaches to all defendant's real estate situated therein not exempt. No lien is credited by judgment on personal property.

Executions may be issued at any time within 5 years after entry of judgment, and do not affect property until there is a levy. Out of justices' courts, as courts

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of record, they may be levied on personal or real property. Real estate sold under execution is subject to redemption within six months. Judgment debtors or their bailees, after the return of execution not satisfied, may be examined under oath concerning their property.

Assignments in trust for the benefit of creditors, are null, as against any creditor not assenting thereto. The deed of assignment must be in writing, acknowledged and recorded like a conveyance of real estate. Made to secure indorsers or sureties are valid. Notes, bills, bonds, accounts and almost every species of contract, is assignable. The party in interest must sue on an assigned contract.

Boats and vessels navigating the waters of this State, are liable for debts contracted by the master, owner, agent, or consignee thereof, for work done or supplies furnished, or for fitting out, repairing, or equipping such boats or vessels, or for all sums due for anchorage or wharfage, or for all injuries done to persons or property by such boat or vessel, provided the wages of mariners, boatmen, and others employed in the service of such boats or vessels, shall have the preference, and be first paid. Vessels are also liable for damages accruing from the non-performance or mal-performance of contract touching the transportation of persons or property. All actions against boats or vessels must be commenced within 15 days after cause of action accrues.

Damages are allowed on bills of exchange protested for non-acceptance or non-payment in favor of holders for value only, as follows: 1. If drawn upon any person in this State, $2 on each $100 of the principal sum specified in the bill. 2. If drawn upon any person out of this State, but in any of the other States or territory west of the Rocky Mountains, $5 on each $100 of the principal sum specified in the bill. 3. If drawn upon any person in the United States east of the Rocky Mountains, $10 on each $100 specified in the bill. 4. If drawn upon any person in any place in a foreign country, $15 on each $100 of the principal sum specified in the bill, and from the time of notice of dishonor and demand of payment, lawful interest must be allowed upon the aggregate amount of the principal sum and damages. Notarial protest is evidence of demand and refusal of payment at the time and in the manner stated in the protest.

DEEDS, MORTGAGES, AND CHATTEL MORTGAGES, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds are not required to be under seal, as all private seals are abolished in this State. Must be acknowledged within the State, before a justice or clerk of the supreme court; or a judge or a clerk of a court of record; or a mayor or recorder of a city; or a court commissioner; or a county recorder; or a notary public; or a justice of the peace. Without this State and in the United States, before a justice of the peace or clerk of any court of record of the United States; or a justice, judge or clerk of any court of record of any State; or a commissioner appointed by the Governor of this State for that purpose; or a notary public or any other officer of the State where the acknowledgment is made, authorized by its laws to take such acknowledgment. Without the United States, before a minister, commissioner or charge d'affaires of the United States, resident and accredited in the country where such acknowledgment is made; or a judge of a court of record of the country where the acknowledgment is made, or a commission appointed for that purpose by the Governor of the State pursuant to special statutes; or a notary public. The husband or wife, can each, without the consent or assistance of the other, convey his or her separate property. They must join in a conveyance of their community property.

The following is the general form of the certificate of acknowledgment:

STATE OF CALIFORNIA, } *ss.*
COUNTY OF AMADOR. }

On this day of , in the year of , before me, John Simpson, notary public, personally appeared, , known to me (or proved to me on the oath of) to be the person whose name is subscribed to the within instrument, and acknowledged to me that he (or they) executed the same.

JOHN SIMPSON, Notary Public.

The form of certificate when grantor is a married woman must be substantially as follows:

STATE OF CALIFORNIA, } *ss.*
COUNTY OF NEVADA. }

On this day of , in the year of , before me, John Johnston, notary public, personally appeared , known to me (or proved to be on the oath of) to be the person whose name is subscribed to the within instrument, described as a married woman, and upon an examination, without the hearing of her husband, I made her acquainted with the contents of the instruments, and thereupon she acknowledged to me that she executed the same, and that she does not wish to retract such execution.

JOHN JOHNSTON, Notary Public.

Property of *every* description acquired by the wife before marriage, and that acquired afterward by gift, bequest, devise, or descent, shall be her separate property, and will in no case be liable for the debts of her husband. The husband's property of every kind similarly acquired, will be his separate property, and not liable for debts due by his wife previous to marriage. The property of each shall be liable only for the debts of the owner. All property acquired subsequent to marriage, aside from that acquired by gift, bequest, devise, or descent, shall be *common* property, but under the husband's entire control. Such common property cannot be sold unless by an instrument in writing, signed by both husband and wife, and acknowledged by her upon an examination separate and apart from her husband, before a justice of the supreme court, judge of the district court, county judge or notary public, or if without the State, there to acknowledge before some judge of a court of record, or a commissioner appointed by authority of the State to take acknowledgement of deeds.

A full and complete inventory of the wife's separate property shall be made out and signed by the wife, and proved in the manner required by law for proof of a conveyance of land; the filing of this inventory in the recorder's office in the county where such property is situated, shall be notice of the wife's title, and all said property shall be exempt from seizure for her husbands debts.

Upon the death of either husband or wife, one-half of the common property shall go to the survivor, and the other half to the descendants, of the deceased husband or wife, subject to the payments of the debts of the deceased. If there be no descendants of the deceased husband or wife, the whole shall go to the survivor, subject to such payment.

As to dower, no estate shall be allowed to the husband as tenant by courtesy upon the decease of his wife, nor any estate in dower be allowed to the wife upon the death of her husband.

Chattel mortgages are void as to third parties, unless possession of chattels passes from mortgagor, albeit the mortgage may be recorded.

Any married woman may dispose of all her estate by will, and may alter and revoke such will, but the consent of the husband, in writing, must be annexed to every such instrument, and it must be subscribed, attested, proven, and recorded in like manner as a will is required to be witnessed, proven, and recorded, unless the wife has power to make a will, conferred by marriage contract, signed by her husband before marriage.

No wills, except noncupative wills, shall be valid, unless in writing, and signed by the testator or by some person in his presence, and by his express direction, and attested by two or more competent witnesses subscribing their names to the will, in the presence of the testator.

No noncupative will bequeathing an estate over $500, shall be valid, unless proved by two witnesses, who were present at the making thereof; nor unless it be proved that the testator, at the time of pronouncing the same, did bid some one present to bear witness that such was his will, or to that effect; nor unless such noncupative will was made at the time of the last sickness, and at the dwelling-house of the deceased, or where he or she had been residing for the space of 10 days or more, except when such person was taken sick from home, and died before his or her return.

SPECIAL LAWS OF COLORADO.

EXEMPTIONS FROM FORCED SALE—*Home worth $2000 and Personal Property.* Every person being a householder and head of a family, is entitled to a homestead not exceeding in value $2000. To entitle such person to this exemption, he must enter the word "Homestead" on the margin of his recorded title. The following property, when owned by any person being head of a family, shall be exempt: Family pictures, school books and library, pew in church, burial sites, all wearing apparel of family, all beds, bedsteads, stoves and cooking utensils, kept for use of debtor and family, and other household furniture not exceeding $100 in value, provision and fuel necessary to the family for 6 months, tools, etc., of any mechanic not exceeding $300 in value, library and implements of any professional man not exceeding $300, draft animals to the value of $200, 1 cow and calf, 10 sheep and the necessary food for them for 6 months, 1 farm wagon, cart, etc., 1 plough, 1 harrow and other farming implements not exceeding

$50, in value. Persons not at the head of a family, only entitled to wearing apparel and property to the value of $300.

MECHANICS' LIEN.—Persons who perform work or furnish materials to the amount of more than $25 for the construction or repairing of any building, may have a lien thereon. Principal contractors must file their lien in 40, and sub-contractors within 20 days after last work done or material furnished. Action thereof must be commenced within 6 months from date of filing lien.

COLLECTION OF DEBTS.—Plaintiff must file a bond, with security, payable to defendant, in double the amount swore to be due, with the customary, conditions, and then file an affidavit, alleging positively one or more of the following causes before attachment can be issued: 1. That the debtor has departed, or is about to depart from the State with intent to conceal his effects. 2. That he is a non-resident, or is a foreign corporation, or conceals himself. 3. That he is about to remove or dispose of his property to the injury of his creditors, or that he fraudulently contracted the debt, or has removed away any of his property with intent to hinder or defraud his creditors.

In attachment, replevin or meritorious defence may be made, when necessary, by the affidavit of the attorney or agent for the plaintiff.

In assignments a debtor has the right to prefer one or more creditors to the exclusion of others, except when the assignment is fraudulent, or where bankruptcy interposes.

Bills, notes, bonds, or other written instruments acknowledging indebtedness, and made payable to any person or persons, are assignable by endorsement, and the assignee may sue in his own name. Assignments are ruled by the common law.

Jurisdiction of justices courts extends to $300 for recovery of money or personal property, probate courts to $2000, over all cases, both at law and in equity, district courts are without limit as to amount or character of claim.

Summons to justice court must be issued 5 days, and served at least 3 days before trial; in probate and district courts they must be issued and served at least 10 days before the return day.

A judgment of a court of record is a lien on an estate, real or personal, of the judgment debtor, owned or afterwards acquired by him, within the jurisdiction of such court, for a period of seven years after the last day of the term of court at which such judgment was rendered; *provided*, execution be issued thereon within one year from the time such judgment lien accrued; judgment before justices of the peace may become a lien on real estate by filing a transcript of such judgment in the office of the clerk of the district court of the county in which such judgment was rendered.

Execution from justice of the peace can be issued immediately after judgment and is a lien on personal estate of the debtor from the time of the delivery to the constable, and can be levied only on personal property. Execution from courts of record, bind the property of debtor from time of delivery to sheriff. Every species of property, real and personal, and every interest in real estate, legal or equitable, is subject to execution. Lands sold on execution may, within six months after such sale, be redeemed by the execution debtor. Execution creditor shall receive from sheriff a certificate of purchase, which should be recorded. After expiration of six, and at any time before the expiration of nine months, *any judgment creditor* may redeem such land by sueing out execution on his judgment and paying to the officer the amount (with ten per cent. per annum thereto, from date of sale) for which the lands were sold.

The process of garnishment may be exercised either on execution or attachment.

Arrest and imprisonment on civil process is prohibited in this State.

In suits on bills, bonds, notes, and similar instruments, the defendant, before he will be permitted to plead, demur, &c., must file an affidavit of merit that he has as he believes, a good and sufficient defence to said suit or some part thereof.

Affidavits of persons without the State may be made before any notary public or clerk of any court of record under their respective seals.

Bills of exchange expressing "Value received," duly presented and protested for non-acceptance or non-payment, entitle holder to recover from drawer or endorser thereof, upon due notice of such protest, the amount of such bill, with legal interest from time when same should have been paid, and ten per centum damages in addition thereto, and costs and charges of protest. Parties to such instruments as endorsers, makers, acceptors, may be sued separately or jointly. Record required to be kept by notaries public, competent evidence to prove time and manner of service of notice of protest, names of parties, and description and amount of instrument.

Sheriffs are amenable in treble damages to aggrieved party, and fine not less than $25 nor more than $250 for any malfeasance in office.

DEEDS, MORTGAGES, CHATTEL MORTGAGES, RIGHTS OF MARRIED WOMEN, WILLS, &C.—Conveyances must be under seal; a scrawl is sufficient. A conveyance made in compliance with all requisites carries with it right to immediate possession. All covenants in the deed run with the land conveyed. A power of attorney to convey should be under seal and recorded with the deed made thereunder.

Acknowledgments of deeds written in the State may be made before any justice or judge of the supreme or district courts, or before any clerk or deputy clerk of such courts under the seal thereof, or before any probate judge under the seal of his court, or before the clerk and recorder of any county or his deputy under the county seal, or before any notary public under his notarial seal, or before any justice of the peace.

Without the State and within the United States, before the secretary of any State or territory, the clerk of any court of record, or commissioner of deeds for this State, or before any officer authorized by the laws of the State were taken to take acknowledgments. The seal of any of the above officers must accompany the certificate, and when not taken before the secretary of a State or territory, or clerk of a court of record, the certificate of the clerk of some court of Record where the officer taking the acknowledgement resides must accompany such acknowledgement that such officer is the person the assumes to be.

Without the United States before any United States consul, mayor of any city under his official seal, any court of record of any foreign state, under the certificate of the judge thereof and the seal of such court.

[Form of Acknowledgment by Unmarried Grantor.]

STATE OF COLORADO, } *ss.*
COUNTY OF BOULDER. }

I, (name and style of office) in and for said county, in the State aforesaid, do hereby certify that A. B., who is personally known to me to be the same person whose name is subscribed to the annexed deed, appeared before me this day in person, and acknowledged that he signed, sealed and delivered the said instrument of writing as his free dnd volnntary act for the uses and purposes therein set forth.

Given under my hand and (style of seal) this day of , A. D. 18 .
(Signature.)
[Official seal.] (Style of office.)

Form of certificate where the husband and wife join in a conveyance is the same as the foregoing form, except that after the name of the husband or wife, A. B,, is inserted, "and C. D., his wife" (or her husband, as the case may be), "who are personally known, etc.," down to the teste, before which is inserted the following:

"And the said C. D., wife of the said A. B., having been first examined by me separate and apart from and out of the hearing and presence of her said husband, and the contents, meaning and effect of the within deed having been by me fully explained to her, acknowledged to me that she executed the same freely and voluntarily, and without any coercion or compulsion on the part of her said husband, and that she does not wish to retract the same."

Teste as in foregoing form. Witnesses to deeds are not necessary, but are desirable.

Any married women may bargain, sell and convey her estate, real and personal, and make any contract with reference thereto, as though a *femme sole.* She may also sue and be sued, contract debts in her own name and upon her own credit, execute any instrument of writing, and judgments may be pronounced and enforced against her as though a *femme sole.*

A chattel mortgage shall not be valid as against third parties, unless there be a delivery to the mortgagee of such property, in whose possession it shall remain until the lien expires; or unless the mortgagor shall acknowledge such mortgage before a justice of the peace in the justice's district where such mortgagor resides, who shall keep a memorandum of the same.

If the mortgagor retain possession of the property mortgaged, the mortgage must expressly provide for such possession; otherwise it is void. A mortgage of a stock of goods wherein the mortgagor has the right to sell the same is void. Chattel mortgages may be acknowledged in any township in which is situated the county seat. Where the mortgagor resides in such township, before any justice of the peace, notary public, or county clerk.

SPECIAL LAWS OF CONNECTICUT.

EXEMPTIONS FROM FORCED SALE.—*No Home exempted.*—Personal property as follows, viz. Of the property of any one person, his necessary apparel and bedding and household furniture necessary for supporting life ; arms, military equipments, uniforms or musical instruments owned by any member of the militia for military purposes ; any pension moneys received from the United States while in the hands of the pensioner ; implements of the debtor's trade, his library, not exceeding $500 in value ; 1 cow, not exceeding $150 in value ; any number of sheep not exceeding 10, nor exceeding in all $150 in value ; 2 swine and the pork produced from 2 swine, or 2 swine and 200 lbs. of pork ; of the property of any one person having wife or a family, 25 bushels of charcoal, 2 tons of other coal, 200 lbs. of wheat flour, 2 cords of wood, 2 tons of hay, 200 lbs. each of beef and fish, 5 bushels each of potatoes and turnips, 10 bushels each of Indian corn and rye, and the meal or flour manufactured therefrom, 20 lbs. each of wool and flax, or the yarn or cloth made therefrom, and 1 stove and the pipe belonging thereto ; the horse of any practicing physician or surgeon of a value not exceeding $200, and his saddle, bridle, harness and buggy ; 1 boat owned by one person and used by him in the business of planting or taking oysters or clams, or taking shad, together with the sails, tackle, rigging and implements used in said business, not exceeding in value $200 ; 1 sewing machine, being the property of any one person using it or having a family ; one pew, being the property of any person having a family ordinarily occupying it, and lots, in any burying ground appropriated by its proprietor for the burial place of any person or family. The husband's interest in the wife's estate cannot be taken for his debts during the life of the wife or any issue of their marriage, except for debts contracted for the support of such wife or issue. Any debt that has accrued for personal service not exceeding $10, or if the debtor have a wife or family not exceeding $25, and all benefits allowed by any association in this State on account of sickness, are exempt ; *provided*, that in suits brought for a debt accruing for house rent, provisions, wearing apparel or fuel, furnished to the debtor or for the use of his family, only $10 are exempt, and no exemption is allowed for personal board of the debtor or his family.

MECHANICS' LIEN.—Material men and mechanics have a lien on land and buildings for the amount of their claim, provided the same exceeds $25. To render the lien valid, the claimant must file a certificate of the claim, verified by oath, with the town clerk within 60 days from the time when he commenced to furnish materials or render services. Where the claimant is a sub-contractor he must, unless his contract with the original contractor is in writing, assented to by the proprietor, give notice in writing to the proprietor within 60 days of the time he commences to furnish materials or render services that he intends to claim a lien, otherwise he can have none. This lien takes precedence of all subsequent incumbrances.

COLLECTION OF DEBTS.—Attachment in civil actions, may be issued and levied upon any property of the debtor that is not by statute exempt from attachment and execution. An attachment may be dissolved by the substitution of a bond. No action lies for damages arising from an attachment, unless the suit was malicious. Where the amount attached is so great as to be vexatious or oppressive, the court will order a release of a portion of the property. An attachment remains a lien for sixty days after the rendition of judgment in the case of personal property, and four months in the case of real estate.

The debtor is exempt from arrest in all actions founded on contract, express or implied. In actions sounding in tort and for fraud the debtor may be imprisoned, but can obtain a discharge on taking the " poor debtor's oath."

Assignments in insolvency are made to a trustee and in use to the benefit of all the creditors. A transfer of property made 60 days before the assignment is good. Conveyances made in the regular course of business, or for a present consideration, are valid in the absence of fraud. Jurisdiction of justice courts extends to $100, and either party has the right of appeal in all cases.

Courts of common pleas and thé district court have original jurisdiction of all causes in equity where the matter in demand does not exceed $500 and causes in law where the demand exceeds $100 and does not exceed $500, and appellate jurisdiction in cases brought by appeal from justices.

The superior court has originally jurisdiction in law and equity of all cases where the demand exceeds $500, and appellate jurisdiction where there is no common pleas or district court in the county. The supreme court of errors has final and conclusive jurisdiction in all matters. In determining the amount of the demand, interest to the commencement of the suit is included, but not costs.

Any debt owing to the defendant, or any goods or estate in the hands of a third party may be taken by process of garnishment.

Execution may be taken out any time during the lives of the parties. If either be dead, *scire facias* on the judgment must be brought. A judgment that has lain dormant for 20 years is presumed to be satisfied. The judgment itself creates no lien, but any property that has been attached in the suit in held to respond to the judgment.

A negotiable note must be for the payment of money only, payable to some person or his order or bearer. A negotiable promissory note on demand is considered over-due and dishonored after four months. Days of grace are not allowed on sight or demand notes, or on bank checks. Protests of inland bills of exchange and promissory notes, protested without this State, are *prima facie* evidence of the facts therein stated. When a bill of exchange, drawn or negotiated in this State upon any person in any other, State, territory or district of the United States, shall be returned unpaid and duly protested, the person to whom the same is payable is entitled to recover the damages, according to the place where payable, over and above the principal sum, together with the lawful interest on the aggregate amount of such principal sum and damages from the time at which notice of such protest shall have been given, and payment of said principal sum and damages demanded.

Sheriffs refusing to pay over money collected, when demanded, are liable to pay two per cent. a month on the amount received from time of demand ; failing to execute process or making false or illegal returns, are liable to pay all damages. Any officer, indorsing, demanding or receiving more than legal fees on any civil process, is liable to pay to the person against whom the charge was made threefold the amount charged.

No person is disqualified as a witness in a civil action by reason of any interest in the case or conviction of any crime, but the fact may be shown to discredit his testimony.

DEEDS, MORTGAGES, CHATTEL MORTGAGES, RIGHTS of married women, &c. Conveyances of real estate must be in writing, sealed by the grantor and subscribed by him or his attorney duly authorized, attested by two witnesses, with their own hands, and acknowledged by the grantor as his free act and deed. A scrawl enclosing the letters L. S. (L. S.) is equivalent to a seal. The acknowledgment, if in this State, is made before a judge of a court of record of this State or of the United States, justice of the peace, commissioner of the school fund, commissioner of the superior court, notary public, town clerk or assistant town clerk ; if in any other State or territory of the United States, before a commissioner appointed by the Governor of this State and residing therein, or any officer authorized to take the acknowledgment of deeds in such State or territory ; and if in a foreign country, before any consul of the United States, or notary public or justice of the peace in such foreign country.

Conveyances of real estate situated in this State and powers of attorney therefor, executed and acknowledged in any other State or territory in conformity to its laws relative to the conveyance of lands therein situated, are valid. The wife need not be privately examined apart from her husband.

The husband joins with the wife in the conveyance of her real estate, but conveys his own without her signature. Dower attaches only to the real estate belonging to the husband at his decease.

The following form of acknowledgment is used in all cases :

STATE OF CONNECTICUT, } ss. , A. D. 18
COUNTY OF , }

Personally appeared , signer and sealer of the foregoing instrument, and acknowledged the same to be his free act and deed before me.

(Signature.)

Married woman may hold real estate to their separate use in their own name. In all conveyances of the same the husband must join. The husband is trustee of the wife's personal estate, and accountable to her for the avails. He may be removed for cause, and another trustee appointed. She may be sued for her contracts and acts ; her husband is not liable upon any of such causes of action. She may also enter into a contract jointly with her husband for the benefit of her sole estate, or their joint estate, and be sued on the same. She may also carry on business, and if any right of action accrues to her therefrom, may sue upon the same as if she were unmarried. The widow shall have the right of dower in one third of the real estate of which her husband died possessed in his own right, to be to her during her natural life.

A chattel mortgage of property not perishable in its nature is good, although the grantor retains possession, but the deed must be executed with all the formalities required in town records, as in the case of real estate. Property exempt from execution is also a proper subject for a chattel mortgage. Conveyances of other species of personal property, unaccompanied by possession, are void as against creditors. Wills must be in writing, subscribed by the testator, and attested by the witnesses, all of them subscribing in his presenec.

SPECIAL LAWS OF DISTRICT OF COLUMBIA.

EXEMPTIONS FROM FORCED SALE.—*No Home exempted. Personal Property of the following value* is exempt from distraint, attachment, or sale on execution, except for servants or laborers wages due: Wearing apparel, household furniture to the amount of $300; provisions and fuel for 3 months, mechanics tools or implements of any trade, to the value of $200, with stock to the same amount; the library and implements of a professional man or artist, to the value of $300; a farmer's team and other utensils, to the value of $100, family pictures and library to value of $400.

MECHANICS' LIENS.—Any person who, by virtue of any contract with owner of any building or his agent, performs labor or furnishes materials for construction or repair of such building, shall, upon filing in office of clerk of the supreme court of the District, at any time after commencement of the building, and within three months after completion of such building or repairs, a notice of his intention to hold a lien upon the property for the amount due or to become due to him, specifically setting forth the amount claimed, have a lien upon such building and lot of ground upon which the same is situated, for such labor done or materials furnished, when amount exceeds $20. Any sub-contractor, journeyman or laborer employed in construction or repair of any building, or in furnishing any materials or machinery for same, may give, at any time, owner thereof notice in writing, particularly setting forth amount of his claim and services rendered for which his employer is indebted to him, and that he holds the owner responsible, and the owner of the building shall be liable for the claims but not to exceed the amount due from him to employer at time of notice, or subsequently, which may be recovered in an action.

COLLECTION OF DEBTS. — A writ of attachment and garnishment may be issued whenever plaintiff, his agent or attorney shall file in clerk's office, at commencement or during pendency of suit, an affidavit (supported by testimony of one or more witnesses,) showing grounds upon which he bases action, and setting forth plaintiff has just right to recover against defendant; and also stating either that defendant is a non-resident of district, or evades service of ordinary process by concealing himself or withdrawing from district temporaily, or has removed or is about to remove some of his property from district to defeat just demands. Plaintiff must also file his undertaking, with sufficient surety, to be approved by clerk, to make good all costs and damages by reason of wrongful suing out of attachment.

Arrest in civil actions is unknown here.

Assignments are regulated by the principles of common law.

Justices of peace have jurisdiction in all civil cases where amount claimed to be due for debt or damages arising out of contracts, express or implied, or damages for wrongs, or injuries to persons or property, does not exceed $100, except in cases involving title to real estate, actions to recover damages for assault, or assault and battery, or for malicious prosecution or actions against justices of peace or other officers for misconduct in office, or in actions for slander, verbal or written. Supreme court of District of Columbia possesses same powers and exercises same jurisdiction as circuit courts of United States. Any one of justices of said court may hold a special term with same powers and jurisdiction possessed by United States district courts. Any one of said justices may hold a criminal court for trial of all crimes and offences arising in the District. Supreme court of District has jurisdiction of cases arising under copy-right and patent laws; and of all applications for divorce; and also has jurisdiction as a probate court.

Judgments are lien on real estate from date of rendition and on personal property when execution is issued and in marshal's hands. Execution may issue the day judgment is rendered. There is no redemption after execution sale.

DEEDS, MORTGAGES, RIGHTS OF MARRIED WOMEN, ETC.—Acknowledgments of deeds may be made before any of the following named officers of State, district, county or territory within United States, in which person making deed may be living, namely: Before any judge of court of record and of law; any chancellor of State; any judge of supreme, circuit, district or territorial courts of the United States; any justice of the peace; any notary public; any commissioner of circuit court of district appointed for that purpose. The officer taking acknowledgment must annex to the deed a certificate under his hand and seal, to following effect:

STATE OF , } (Or city, etc.), to-wit:
COUNTY . }

I, Joseph Mercer, a notary public, (or other prescribed officer, giving his title) in and for the county (or city, or parish, or district) aforesaid, in the State (or territory, or district) of , do hereby certify that A. B., a party (or A. B. and C. D., parties) to a certain deed bearing date on the day of , and hereto annexed, personally appeared before me in the county (or city, etc.), aforesaid, the said A. B. (or A. B. and C. D., etc.,) being personally well known to me as (or proved by the oaths of credible witnesses before me to be) the person (or persons) who executed the said deed, and acknowledged the same to be his (her or their) act and deed.

Given under my hand and seal this day of , A.D, 18 .

[SEAL.] JOSEPH MERCER.

The following is the form where husband and wife join in the deed, the latter relinquishing dower, or when she is a party with her husband to any deed:

STATE OF , } (Or city, etc.), to-wit:
COUNTY . }

I, Joseph Mercer, a notary public in and for the county aforesaid, do hereby certify that A. B. and C. D., his wife, parties to a certain deed bearing date on the day of , A, D. 18 , and hereto annexed, personally appeared before me, in the county aforesaid; the said A. B. and C. D., his wife, being personally well known to me as (or proved by the oaths of credible witnesses before me to be) the persons who executed the said deed, and acknowleged the same to be their act and deed; and the said C. D., wife of said A. B., being by me examined privily and apart from her said husband, and having the deed aforesaid freely explained to her, acknowledged the same to be her act and deed, and declared that she had willingly signed, sealed and delivered the same, and that she wished not to retract it.

Given under my hand and seal this day of , A.D. 18 .

JOSEPH MERCER.

When acknowledgments are made beyond limits of District, within United States, the certificate of the same must be accompanied by a certificate of the register clerk or other public officer having cognizance of the fact under his official seal, that, at the date of the acknowledgment, the officer taking the same was, in fact, the officer he purported to be. Deeds made in a foreign country may be executed and acknowledged before any judge or chancellor of any court, master or master extraordinary in chancery, or notary public, or before any secretary of legation or consular officer of the United States.

CHATTEL MORTGAGES—Must be recorded within twenty days after execution. No bill of sale, deed of trust or mortgage for property exempt by law from execution is binding, unless signed by wife of debtor. The right of any married woman to property, personal or real, belonging to her at time of marriage or acquired during marriage in any other way than by gift or conveyance from her husband, are as absolute as if she were unmarried and are not subject to disposal of her husband nor liable for his debts. Any married woman may convey, devise and bequeath her property or any interest therein in the same manner and with like effect as if she were unmarried. Any married woman may contract and sue and be sued in her own name, in all matters having relation to her sole and separate property, in the same manner as if she were unmarried. Neither the husband nor his property is bound by any such contract made by a married woman, nor liable for any recovery against her in any such suit, but judgment may be enforced by execution against her sole and separate estate in same manner as if she were unmarried.

DAKOTA, HOMESTEAD LAW.

EXEMPTION FROM FORCED SALE.—*Home of 80 Acres with buildings, or House, and one-half acre in a Village or City, and Personal Property.* The householder is entitled to a homestead consisting of not more than 80 acres of land with buildings and appurtenances thereon, and personal property aggregating in value not to exceed $1500, which personal property is defined by statute.

SPECIAL LAWS OF DELAWARE.

EXEMPTIONS FROM FORCED SALE.—*No Home Exempted, Personal Property,* $275.—Family library, school books, family Bible, family pictures, seat or pew in church, lot in burial ground, all wearing apparel of debtor and family; and in addition to above, tools, implements and fixtures necessary to carry on trade or business, not exceeding $75. Head of family, in addition to above, or other personal property not exceeding $200. And in Newcastle county, wages for labor and service are exempt from execution attachment.

MECHANICS LIEN—Mechanics, builders, artizans, laborers or other persons, having performed or furnished work and labor or materials or both, to an amount exceeding $25, in or for the erection, alteration or repair of any house, building or structure, in persuance of any contract, express or implied, with the owner or agent of such building or structure, may at any time within six months from the completion of said work and labor, or the furnishing of such materials, file in the office of the prothonotary of the county in which said building is situate a bill of particulars of his claim, with an affidavit setting forth that the defendant is justly indebted to the plaintiff in a sum of $25, and has refused or neglected to pay or secured to be paid to the said plaintiff the amount due on his claim. The affidavit must identify the property and give the names of the parties claimant, and the owner or reputed owner of said building. Judgment obtained shall be a lien on said building or structure and the real estate attached thereto upon which the same is erected, and shall relate back to the day upon which the work or laborer furnishing of materials was commenced, and shall take priority according. Where several contractors are employed, in pursuance of any contract with the owner or agent, there shall be no priority of lien, but all be paid pro rata.

COLLECTION OF DEBTS.—What is known as a "*domestic attachment*," may be issued against any inhabitant of this State after a return to a summons or capias issued and delivered to the sheriff or a coroner ten days before the return thereof, showing that the defendant cannot be found, and proof satisfactory to the court of the cause of action; or upon affidavit made by the plaintiff or some other credible person, and filed with the prothonotary "that the defendant is justly indebted to the plaintiff in a sum exceeding $50, and has absconded from the place of his usual abode, or gone out of the State with intent to defraud his creditors or to elude process, as is believed." All creditors share in proceeds of sale of property.

A foreign attachment may be issued against a person not an inhabitant of this State, after a return to a summons or capias, issued and delivered to the sheriff or coroner 10 days before the return thereof, showing that the defendant cannot be found, and proof, satisfactory to the court, of the cause of action; or upon affidavit made by the plaintiff or some other credible person, and filed with the prothonotary, "that the defendant resides out of the State, and is justly indebted to the said plaintiff in a sum exceeding $50."

No capias shall be issued on any judgment in a civil action (against any free white person) until the return of execution determines that the defendant has not sufficient real or personal property within the county to satisfy the debt or damage therein expressed; or until the plaintiff in such judgment, or some credible person for him, sh ll make a written affidavit, to be filed in prothonotary's office before the issuing of the writ, to the same effect; nor then unless the plaintiff in said judgment (or decree), or some credible person for him, shall, in addition to the above requirement, make a written affidavit, to be filed in the prothonotary's office (r register in chancery) before the issuing of the process stating "that the defendant in such judgment (or decree) is justly indebted to the said plaintiff in a sum exceeding $50, and that he verily believes the said defendant has secreted, conveyed away, assigned, settled or disposed of either money, goods, chattels, stocks, securities for money, or other real or personal estate of the value of more than $50, with intent to defraud his creditors, and shall, moreover, in such affidavit, specify and set forth the supposed fraudulent transactions."

As to remedy, the party arrested may have a hearing before any judge, upon the specification of fraud, upon petition and reasonable notice to the other side.

As to assignments, all bonds, specialties, and notes in writing, payable to any person, or order, or assigns, may be assigned, and the assignees, or indorsees, or their executors or administrators, may in their own name sue for and recover the money due thereon; *provided*, that all such assignments of bonds and specialties shall be under hand and seal, and before at least two credible witnesses.

In assignments for the benefit of creditors, the assignee, within 30 days after the execution of said assignment, shall file in office of the register of chancery of the county in which the real and personal estate of the assignor is situate, an inventory or schedule of the estate or effects so assigned, together with the affidavit of said assignee that the same is a full and complete inventory of all such estate and effects, so far as the same has come to his knowledge. The chancellor shall appoint two appraisers, who shall appraise the same and make return thereof under oath. The assignee shall give bond, with at least two sufficient sureties, to be approved by the chancellor, in double the amount of the appraised value of the estate so assigned. The assignee to render annual accounts of his trusteeship until his final account is rendered and approved. Exceptions may be filed to the account of said assignee, and a hearing be had upon the same and proceedings be had upon said bonds for the protection of interested parties.

As to garnishment, in writs of attachment, domestic or foreign, to compel appearance of defendant, there is a clause commanding the sheriff, "That he summon the defendant's garnishees to appear at the next superior court, to declare what goods, chattels, rights, credits, money or effects of the defendant they have in their hands respectively." The writ is dissolved at any time before judgment, by the defendant giving special bail to the action, and the garnishees are discharged. If a garnishee, duly summoned, does not appear as required, he may be compelled by attachment to appear and answer or plead, and he shall be so compelled within two terms, or the attachment, as to him, shall be dissolved. If he appear, and at the request of the plaintiff, answers under oath that he had no money, goods, chattels, rights, credits or effects of the defendant liable to attachment, in his hands or possession, at the time he was notified of the attachment, or at any time after, he shall be discharged. But if the plaintiff shall require him to plead, he shall plead *nulla bona*, on which the plaintiff may take issue and go to trial; and if it be found that the garnishee had, at the time he was notified of the attachment, or at any time after and before his plea pleaded, any money, goods, chattels, or effects of the defendant in his hands or possession, the jury shall render a verdict for the plaintiff and assess damages to the value of such property, and judgment shall be entered against such garnishee therefor, with costs; such judgment shall be pleadable by the garnishee in bar to any action at the suit of the defendant.

Judgments of courts are liens from the time of entering upon the real estate of defendant within the county in which they are rendered; after the lapse of 20 years they are presumed to be paid, but this presumption may be rebutted. Upon a return of *nulla bona*, on execution issued by a justice of the peace, or when the defendant pleads his freehold, a transcript of said judgment may be filed in the superior court of the county, and the judgment made a lien upon land, and execution then issues out of said superior court.

Executions may issue to any county: personal preperty must be first exhausted before real estate can be levied upon. Personal property is bound from the time the writ comes into the hands of the sheriff, if an actual levy be made within 60 days thereafter. The lien of such a levy remains in full force for 3 years, as against a subsequent execution levied upon the same goods. Sale at expiration of 30 days after levy. Notice by advertisement, posted at least 10 days in five or more public places in the county, two of which shall be in the hundred of defendant's residence. Goods and chattels of a tenant are liable to one year's rent in arrear or growing due, in preference to execution.

After exhausting personalty, inquisition is held on lands, upon 10 days' notice. If the rents and profits for seven years are sufficient to satisfy the debt and costs, a writ of *elegit* may issue, under which the lands are delivered to the plaintiff, to be held until the debt is satisfied. If not sufficient, a writ of *venditioni exponas* issues and the land is sold, upon 10 days' notice by advertisements and publication. When the sale is confirmed by the court the officer makes a deed to purchaser, *capias ad satisfactendum*.

Property of the debtor in the hands of third persons can be reached either before or after final judgment, and under attachment by process of garnishment, upon an affidavit being made by the plaintiff, his agent or attorney, that he does not believe the debtor will have in his possession visible property in this State of sufficient value to satisfy his demand.

Damages for non-payment or non-acceptance of foreign bills, bills of exchange are at the rate of 5 per cent. on the hundred of the principal sum. Notes and bills in this State are assignable as at common law.

Jurisdiction of justice courts extends to $50, county courts to $300, besides probate powers, and final jurisdiction where amount in controversy does not exceed $100. Circuit courts have general jurisdiction in both law and equity cases, with appellate jurisdiction from cases arising in the county courts, and final jurisdiction in such cases. The supreme court has appellate jurisdiction in all cases in equity, and all cases at law where the amount in controversy exceeds $300.

Judgments obtained in courts of record are liens on all the estate of the defendant in the county where the judgment was obtained, from its date. If obtained in any other county in the State than where the land lies, becomes a lien on the land of the defendant from the time it is recorded in said county. Judgments obtained before a justice of the peace can be made a lien on the real estate of the defendant, if it is recorded within ten days after it is obtained, in the county clerk's office. Judgments from other States can be used only as evidence in a suit brought on them in this State.

All the lands, goods and chattels of the defendant may be levied on and sold under execution, and is a lien on the personal property of the defendant from the time it comes to the hands of the sheriff. There is no stay of execution and no redemption of property sold under execution.

DEEDS, MORTGAGES, RIGHTS OF MARRIED WOMEN, &c.—Deeds must be in writing, sealed and delivered in the presence of not less than two witnesses—a scrawl, with the word seal written in it, is sufficient seal. If a deed is executed in this State it must be before two witnesses, and the grantor may acknowledge the execution of the same before any judge, clerk of the circuit court, notary public or justice of the peace within the State. If executed out of the State and in any other State or territory, the deed may be executed according to the laws of the State or territory where executed and the execution thereof acknowledged before any judge or clerk of a court of record, notary public, justice of the peace or other officer authorized by the laws of such State or territory to take the acknowledgment of deeds, or before any commissioner of the State of Florida. If executed in any foreign country, it may be executed according to the laws of such country, and acknowledged before any notary public, or any minister plenipotentiary, extraordinary, minister resident, *charge d'affaires*, commissioner or consul of the United States—should the deed be acknowledged in any other State or country, before any officer not having a seal of office, he should have attached thereto a certificate of the clerk of a court of record, a certificate of the secretary of state, minister plenipotentiary, extraordinary, minister resident, *charge d'affaires*, commissioner or consul (as the case may be), that the person whose name is subscribed to the certificate of acknowledgment was, at the date thereof, such officer as he is therein represented to be, that he believes the signature of such persons subscribed thereto to be genuine, and that the deed is executed and acknowledged according to the laws of such State, territory or foreign country.

The following is the form used where the acknowledgment is taken out of the State:

STATE OF ,
COUNTY OF . } *ss.*

Be it remembered that on this day of 187 , personally appeared before me, a notary public, duly appointed and authorized by the executive authority of the State of , under the laws of said State, to take within said State proof and acknowledgments of deeds (or other officer as the ease may be), to be used and recorded in such State, A. B., to me well known to be the person who executed the foregoing (and annexed) deed by him sealed, subscribed, and the said A. B. acknowleged the execution thereof to be his free act and deed, for the uses and purposes therein mentioned.

In witness whereof, I have hereunto set my hand and affixed my official seal, the day and year first above written.

J. HILL, *Notary Public.*

They take priority according to date of recording in proper office, and are liens only from such date. The lien of a purchase money mortgage recorded within sixty days after it is made has preference to any judgment against the mortgagor, or other lien of a date prior to the mortgage chattel, unknown.

The real and personal property of any married woman, acquired prior to March 17, 1875, or which she then held, or which she may acquire after that date, in any manner whatever, from any person other than her husband, shall be her sole and separate property; and the rents, issues and profits thereof shall not be subject to the disposal of her husband nor liable for his debts. Married women, purchasers of real estate, may secure purchase money, or part of it, by recognizance, bond, mortgage or otherwise, as single women may; her husband need not be a party or consent to such act of giving security, and is not liable unless he is a party thereto. May give bond with or without warrant of attorney. Married women may receive wages for her personal labor and maintain an action therefor, may deposit same or other moneys belonging to her in bank, etc., free from her husband's control. May prosecute and defend suits at law, or in equity, for preservation and protection of her property; make contracts in respect to her property, upon which suits may be brought as though she was *femme sole*, whether the contracts were made before or after marriage, and her property shall be charged therewith.

Wills must be in writing, and signed by the testator, or by some other person subscribing the testator's name, in his presence and by his express direction, and attested and subscribed by two competent witnesses, in the presence of the testator.

SPECIAL LAWS OF FLORIDA.

EXEMPTIONS FROM FORCED SALE.—*Home, Farm, or House and Lot, and Personal Property.*—A homestead to the extent of 160 acres of land, or the half of one acre within the limits of any incorporated city or town, owned by the head of a family residing in this State, together with $1,000 worth of personal property, and the improvements on the real estate, shall be exempted from forced sale under any process of law, and the real estate, shall not be alienable without the joint consent of husband and wife, when that relation exists. "But no property shall be exempt from sale for taxes, or for the payment of obligations contracted for the purchase of said premises, or for the erection of improvements thereon, or for house, field or other labor performed on the same. The exemption herein provided for, in a city or town, shall not extend to more improvements or buildings than the residence or business house of the owner."

MECHANICS' LIEN.—Mechanics and other persons performing labor or furnishing materials for the construction or repair of any building, or who may have furnished any engine or other machinery for any mill, distillery or manufactory, may have a lien on such building, mill or distillery, etc., for the same to the extent of the interest of the tenant or contractor. Sub-contractors, journeymen and laborers have also lien, upon their giving notice in writing to the owner that they hold him responsible for whatever may be due them.

COLLECTION OF DEBTS.—There is no imprisonment for debt in this State. Attachment may be had of the debtor's property upon affidavit made by the plaintiff, or his agent, or attorney, that the defendant is removing his property out of the State, or about to remove it, or is a non-resident of the State, or is removing or about to remove beyond the limits of the State, or absconds or secretes himself, or is fraudulently disposing of his property, or is concealing the same, or is removing same out of the judicial district where defendant resides. Before the attachment can issue the plaintiff must enter into a bond with sufficient securities in an amount double the sum claimed by him. An attachment will also be issued against the property of the defendant on a debt that is not due; *pro ided*, it falls due in nine months from the time it is asked for—upon an affida it by the plaintiff or his agent, setting forth the facts of the case; and, also, that the defendant is actually removing his property from out the State, or is fraudulently concealing or disposing of the same for the purpose of evading his just debts. A bond shall also be given, as in the case where the debt is actually due.

Assignments, unless fraudulent, are good in this State, though preference be given to creditors; and even assignments made in another State, conveying property situated in this State, are held good against an attaching creditor.

Stay of execution on judgment, for want of affidavit of defense; 6 months, if security be given 20 days after judgment. On judgments before justice of the peace 6 months' stay on defendant pleading his freehold, and 9 months' stay on his giving security.

All checks, notes, drafts or bills, inland or foreign, payable without time or at sight, are due and payable on presentment, without grace; days of grace shall be allowed on all checks, drafts or bills, foreign or inland, payable at a future or different time from that in which they are dated, or which are made payable on a particular day after date.

The damages on bills of exchange drawn upon any person beyond the seas, and returned with legal protest, shall as to the drawer, indorser and all concerned, be at the rate of 20 per centum on the contents of such bills in addition thereto. Notes, checks and other negotiable instruments, becoming payable on Christmas day, fourth day of July, Thanksgiving day, first day of January, and twenty-second day of February, shall be deemed to become due on the secular day next preceding the aforementioned days respectively.

Summons may be served on defendant by stating the substance of it to him personally, or by leaving a copy at his usual place of abode, in the presence of a white adult person, 6 days before the return thereof. And whenever suit is brought against persons not residing in this State but doing business here, either by branch establishment or agency, it shall be sufficient service of writ of summons to leave a copy thereof with any agent, or at the usual place of business of such person or persons, or his, her or their agent, 10 days before the return thereof.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Acknowledgments may be taken out of the State before any consul-general, consul or commercial agent of the United States, duly appointed in any foreign country, at the places of their respective official residences, or before any judge of the district or circuit court of the United States, or the chancellor or any judge of a court of record, or the mayor or chief officer of any city or borough, and certified under the hand of such chancellor, judge, mayor or officer and the seal of his office, court, city or borough; or in open court, certified under the hand of the clerk, and the seal of the court; or before a commissioner of deeds, appointed by the Governor (whose seal shall be so engraved as to make an impression that will show distinctly the name, official title, date of appointment and term of office of such commissioner). Only one witness is necessary to a deed. A scrawl is regarded as a seal.

The certificate of acknowledgment *must* show the wife relinquishes her dower, and the private examination *should* be certified in the words stated in the following form:

[Form by Man and Wife.]

STATE OF DELAWARE, } *ss.*
COUNTY OF .

Be it remembered, that on the day of , in the year of our Lord one thousand eight hundred and , personally came before the subscriber (name and title), John Wilson and Mary Wilson, his wife, parties to this indenture, known to me personally (or proved on oath of Richard Roe) to be such, and severally acknowledged said indenture to be their act and deed respectively, and the said Mary Wilson being at the same time privately examined by me, apart from her husband, acknowledged that she executed the said indenture willingly, without compulsion, or threats or fear of her husband's displeasure.

Given under my hand and official seal the day and year aforesaid.

(Signature and title.)

[Form of Certificate where Grantor is Unmarried.]

STATE OF DELAWARE, } *ss.*
COUNTY OF .

Be it remembered, that on the day of , in the year of our Lord one thousand eight hundred and , personally came before the subscriber (name and title), John Wilson, party to this indenture, known to me personally (or proved on oath of Peter Smith), to be such, and acknowledged said indenture to be his act and deed.

Given under my hand and official seal the day and year aforesaid.

(Signature and title.)

There is no statutory provision for proof of deed by subscribing witness out of the State. Deeds must be recorded within one year after the sealing and delivery of the instrument.

Mortgages are executed and acknowledged in the same manner as deeds, and are foreclosed by proceedings in the superior court by writ of *scire facias*, and after judgment, sale of the premises is made by writ of *levari facias*.

The wife must join with the husband in the execution of deeds to relinquish her dower, and the following should be in the certificate of acknowledgment:

"Personally came C. D., wife of the said A. B., to me well known, etc., and acknowledged she made herself a party to and executed the same for the purpose of relinquishing her dower, in and to the lands and tenements therein described; and the said C. D., on a private examination taken and made before me, separately and apart from her said husband, acknowledges and says that the said relinquishment and renunciation of dower was and is made freely and voluntarily, and without any compulsion or constraint, apprehension or fear from her said husband, the said A. B., to which acknowledgment the said C. D. has in my presence and this day set her handand seal." (Signature and title.)

All personal and real property owned by the wife before her marriage, or to which she shall become entitled by inheritance, gift, purchase or devise during marriage, shall be and remain her sole and separate property, and free from the debts of the husband. But, in order that it shall be free from his debts, an inventory of the same must be made out in six months after marriage, or after the same shall be acquired by her, and recorded in the circuit court clerk's office in the county in which it is situated. A married woman can sell and convey all real estate inherited by her in the same way as she could if she were sole; but in all conveyances of any of her real estate her husband must join in the execution and acknowledgment. She is also entitled to dower in one-third of all the real estate seized by her husband at the time of his death, or at any time during his life, unless she has relinquished the same; and she is also entitled to one-third of his personalty.

No mortgage of personal property shall be effectual or valid to any purpose whatever, unless such mortgage shall be recorded in the office of record for the county in which the mortgaged property shall be at the time of the execution of the mortgage, and unless the mortgaged property be delivered at the time of execution of the mortgage, or within twenty days thereafter, to the mortgagee, and shall continue to remain truly and *bona fide* in his possession. Mortgages of personal property shall be admitted to record upon the same proof as real property, or by proof being made upon oath by at least one credible person, before the recording officer, of the hand-writing of the mortgagor, in cases in which there shall be no attesting witnesses to the mortgage.

Wills must be in writing, signed by the testator or by some other person in his presence, and by his express directions, and shall be attested and subscribed in the presence of the testator by THREE or more witnesses.

SPECIAL LAWS OF GEORGIA.

EXEMPTIONS FROM FORCED SALE.—*A Home worth* $2000, *and personal Property worth* $1000. Each head of a family, or guardian or trustee of a family, of minor children, shall be entitled to a homestead or realty to the value of $2,000 in specie, and personal property to the value of $1,000 in specie, both to be valued at the time they are set apart. And no court or ministerial officer in this State shall ever have jurisdiction or authority to enforce any judgment, decree or execution against said property so set apart—including such improvements as may be made thereon from time to time—except for taxes, money borrowed and expended in the improvement of the homestead, or for the purchase money of the same, and for labor done thereon, or material furnished therefor, or removal of incumbrances thereon. And it shall be the duty of the General Assembly as early as practicable, to provide, by law, for the setting apart and valuation of said property, and to enact laws for the full and complete protection and security of the same to the sole use and benefit of said families as aforesaid.

MECHANICS' LIEN.—Laborers shall have a general lien upon the property of their employers liable to levy and sale for their labor, which is superior to all other liens, except liens for taxes, the special liens of landlords on yearly crops, and such other liens as are declared by law superior to them. Laborers shall also have a special lien on the products of their labor superior to all other liens, except liens for taxes, and special liens of landlords on yearly crops, to which they shall be inferior. All mechanics of every sort, who have taken no personal security therefor, shall, for work done and material furnished in building, repairing or improving any real estate of their employers, all contractors, material men and persons furnishing material for the improvement of real estate, all contractors for building factories, furnishing material for the same or furnishing machinery for the same, and all machinists and manufacturers of machinery including corporations engaged in such business, who may furnish or put up in any county of this State any steam mills or other machinery, or who may repair the same, and all contractors to build railroads shall each have a special lien on such real estate, factories and railroads.

COLLECTION OF ACCOUNTS.—Attachment may issue where the debtor resides out of the State; when he is actually removing or about to remove without the limits of the county; when he absconds; when he conceals himself; when he resists a legal arrest; when he is causing his property to be removed beyond the limits of the State; when the debt is created by the purchase of property, upon such debt becoming due; when the debtor who created such debt is in the possession of the property for the purchase of which the debt was created; when a debtor shall sell or convey or conceal his property liable for the payment of his debts, for the purpose of avoiding the payment of the same, or whenever a debtor shall threaten or prepare so to do. Attachment bonds must be in double the amount of the debt, and conditioned to pay the defendant all damages sustained in consequence of the attachment, in the event the plaintiff shall fail to recover.

Arrest and imprisonment for debt is unknown in this State.

An assignment or transfer by a debtor, insolvent at the time, of real or personal property, or choses in action of any description, to any person, either in trust or for the benefit of or in behalf of creditors, when any trust or benefit is reserved to the assignor, or any person for him, is fraudulent in law against creditors, and as to them null and void. A debtor may prefer one creditor to another, and to that end he may *bona fide* give a lien by mortgage, or other legal means, or he may sell in payment of the debt, or he may transfer negotiable papers as collateral security, the surplus in such cases not being reserved for his own benefit, or that of any other favored creditor, to the exclusion of other creditors. All choses in action arising upon contract may be assigned so as to vest the title in the assignee, but he takes it, except negotiable securities, subject to the equities existing between the assignor and debtor at the time of the assignment and until notice of the assignment is given to the person liable.

In cases where suit is pending, or where judgment has been obtained, the plaintiff shall be entitled to the process of garnishment under the following regulations. The plaintiff, his agent or attorney-at-law, shall make an affidavit before some officer authorized to issue an attachment by this code, stating the amount claimed to be due in such action, or on such judgment, and that he has reason to apprehend the loss of the same, or some part thereof, unless the process of garnishment do issue, and shall give bond, with good security, in a sum at least equal to double the amount sworn to be due, payable to the defendant in the suit or judgment, as the case may be, conditioned to pay said defendant all costs and damages that he may sustain in consequence of suing out said garnishment, in the event that the plaintiff fails to recover in the suit pending, or it should appear that the amount sworn to be due on such judgment was not due.

If any bill of exchange, draft or order, is made payable at any place out of this State and within the United States, and the same is returned under protest for non-acceptance or non-payment, the holder thereof shall be entitled to recover of the drawer and endorsers in the first case, and the acceptor also in the latter case, in addition to the principal, interest and protest fees, five per cent. on the principal as damages for non-acceptance or non-payment. If such bill, draft or order is payable at a place without the limits of the United States, the holder may recover ten per cent. damages as right for non-acceptance or non-payment.

The superior courts are the highest courts of general original jurisdiction. They have exclusive jurisdiction of divorce suits, cases respecting titles to land and equity cases. The powers of a court of ordinary and probate are vested in an ordinary for each county. Justices of the peace have jurisdiction in all civil cases where the principal sum claimed does not exceed $100, except where jurisdiction is exclusively vested in other courts.

Writs to the superior courts must be filed twenty days, and served fifteeen days before the first day of the term to which they are returnable. Actions are triable only at the second term, except suits for rent, which are triable at the first term. In justices' courts, summonses shall bear date 15 days before the time of trial, if the amount is under $50, and shall bear date 20 days before the time of trial when the amount is over $50, and shall be served at least 10 days before the time of trial.

All judgments obtained in the superior, inferior, justices' or other courts of this State shall be of equal dignity and shall bind all the property of the defendant, both real and personal, from the date of such judgment, except as otherwise provided in this code. When any person has *bona fide* and for a valuable consideration purchased real or personal property, and has been in possession of such real property for four years, or of such personal property two years, the same shall be discharged from the lien of any judgment against the person from whom he has purchased. When a judgment lien has attached on personal property which is removed to another State and sold, if brought back again to this State it will be subject to the judgment lien. No judgment hereafter obtained in the courts of this State shall be enforced after the expiration of seven years from the time of its rendition, when no execution has been issued upon it; or when execution has been issued, and seven years shall have expired from the time of the entry upon the execution, made by an officer authorized to execute and return the same; such judgments may be revived by *scire facias*, or be sued on, within three years from the time they become dormant. Execution may issue immediately upon the rendition of judgment.

Deeds, Mortgages, Rights of Married Women, Wills, &c., A deed to lands in this State must be in writing, under seal, signed by the maker, attested by at least two witnesses and delivered to the purchaser, or some one for him, and be made on a valuable or good consideration. No prescribed form is essential to the validity of a deed to lands or personalty. If sufficient in itself to make known the transaction between the parties, no want or form will invalidate it. A deed to personalty needs no attesting witness to make it valid; in other respects, the principles applicable to deeds to lands are applicable to it. Generally a deed is not necessary to convey title to personalty. Every deed conveying lands shall be recorded in the office of the clerk of the superior court of the county where the land lies within one year from the date of such deed; on failure to record in this time, the record may be made at any time thereafter; but such deed loses its priority over a subsequent deed from the same vendor recorded in time and taken without notice of the existence of the first. To authorize the record of a deed to realty or personalty, it must be attested, if executed out of this State, by a commissioner of deeds for the State of Georgia, or a consul or vice-consul of the United States (the certificates of these officers under their seals being evidence of the fact), or by a judge of a court of record in the State where executed, with the certificate of the clerk, under the seal of such court, of the genuineness of the signature,of such judge. If executed in this State, it must be attested by a judge of a court of record of this State, or a justice of the peace, or notary public, or clerk of the superior court in the county in which the last three mentioned officers respectively hold their appointments; or if subsequently to its execution the deed is acknowledged in presence of either of the above-named officers that fact certified on the deed by such officer shall entitle it to be recorded. If a deed is neither attested by nor acknowledged before either of the officers aforesaid, it may be admitted to record upon the affidavit of a subscribing witness before either of the above-named officers testifying to the execution of the deed and its attestation according to law.

All property of the wife at the time of her marriage, whether real or personal or choses in action, shall be and remain the separate property of the wife, and all property given to, inherited or acquired by the wife during coverture, shall shall vest in and belong to the wife, and shall not be liable for the payment of any debt, default or contract of the husband. The wife is a *femme sole* as to her separate estate, unless controlled by the settlement. Every restriction upon her power in it must be complied with; but while the wife may contract, she cannot bind her separate estate by any contract of suretyship, nor by any assumption of the debts of her husband, and any sale of her separate estate, made to a creditor of her husband in extinguishment of his debts, shall be absolutely void.

Wills must be in writing, signed by the testator or some person in his presence and by his express direction, and attested and subscribed, in the presence of the testator, by three competent witnesses if to pass real estate, and two if personal property.

SPECIAL LAWS OF IDAHO.

Exemptions from Forced Sale.—*Home worth $2000, and Personal Property worth $300.* The head of a family, being a householder, either husband or wife, may select a homestead not exceeding in value $2000; while furniture, teams, tools, stock, and other personal property enumerated by statute, to the value of $300 or more, according to valuation, shall be exempt from execution, except upon a judgment recovered for its price, or upon a mortgage thereon.

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SPECIAL LAWS OF ILLINOIS.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1000, *and Personal Property.* Exemptions are as follows, except for wages of any laborer or servant: An estate of homestead to the extent in value of $1,000, and proceeds of the sale thereof to that amount for one year after such sale. Insurance on homestead is exempt where a loss occurs thereon to the extent property insured would have been if not destroyed. Personal property is exempt as follows: 1. The necessary wearing apparel of every person. 2. One sewing machine. 3, The furniture, tools and implements of any person necessary to carry on his or her trade or business, not exceeding in value $100. 4. Materials and stock designed and procured by him or her and necessary for carrying on his or her trade and business, and intended to be used or wrought therein, not exceeding $100 in value. 5. The implements or library of any professional person, not exceeding $100 in value.

And in addition to the above property, when the debtor is the head of a family and resides with the same, the following: 1. Necessary beds, bedsteads and bedding, two stoves and pipe. 2. Necessary household furniture, not exceeding in value, $200. 3. One cow and calf, and two swine. 4. One yoke of oxen, or two horses in lieu thereof, used by the debtor in obtaining the support of his family, not exceeding in value $200, and the harness thereof, not exceeding in value $40. 5. Necessary provisions and fuel for the use of the family for three months, and necessary food for the stock hereinbefore exempted for the same time. 6. The bibles, school books and family pictures. 7. The family library. 8. Cemetery lots or rights of burial, and tombs for repositories, for the dead. 9. $100 worth of other property suited to his or her condition in life, selected by the debtor.

When the head of a family dies, deserts, or does not reside with same, such family is entitled to the benefit of exemptions just mentioned. The wages and services of a defendant, being the head of a family and residing with the same, to an amount not exceeding $25, are exempt from garnishment.

MECHANICS' LIEN.—Any person, by contract, express or implied, or both, with the owner of any lot or piece of ground, furnishing labor or materials in building, altering, repairing or ornamenting any house or building on such lot has a lien upon such lot or building for the amount due him for such labor or material. To the extent that the furnishing such labor or materials has increased the value of such property, such lien takes precedence over prior incumbrances. Proceedings to enforce a mechanics' lien must be commenced by the original contractor within six months from the time when the last payment for labor, or materials becomes due, in order to enforce such lien against other creditors or incumbrances

COLLECTION OF DEBTS.—Arrests in civil actions, may be made under a Statute which provides that when any person shall be about to commence a suit in any court of record in this State founded upon contract, if he shall file an affidavit setting forth the cause of action, the amount due the plaintiff, and facts showing that defendant fraudulently contracted the debt, or that he has concealed, assigned, removed or disposed of his property with intent to defraud such plaintiff; and shall present such affidavit to a judge of a court of record, or if there be no such judge in the county at the time, then to a master in chancery; and if sufficient cause be shown, bail may be given. The judge or officer ordering the issuing of such *capias* must require bond from the plaintiff, with security to be approved by the clerk issuing the writ, in double the amount sued for, conditioned for the effectual prosecution of the *capias* by plaintiff and payment of all damages defendant by him sustained, on account of the wrongful suing out of writ.

Writs of attachment may issue for the following causes: 1. Where the creditor is a non-resident, 2. When the debtor conceals himself or stands in defiance of an officer so that process cannot be served on him. 3. Where the debtor has departed from the State with the intention of having his effects removed therefrom. 4. Where the debtor is about to remove his property from this State to the injury of creditor seeking to attach. 5. Where the debtor has within two years preceding the filing of the affidavit required in this proceeding to be filed by attaching creditor, fraudulently conveyed or assigned his effects, or a part thereof, so as to hinder or delay his creditors. 6. Where the debtor has, within two years prior to the filing of such affidavit, fraudulently concealed or disposed of his property so as to hinder or delay his creditors. 7. When the debtor is about fraudulently to conceal, assign or otherwise dispose of his property or effects so as to hinder or delay his creditors. 8. When the debt sued for was fraudulently contracted on the part of the debtor; *provided*, the statements of the debtor, his agent or attorney, which constitute the fraud, shall have been reduced to writing and his signature attached thereto by himself, his agent or attorney.

To entitle a creditor to sue out an attachment, the claim which he seeks to make the basis of this proceeding must exceed $20 in a court of record. Plaintiff, in attachment before issuance of writ, is required to file with the clerk issuing same a bond to the defendant with sufficient surety in double the sum sworn to be due to him, conditioned for the payment of all damages and costs recovered against him for wrongfully suing out such attachment. Attachments may be issued by justices of the peace where the amount claimed is within their jurisdiction for the same causes which authorize their issue from courts of record and under substantially the same restrictions.

Assignments for the benefit of creditors may be made so as to prefer one or more, or a certain class of creditors.

If no preference is made by the debtor the creditors have an equitable lien for their *pro rata* proportions. If the assignment is made with the intent of delaying or defrauding creditors, it is void—not necessarily so, if its effect is to delay creditors.

One partner can assign all the partnership assets for the payment of firm debts. *Choses in action*, except negotiable instruments, can not be assigned here so as to give assignee a right of action on them in his own name.

Garnishee process may issue both from justices courts and courts of record, either on attachment or after judgment and execution returned *nulla bona* against any person owing debtor or having money, property or effects belonging to the debtor in his possession.

The acceptance of a bill need not be in writing. Where foreign bills, drawn within this State and payable out of the United States, are duly protested for non-payment or non-acceptance, the holder is entitled to ten per cent. damages, in addition to the costs of protest, from the drawer or indorser. On bills drawn in this State and payable out of the State, but within the United States, duly protested as aforesaid, to five per cent. damages. Any note, bond, bill or instrument in writing, made payable in money or articles of personal property to any person named as payee therein, is assignable by indorsement under the hand of such person, in the same manner as all bills of exchange. Every assignor or indorser of such instrument is liable to the action of any subsequent assignee thereof, if such assignee has used due diligence by the institution and prosecution of a suit against the maker thereof for the recovery of the money or property due thereon, or damages in lieu thereof, and has obtained judgment, but by the use of due diligence has been unable to obtain satisfaction thereof. A note, bond, bill or other instrument in writing, payable to bearer, is transferable by delivery, and every indorser thereof is a guarantor, unless otherwise expressed in his indorsement.

Justices of the peace have jurisdiction in their respective counties, where the amount claimed, including interest, does not exceed $200. 1. In all actions arising on contract for the recovery of money only. 2. In actions for damages for injury to real property, or for taking, detaining or injuring personal property. 3. In actions for rent and distress for rent. 4. In actions against railway companies and those operating railways for killing or injuring horses or other stock; for loss or injury to baggage or freight; and for injury or damage to real or personal property, caused by setting fire to the same by their engines or otherwise. 5. In replevin when the value of the property claimed does not exceed $200. 6. In actions for damages for fraud in the sale, purchase or exchange of personal property, and in all cases where the action of debt or assumpsit will lie.

Circuit courts have, by the Constitution, original jurisdiction of all causes at law and in equity, and such appellate jurisdiction as may be provided for by law. Appeals lie from justices' courts directly to these courts, defendant to plead at said term. Before justices, summons must be served three days before returned.

Judgments from courts of record are a lien on the real estate of the judgment debtor, situated in the county wherein judgment is obtained from the time same are obtained, are revived for the period of 7 years. When execution is not issued on a judgment within one year from the time the same becomes a lien, it shall thereafter cease to be a lien; but execution may issue on such judgment at any time within said 7 years, and it becomes a lien on such real estate from the time of the delivery of such writ to the officer for service. Such judgments may be sued upon or revived within 20 years after the date thereof and not after. Judgments rendered by justices of the peace may be made a lien on real estate by filing a transcript thereof in the office of the clerk of the circuit court for the county in which judgment was rendered. Such transcripts can only be filed when it appears by return of execution on judgment that defendant has not personal property in the county where same was obtained to satisfy such judgment and costs.

Executions issue from courts of record immediately after rendition of judgment and at any time thereafter for seven years, and to any county in the State. They are a lien upon the personal property of the judgment debtor from the time of delivery to the officer. Real estate sold under execution may be redeemed in twelve months. Executions from justices' courts cannot be levied on real estate, and do not issue until twenty days after judgment, unless the judgment creditor or his agent make oath that the benefit of the judgment is in danger of being lost unless execution issue immediately. Executions from justices' courts are also a lien upon the personal property of the defendant from the time of their delivery to the constable. There is no way of staying executions in this State except by appeal.

Deeds, Mortgages, Rights of Married Women, Wills, &c. Deeds and other conveyances of real estate, must be under seal; any scrawl intended for a seal is, however, sufficient. No subscribing witness is necessary, either to the validity of the instrument or to entitle the same to record. Such instruments may be acknowledged within this State before a master in chancery, a notary public, a United States commissioner, circuit or county clerk, justice of the peace, or any court of record having a seal, or any judge, justice or clerk of such court. Such acknowledgment must be attested when taken before a notary public or United States commissioner by his official seal. When taken before a court or clerk thereof, by the seal of such court; and when taken before a justice of the peace residing out of the county where the land conveyed is situated, a certificate of the county clerk of the county wherein such justice resides, must be added, under his seal of office, to the effect that the person taking such acknowledgment or proof was a justice of the peace in said county at the date thereof. When acknowledged without the State, but within the United States, such acknowledgment may be taken before a justice of the peace, a notary public, United States commissioner, commissioner to take acknowledgments of deeds, mayor of a city, clerk of a county, or before any judge, justice or clerk of the supreme court, or any circuit or district court of the United States, or any judge, justice or clerk of the supreme, circuit, superior, district, county or common pleas court of any of the United States or their territories. When such acknowledgment is made before any notary public, United States commissioner, commissioner of deeds or clerk, it shall be certified by such officer under his official seal; if before the mayor of a city, under the seal of the city; if before a justice of the peace, a certificate must be added as in case of proof or acknowledgment within the State before a justice of the peace residing without the county where the land conveyed is situated. Acknowledgments may be made in accordance with the laws of the State, territory or district where made, and the certificate of a clerk of a court of record in such jurisdiction to that effect, under his hand and the seal of said court, is evidence that such acknowledgment was so made.

When acknowledged without the United States, such acknowledgment may be taken before any court of any republic, State, kingdom or empire having a seal, or any mayor or chief officer of any city or town having a seal, or before any minister or secretary of legation, or consul of the United States in any foreign country, attested by his official seal, or before any officer authorized by the laws of such foreign country to take acknowledgments of conveyances of real estate, if he have a seal; such acknowledgment, in all cases, must be attested by the official seal of such court or officer; and in case such acknowledgment or proof is taken other than before a court of record, or mayor, or chief officer of a town having a seal, proof that the officer taking the same was duly authorized by the laws of his country so to do must accompany the certificate of such acknowledgment.

The following in the statutory form of certificate. It is the same, substantially, whether grantor is unmarried or deed executed by husband and wife:

State of Illinois, }
County of Sangamon. } *ss.*

I, (name of officer and title), do hereby certify that (grantor and if wife join her name "his wife"), personally known to me to be the same person whose name is subscribed to the foregoing instrument, appeared before me this day in person and acknowledged that he signed, sealed and delivered the said instrument as his free and voluntary act, for the uses and purposes therein set forth.

Given under my hand and (private or official as the case may be) seal, this (day of month) day of (month), A. D. (year).
[SEAL.] (Signature of officer.)

No deed or other instrument can be construed as releasing or waiving the right of homestead, unless the same shall contain a clause expressly releasing or waiving such right; and in such case, the certificate of acknowledgment must contain a clause substantially as follows: "including the release and waiver of the right of homestead."

No chattel mortgage or trust deed is valid as against the rights of third persons, unless possession thereof shall be delivered to and remain with the grantee, or the instrument shall provide for the possession of the property with the grantor, and be properly acknowledged and recorded. Such instruments may be ackowledged as deeds. They are valid for any period not exceeding two years. After the expiration of the time provided in the mortgage for the possession of the mortgaged property by the mortgagor, such possession, if continued, renders the mortgage fraudulent and void as to third parties with or without notice, actual or constructive, of such mortgage.

Married women may own in their own right real and personal property, and manage, sell and convey the same to the same extent, and in the same manner that a married man can, properly belonging to him. They may sue and be sued without joining their husbands, to the same extent as if unmarried. A married woman may make contracts and incur liabilities which may be enforced against her to the same extent as if she were *sole*, but she cannot enter into or carry on any partnership business without her husband's consent, unless he has abandoned or deserted her, is idiotic or insane, or is confined in the penitentiary. The estate of courtesy is abolished, and the surviving husband or wife is endowed of one-third part of all lands whereof the deceased husband or wife was seized of an estate of inheritance at any time during the marriage, unless the same has been relinquished in legal form. Dower may be barred by release thereof in due form of law, and by jointure or devise, accept in lieu thereof.

Wills must be in writing, signed by the testator, or by some one in his presence and by his direction, and attested by two credible witnesses.

SPECIAL LAWS OF INDIANA.

EXEMPTIONS FROM FORCED SALE.—*Home and Personal Property of the following value.*—Any resident householder has an exemption from levy and sale under execution, of real and personal property, or both, as he may select, to the value of $300. The law further provides that no property shall be sold by virtue of an execution for less than *two thirds* of its appraised cash value, The provisions of this law can be waived in contracts. To do this, the note or contract should read: "Payable without any relief whatever from valuation or appraisment laws."

MECHANICS' LIEN.—Material men and mechanics have lien for labor and material on the land and improvements to the extent of their claims. The original contractor must file his claim within two months, laborers within 60 days, and all other persons claiming a lien within two months after the debt accrued. This lien has precedence over all other liens or encumbrances placed on the property subseqnent to the commencement of the building or improvements. Must be foreclosed in 12 months.

COLLECTION OF DEBTS.—No persons can be arrested here except in cases of fraud, *actual*.

Writs of attachment, which may be obtained by any creditor, can only be issued on the following grounds:—1. Non-residence of any of defendants. 2. Where any of defendants is secretly leaving the State, or has left the State with intent to defraud his creditors. 3. Or conceals himself that summons cannot be served upon him. 4. Or is removing, or about to remove, his property subject to execution, or part thereof, out of the State, not leaving enough to satisfy plaintiff's claim. 5. Or has sold, conveyed or otherwise disposed of his property subject to execution, or has suffered or permitted it to be sold with the fraudulent intent to cheat, hinder or delay his creditors. 6. Or is about to sell, convey or dispose of same with such intent. A statutory undertaking in all cases in attachment must be executed, the measure of damages in an action on which is in the discretion of the jury.

In attachments levied on real estate, the levy and *dis pendens* are notice for all purposes. In attachments, except on ground of non-residence, caution should be used.

An assignment in trust, for the benefit of creditors, inure for the benefit of all creditors of the grantor, whether named in the deed of assigment or not; the deed of assignment must be acknowledged and recorded like other deeds. One partner cannot assign all the partnership assets for the payment of partnership debts, but only his own share of them. Assignments made to secure sureties or endorsers prior to any payment by them, are valid. Notes, bills, accounts and every species of contract or claim are assignable, and the assignee can sue on it in his own name.

In notes and bills, acceptors are chargeable only when their acceptance is in writing on the bill; or, if on a seperate piece of paper, when the party who gave the credit saw the seperate paper; or if a promise is made in writing to accept a draft before it is drawn, and the draft is in the hands of any person who gave credit on the strength of of this writing.

All parties to notes or bills, whether indorsers, makers or acceptors, or parties in any manner, can be sued jointly or separately in the same or in several actions. Drafts, orders or bills of exchange, payable at sight or on demand, are deemed due the day they are presented for payment, and if unpaid, may be protested. Notarial protest is evidence of demand and refusal of payment, at the time and in the manner *stated in the protest.*

A bill *in the State*, payable out of the State, protested, if payable in the United States, is entitled to eight per cent. damages; if payable out of the United States, ten per cent. damages. Sheriff's are liable to pay ten per cent. damages on failure to pay over any money collected by them.

Justice Courts have exclusive jurisdiction of all sums under $50, and concurrent jurisdiction with the circuit courts to $200. Service of summons must be made in circuit courts 10 days before the first day of term, and in justice courts 3 days before trial.

Judgments in courts of record are liens on real estate for a period of ten years; the judgment may then be revived for ten years longer; judgments are no liens on personal property. Transcripts of judgment before justice, if filed in the circuit court, are liens on real estate.

Executions issue, on plaintiff's order, the day after judgment, and are a lien on personal property, when issuing out of a justice's court, from the time they are delivered to the officer; when issuing from courts of record, from the time they are issued. Executions from a justice cannot be levied on real estate. Every species of property, real or personal, books of account, debts and judgments, whether the interest in real estate be a legal or equitable title, is subject to execution and sale at law. Redemption after execution sale is permitted. If an execution from a court of record is returned unsatisfied, the debtors can be summoned and required to state under oath what property or interests they have or own which may be reached by execution.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds, must be under seal, a scrawl, however, is regarded as a seal. The acknowledgment, if made in this State, may be made before a justice of the peace of the county where the land lies, before a judge or before a notary public; if out of the State, before a commissioner of this State, notary public, or before the chief officer or mayor of a town or city who has a seal, or before a consul or minister of the United States who has a seal. The seal must be attached, and the deed recorded in the county where the land lies.

The following is the form of certificate where the grantor is unmarried:

[Form.]

STATE OF INDIANA, } *ss.*
COUNTY OF STARK. }

Before me, , a in and for said county, this day of , 187 , personally appeared the within-named, and acknowledged the execution of the within and foregoing deed of conveyance.

Witness my hand and official seal. (Signature and title.)

Married women can hold real or personal property to their seperate use. A note or endorsement by a married woman will not bind her seperate estate; it will be a nullity. The widow is endowed with one full and equal third part of all the lands, the legal title to which was in her husband during coverture, unless such right of dower was legally barred.

A chattel mortgage of perishable articles which are left in the hands of the grantor, with right to use the same, is void; so is a mortgage of a stock of goods, the grantor having a right to sell; so is any mortgage, if unregistered and the chattels left with the grantor; a chattel mortgage unrecorded more than ten days is void, except between the parties; so is also a recorded mortgage, if the goods are left unreasonably long with the grantor after default is made in payment.

Wills must be in writing, and signed by the testator, or by some person in his presence and by his express direction, and attested and subscribed in the presence of the testator by two or more competent witnesses.

SPECIAL LAWS OF IOWA.

EXEMPTIONS FROM FORCED SALE.—*Farm of 40 Acres or House and Lot in City and Personal Property.*—The homestead must embrace the house used as a home by the owner thereof, and if he has two or more houses thus used by him, at different times and places, he may select which he will retain as a homestead. If within a town plat it must not exceed ½ acre in extent, if not in a town plat it must not embrace in the aggregate more than 40 acres. But if when thus limited, in either case its value is less than $500, it may be enlarged until its value reaches that amount.

Wearing apparel kept for actual use; trunks to contain same; 1 gun; private libraries and family portraits; musical instruments not kept for sale; 2 cows; 1 horse; 50 sheep; 5 hogs; 6 hives of bees; 1 bed and bedding for every two in the family; household and kitchen furniture not exceeding $200; spinning-wheel, loom and sewing machine; provisions and fuel for 6 months; the tools, instruments or books of debtor, if a farmer, mechanic, surveyor, lawyer, clergyman, physician, teacher or professor. If a printer, printing-press, and types, etc., for the use of such newspaper office, not exceeding $1200. The personal earnings of the debtor and his family for the 90 days *preceding* the execution. To an unmarried person, a person not the head of a family, ordinary wearing apparel and trunks to contain the same are exempt. If a debtor absconds and leaves his family, such property allowed to the head of a family shall be exempt in hands of his wife and children, or either. A single man, not the head of a family, non-residents, and those who have started to leave the State are excluded from the above exemptions; their property is liable to execution, with the exception of ordinary wearing apparel, and trunks to contain the same; value not to exceed $75.

No exemption shall protect property against execution for the purchase money thereof.

MECHANICS' LIEN.—Every mechanic or other person doing any labor, or furnishing any material, machinery or fixtures for the erection or improvement of any building, by virtue of any contract with the owner, agent, trustee, contractor or sub-contractor, shall have a mechanics' lien on the buildings, fixtures and real estate. Railways are liable in the same way as other property for construction and improvements. No person who takes collateral security on the same contract is entitled to a lien. The lien must be filed in ninety days after the labor to affect purchasers or incumbrances without notice; as between the original parties, it can be filed any time in five years.

COLLECTION OF DEBTS.—Arrest in civil action is unauthorized by law in this State.

Writs of attachment may issue, by sworn petition, on one or more of the following grounds: 1. That defendant is a foreign corporation or acting as such. 2. That he is a non-resident of the State. 3. That he is about to remove his property out of the State, without leaving sufficient remaining for the payment of debts. 4. That he has, or is about to dispose of his property, in whole or in part, with intent to defraud creditors. 5. That he has absconded, so that ordinary process cannot be served upon him. 6. That he is about to remove permanently from the State and refuses to secure the debt. 7. That he is about to convert property into money for purpose of placing it beyond the reach of creditors. 8. He has property and rights which he conceals. 9. That the debt is for property obtained under false pretenses. In No. 4, 6, and 9, attachment may be commenced *before the debt is due.* Bond must be three times the amount claimed, and sheriff may attach fifty per cent. in value more than amount claimed. Attachment can only be levied on property not exempt from execution.

Assignments for the benefit of creditors must be made for the benefit of all creditors *pro rata.* An inventory of assets and liabilities must be sworn to by the insolvent, with a list of the creditors and their respective demands. Assignments must be duly acknowledged as transfers of real estate, and recorded in the county where the insolvent resides, or where the business in respect of which the same is made has been conducted. The assignee shall file the assignment and inventory with the clerk of the district court, and shall give bond for the performance of his duty in double the amount of the inventory and valuation. No dividend can be declared in less than three months. Creditors may accept their *pro rata* of assets, and take judgment for the remainder if they choose.

Garnishment can be issued either on execution or attachment against any person owing the debtor or having his property in possession. The garnishee is entitled to compensation for his trouble and expense; this is payable out of the fund, if any is found in his hands, or if nothing is due from the garnishee, then the plaintiff is bound to pay this sum.

Acceptors of notes and bills are liable only when their acceptance is indorsed in writing; or, if on seperate piece of paper, when the party who gave the credit saw the seperate paper; or if a promise is made in writing, to accept a draft before it is drawn, and the draft is in the hands of any person who gave credit on the strength of this writing. The rate of damages to be allowed and paid on the non-acceptance or non-payment of bills of exchange drawn or endorsed in this State is as follows: If bill be drawn upon a person at a place out of the United States, or in California, Oregon, Neveda, or any of the territories, five per cent. upon principal specified in the bill, and interest on the same from the time of protest. If drawn upon a person at any other place in the United States, other than in this State, three per cent, with interest. All parties to notes and bills, whether endorsers, acceptors or makers, can be sued jointly or seperately. Notarial protest is evidence of demand and refusal of payment as stated therein.

Jurisdiction of Justices of the peace, $100, but by agreement of parties may be extended to $300.

Circuit court has exclusive jurisdiction of probate business and appeals from justices of peace. District court has exclusive criminal jurisdiction. The two courts have concurrent jurisdiction in civil cases, except such as are special to circuit court as above. Service of summons must be ten clear days in district and circuit, and five in justice courts.

Judgments in courts of record are a lien from their rendition and for 10 years thereafter, on all real estate owned by the defendant, or subsequently acquired by him, and situated in the county where the judgment is rendered. The judgment can be revived at the end of that time. No execution can issue on a judgment in a court of record older than ten years; new suit has to be brought on the same. Judgments in courts of record create no lien on personal property. No execution can issue on a justice's judgment five years after its rendition, without revivor. Judgments before justice can be made to create lien on real estate by filing a transcript of the judgment in the circuit court.

Execution may issue as soon as judgment is obtained, but one can be out at the same time. Execution from a court of record, may issue to any county in the State. From a justice, can be levied on personal property *only*. Real estate may be redeemed within a year after sale; but if defendant files stay bond, or appeals to supreme court, his equity of redemption is cut off. If the defendant fails to redeem in six months, any creditor of the defendant, whose demand is a lien on the real estate sold, may redeem within nine months from date of sale.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Acknowledgment of deeds, made in the State, must be before a judge of any court of record, clerk of supreme, district and circuit courts, or their deputies, county auditor or his deputy, each notary public and justice of the peace in his own county. Acknowledgments out of State must be before some court of record, before some commissioner for the State of Iowa, or before a notary public or justice of the peace. If before a justice of the peace the certificate of clerk of the district court of the county as to his official character must be attached.

Chattel mortgages must be acknowledged as other conveyances and recorded in the county where property is situate. Foreclosures can be made by sheriff without action in court. The mortgaged property is left in possession of mortgagor, unless otherwise provided. Sales under chattel mortgage foreclosures shall be in the same manner as other sheriff's sales.

Married women can hold property the same as any other person, and are liable on all contracts made by them, but her own property is in no case liable for her husband's debts. The common law right of dower exists in this State, and in executing deeds, she must acknowledge separate and apart from her husband, that she was made acquainted with the contents of such conveyance, and relinquished her dower freely and without compulsion from her husband.

All Wills, except noncupative, must be in writing, signed by the testator, or by some person in his presence and by his express direction, and attested and subscribed in his presence by two or more competent witnesses. Subsequent incompetency of the witness will not invalidate the will. Noncupative wills, proved by two competent witnesses, when the value of the estate does not exceed $300, are valid.

SPECIAL LAWS OF KANSAS.

EXEMPTIONS FROM FORCED SALE.—*Home of* 160 *Acres of Farm Land, or House and One Acre in a Village or City, and Personal Property.* A homestead to the extent of 160 acres of farming land, or of one acre within the limits of an incorporated town or city, occupied as a residence by the family of the owner, together with all improvements on the same, of whatever value is exempt. Exemptions of personal property allowed a resident, being the head of a family, are: the family library, bible and school books; family pictures and musical instruments in use; a pew in a church and lot in a burial ground; all the wearing apparel and all beds, bedsteads and bedding used by the family; cooking-stove, appendages and cooking utensils, and other stoves and appendages necessary for the use of the family, a sewing machine; all spinning wheels and looms, and other implements of industry and other household furniture not abve enumerated, not to exceed $500 in value; 2 cows, 10 hogs, 1 yoke of oxen, and 1 horse or mule, or, in lieu of the yoke of oxen and horse or mule, a span of horses or mules; 20 sheep and wool from same, either raw or manufactured; the necessary food for the stock mentioned above for one year; 1 wagon, cart or dray; 2 plows, one drag and other farming utensils not exceeding $300 in value; provisions and fuel on hand sufficient for a year; the necessary tools and implements of any mechanic, miner or other person, used and kept for the purpose of carrying on his trade and business, together with stock in trade not exceeding $400 in value; the library, implements and office furniture of any professional man. Exemptions of personal property allowed a resident of this State, not the head of the family, are: wearing apparel; pew in a church and lot in a burial ground; necessary tools and instruments of any mechanic, miner or other person, used and kept for the purpose of carrying on his trade or business, together with stock in trade as above. The earnings of a debtor also, for personal services rendered within 3 months next preceding the issuing of an execution, are exempt, if it appear they are necessary, in whole or in part for the support of his family. No personal property is exempt from attachment or execution for the wages of any clerk, mechanic, laborer or servant.

MECHANICS' LIEN.—Material men and mechanics have lien for labor and material on the land and improvements to the extent of their claims. The original contractor must file his claim within four months; all other persons claiming a lien, within two months after the debt accrued. This lien has precedence over all other liens or encumbrances placed on the property subsequent to the commmencement of the building or improvements.

COLLECTION OF DEBTS.—Arrest and bail, in civil actions, are provided for by the laws of this State.

The order of arrest is issued by the clerk, or by the justice, only upon positive affidavit showing one or more of the statutory grounds therefor ,similar to those on which writs of attachment issue. (See Attachments.) Before the order issues, the plaintiff must also file an undertaking, with sufficient surety, conditioned for the payment of damages occasioned by the arrest, if wrongful. In practice, this remedy is seldom resorted to in Kansas.

Attachment, against the property of defendant may issue in civil cases, when the defendant, or one of several defendants, is a foreign corporation or non-resident (but not in either of these instances for any claim other than a debt or demand arising on contract, judgment or decree, unless the cause of action arose wholly within the limits of this State. It may also issue when the defendant or one of several defendants has absconded with fraudulent intent, or has left the county of his residence to avoid summons, or concealed himself to avoid summons, or is about to remove his property, or a part thereof, out of the jurisdiction of the court with fraudulent intent; or is about to convert it into money to put it beyond reach of creditors; or has property which he conceals, or has assigned, removed or disposed of his property; or is about to do so, with intent to defraud, hinder or delay creditors; or fraudulently contracted or incurred the debt, liability or obligation; or where the action is brought for damages arising from the commission of any crime, or for seduction, or where the debtor fails to pay on delivery where, by the contract, he was to pay on delivery. The order is issued (as in case of arrest and bail, *supra*), only upon affidavit and undertaking. But, where the defendant is a foreign corporation, or where the defendant or defendants are all non-residents of the State, the undertaking is not required.

Garnishee process, in attachment proceedings, is also provided for against any person or corporation having possession of property or being indebted to the defendant.

Assignments in trust, for the benefit of creditors, inure for the benefit of all creditors of the grantor, whether named in the deed of assignment or not; the deed of assignment must be acknowledged and recorded like other deeds. Assignments made to secure sureties or indorsers, prior to any payment by them, are valid here. Assignment of every species of contract or claim may be made in this State, and the assignee may sue thereon in his own name.

Acceptors of notes and bills are chargeable only when their acceptance is in writing on the bill; or, if on separate piece of paper, when the party who gave the credit saw the separate paper; or if a promise is made in writing to accept a draft before it is drawn, and the draft is in the hands of any person who gave credit on the strength of this writing. (Bills of exchange and notes duly protested for non-payment or non-acceptance, entitle the holder to recover damages as follows: if drawn on or made by a person outside the State, six per cent.; if outside any of the United States or territories, ten per cent. damages on the principal sum). All parties to notes or bills, whether endorsers, makers or acceptors, or parties in any manner, can be sued jointly or separately in the same or in several actions.

Justices of the peace have jurisdiction in actions on contract on account, bill, note or bond where the amount claimed or balances due does not exceed $300, in actions on undertakings given in civil proceedings before them where the sum due or demanded does not exceed $500; in replevin where the value of the property does not exceed $100. District courts have general original jurisdiction in all cases, and appellate jurisdiction from inferior courts. Upon default, judgments may be obtained before justices after three days' service of summons, but in contested cases, a delay of thirty days may be readily obtained before judgment, and afterward by a stay of execution as above stated. (See Executions.) In the district court, if in session, judgment may be taken upon default after forty days' service of summons, but in contested cases, issues must be made up for trial ten days prior to the term. Terms of the several district courts of the State are held as often as every six months.

Judgments are a lien upon the real estate of the debtor in the county where rendered, for the period of five years, and may be made a lien upon real estate in other counties by filing in the clerk's office therein an attested copy of the journal entry of the judgment. Justices' judgments may be made a lien upon real estate in same manner. But if execution be not taken out and levied within one year after rendition of judgmant, the lien becomes inoperative as against other judgment creditors. Judgments which have become dormant may be revived by the court upon motion of the judgment creditor and notice to the parties interested.

Executions may issue the day judgment is rendered.—*Exceptions.*—If the word "appraisement waived," or words of similar import, be inserted in any mortgage, bond, note, bill or written contract, judgment shall be rendered accordingly, and execution shall not issue thereon for 6 days. If upon the docket, in cases of judgment rendered by justices of the peace, any person, resident of the county, being good and sufficient security, shall, within 10 days, undertake that the judgment shall be duly paid, execution shall be stayed for periods ranging from 30 to 120 days, according to the amount of the judgment.

Executions are a lien on personal property only from the time they are actually levied. Executions from a justice cannot be levied on real estate. Redemption, after execution sale, is unknown. If an execution (from a court of record) is returned unsatisfied, the debtors can be summoned and required to state under oath what property or interest they have or own, which may be reached by execution.

Deeds, Rights of Married Women, &c.—Deeds in this State need not be under seal. When acknowledged within this State, it must be before some court having a seal, or some judge, justice or clerk thereof, or some justice of the peace, notary public, county clerk or register of deeds, or mayor or clerk of an incorporated city. When acknowledged without this State, it must be before some court of record, or clerk or officer holding the seal thereof, or before some notary public or justice of the peace, or commissioner to take acknowledgments appointed by the Governor of this State, or before any consul of the United States, resident in a foreign port or country. If taken before a justice of the peace, the acknowledgment must be accompained by a certificate of his official character, under the hand of some court of record, to which the seal of said court shall be affixed.

The following is the form of acknowledgment required:

STATE OF , } ss.
COUNTY OF . }

On this day of , A. D. 187 , before me, a in and for said , personally came , to me personally known to be the same person whose name affixed to the foregoing conveyance as grantor and duly acknowledged the execution of the same.

In testimony whereof, I have hereunto subscribed my name and affixed my seal, the day and year last above written.

(Husband and wife should always join in conveyances.) No separate acknowledgment is required on the part of the wife.

Married women can hold real or personal property, to their separate use, the same as unmarrried. A note or endorsement made by a married woman will bind her property the same as if she were unmarried.

Chattel mortgages of perishable articles, which are left in the hands of the mortgagor, with the right to use the same; or of a stock of merchandise which is left in the hands of the mortgagor with privilege to sell in due course of his business, or in any manner for his own benefit; or of any chattels which are left in the possession of the mortgagor, the mortgage not being duly registered, are void as to the creditors of the mortgagor, unless they have notice of the same.

SPECIAL LAWS OF KENTUCKY.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1,000, *and Personal Property.* To *bona fide* housekeeper with a family, resident in the State: 2 work beasts, or 1 work beast and 1 yoke of oxen; 2 plows and gear; 1 wagon and a set of gear, or 1 cart or dray; 2 cows and calves; 10 head of sheep; provisions sufficient to sustain the family one year, and provender sufficient to support the stock one year; 1 sewing machine; the usual household and kitchen furniture of limited value, etc.; the tools of a mechanic not exceeding $100 in value; the libraries of ministers of the gospel, physicians and attorneys-at-law not to exceed in value $500, but the last is not in addition to the two work beasts, wagon, cart or dray. In addition to the personal property exempt from execution on all debts or liabilities created after the 1st of June, 1866, so much land, including the dwelling-house and appurtenances owned by the debtor as shall not exceed $1,000, shall also be exempt to the bona fide housekeeper with a family.

MECHANICS' LIENS.—There is a general law for the State (not applying to Jefferson county, which has a special act in some respects different) giving mechanics and material men liens upon the improvements and interest of the employer in the land for work done and material furnished. Sub-contractors and laborers may acquire a lien, by giving the employer written notice of their claim, and that they look to the land and improvements for compensation. Liens must be filed in sixty days and suit brought in six months, to enforce claims, or they are lost.

COLLECTION OF DEBTS.—A defendant in a civil action may be arrested when an affidavit is filed and bond given, for causes for which an attachment will lie.

The defendant may give bail, or in lieu of bail, deposit in the hands of the sheriff, or in court, the amount of money mentioned in the order of arrest. In default of both, he will be committed to jail, there to remain until he pays the debt, gives bail or take the insolvent debtor's oath.

Attachment, in a civil action for the recovery of money, may issue against the property of the defendant, or a garnishee where the action is against: 1. A defendant, or several defendants, who, or some one of whom, is a foreign corporation or a non-resident of the State. 2. Who has been absent therefrom four months. 3. Has departed from the State with intent to defraud his creditors. 4. Who has left the county of his residence to avoid the service of a summons. 5.

So conceals himself that a summons cannot be served on him. 6. Is about to remove, or has removed his property, or a material part thereof, out of this State, not leaving enough therein to satisfy the plaintiff's claim or the claim of said defendant's creditors. 7. Has sold, conveyed or otherwise disposed of his property, or suffered or permitted it to be sold, with the fraudulent intent to cheat, hinder or delay his creditors. 8. Is about to sell, convey or otherwise dispose of his property with such intent. An attachment shall not be granted on the ground that the defendant, or defendants, or any of them, is a foreign corporation, or a non-resident of this State, for any claim other than a debt or demand arising on contract. To obtain an attachment, the plaintiff must file an affidavit, showing: 1. The nature of his claim. 2. That it is just. 3. The amount which the affiant believes the plaintiff ought to recover. 4. The existence in the action of some one of the grounds above enumerated. No attachment will issue until bond and security in double the amount of the debt is given.

A defendant may be arrested in a civil action for causes for which an attachment may issue, on filing affidavit and giving bond.

Assignments, sales, mortgages, judgments suffered in contemplation of insolvency and with a design to prefer one or more creditors to the exclusion in whole or in part of others, shall operate as an assignment and transfer of all the property and effects of the grantor, and shall enure to the benefit of all his creditors.

Garnishee may be summoned on attachment. He shall not be subject to costs beyond those caused by his resistance of the claim against him. After return of execution, endorsed "no property found," an equitable action may be brought for the discovery by the defendant of money, choses in action, equitable and legal interests, etc. In such an action, any one indebted to the defendant or holding money or property belonging to him may be made defendant. Attachments may issue without affidavit or bond. The court shall enforce the surrender of money, property, etc., and may commit to jail any defendant or garnishee refusing to make such surrender.

All bills, bonds or notes, for money or property shall be assignable so as to vest in the assignee the right of action. Three days of grace are allowed on bills of exchange. The endorser on a note, unless put on the footing of a foreign bill, is discharged, unless the holder brings suit against the maker, if note remains unpaid, at the first court held after its maturity, and prosecutes the maker to insolvency. Promissory notes, payable and negotiable at a bank in this State, which shall be endorsed and discounted by said bank, or by any other bank, shall and are placed on the same footing as foreign bills of exchange.

Justice courts have jurisdiction exclusive of the Circuit Court, but concurrent with the quarterly court, of all actions and proceedings for the recovery of money or personal property, where the matter in controversy, exclusive of interest and costs, does not exceed \$50 in value, and in other cases specially provided by stat ute. Justices of the peace in Jefferson county and a few other counties have jurisdiction to the extent of \$100, exclusive of interest and costs.

The *Court of Appeals* has general appellate jurisdiction over all courts, except where the judgment grants a divorce, or is rendered by a quarterly, county, police, city, mayor's or justice's court. *Circuit Courts* have general original jurisdiction of all actions and proceedings for the enforcement of civil rights and redress of civil wrongs, except when exclusive jurisdiction is given to other courts. (Civil Code, § 18.) They have appellate jurisdiction of the judgments of quarterly courts when the amount in controversy exceeds \$20. *Quarterly Courts* have jurisdiction of actions to recover *money* or *personal* property not exceeding in value \$100. They have appellate jurisdiction from judgments of justices of the peace for \$5 and over.

Summons must be issued and served 10 days before return day thereof. In equitable proceedings the summons is returnable in twenty days. In justices' courts, on sums less than \$50, it is returnable in five days, and on sums greater than \$50, in ten days.

Executions issue, from magistrates courts for sums less than \$50, in 5 days, for sums over \$50, in 10 days; from the Jefferson court of common pleas, quarterly courts and circuit courts, in ten days; from the Louisville Chancery court in 15 days after judgment rendered; is returnable to some rule day of the court, not under 30 nor over 70 days from the test, and binds the real estate but not the personal estate (until levied) of the defendant only from the time the same is delivered to the proper officer to execute. For cause shown, the court may order immediate execution.

A judgment is not a lien on the property of the defendant. A judgment may be enforced by issuing execution at any time within 15 years from its rendition.

Each renewal of execution revives the judgment for 15 years from the date of such renewal. Foreign judgments must be proven by certificate of judge and clerk.

Writs of provisional seizure may also issue, without the plaintiff giving bond.

A defendant may replevy for 3 months a judgment or execution against him, at any time before a sale of property under the same, by giving to the officer an obligation, payable to the plaintiff with good security for the amount thereof, including interest, costs and half commissions up to that time.

If land sold under execution does not bring two-thirds of its value, the defendant or his representatives shall have the right to redeem the same within a year.

Deeds, Rights of Married Women, Wills, &c.—Deeds need not be under seal. Deeds executed in this State by persons other than married women, may be admitted to record: first, on the acknowledgment before the clerk of a county court by the party making the deed; or second, by the proof of two subscribing witnesses, or by the proof of their signatures. Deeds executed out of the State, and within the United States, by persons other than married women, may be admitted to record when the same shall be certified under his seal of office by the clerk of a court or his deputy, or by a notary public, mayor of a city or secretary of state, or commissioner to take the acknowledgment of deeds, or by a judge under the seal of his court to have been acknowledged or proved before him in the manner hereby required. Deeds executed out of the United States by persons other than married women, may be admitted to record when the same shall be certified by any foreign minister or consul, secretary of legation of the United States, or by the secretary of foreign affairs, certified under his seal of office or the judge of a superior court of the nation where the deed shall be executed, to have been acknowledged or proved before him in the manner prescribed by law.

A deed of a married woman, to be effectual, shall be acknowledged before some of the officers named in the preceding sections, and lodged in the proper office for record. Previous to such acknowledgment, it shall be the duty of the officer to explain to her the contents and effect of the deed separately and apart from her husband, and thereupon, if she freely and voluntarily acknowledge the same, and is willing for it to be recorded, the officer shall certify the same. (Privy examination need not be stated in certificate.) When the acknowledgment shall be taken by an officer out of this State, the same shall be acknowledged and certified to the effect following:

State of Kentucky, }
County of Mercer. } *ss.*
(or town, city, department or parish of .)

I, A. B. (here give his title), do certify that this instrument of writing from C. D. and wife (E. F., or from E. F., wife of C. D.), was this day produced to me by the parties, and which was acknowledged by the said C. D. to be his act and deed, and the contents and the effect of the instrument being explained to the said E. F. by me separately and apart from her husband, she thereupon declared that she did freely and voluntarily execute and deliver the same, to be her act and deed, and consented that the same might be recorded.

Given under my hand and seal of office.

[SEAL.] A. B. (signature and title.)

Proof by subscribing witness.

State of Kentucky, }
County of Mercer. } *ss.*

I, A. B. (here give the title), do certify that this day came before me G. H. and I. J. the subscribing witnesses to the foregoing deed (or other instrument) by C. D. to L. M., which witnesses are personally known to me to be the same whose names are so written as witnesses, and being solemnly sworn by me in due manner, did severally declare, on their oaths, that the said C. D. did acknowledge this instrument to be his act and deed, and that the signature thereto was made by him; that they know him to be the same person who is named as the grantor therein, and that they did subscribe said deed as witnesses by his request.

Given under my hand and seal this day of , 18 .

[SEAL.] (Signature and title.)

Deeds made by residents of the State, must be legally lodged for record within sixty days from the date thereof. By non-residents, and in the United States, within four months; if out of the United States, within twelve months. Deeds are not legally recorded until the clerk's tax is paid. The county clerk is the recorder of deeds. Deeds must be recorded in the county where the land lies, and take effect in the order in which they are recorded.

Chattel mortgages must be duly acknowledged and recorded. The possession of the property mortgaged may remain in the mortgagor. Five years' possession operates as a bar to the mortgagee. A mortgage on a stock of goods is only valid as to the goods in store at the time it is given, and is not good as to after-acquired stock.

The real estate of a married woman owned before, or acquired after marriage, shall not be liable for the debts of her husband, but are liable for debts of her and her husband jointly created, in writing, for necessaries furnished her or any member of her family. The property of the husband shall not be subject to the payment of any of the wife's debts incurred previous to marriage.

Wills must be in writing, signed by the testator or by some other person in his presence and by his direction: and if not written wholly by himself, must be attested by two or more competent witnesses, subscribing their names in his presence.

SPECIAL LAWS OF LOUISIANA.

EXEMPTIONS FROM FORCED SALE.—*Home of* 160 *Acres of Land, and Personal Property, in all worth* $2,000.—160 acres of land, with buildings and improvements thereon, occupied as a residence, and *bona fide* owned by the debtor, having a family, a person or persons dependant upon him for support; together with personal property, making in all a value not exceeding $2,000. Tools of trade, salaries, wages, and personal services, all wearing apparel, all agricultural implements, working cattle, and provisions and supplies necessary for carrying on the plantation for the coming year. No home exempted in the city or villages, and in any case only for benefit of persons having a family.

MECHANICS' LIEN.—The contractor has a lien for the payment of his labor on the building or other work which he may have constructed. Workmen employed immediately by the owner in the construction or repair of any building have the same privilege. If the contractor be paid by the employer, actions for work and supplies furnished the former will not lie against the latter, but moneys due the contractor by the employer may be seized and applied towards payment. No agreement for work exceeding $500, unless reduced to writing and registered with the recorder of mortgages, shall be privileged as above. For amounts less than $500, this formality is dispensed with, but the privilege is limited to 6 months from the time of completed work. Workmen employed on vessels or boats have a lien on the same, and are not, in any case, bound to reduce their contracts to writing, but their privileges closes if they allow the vessels to depart without exercising their right.

COLLECTION OF DEBTS.—Arrest, in civil action, may be made of a debtor who is about to leave the State without leaving sufficient property to satisfy the judgment sought to be obtained by the creditor, and held until security is given that he will not depart from the State without leave of court; *provided*, that no citizen of another State shall be arrested at suit of resident or non-resident creditor, except upon oath that the debtor has absconded from his residence. Arrest or attachment may be made whether the debt is due or not, and agent or attorney may swear to the best of his knowledge and belief.

Writ of attachment may issue against a defendant for the following causes: 1. Where the defendant is a non-resident. 2. Where he is about to leave the State permanently. 3. Where he conceals himself to avoid being cited. 4. Where he has mortgaged, assigned or disposed of his property, or is about to do so, with intent to give an unfair preference to some of his creditors, or place his property or evidence of debt beyond the reach of his creditors. In every case where an attachment is sought, the petitioning creditor must give a bond, payable to the clerk of the court for an amount one-half over the claim demanded, with surety residing within the jurisdiction of the court. Writs of sequestration may issue in this State upon an affidavit made by party, or agent, or attorney in his absence, showing one of the following grounds, after executing a bond with one good resident surety in an amount to be determined by the judge; 1, Where the plaintiff, who has had possession of the property for one year, has been ejected by force. 2. Where the plaintiff seeks the possession of movable property, and fears the party having possession of the same may impair its value, may remove it beyond the jurisdiction of the court, or may conceal or dispose of it during the continuance of the suit. 3. Where a wife sues for separation from bed and board, or for separation from property alone, and has reason that her husband may injure her dotal property or waste the fruits and revenues produced by the same during the pendency of the suit. 4. Where the defendant has asked for a stay of proceeedings against him, and at a meeting of his creditors they should fear he will avail himself of such stay of proceedings to dispose of the whole or part of his property. 5. Where the plaintiff has a lien or privilege on property.

Writs of sequestration may also issue, without the plaintiff giving bond, in cases where he seeks to enforce a landlord's, seaman's, mechanic's or laborer's lien.

The assignment of notes, bills, accounts, or claims of any kind is valid, and the assignee may sue in his own name, but the assignment of a debt must be notified to the debtor. Garnishment can issue on an execution or attachment against any person owing the debtor, or having his property in possession.

Justice of the peace has jurisdiction up to $100, including parish courts, original jurisdiction, from $100 to $500. District courts on all amounts over $500. Appeals from justices, when over $10, returnable to the parish courts, except in the parish of Orleans, where returnable to third district court when over $10. Appeals lie from parish court on sums over $100. From district court to supreme court over $500. Service of citation must be made for ten days before any action can be taken.

Judgments, to operate as a lien, must be recorded in the mortgage book of the parish recorder. It then becomes a judicial mortgage on all the real estate of the debtor where recorded.

There is no stay of execution, and it can issue at any time after judgment. No redemption of property sold under execution or mortgage.

Deeds, Rights of Married Women, Wills.—Deeds are valid without scrawl or seal. They must be acknowledged in the State before a notary public or recorder, or in presence of two witnesses, who may prove the signature. If acknowledged out of the State, before a commissioner of Louisiana, or in conformity to the laws of the State where acknowledged, and in the latter case the official character of the officer before whom the acknowledgment is taken must be properly verified. The husband must join in the execution of a deed made by the wife conveying her real estate, and authorize her.

When the husband sells his own real estate, the wife must join him and renounce all her rights, and she must be examined apart from her husband and duly informed of the nature of the act. No particular form of words is necessary, except the above must be shown. This form is used:

State of ,
County of . } ss.

Be it remembered that on this day came before me, John Hampden, a notary public within and for the county aforesaid, duly commissioned and acting as such, A. B. and his wife, C. D., to me known personally (or proved such by two credible witnesses) to be the persons whose names are subscribed to the foregoing deed; and the said A. B. acknowledged that he had executed the said conveyance, for the consideration and purposes therein mentioned and set forth; and the said C. D., being by me first made acquainted with the contents of said instrument, in an examination apart from her husband, and fully advised of the nature of her rights upon his property, acknowledged that she executed the same freely, and without compulsion or undue influence of her said husband.

Witness my hand and seal of office, on this day of , 187 .

JOHN HAMPDEN, *Notary Public.*

The estate of a married woman, whether acquired before or after marriage, remains her separate estate, and cannot be sold by her husband. All property acquired during marriage from the joint or separate earnings of husband and wife, and the revenues of the separate property of each, is equally divided between them. A married woman has no dower in her husband's estate, but it is best for her to join in any conveyance made by him, in order to renounce any claims she may have on his estate. (She has no claim unless her lien or mortgage is recorded.) The husband must join his wife in any conveyance of her separate estate.

There is no chattel mortgage in this State, but the law creates certain privileges upon movables, which are as follows: 1. The vendor's privilege on the movables not paid for; 2. For debts due for necessary supplies furnished to any farm or plantation and for money actually advanced for the supplies and necessary expenses for any farm or plantation on the crops of the year or the proceeds thereof; 3. The lessor's privilege on the crops and movables on the property leased; 4. Architects, undertakers, furnishers of material, etc., on the edifices or other works built or repaired.

These privileges are, however, preserved, and can be acquired only by having recorded in the parish where the property is the account containing the statement of indebtedness in detail, and the balance due, under the oath of the party doing or having the work done, and this to be recorded the day the contract was entered into, to have effect against third parties.

The estate of a married woman, whether acquired before or after marriage, remains her separate estate, and cannot be sold by the husband. All property acquired during marriage from the joint or separate earnings of husband and wife, and the revenues of the separate property of each, is equally divided between them. A married woman has no dower in her husband's estate, but it is best for her to join in any conveyance made by him, in order to renounce any claims she may have on his estate. (She has no claim unless her lien or mortgage is recorded.) The husband must join his wife in any conveyance of her separate estate. The wife may make her last will without the authority of her husband.

SPECIAL LAWS OF MAINE.

EXEMPTIONS FROM FORCED SALE.—*Home worth $500 and Personal Property.* Homestead to the value of $500, or lot purchased from the State, for a homestead. After the death of the debtor, his widow and minor children are entitled to the same exemption. A lot in a burying-ground; wearing apparel; necessary household furniture not exceeding $50; 1 bed, bedstead and bedding for every two in the family; all family portraits; bibles and school-books in use; copy of the statutes, and a library not exceeding $150; one cooking-stove, 12 cords wood, 5 tons anthracite coal and 50 bushels bituminous coal; $10 worth of lumber, wood or bark; all produce until harvested; 1 barrel of flour; 30 bushels corn and grain; all potatoes; all flax raised on 1 acre of land and all articles manufactured therefrom for the family; tools in trade; 1 sewing machine worth $100; 1 pair working cattle or mules; 1 or 2 horses, not exceeding in value $300, and hay to keep them through the winter; one cow and heifer; 10 sheep, and the lambs and wool raised from them, and hay to keep them during the winter; 1 plow; a cart or truck wagon; harrow; yoke with bows, ring and staple; 2 chains; a mowing machine, and one boat of 2 tons.

MECHANICS' LIEN.—Mechanics have a lien on buildings for labor and materials furnished for erecting or repairing same, which may be enforced by attachment in ninety days after same are furnished or labor done, and against vessels for four days after same is launched.

COLLECTION OF DEBTS.—Arrests in civil actions can be made. In actions of tort, the body is committed, unless bail is given. In actions on contract over ten dollars, and the debtor is about to depart from the State to reside beyond the limits of the State, and carries with him property more than sufficient for his support, he can be arrested.

Every assignment made by a debtor for the benefit of creditors shall provide for a proportional distribution of all his real and personal estate, except what is by law exempt from attachment, among all his creditors, becoming parties thereto, and in whatever form made shall have the effect aforesaid, and be also construed to pass all such estate, whether specified therein or not. A release may be inserted in the deed of assignment, which shall forever discharge the assignor from the claims of such creditors as become parties thereto. The assignor shall make oath as to the truth of the assignment. The assignee must, within fourteen days after the assignment is made, give public notice of his appointment in some newspaper printed in the county where the assignor lives, such notice to by continued three weeks successively. Three months from such assignment is allowed creditors to become parties thereto. If the assignment is not sworn to and notice not given, then the same is void against attaching creditors. All property conveyed by the assignor previous to and in contemplation of the assignment, with the design to delay, hinder or defraud creditors, or to give preference to one creditor over another, shall pass to the assignee notwithstanding such transfer.

Writ of attachment may be issued in any civil action and can be levied on all property not exempt, which creates a lien that continues for 30 days after execution issues.

Negotiable notes, bills, and bonds are assignable, so that assignees may sue in their own name. Any person who holds any goods, effects or credits belonging to a debtor may be required, under the "trustee process," to deliver up the same for the credtitor to reach, except $20 due the debtor for wages, and even then when the debt is for necessaries.

As to notes and bills, on any promissory note, inland bill of exchange, draft or order for payment of money, payable in this State at a future day, or at sight, and not on demand, a grace of three days shall be allowed. In an action on a promissory note, payable at a certain place, either on demand or on demand at or after a time specified therein, the plaintiff shall not recover unless he proves a demand made at the place of payment prior to the commencement of the suit. No person shall be charged as an acceptor of a bill of exchange, draft or written order, unless his acceptance shall be in writing, signed by him or his lawful agent; and no waiver of demand and notice by an indorser of any promissory note or bill of exchange shall be valid unless it is in writing and signed in like manner. No action can be maintained upon any note or other security given for intoxicating liquors, sold in violation of the act relating to sales of intoxicating liquors, unless the security is negotiable paper in the hands of an innocent holder, and for value. No agreement that personal property, bargained and delivered to another, for which a note is given, shall remain the property of the payee till the note is paid, is valid, unless it is made and signed as a part of the note; nor when it is so signed in a note for more than $30, unless it is recorded like mortgages of personal property. Damages on protest of bills of exchange, of $100 or more, payable by the acceptor, drawer or indorser of one, in this State are, if payable at a place 75 miles distant, one per cent.; if payable in the State of New York, or in any State northerly of it, and not in this State, three per cent.; if payable in any Atlantic State or territory southerly of New York and northerly of Florida, six per cent.; and in any other State or territory, nine per cent.

The jurisdiction of justice courts extends to $20, supreme judicial court, of all civil and criminal matters, and, except in county of Cumberland, exclusive of all sums over $20; in county of Cumberland over $500, concurrent jurisdiction.

Service must be had, in cases before justice of the peace, 7 days before the return day. In the courts of record, on individuals, 14 days, and on corporations, 30 days, before the return day.

Judgments are liens for 30 days where it is created by attachment, but not otherwise. Execution can issue on judgments after term of the court expires at which judgment was obtained for 3 years, and for the same length of time after the last execution. Judgments can be sued on for 20 years. The execution cannot be stayed unless it is issued wrongfully, and then only upon giving bond to the judgment creditor.

Deeds, Rights of Married Women, Wills, &c.—Deeds must be under seal; a scrawl is not sufficient. It is not necessary to have witnesses, but it must be acknowledged in the State before a justice of the peace. Out of the State, before any justice of the peace, magistrate, notary public, commissioner for the State, or by any United States minister, consul, or any notary public in any foreign country. The wife must join in the deed to relinquish dower, or she may do it by a separate deed. When she joins with her husband in the same deed, either can acknowledge the instrument. No separate examination of the wife is necessary.

The following is the form of acknowledgment to be used in this State·

State of Maine, } ss.
County of Waldo. }

On this day of , 187 , personally appeared the above-named grantor, and aknowledged the foregoing instrument, by him signed, to be his free act and deed.

Before me, Sam Johnson,
Justice of the Peace.

If acknowledged out of this State, use this form:

State of Vermont, } ss.
County of Windham. }

On this day of , 187 , personally appeared before me R. Anderson, notary public, the above-named , the grantor, and acknowledged this instrument to be his free act and deed.

In witness whereof, I have hereunto set my hand and affixed my official seal the day and year aforesaid.

[SEAL.] R. Anderson, *Notary Public.*

As to property, both real and personal not obtained by them from their husbands, married women can control, dispose of, and encumber as though they were *femme sole*, and free from the debts of their husbands. They can make contracts, for which they and their property are liable, whether notes or otherwise, and their property may be attached and taken on execution to satisfy any judgment received against them. They cannot be arrested. A wife must join in a deed from the husband in selling his real estate, to relinquish dower, and he must join with her in selling her real estate only when it comes to her from him.

All chattel mortgages made to secure over $30 are void, unless possession is given to the mortgagee, or rather taken out of the possession of the mortgagor, and the mortgage recorded in the town where the mortgagor lives.

In this State all wills must be in writing, signed by the testator, or by some person in his presence and by his express direction, and shall be attested and subscribed in his presence by three credible witnesses.

SPECIAL LAWS OF MARYLAND.

EXEMPTIONS FROM FORCED SALE.—*No Homestead Exemption, but Personal Property.* The property exempted is the personal property *actually necessary* for the sustenance of the family and the implements or tools *necessary* to earn a livlihood, and wearing apparel. The Constitution of the State directs the Legislature to pass laws exempting from judicial sale property not exceeding $500. $100 is the amount fixed and exempted in pursuance of this constitutional requirement. The exact language of the law is, "all wearing apparel, books, and the tools of mechanics."

MECHANICS' LIEN.—Every building erected, and every building repaired, rebuilt or improved to the extent of one-fourth of its value, shall be subject to a lien for the payment of all debts contracted for work done or material furnished for or about the same ; also vessels, boats or machines constructed or repaired within this State are subject to mechanics' lien. The lien must be filed in the record office within six months after the work has been finished or materials furnished. If the contract shall have been made with an architect or builder, or any person other than the owner of the ground on which the building is erected, or his agent, notice of intention to claim a lien must be given to the owner within sixty days. The mechanics' lien has priority over all other liens or incumbrances placed on the property after the commencement of the building, and over mortgages to secure future advances, where the loan or advance is not actually made until after the commencement of the building.

COLLECTION OF DEBTS.—No person can be arrested in civil action here. Writs of attachment may be obtained on the following grounds: Non-residence of the defendant, absconding or secretly removing from his place of abode, with intention to evade payment of his debts. When two summons have been returned *non est* in any action. No bond is required before issuing in the foregoing cases. Attachment may be had on any debt due by a married woman trading as a *femme sole*. Upon affidavit and approved bond in double the debt claimed, attachment for fraud will be issued where debtor is about to abscond from the State ; or has, or is about to assign, dispose of, or conceal his property, or some part thereof, or to remove the same with intent to defraud his creditors ; or has fraudulently contracted the debt. In these cases caution should be used not to resort to attachment unless the proof of the alleged fraud is such as would satisfy a jury upon trial.

Every species of property, or legal, or equitable interest in property, is subject to attachment and execution at law.

Assignments, in trust, for the benefit of creditors, are not regulated by any special enactments and are common in use. The debtor, so far as the State laws are concerned, may prefer any creditor or class of creditors, or may exact releases, if he assigns all his property. Any chose in action, judgment, bond, legacy or distributive share of an estate may be assigned in writing, signed by the person authorized to assign the same, and the assignee may sue in his own name.

As to garnishment, attachments, either on judgment or on original process, in those cases where attachments are authorized, may be laid in the hands of any person or corporation who may then be made to disclose under oath whether they owe or are indebted to the defendant or have any property of his in their possession. $100 of the wages due to any laborer, or employee is exempt from attachment or garnishment.

As to notes and bills, a protest made by a notary public for non-payment or non-acceptance, is *prima facie* evidence of the presentment and non-payment or non-acceptance at the time and in the manner stated in the protest, and that notices thereof have been sent or delivered in the manner therein stated. The holder of a protested bill of exchange, drawn in this State on a foreign country, shall recover so much current money as will purchase a good bill on the same country, and fifteen per cent. damages, and costs and legal interest. If the bill is drawn upon any person in any other State, district or territory of the United States, the holder shall recover so much current money as will produce a good bill on the same place and eight per cent. damages, and costs and legal interest.

Justices of the peace have jurisdiction in cases where the debt or damage claimed does not exceed one hundred dollars, and in all cases of greater amount the circuit courts of the several counties have jurisdiction, and in Baltimore city either the superior court, court of common pleas, or city court.

An execution or attachment may issue at any time within 12 years from the date of such judgment, or, if there be a stay thereon, at any time within 12 years after the expiration of such stay, where there has been no change of parties to such judgment. In the city of Baltimore, execution can issue on the day judgment is rendered. In some of the counties, when judgment is rendered at the first trial term, there is a stay, by rule of court, until the next term. Every kind of property can be reached either by execution or attachment. Redemption after sale upon execution is not allowed. Execution may be stayed for six months by superseding the judgment within sixty days after it is entered, by giving two securities who must confess judgment.

Judgments are a lien upon the real estate of the defendant from the date of the judgment, and upon all leasehold interests and terms for years, except leases for not more than five years and not renewable. But a judgment is not a lien upon personal property until execution is put into the hands of the sheriff. Execution may issue at any time within twelve years, but after twelve years the judgement is barred by limitations, unless previously renewed by *scire facias*. Judgments of justices of the peace can be made a lien on real estate by being recorded.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—The form of conveyances have been simplified by the code. No words of inheritance are necessary. A *fee simple* estate passes, unless a contrary intention shall appear by express terms or be necessarily implied. Deeds must be under seal (a scrawl is sufficient), and the signature must be attested by at least one witness. A consideration must be stated. In deeds of fee simple property, the wife must join to release her right of dower. No special form of acknowledgment or separate examination is necessary for a married woman.

The following is the form of certificate.

STATE OF MARYLAND, } *ss.*
COUNTY OF CARROL. }

I hereby certify that, on this day , in the year , before the subscriber (here insert the official style of the officer taking the acknowledgment), personally appeard (here insert the name of person or persons making the acknowledgment), and acknowledged the aforegoing deed to be his act (or did each acknowledge the aforegoing deed to be their respective act).

[SEAL.] (Signature.)

In testimony whereof, I have hereunto set my hand and affixed my official seal the day and year aforesaid.

The acknowledgment, if made within the State, may be made before a justice of the peace for any county or city, or a judge of a court of a county or city having a seal. If acknowledged before a justice of the peace within the State, but out of the county or city in which the real estate lies, the official character of the justice of the peace must be certified by the clerk of the circuit court or superior court under his official seal.

If acknowledged without the State, but within the United States, the acknowledgment may be made before: First, a notary public (who must affix his notarial seal); second, a judge of any court of the United States; third, a judge of any court of any State or territory having a seal; fourth, a commissioner of Maryland to take acknowledgment of deeds.

If acknowledged without the United States, the acknowledgment may be made before: First, any minister or consul of the United States; second, a notary public; third, a commissioner of Maryland to take acknowledgments. To every certificate before a judge the seal of the court must be affixed.

Married women hold their real and personal property for their own separate use and entirely protected from the debts of the husband, and there is no necessity for a trustee. They may devise the same as fully as a *femme sole*, or may convey the same by a joint deed with the husband. If the wife die intestate, leaving children, her husband has a life estate in her property; if she die intestate leaving no children, her husband has a life estate in her real estate and her personal property vests in him absolutely. A married woman may be sued jointly with her husband on any note, contract, or agreement which she has executed jointly with him, and the judgments recovered in such cases are liens on the property of both, and may be collected in the same manner as if the defendants were not husband and wife. A woman becomes of legal age to convey real estate at twenty-one, but may receive her property and release her guardian at eighteen, or upon marriage.

Bills of sale or chattel mortgages are valid, although the vendor or mortgagor of the chattels remains in possession; *provided*, they are properly acknowledged and recorded, and the vendee or mortgagee shall make oath at the time of execution before some person authorized to take the acknowledgment, that the consideration stated in the bill of sale or mortgage is true and *bona fide*. They may be acknowledged out of the State before any person authorized to take acknowledgment of deeds, and must be recorded in the county or city where the *vendor resides*, within twenty days from date. If acknowledged within the State, it must be before a justice of the peace or judge of the orphans' court of the city or county where the vendor resides.

Wills should be in writing, and signed by the party making them, or by some other person in his presence and by his express directions, and shall be attested and subscribed in the presence of the testator, by three or four credible witnesses. A wife may make a will and give all her property, or any part thereof to her husband, or any one other person, with the consent of the husband subscribed to said will. Provided the wife shall have been privately examined by witnesses to said will, apart out of the presence and hearing of her husband, &c. (in the same manner as provided for in deeds), and provided also said will be made 60 days before death of the testatrix.

SPECIAL LAWS OF MASSACHUSETTS.

EXEMPTIONS FROM FORCED SALE.—*Home worth $800, and Personal Property.* Every householder having a family shall be entitled to an estate of homestead to the extent in value of $800, in the farm or lot of land and buildings thereon owned or rightly possessed by lease or otherwise and occupied by him as a residence, and such homestead and all right and title therein shall be exempt from attachment, levy or execution, sale for the payment of his debts or other purposes. To constitute such estate of homestead and to entitle property to such exemption, it shall be set forth in the deed of conveyance by which the property is acquired that it is designed to be held as a homestead, or after the title has been acquired such design shall be declared by a writing duly signed, sealed, acknowledged and recorded on the registry of deeds for the county or district where the property is situated. Personal property is exempt as follows: The necessary wearing apparel of the debtor and his family; 1 bedstead, bed, and the necessary bedding for every two persons of the family; stove and fuel not exceeding $50 in value; other necessary household furniture not exceeding in value $300; the family library not exceeding $50 in value; 1 cow, 6 sheep, 1 swine and 2 tons of hay; tools, implements and fixtures for carrying on trade or business not exceeding $100 in value; materials and stock designed for his trade or business not exceeding $100 in value; necessary provisions not exceeding $50 in value; the boat, fishing tackle and nets of fishermen, actually in use in their business, not exceeding $100 in value; the uniform, arms and accoutrements required by law to be kept by the citizens; 1 sewing machine to the value of $100, and the wages for personal labor are exempt from attachment to the extent of $20 for, a debt or demand other than for necessaries furnished to the debtor or his family.

MECHANICS' LIEN.—Any person furnishing labor and materials for the erection, alteration or repairs of any building, shall have a lien on the same, but no lien for the materials shall attach unless he shall notify the owner, in case he is not the purchaser, in writing, that he intends to claim a lien for the same before they are furnished. Where the contract for furnishing labor and materials is for an entire sum, a lien will attach for the labor, if its value can be ascertained separate from the materials, but not beyond such entire sum. Notice in writing from the owner of such building, that he will not be responsible for the labor and materials to be furnished to the party furnishing or performing the same, will prevent the lien from attaching.

COLLECTION OF DEBTS.—When an arrest of the defendant in a civil action, on *mesne process*, in an action of contract, is desired by the plaintiff, the plaintiff, or some person in his behalf, makes affidavit, and proves to the satisfaction of some justice of a court of record, police court, judge of a probate court, master in chancery, commissioner of insolvency, and, except in the county of Suffolk, trial justice or of any justice of the peace,—1. That he has a good cause of action, and reasonable expectation of recovering a sum amounting to $20, exclusive of all costs which have accrued in any former action. 2. That he believes, and has reason to believe, the defendant has property not exempt from being taken on execution, which he does not intend to apply to payment of the plaintiff's claim; and, 3. That he believes, and has reason to believe, that the defendant intends to leave the State, so that execution, if obtained, cannot be served upon him; or (instead of the second or third), that the defendant is an attorney-at-law; that the debt sought to be recovered is for money collected by the defendant for the plaintiff, and that the defendant unreasonably neglects to pay the same to the plaintiff. And such affidavit, and the certificate of the magistrate that he is satisfied the same is true, shall be annexed to the writ.

In actions of tort, the arrest of the defendant may be procured when the plaintiff, or some one in his behalf, makes oath, to the satisfaction of any one of said magistrates, that he believes, and has reason to believe, that he has a good cause of action against the defendant; that he has reasonable expectation of recovering a sum equal, at least, to one-third the damages claimed in the writ; and that he believes, and has reason to believe, that the defendant intends to leave the State, so that if execution be obtained it cannot be served on him. An order for arrest on an execution issued on a judgment for debt or damages in a civil action, except in actions of tort, may be obtained when the plaintiff, or some one in his behalf, makes affidavit and proves to the satisfaction of any one of said magistrates: 1. That he believes, and has good reason to believe, that the debtor has property not exempt from being taken on execution, which he does not intend to apply to the payment of the plaintiff's claim; or, 2. That since the debt was contracted, or the cause of action accrued, the debtor has fraudulently conveyed, concealed, or otherwise disposed of some part of his estate, with a design to secure the same to his own use and defraud his creditors; or, 3. That since the debt was contracted, or cause of action accrued, the debtor has hazarded and paid money or other property to the value of $100 or more in some kind of gaming prohibited by the laws of this State; or, 4. That since the debt was contracted the debtor has wilfully expended and misused his goods and estate, or some part thereof, for the purpose of enabling himself to swear that he has not any estate to the amount of $20, except such as is exempt from being taken on execution; or, 5. (If the action was founded on contract.) That the debtor contracted the debt with an intention not to pay the same; or, 6. That the debtor is an attorney-at-law; that the debt upon which the judgment on which the execution issued was for money collected by the debtor for the creditor, and that said attorney unreasonably neglects to pay the same. And such affidavit and the certificate of the magistrate that he is satisfied there is reasonable cause to believe the charges therein contained, or some one of them, are true, shall be annexed to the execution.

No woman shall be arrested on any civil process except for tort. But whenever any person shall obtain a judgment against any woman, whether married or unmarried, for the sum of $20 and upwards, exclusive of all costs, which make a part of said judgment, and while so much as that amount remains uncollected, and shall take any execution upon the same, he may demand payment of the same, and upon failure to satisfy said execution, the judgment creditor may cite the judgment debtor to appear before the court and submit to an examination touching her estate and the disposition of the same.

When a person is arrested on *mesne process* in actions of contract, as above described, he may obtain his release by proving, to the satisfaction of any one of said magistrates, that he does not intend to leave the State, so that execution, if obtained, cannot be served on him, or by taking the oath for the relief of poor debtors, or by giving bail either to pay the judgment or to answer to the execution. When a person is arrested on *mesne process* in an action of tort, he may obtain his release by giving bail. When arrested on execution, the defendant may obtain his discharge by taking the oath for the relief of poor debtors, before any one of said magistrates, and satisfying said magistrates of its truth. The oath is as follows: "I," A. B., "do solemnly swear that I have not any estate, real or personal, to the amount of thirty dollars, except the estate, goods and chattels which are by law exempt from being taken on execution, and that I have not any other estate now conveyed, concealed, or in any way disposed of with the design to secure the same to my own use or to defraud my creditors."

When any of the charges of fraud aforesaid are proved, the debtor shall have no benefit from the provisions for the relief of poor debtors, and may be sentenced to confinement at hard labor in the house of correction. If the debtor is discharged on execution by taking the poor debtors' oath, the judgment remains in full force against his goods and estate, but he is not liable to a second arrest of the body.

An attachment of the property of defendant is permitted in all cases in *mesne process;* either by direct attachment or by trustee or garnishee process. And when the property of the defendant cannot be reached, so as to be attached in a suit at law, it may be reached in equity. In cases of doubt as to the ownership of the property to be attached, the officer requires a bond of indemnity.

Besides the courts of minor jurisdiction, as of a justice of the peace outside of Suffolk county having a jurisdiction not exceeding $100, and of police, district, and municipal courts having jurisdiction not exceeding $300, and established in the larger towns and cities of the State, there are two courts established having jurisdiction throughout the State. *First*—The superior court holds terms in most of the counties every three months. It has concurrent jurisdiction with the first-named courts from $20 to their limit, and exclusive jurisdiction of claims exceeding $300 and not exceeding $1000 in all counties except Suffolk county. In the latter county, the jurisdiction extends to $4000, and concurrent jurisdiction with the supreme judicial court of all claims exceeding said sums of $1000 and $4000. Service of process must be made in the superior court 14 days before return day. *Second*—The supreme judicial court has jurisdiction in equity, concurrent jurisdiction with the superior court as above described, exclusive jurisdiction of libels for divorce, and jurisdiction of questions of law brought up from the superior court.

Judgments are not a lien upon property, but when an attachment has been made on *mesne process*, the lien holds for 30 days after judgment, in which to make a levy on the execution. No execution will be issued within 24 hours after judgment has been entered, and all original executions must be issued within one year after the party is entitled to sue it out, and no successive execution will be issued unless within five years after the return day of the one preceding it. All executions are returnable in sixty days from their date.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &C.—Conveyances of lands, or of any estate or interest therein, may be made by deed executed by any person having authority to convey the same, or by his attorney, and acknowledged and recorded in the registry of deeds for the county or district where the lands lie, without any other act or ceremony.

A wafer, or other tenacious substance upon which an impression may be made, is a valid seal in this State. The acknowledgment of deeds shall be by the grantors, or one of them, or by the attorney executing the same, and may be made before any justice of the peace, magistrate or notary public, or commissioner appointed for that purpose by the Governor of this State within the United States, or in any foreign country, or before a minister or consul of the United States in any forign country. No subscribing witness is required when the deed is acknowledged by one of the grantors. In case the grantor refuses to acknowledge the same, it may be proved before a justice of the peace in the county where the land lies, or where the grantor or any subscribing witness to the deed resides, by the testimony of the subscribing witness, and he shall certify the due execution of same. In signing deeds it is not necessary that the wife be separately examined; it is sufficient to bar her dower, if she join with her husband in the conveyance.

A married woman may hold real and personal property. May convey the same, make contracts, sue and be sued in the same manner as if she were sole; but her separate conveyance of her real estate shall be subject to her husband's tenancy by the courtesy. Conveyances, contracts and suits are not authorized between husband and wife. Every woman shall be entitled to her dower at common law in the lands of her husband, to be assigned to her after his decease, unless she is lawfully barred thereof.

Chattel mortgages of personal property shall be recorded on the records of the city or town where the mortgagor resides when the mortgage is made, and on the records of the city or town in which he then principally transacts his business, or follows his trade or calling. If the mortgagor resides without the State, his mortgage of personal property within the State when the mortgage is made, shall be recorded on the records of the city or town where the property then is; unless a mortgage is so recorded within fifteen days from the date thereof, or the property mortgaged is delivered to and retained by the mortgagee, it shall not be valid against any person other than the parties thereto, except in the case of a mortgage, contract of bottomry or respondentia, or any transfer, assignment or hypothecation of a ship or vessel, and also except in case of any transfer or mortgage of goods at sea or abroad, if the mortgagee takes possession of such goods as soon as may be after their arrival in this State. When it is required that a mortgage of personal property shall be recorded in the records of two municipalities, such mortgage shall be considered as duly recorded, when recorded in the record of one of them; *provided*, it is recorded in the records of the other within ten days from the date of such first record.

Wills must be in writing, and signed by the testator, or by some other person in his presence and by his express direction, and attested and subscribed in the presence of the testator by three or more competent witnesses.

SPECIAL LAWS OF MICHIGAN.

EXEMPTIONS FROM FORCED SALE.—*Home worth $1500 and Personal Property.* A homestead consisting of any quantity of land, not exceeding 40 acres and dwelling house thereon and its appurtenances, not included in any recorded town plat or city, or village; or instead thereof, at the option of the owner, one lot in a recorded town plat or city, or village, and the dwelling house thereon and its appurtenances. Said property, however, must not exceed $1,500 in value; if so, it may be sold and the excess applied in payment of the judgment. Personal property is exempt as follows: All spinning wheels, weaving loom with the apparatus, and stoves put up and kept for use in any dwelling house, a seat, pew or slip occupied by a person or family in any place of public worship, all cemeteries, tombs and rights of burial, all arms and accoutrements required to be kept by any person, all wearing apparel of every person or family, library and school books of every individual and family not exceeding $150 in value, and all family pictures. To each householder 10 sheep with their fleeces, and the yarn or cloth manufactured from the same, 2 cows, 5 swine, and provision and fuel for six months' use, all household goods, furniture and utensils not exceeding in value $250; tools, implements, materials, stock, apparatus, team, vehicle, horses, harness or other things to enable any person to carry on the profession or trade, occupation or business in which he is wholly or principally engaged, not exceeding in value $250; and a sufficient quantity of hay, grain, feed and roots for properly keeping for six months the animals hereinbefore specified; 1 sewing machine for family use is also exempt. No portion of the property above specified, however, is exempt from execution upon a judgment for the purchase money.

MECHANICS' LIEN.—Any person who shall, by contract with the owner, part owner or lessee of any piece of land, furnish labor or materials for constructing or repairing any building, wharf or appurtenances on such land, has a lien therefor upon said building, wharf, machinery, appurtenances, the entire interest of said owner, part owner or lessee in and to said land not exceeding one quarter-section; or if in the limits of an incorporated village or city, in the lot or lots on which said building, wharf, machinery or appurtenances are situated, to the extent of his claim. He must file a verified certificate with the register of deeds, containing a copy of the contract, if in writing, or if not a statement of its terms, with a description of the land, and a statement of the amount due and to become due, with all credits to which the owner may be entitled.

The owner, part owner or lessee must be notified of the filing of the certificate. In order to have the benefit of the lien, proceedings to foreclose must be taken within six months after the last installment shall become due. A subcontractor has a lien to the extent of the interest of the original contractor, upon complying with substantially the same provisions as in case of an original contractor. Mechanics, workmen, and other persons, also have a lien in certain cases, for performing labor or furnishing materials in building, altering, repairing, beautifying or ornamenting any house or other building, machinery or appurtenances to any house or building.

COLLECTION OF DEBTS.—Persons may be arrested by *capias ad respondendum*, in actions arising on contract, to recover damages for breach of promise to marry, for moneys collected by a public officer, for any misconduct or neglect in office, or in any professional employment, and in other actions than those arising upon contract, where an order for bail shall be indorsed on the writ by a judge of the court, or by a circuit court commissioner.

Arrests may also be made in other actions upon contract than those above specified, if it be made to appear that the defendant fraudulently contracted the debt or incurred the obligation, or that he has property which he has removed, or is about to remove, out of the jurisdiction of the court, with intent to defraud his creditors, or which he fraudulently conceals, or which he unjustly refuses to apply to the payment of any judgment which shall have been rendered against him.

Attachments may issue in favor of any creditor against any debtor having property in the county in which the creditor or debtor may reside, subject to the attachment, in the circuit court of said county; or in case the debtor has no property in the county, or is a non-resident of the State, then an attachment may issue in the circuit court of any county where the property of the debtor may be found.

The following are the principal causes of attachment: 1. That the defendant has absconded or is about to abscond from this State, or that he is concealed therein, to the injury of his creditors. 2. That the defendant has assigned, disposed of, or concealed, or is about to assign, dispose of, or conceal any of his property, with intent to defraud his creditors. 3. That the defendant has removed or is about to remove any of his property out of the State, with intent to defraud his creditors. 4. That he has fraudulently contracted the debt or incurred the obligation respecting which the suit is brought. 5. That he is a non-resident of the State and has not resided therein for three months immediately preceding the time of commencing the suit; or, 6. That the defendant is a foreign corporation.

No bond is required on commencement of suit, but the defendant may recover the possession of the property taken by virtue of the writ by delivering to the officer a bond conditioned for the payment of any judgment or the return of the property. Unless this is done, the property must remain in the hands of the officer. Attachments may be dissolved by a judge of the court, or by a circuit court commissioner, upon application of the defendant, if he shall be satisfied that the plaintiff had not a good and legal cause for suing out the writ.

Assignments of bonds, notes, and other choses in action not negotiable under existing laws, are valid, and the assignee may sue for and recover the same in his own name.

A writ of garnishment may issue in a personal action arising upon contract.

As to notes and bills, no person in this State can be charged as an acceptor on a bill of exchange, unless his acceptance is in writing, signed by himself or his lawful agent. Bills of exchange, duly protested for non-acceptance or non-payment, if drawn or endorsed within this State, payable at any place without the State but in the United States, entitle the holder to recover damages in addition to the contents of such bill, with interest and costs, as follows: When payable within either of the States of Wisconsin, Illinois, Indiana, Pennsylvania, Ohio and New York, three per cent. on the contents of the bill; when payable within either of the States of Missouri, Kentucky, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, Virginia or the District of Columbia, five per cent., and if payable elsewhere within any of the United States or territories thereof, ten per cent. No damages are allowed, if payable within this State. If payable outside of the United States, five per cent. is allowed, besides the current rate of exchange at time of demand. All parties to notes or bills, whether drawers, makers, guarantors of payment, endorsers or acceptors, may be sued in one action, and judgment may be rendered and execution issued in the same manner as though all were joint contractors. Any bill of exchange, note, or draft payable on demand, and any check, bill of exchange, or draft drawn upon any bank or banking institution, is deemed to be due on the day mentioned for the payment of the same, without any days of grace being allowed. Guarantees of payment or of the collection are negotiable, and pass to the holder of the note. Notarial protest is evidence of non-acceptance or non-payment, at the time and in the manner stated in the protest, unless the defendant shall annex to his plea an affidavit denying the fact of having received such notice.

Justices of the peace have jurisdiction in all civil actions wherein the debt or damages do not exceed $100, and concurrent jurisdiction with the courts of record in all actions upon contract wherein the debt or damages do not exceed $300, except actions for a disturbance of a right of way or other easement; actions for libel, slander, or for malicious prosecutions, and actions against executors or administrators as such, except in cases specially provided by law. Circuit courts, in their respective counties, have and exercise original and exclusive jurisdiction of all civil actions and remedies of whatever name and description, and of all prosecutions for crimes, misdemeanors, offences and penalties, except in cases where exclusive or concurrent jurisdiction is given to or possessed by some court or tribunal in virtue of some statutory provisions, or the principles and usages of law. Said court has such appellate jurisdiction and powers as are provided by law. Service of summons may be made at any time before return day.

A judgment has no effect upon the property of a judgment debtor, either real or personal, until the issue and levy of an execution. A certified transcript of the judgment of a justice of the peace for twenty dollars and over, exclusive of costs, on certain conditions, may be filed in the office of the clerk of the circuit court of the county in which the judgment shall have been rendered, in which case the judgment shall be of the same effect as a judgment rendered in said circuit court. Judgments may be entered in any court upon confession.

Executions in courts of record may issue upon the rendition of judgment to the proper officer of any county in the State, and successive or alias executions may issue one after another upon the return of any execution unsatisfied in whole or in part. They are not a lien upon property until a levy is made. Executions in justices' court, except in certain specified cases, may issue at the expiration of five days from the rendition of judgment, unless the execution be stayed. The defendant in the execution in justices' court may stay the same, except in certain specified cases, by filing proper security for the payment of the money, with interest and costs for four months from the commencement of suit, if the judgment shall not exceed fifty dollars, aud for six months if the judgment exceeds fifty dollars.

Land sold under execution may be redeemed within one year from the time of sale. Every species of property, real or personal, and the interest of the defendant in any property, except such as is exempt from execution by statute, is subject to execution and sale.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &C.—Deeds must be under seal, with two witnesses; a scrawl is regarded as a seal. The execution of deeds must be acknowledged before any judge or commissioner of a court of record, or before any notary public or justice of the peace within the State. The deed must be recorded in the county where the land lies. Deeds executed in any other State must be executed according to the laws of such State, and the execution thereof may be acknowledged before any officer authorized by the laws of such State to take acknowledgments; or they may be acknowledged before any commissioner appointed by the Governor of this State for such purpose.

If made before any other officer than a commissioner of this State, the deed must have attached thereto a certificate of the clerk of a court of record of the county or district within which such acknowledgment was taken under his seal of office; that the person whose name is subscribed to the certificate of acknowledgment was, at the date thereof, such officer as he is therein represented to be, that he believes the signature of such person subscribed thereto be genuine, and that the deed is executed and acknowledged according to the laws of such State.

The acknowledgment of a deed by a married woman, when she joins with her husband in a deed of conveyance, must be taken separately and apart from her husband, and she must acknowledge that she executes the same freely and without any fear or compulsion from any one.

A husband is not required to join in a deed by the wife conveying her property. No particular form of certificate of acknowledgment is required, but it should appear from such certificate that the person making the same was legally authorized to take such acknowledgment; that the grantor or grantors were personally known to him, and that they appeared before him and acknowledged the deed to be his or their free act. When executed by a married woman, it should show that she executed the same freely and without fear or compulsion *from any one.*

Married women may hold real and personal estate to their separate use, and may contract in reference to the same, and in the same manner, and with the like effect, as if they were unmarried. And they may sue and be sued in relation to their sole property in the same manner as if they were unmarried. Dealings directly between husband and wife are permitted. The husband has no interest in the property of the wife as *tenant by the courtesy*, Separate property acquired by females before or after marriage is not liable for the husband's debt. The wife is entitled to dower in all lands owned by her husband during coverture.

Wills must be in writing, subscribed by the testator or by some person in his presence and by his express direction, attested and subscribed in the presence of the testator by two or more competent witnesses.

SPECIAL LAWS OF MINNESOTA.

EXEMPTIONS FROM FORCED SALE.—*Home of Eighty Acres in Farm Lands, and Lot in Village or City, with Personal Property.* Eighty acres of land and dwelling house thereon, or instead thereof, one town or city lot and the dwelling houses thereon, regardless of value. Family Bible, books, pictures and musical instruments; church pew and cemetery lot; wearing apparel of debtor and family, also beds, bedsteads and bedding; stoves and appendages, cooking utensils, and furniture not enumerated not exceeding $500 in value; 3 cows, 10 swine, 1 yoke of oxen, and a horse (or a span of horses or mules), 20 sheep; necessary food for stock for one year; 1 wagon, cart or dray, 1 sleigh, 2 ploughs, 1 drag, and other farming utensils not exceeding $300 in value; one sewing machine; seed grain for one year; one year's provisions for debtor and family; one year's fuel; tools or instruments used for carrying on trade, and stock in trade not exceeding $400; library and implements of any professional man; 80 acres of land and dwelling house thereon, or instead thereof, one town or city lot, and the dwelling houses thereon, regardless of value. Also the wages of any laboring man or woman or their minor children, not exceeding $50, due for services rendered during the ninety days preceding the issue of the process.

MECHANICS' LIEN.—Mechanics and material men have a lien for labor done or material furnished on land and improvements. Such lien is subject to the rights of prior *bona fide* lien holders. The claim must be filed within one year, and this gives a lien for two years. Sub-contractors, laborers and persons furnishing materials to the contractors, may acquire a lien on the *payments* due to the original contractor by serving an attested account on the owner.

COLLECTION OF DEBTS.—Arrest in civil action is unknown here.

Writs of attachment may issue on the following grounds: Defendant being a non-resident or a foreign corporation, or has departed from the State with intent to delay or defraud his creditors, or keeps himself concealed with like intent; that the debt was fraudulently contracted; or that defendant has assigned, secreted or disposed of his property with intent to delay or defraud his creditors; or that he is about to do so. Attachments are levied on bulky articles of personal property without removal, by filing a copy of the writ with the town or city clerk, and on real estate by recording the writ in the office of the register of deeds.

Assignments for the benefit of creditors are not governed by statute and follow common law rules. No filing or record is necessary.

Garnishment may issue at the time of filing the complaint, or issuing summons, or at any time thereafter. The indebtedness of the garnishee, or the value of property in his hands, as well as the indebtedness of the defendant, must not be less than $25, besides costs, to entitle the plaintiff to judgment in the district court, and not less than $10 in the justice's court.

On notes and bills grace is allowed, unless the contrary is expressed, on all time paper, and on that payable at sight, but not on that payable on demand. Liability of indorsers is fixed by protest and notice, same as at common law. Demand paper must be presented within sixty days from its date to charge the indorser. Acceptances must be in writing, and signed by the acceptor or his duly authorized agent.

District Courts and Courts of Common Pleas have original jurisdiction in all equitable actions where a justice of the peace has not jurisdiction, regardless of amount; and in all civil actions where the amount exceeds $100, and below that sum, with certain provisions as to costs. Justices of the peace have jurisdiction of all amounts under $100 in civil actions, except cases involving title to real estate, false imprisonment, libel, slander, malicious prosecution, *crim. con.*, seduction, or promise to marry; or for an action against an administrator or executor.

Judgments upon being docketed in the office of the court of record, become a lien on all real property of the judgment debtor in the county where docketed, for ten years. No lien on personal property is created by a judgment. Justices' judgments become liens when a transcript is filed in the district court.

Executions issue from district courts when demanded, or any time within ten years after judgment is rendered. They are returnable in district courts within sixty days; personal property is first levied upon, and is sold at ten days' notice; real estate is sold on a notice of six weeks, published in a newspaper of the county, and notices posted in three public places for the same time. Real estate sold on execution may be redeemed within one year

DEEDS, RIGHTS OF MARRIED WOMEN, &c.—Deeds must be signed, sealed (a scrawl answering for a seal) and acknowledged by the grantor, attested by two witnesses, and recorded in the county where the lands are situated. Acknowledgments in this State may be made before a judge of the supreme, district or probate court, or a clerk of said courts, notary public, justice of the peace, or court commissioner. Out of this State, acknowledgments of deeds to lands in this State may be made before a judge of a United States court, judges or justices of any State or territorial court of record, clerks of any of said courts, justices of the peace, notaries public, or commissioners appointed by the Governor of this State for that purpose. Justices of the peace or other officers not using a seal, must have their official character certified to by the clerk of a court of record. No separate acknowledgment to a deed is required by a wife, but she must join in her husband's acknowledgment.

The following form of acknowledgment is used indifferently for single persons and for husband and wife :

STATE OF MINNESOTA, } ss.
COUNTY OF . }

Be it known that on this · day of , A. D. 187 , personally appeared before me , to me personally known to be the same person described in , and who executed the foregoing instrument and acknowledged that executed the same freely and voluntarily, without any fear or compulsion from any one, for the uses and purposes therein expressed.

Married women may hold property, real or personal, in their own name and for their own use, whether acquired before or after marriage. She may make contracts, and her property is liable for her debts ; but no conveyance of her separate real estate is valid unless her husband join therein.

Chattel mortgages are void as against creditors and subsequent mortgagees and purchasers in good faith, when the mortgagor retains possession of the property, unless duly acknowledged and filed in the office of the town or city clerk, both where the mortgagor resides and where the property is located. They cease to be notice after two years from the date of filing.

SPECIAL LAWS OF MISSISSIPPI.

EXEMPTIONS FROM FORCED SALE.—*Home worth $2,000 and Personal Property* On debts contracted after Sept. 1, 1870, only 80 acres of land to the head of each family, being a housekeeper, to a resident of any incorporated town, being the head of a family, and a housekeeper, $2,000 worth of real property, comprising the proper homestead. The exempt personality is, 1. The tools of a mechanic necessary for carrying on his trade. 2. The agricultural implements of a farmer necessary for two male laborers. 3. The implements of a laborer. 4. The books of a student required for the completion of his education. 5. The wearing apparel of every person. 6. The libraries of licensed attorneys-at-law, practicing physicians and ministers of the gospel, not exceeding in value $250. 7. The arms and accoutrements of every person enrolled in the militia of the State. 8. All books, globe and maps used by teachers of schools, academies and colleges; also, the following property of each head of a family or housekeeper: one work horse or mule, or 1 yoke of oxen, 2 cows and calves, 5 head of stock hogs and 5 sheep, 50 bushels of corn, 10 bushels of wheat or rice, 200 lbs. of meat, 1 cart or wagon, not to exceed in value $100, household and kitchen furniture not to exceed $100 in value; and $100 of the wages of laborers is exempt from garnishment, in the hands of their employers.

LIENS.—Judgments, when enrolled, are liens on all property in the county where rendered ; may be made liens in any county by having abstract enrolled there. Mortgages and deeds in trust are also liens. They must be acknowledged and recorded in the same manner as ordinary deeds of conveyance. Mechanics have a lien for labor done and materials furnished in the erection and repair of buildings, but suits to enforce a mechanic's lien must be commenced in six months.

COLLECTION OF DEBTS.—No person can be arrested for debt in this State. Writs of attachment may be issued on one or more of the following grounds: 1. That the defendant is a foreign corporation, or is a non-resident of this State ; or, 2. That he has removed or is about to remove himself or property out of this State ; or, 3. That he so absconds or conceals himself that he cannot be served with a summons ; or, 4. That he has property or rights in actions which he conceals, and unjustly refuses to apply to the payment of his debts ; or, 5. That he has assigned or disposed of, or is about to assign or dispose of his property or rights in action, or some part thereof, with intent to defraud his creditors, or give an unfair preference to some of them; or, 6. That he has converted or is about to convert his property into money, or evidences of debt, with intent to place it beyond the reach of his creditors; or, 7. That he has fraudulently contracted the debt, or incurred the obligation for which the suit has been, or is about to be brought.

Before any writ of attachment shall issue, the creditor, his agent or attorney, must make an affidavit as to the amount and character of his debt or claim, and the existence of one or more of said grounds of attachment, and give bond in double the amount of the principal of the claim, conditioned to pay all damages which the defendant may sustain by reason of the wrongful suing out of the attachment.

Writs of garnishment may issue on suggestion that any party is indebted to or has property of the defendant in his hands.

The assignment of notes, bills, accounts, and other legal or equitable demands is valid, and when the assignment is in writing, the assignee may sue in his own name. No particular form of words is necessary to constitute a valid assignment. The maker of any bill, note, etc., may plead any payment, off-set or other equity in defense of the same against the assignee, had or possessed by him against the assignor previous to notice of the assignment.

Justices' courts have jurisdiction up to $150; Circuit courts over that amount. Chancery courts have jurisdiction in the administration of estates, all probate matters over minors and lunatics, in matters of dower and divorce, and the foreclosure of mortgages, and they have nearly all the jurisdiction of English chancery courts.

Executions are required to be issued, unless otherwise ordered by the plaintiff, within 20 days after the adjournment of the term of court at which the judgment is rendered. No stay law for staying executions except in justices' courts, and only then upon giving bond. Parties may, by consent, however, have judgment entered up, with stay of execution for any specified time.

Claims against deceased persons must be probated in the office of the clerk of the chancery court having charge of the estate, within one year from the date of the first notice to creditors to present their claims, otherwise they are barred. If the evidence of debt is a bond, note or bill, it must be filed, with the affidavit of the creditor attached, that no portion of the money intended to be secured by it has been received, and no security or satisfaction given for the same except the amount credited, if any. If it is an open account, the affidavit must set out that the amount stated is just and true, and that no part of the money stated to be due, nor any security or satisfaction for the same has been received except what is credited, if any. If it is a judgment, a certified transcript must be filed, accompanied with a similar oath.

The above affidavits may be made by non-residents before a commissioner for the State of Mississippi, a judge or clerk of any court of record, a notary public, or justice of the peace, with the certificate of a judge or clerk of some court of record as to his official character.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds to lands must be recorded in the office of the chancery clerk, in the county where the lands lie. Before being recorded they must be acknowledged. The acknowledgment must be substantially as follows:

STATE OF MISSISSIPPI, } *ss.*
COUNTY OF MARION. }

Personally appeared before the undersigned (here follows the name and title of the officer), John Leslie, who acknowledged that he signed, sealed and delivered the foregoing deed of conveyance as his own act and deed, on the day and year and for the purposes therein mentioned.

Given under my hand this day of , A. D., 187 .

(Signature and title of officer.)

If a married woman is a party to the deed, the following should be added to the foregoing form of acknowledgment, immediately after the word "mentioned:" Also personally appeared before me, Mary Leslie, wife of the said John Leslie, who, on a private examination before me, separate and apart from her said husband, acknowledged that she signed, sealed and delivered the foregoing deed of conveyance, as her own voluntary act and deed, freely, without any fear, threats or compulsion of her said husband, on the day and year and for the purpose therein mentioned. Given under my hand, etc. (as above).

The foregoing acknowledgments may be taken before any judge of the supreme court, or any judge of the circuit court, any chancellor, any clerk of a court of record, or any justice of the peace or member of the board of supervisors, whether the land conveyed lie in or out of his county.

If the party conveying land in this State is a non-resident, his acknowledgment may be made before any of the judges of the supreme court of the United States, or a judge of the district court of the United States, or justice of the supreme court or superior court of any State or territory of the Union, or any justice of the peace whose official character shall be certified to under the seal of some court of record in his county, or before any commissioner residing in such State or territory who may be appointed by the Governor of this State to take acknowledgments and proof of deeds and other conveyances. Every deed must be sealed, but a mere scrawl answers for a seal.

Property acquired by married women either before or after marriage, enures with the income solely to the wife's benefit. She may sell the same, provided her husband joins in the deed of conveyance; and she may dispose of it by last will and testament. She cannot bind her property for her husband's debts beyond its income.

All contracts made by the husband and wife or either of them, for supplies for the plantation of the wife, may be enforced and satisfaction had out of her separate estate. All contracts made by the wife, or by the husband *with her consent*, for family supplies or necessaries, wearing apparel of herself and children, or for their education, or for materials used or work done for the benefit of her separate estate, or for household furniture, are binding on her, and satisfaction may be had out of her separate estate.

A married woman may engage in trade as a *femme sole*. When she does, she is bound as though unmarried for all contracts made in the course of her trade. She is liable for debts contracted before marriage. The husband is not liable for ante-nuptial debts. All other contracts than those enumerated, made by a married woman, are absolutely void.

As to dower the widow is entitled to one-third of all lands of which her husband died seized and possessed, or which he had conveyed during his lifetime otherwise than in good faith or for a valuable consideration, during her life. If there are no children, she inherits all of her husband's estate.

The husband is entitled, in courtesy, to one-half of all his deceased wife's lands during his life, dependant, however, upon the common law prerequisites.

Wills should be in writing, subscribed by the testator, and attested by three credible witnesses. If the will is wholly written by the testator, and subscribed by him, it need not be attested by any witnesses.

SPECIAL LAWS OF MISSOURI.

EXEMPTIONS FROM FORCED SALE.—*Homestead* $1500 *to* $3000, *and Personal Property*. Homestead, if in the country, not to exceed $1500 in value, and in cities of over 40,000 inhabitants, not to exceed $3000 in value. Personal property is exempt as follows: For heads of families, all wearing apparel, usual household furniture not to exceed $100 in value, provisions in the house and the usual tools of trade of a mechanic; for farmers, working and other kind of animals amounting in value to about $300. Persons may claim, in place of the aforesaid animals, any kind of property, real or personal. Women, being abandoned by their husbands, and being heads of families, may claim the same exemptions as the husbands. Persons, other than heads of families, are allowed, as exemptions, their wearing apparel and the necessary tools of a mechanical trade. The last month's wages, regardless of amount, are exempt from execution and attachment.

MECHANICS' LIEN.—Material men and mechanics have lien for labor and material on the land and improvements to the extent of their claims. The original contractor must file his claim within six months, laborers within thirty days, and all other persons claiming a lien within four months after the debt accrued. This lien has precedence over all other liens or encumbrances placed on the property subsequent to the commencement of the building or improvements.

COLLECTION OF DEBTS.—Arrest for debt is unknown here. Writs of attachment may be obtained on the following grounds:—Non-residence; being about to remove from the State; concealment with view to avoid service; removal of property from State, or concealment of the same, with a view to hinder and delay creditors; where debt is contracted out of the State, and debtor absconds from there and secretly removes his property into this State; for debt contracted fraudulently or from commission of felony; or where goods were bought and payment is to be made in cash and the same is not done; bond must be in double the debt claimed, with one or more sureties, who must be resident householders in the county where suit is brought. Attachments should be resorted to in this State with great caution, and only where the proof is strong and clear. Every species of property, whether it be legal or equitable, is subject to attachment and execution at law. When attachment is levied on real estate, notice is to be filed at the recorder's office, and this fixes legal notice of the encumbrance.

Assignments, in trust for the benefit of creditors, inure for the benefit of all creditors of the grantor, whether named in the deed of assignment or not; the deed of assignment must be acknowledged and recorded like other deeds. One partner cannot assign all the partnership assets for the payment of partnership debts, but only his own share of them. A creditor, if he attacks an assignment as fraudulent, and is defeated, cannot afterwards claim the benefit of the assignment and be allowed to prove his debt before the assignee. Assignments, made to secure sureties or endorsers, prior to any payment by them, are valid here. Notes, bills, accounts and every species of contract or claim is assignable, and the assignee can sue on it in his own name.

Garnishment can be issued, either on execution or attachment, against any person owing the debtor or having his property in possession. The garnishee is entitled to compensation for his trouble and expense, including attorney's fees; this is payable out of the fund, if any is found in his hands, or if nothing is due from the garnishee, then the plaintiff is bound to pay this sum.

Acceptors of notes and bills are chargeable only when their acceptance is in writing on the bill; or, if on separate piece of paper, when the party who gave the credit saw the separate paper; or if a promise is made in writing to accept a draft before it is drawn, and the draft is in the hands of any person who gave credit on the strength of this writing.

Bills of exchange and notes drawn and negotiated in this State or on any person within the State, expressing on their face for "value received," and duly protested for non-payment or non-acceptance, entitle the holder to recover damages as follows: If drawn on a person residing in this State, four per cent.; if outside the State, ten per cent.; if outside any of the United States or territories, twenty per cent. damages on the principal sum. These damages are not recoverable if the bill is drawn by and on a person residing in this State, and payment of the principal is made within twenty days after dishonor. All parties to notes or bills, whether endorsers, makers, or acceptors, or parties in any manner, can be sued jointly or separately in the same or in several actions. Drafts, orders or bills of exchange, payable at sight or on demand, are deemed due the day they are presented for payment, and if unpaid, may be protested. Notarial protest is evidence of demand and refusal of payment, at the time and in the manner *stated in the protest.*

Sheriffs are liable, for failure to pay over money, to pay five per cent. damages per month from the time demand is made of them, in addition to legal interest. They are also liable for the full value of property in replevin or attachment suits, when they have taken insufficient bond.

The jurisdiction of justices' courts, in counties having over 50,000 inhabitants, on bonds and notes for the payment of money up to $300, on other contracts up to $200, on actions for torts up to $100. In counties having under 50,000 inhabitants, on notes and bonds for payment of money up to $150, on other contracts up to $90, and in torts up to $50. In actions for recovery of specific personal property, up to $200, in the former, and up to $100 in the latter class of counties. All these amounts are exclusive of interest. Circuit courts have concurrent jurisdiction with justices' courts as follows, in counties irrespective of population: On written or verbal contracts, in sums over $50, and in the former class of counties for torts, in sums over $25, and for recovery of specific personal property up to $200; in the latter class of counties for torts, in sums over $25, and for recovery of personal property in sums not exceeding $100.

Service of summons must be made in circuit courts 15 days before return day, and all actions are triable, in counties having over 40,000 inhabitants, at the return term; in other counties, actions on notes and bonds are triable at the return term, and other actions at the next term.

Before justices, service must be made 15 days before trial, in cases where they have concurrent jurisdiction with circuit courts; in other cases 6 days is sufficient; but in St. Louis county 15 days is required in all cases.

Judgments, in courts of record are a lien from their rendition, and for three years thereafter, on all real estate owned by the defendant, or subsequently acquired by him, and situated in the county where the judgment is rendered. The judgment can be revived so that the lien can be kept up for ten years after its rendition. No execution can issue on a judgment in a court of record older than ten years, new suit has to be brought on the same. Judgments in courts of record create no lien on personal property. No execution can issue on a justice's judgment three years after its rendition, without revivor. Judgments before justice can be made to create lien on real estate by filing a transcript of the judgment in the circuit court.

Execution issues the day judgment is rendered, and are a lien on personal property, when issuing out of a justice's court from the time they are delivered to the officer; when issuing from courts of record, only from the time they are actually levied. Executions from a justice cannot be levied on real estate. Every species of property, real or personal, books of account, debts and judgments, whether the interest in real estate be a legal or equitable title, is subject to execution and sale at law. Redemption, after execution sale, is unknown here. If an execution from a court of record is returned unsatisfied, the debtors can be summoned and required to state under oath what property or interests they have or own, which may be reached by execution.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds must be under seal, a scrawl is regarded as a seal. The acknowledgment, if made in this State, may be made before a justice of the peace of the county where the land lies, before a court or judge, the court having a seal, or before a notary public; if out of this State, before a commissioner of this State, notary public, or before a court or judge or clerk of a court having a seal, or before the chief officer or mayor of a town or city who has a seal, or before a consul or minister of the United States who has a seal. The seal must be attached, and the deed recorded in the county where the land lies.

The following is the form of certificate where the grantor is unmarried:

[Form of Acknowledgment.]

STATE OF MISSOURI, } *ss.*
COUNTY OF PIKE. }

Be it remembered, that on this day of , A. D. 18 , before the undersigned, a , within and for the county of , and State of Missouri, personally came , who are personally known to me to be the same persons whose names are subscribed to the foregoing and annexed instrument of writing as parties thereto, and acknowledged the same to be their act and deed for the purposes therein mentioned.

In testimony whereof, I have hereunto sat my hand, and affixed my official seal, at my office in , the day and year first above written.

[L. S.] (Signature and title.)

The following is the form where husband and wife join in the deeds, the latter releasing dower. Husband and wife always must join in deeds, whether her or his real estate are to be conveyed:

[Form of Acknowledgment.]

STATE OF MISSOURI, } *ss.*
COUNTY OF PIKE. }

Be it remembered, that on this day of , A. D. 18 , before the undersigned, a , within and for the county of , and State of Missouri, personally came , who are personally known to me to be the same persons whose names are subscribed to the foregoing and annexed instrument of writing as parties thereto, and acknowledged the same to be their act and deed for the purposes therein mentioned. And the said , being by me first made acquainted with the contents of said instrument, upon an examination separate and apart from husband , acknowledged that executed the same, and relinquishes dower in the real estate therein mentioned, freely and without fear, compulsion or undue influence of said husband.

In testimony whereof, I have hereunto set my hand, and affixed my official seal, at my office in the day and year first above written.

[SEAL.] (Signature and title.)

Married women can hold real or personal property to their separate use, through a trustee. A note or endorsement made by a married woman will bind her separate estate; it will not, however, bind her general estate, and will be a nullity unless she has a separate estate to be bound by the paper. If, however, her note is for purchase money of property, then it will bind even her general estate.

The wife's separate property, whether acquired before or previous to marriage, is not liable for her husband's debts. The wife is endowed of one-third of all the lands of which her husband, or any one to his use, was seized of an estate of inheritance, at any time during the marriage; also, of leasehold estate for the term of 20 years or more.

A chattel mortgage of perishable articles, which are left in the hands of the grantor, with right to use the same, is void; so is mortgage of stock of goods, the grantor having right to sell; so is any mortgage, if unregistered and the chattel left with the grantor; so is also a registered mortgage, if the goods are left unreasonably long with grantor, after default is made in payment.

Wills must be in writing, signed by the testator, or by some person in his presence, and at his request, and attested by two competent witnesses, who shall subscribe their names as witnesses in the presence of the testator. Wills must be recorded 30 days after probate; if lands in different counties are devised a copy of the will will be recorded in the recorder's office in each county, within six months after probate.

SPECIAL LAWS OF MONTANA.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $2500, *and Personal Property.* A homestead not exceeding in value $2500; in a city or village not to exceed one quarter acre, or farm land not exceeding 80 acres, the debtor taking his choice selecting either, with all improvements thereon included in the valuation. The lien of a mechanic, laborer, or mortgage lawfully obtained upon the same is not affected by such exemption. In addition to the homestead, personal property to the value of $1400, and more, according to value of articles enumerated by statute, is allowed to the householder occupying the same.

SPECIAL LAWS OF NEBRASKA.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $500, *and Personal Property.* A homestead containing any quantity of land not exceeding 160 acres, and the dwelling house thereon, and its appurtenances, to be selected by the owner thereof, and not included in any incorporated city or village; or instead thereof, at the option of the owner, a quantity of contiguous land, not exceeding two lots in any incorporated town, city, or village, and according to the recorded plat of said incorporated town, city, or village; or, in lieu of the above, a lot or parcel of contiguous land, not exceeding 20 acres, being within the limits of an incorporated town, city, or village, the said parcel or lot of land not being laid off into streets, blocks, and lots, owned and occupied by any resident of the State, being the head of a family, shall not be subject to attachment, levy or sale upon execution, or other process issuing out of any court in this State, so long as the same shall be occupied by the debtor as a homestead. All heads of families, who have neither lands, town lots, nor houses entitled to exemption as a homestead, under the laws of this State, shall have exemption from forced sale on execution the sum of $500 personal property.

MECHANICS' LIEN.—Any person who shall have performed any labor, or furnished any material or machinery for the erection, reparation or removal of any house or other building or purtenances, by virtue of a contract, expressed or implied, with the owner thereof, or his agent, shall have a lien thereon to secure the payment for such labor performed or materials furnished. Said lien shall be obtained by filing, in the office of the county clerk for record, an account, in writing, of the items, and making oath thereto, within four months after furnishing such materials, or work and labor. The lien shall operate from the date of the first item till two years from the date of the last item.

COLLECTION OF DEBTS.—An order for the arrest of the defendant may be obtained on affidavit by the plaintiff, his agent, or attorney, that the claim is just, and that one or more of the following particulars are true: that the defendant has begun to remove any part of his property out of the jurisdiction of tho court with intent to defraud; that he has begun to convert the same into money to place it beyond the reach of his creditors; that he has property of rights of action which he fraudulently conceals; that he has assigned, removed or disposed of his property or any part thereof with intent to defraud; that he has fraudulently contracted the debt or incurred the obligation on which the action is based. The affidavit must further contain a statement of the facts claimed to justify a belief in one or more of the above particulars. A bond must be executed like that in cases of attachment.

The plaintiff in a civil action may obtain a writ of attachment against all the lands, tenements, goods, chattels, stocks, or interest in stocks, rights, credits, moneys and effects of the defendant in his county, not exempt by law, upon the following grounds, in addition to those enumerated in the last above section: when the defendant, or one of several, is a non-resident or foreign corporation; when he absconds with intent to defraud; when he has left the county to avoid service, or so conceals himself that summons cannot be served upon him. When the ground of attachment is that the defendant is a non-resident or foreign corporation, the claim must be a debt or demand arising on contract, judgment or decree. A bond, in not more than double the amount claimed, with one or more sureties to be approved by the clerk, is required, except when the defendant is a non-resident or foreign corporation.

In cases of attachment, "when the plaintiff, his agent or attorney, shall make oath in writing that he has good reason to, and does believe, that any person or corporation, to be named and within the county where the action is brought, has property of the defendant (describing the same) in his possession," the said property, whether debts, choses in action, chattels or other property, may be garnished and held the same as property otherwise attached. In all cases where an execution shall be returned unsatisfied, and the judgment creditor, his agent or attorney, shall file an affidavit, that any person or corporation (naming the same) has property of, and are indebted to the judgment debtor, such person or corporation may be summoned as garnishee.

All bonds, promissory notes, bills of exchange, foreign and inland, drawn for any sum or sums of money, certain and made payable to any person or order, or assigns, shall be negotiable by endorsement; made payable to bearer, shall be transferable by delivery without endorsement. All such negotiable paper shall be entitled to three days' grace. January 1st, February 22d, July 4th, December 25th, and any day appointed or recommended by the governor of this State, or the President of the United States, as a day of fast or thanksgiving, are legal holidays for commercial purposes; when such day comes on Monday, then the day after is when the act is to be performed. When any bill of exchange shall be drawn for the payment of any such sum of money, and such bill shall be legally protested for non-acceptance or non-payment, the drawer or drawers, endorser or endorsers, shall be subject to payment of twelve per cent. damages thereon, if drawn on any person or persons, or body-corporate, without the jurisdiction of the United States, and six per cent. damages thereon if drawn upon persons or body-corporate within the jurisdiction of the United States, and without the jurisdiction of this State.

The supreme court has appellate jurisdiction only except in cases relating to *revenue*, *mandamus*, *quo warranto*, *habeas corpus*, and such cases of impeachment as may be required to be tried before it; and both the supreme and district courts shall have both chancery and common law jurisdiction. The district court has original and exclusive jurisdiction over all matters and suits at law and in chancery arising in each county in their respective districts, except when justices of the peace have jurisdiction, and concurrent jurisdiction with said justices of the peace, in cases where the cause of action exceeds fifty dollars, and not exceeding one hundred dollars, and has jurisdiction in all cases of appeals from a justice of the peace or judge of probate. Justices of the peace have jurisdiction co-extensive with their counties, and extends to all cases wherein the sum involved does not exceed $100. When action is rightly brought in any county, a summons may issue to any other county, and, unless otherwise provided for, shall be returnable on second Monday from its date, but when issued to another county, it may be made returnable, at the option of the party having it issued, on the third or fourth Monday after its date. Personal service before justices of the peace, three days before trial; constructive service may also be made in certain cases by publication.

Judgments in district court, are liens upon the lands of the judgment debtor, situated in the same county, from the first day of the term at which judgment is rendered; but judgments by confession, and those rendered at the same term in which the action is commenced, are liens only from the day on which such judgments are rendered. To create a judgment lien in other counties, a transcript must be filed or levy made.

Judgments in probate and justices' courts, operate as a lien upon the realty of the debtor when a transcript thereof is filed and docketed in the office of the clerk of the district court.

Lands, tenements, goods and chattels, not exempt by law, are subject to levy. Executions, unless stayed, issue at any time after judgment on order therefor. May issue to any county in the State, and simultaneously to any other counties; must first exhaust goods and chattels, and afterwards realty. Are not liens on personalty or realty in counties other than the one in which judgment is obtained, until levy has been made or transcript filed. No redemption of property sold on execution or order of sale on foreclosure of mortgage; title becomes absolute on confirmation of sale. Judgments become dormant and cease to be a lien on debtors' property if execution is not issued within five years from rendition of judgment, or if five years intervene between the issuing of two executions. Judgments cease to operate as a lien on the debtor's estate to the prejudice of any subsequent *bona fide* judgment creditors, unless execution is issued within one year from date of said judgment; but when the issuing of an execution is prevented by stay, appeal, proceedings in error, etc., such year does not begin to run until after the removal of said disability. If an execution be returned unsatisfied, the debtor can be summoned, and be required to state under oath what property or interests he has or owns, which may be reached by execution.

Chattel mortgages are valid against *bona fide* purchasers and creditors, if the instrument shall be filed and recorded in the office of the county clerk; but cease to be valid against creditors, purchasers and subsequent mortgagees in good faith after the expiration of one year from the filing thereof, unless within thirty days next preceding the termination of said year a true copy of the mortgage, together with a statement exhibiting the interest of the mortgagee in the mortgaged property, shall again be filed and recorded. Sale or mortgage of chattels, unless accompanied by immediate, actual delivery and continued change of possession, are *prima facie* fraudulent and void as against creditors and subsequent *bona fide* purchasers, unless the instrument has been duly filed and recorded in the office of the county clerk.

DEEDS, RIGHTS OF MARRIED WOMEN, &c.—All deeds affecting the title to real property, or any interest therein, in this State, except leases for one year or for a less time, must be signed by the grantor, of lawful age, in the presence of at least one competent witness, who shall subscribe his name as a witness thereto, and be duly acknowledged or proved and recorded. Acknowledgments or proofs may be taken in the State, before a judge or clerk of any court, justice of the peace, or notary public; no officer can take any such acknowledgment or proof out of his State jurisdiction.

The certificate of acknowledgment must be indorsed on the instrument, and show that the grantor acknowledged the same to be his voluntary act and deed, and that the officer before whom the same was taken knew him to be the identical person whose name was affixed as grantor, or had satisfactory evidence of the fact. If, after the instrument is executed but not acknowledged, the grantor die, or if, from any cause, his attendance cannot be procured in order to make the same, or, having appeared, he refuses to acknowledge it, proof of the execution and delivery of the deed may be made by any competent subscribing witness thereto, before any officer authorized to take the acknowledgment; such witness must be personally known to the officer, or such officer must have satisfactory evidence that the witness is the person who subscribed the instrument as a witness. If all the subscribing witnesses are dead, or out of the State, the execution of the deed may be proved by proving the handwriting of the grantor and of any subscribing witness thereto. All deeds, duly executed and acknowledged, must be recorded in the office of the clerk of the county in which the land lies; in case the land is situated in an unorganized district, the deed is to be recorded in the office of the clerk of that county to which said district is attached for judicial purposes. All deeds, mortgages and other written instruments take effect, and are in force as to third parties, from and after the time they are delivered to the clerk for record. No separate examination is required in taking a wife's acknowledgment; to convey her right of dower she must execute a deed with or without her husband. All deeds should have at least one subscribing witness. Private seals are abolished, not even scrawls are required.

[Form of Certificate of Acknowledgment of Husband and Wife.]

STATE OF , } *ss.*
COUNTY OF . }

On this day of , A. D. 187 , before me (here insert name and title of officer), duly appointed, commissioned (or elected) and qualified for, and residing in said county, personally appeared and , his wife, to me personally known (or by the oaths of one or more witnesses whose names are hereto subscribed, satisfactorily proved) to be the identical persons described in, and whose names are affixed to, the foregoing instrument as grantors, and they severally acknowledged the same to be their voluntary act and deed.

In testimony whereof, I have hereunto set my hand and official seal, at , in said county, the day and year last above written.

[SEAL.] (Signature and title.)

The property, real and personal, which any woman in this State may own at the time of her marriage, the rents, issues, profits or proceeds thereof, and any real, personal or mixed property which shall come to her by descent, devise or bequest, or the gift of any person except her husband, shall remain her sole and separate property, and not be subject to the disposal of her husband, or liable for his debts. She may bargain, sell and convey her real and personal property, and enter into any contract in reference thereto, in the same manner, to the same extent, and with like effect as a married man. She may sue and be sued as if unmarried, and carry on trade or business on her separate account. Her earnings are her sole property. If married out of the State, she may here enjoy all rights to property there acquired.

SPECIAL LAWS OF NEVADA.

EXEMPTIONS FROM FORCED SALE.—*A Homestead worth $5000, and Personal Property.* A homestead owned by a head of the family, worth $5000, and the following personal property: household furniture to the value of $100; provisions and fire-wood for one month; farming utensils of a farmer not exceeding in value $200; two horses, two oxen or two mules, and two cows, one cart or wagon, mechanics' tools; a miner's dwelling, in value $500, and his mining tools; a library of a dentist, physician, lawyer or surgeon; one sewing machine worth $150. A mortgage or other security on the homestead is void, unless for purchase money or mechanics' lien.

MECHANICS' LIEN.—Persons who perform labor or furnish materials for the erection or improvement of any building has a lien on the same for such work and materials for all amounts over $25.. And so have all laborers on all work done by them on any railroad, toll-road, canal, water-ditch, mine or mining-shaft, or tunnel, or building lot in a city or town; *provided*, the original contractor shall file his lien in sixty days, and the sub-contractor or laborer in thirty days after the work is completed, and suit commenced in six months.

COLLECTION OF DEBTS.—A debtor may be arrested and held in custody or released on bail, upon an affidavit being made by the plaintiff, or his agent or attorney, that the defendant is fraudulently disposing of his property, or is absconding from the State, or where the debt was contracted in some fiduciary capacity, or where the action is for libel or slander, or where the debtor is concealing his property to defraud his creditors.

Writ of attachment may issue against any property, whether real or personal, of the debtor may be attached upon the plaintiff entering into a bond, as required by the statute, not to be less than $200 in gold coin, with sufficient sureties, and making an affidavit that the debt claimed is an actual *bona fide* debt due to plaintiff from the defendant; that the attachment is not asked to hinder, delay or defraud the defendant or his creditors; that the action brought is on a contract for the direct payment of money, and which is not secured by a mortgage or other lien, or upon a contract executed by a party not in this State. And the property so attached will be held to abide the judgment the plaintiff may recover.

A debtor may prefer one or more of his creditors, by assigning his property for their benefit; *provided*, the assignment is *bona fide*, and bankruptcy does not intervene.

Notes and bills for the payment of money are negotiable like bills of exchange. Acceptance must be in writing, on the bill or on separate paper; it shall not bind the acceptor, except in favor of the person to whom such acceptance was shown, and who gave value for the same on the strength of the acceptance. Rates of damages for non-payment or non-acceptance are as follows: On bills drawn on persons in the United States, east of the Rocky Mountains, $15 on the $100; if drawn on Europe or other foreign country, $20 on the $100; these damages are in lieu of protest fees. Paper maturing on any legal holiday must be protested the day previous. Legal holidays are: Sundays, January 1st, February 22d, July 4th, Christmas and Thanksgiving Days. Sight bills or drafts are not entitled to grace.

The jurisdiction of justices' courts extends to $300, except when suits concern land or mining claims. District courts have general jurisdiction of all matters, either of a legal or equitable nature, when the amount exceeds $300, and appellate jurisdiction in all cases which originates before a justice of the peace. The supreme has appellate jurisdiction from district courts.

Judgments from courts of record, are liens on the debtor's lands in the county where obtained, and upon his land in any other county where transcript of same is filed; and judgments before justice of the peace become liens on the debtor's land, where a transcript of the same is filed with the clerk of the district court of the county.

Execution may be stayed by the court in which the judgment was obtained a reasonable time; and, unless same is thus stayed, it can issue at any time within the limitation, five years, and may be levied on any of the property of the defendant not exempt by law. It is not a lien on personalty until an actual levy. As the judgment is a lien on the debtor's land, it can be enforced by the execution.

DEEDS, RIGHTS OF MARRIED WOMEN, &c.—Deeds must be in writing, a scrawl will answer for a seal. Witnesses are not necessary to its validity.

If proven or acknowledged in this State, it must be before a judge, or clerk of a court having a seal, a notary public, or a justice of the peace. If without the State, before any judge, clerk of a court having a seal, notary public or justice of the peace, or a commissioner of this State. If before a justice of the peace, it must be accompanied by a certificate of the clerk of a court of record, certifying to the official capacity and signature of the justice. If taken without the United States, before some judge or clerk of a court of a State, Kingdom or Empire having a seal, a notary public, or by a minister, commissioner or consul of the United States. If the grantor does not acknowledge the execution of the deed, the witness may prove his signature; but if the witnesses are dead, or cannot be had, proof by competent parties, under oath, of the signature of the grantor and at least one witness.

The wife must join the husband in the execution of a deed, and this form can be used for the certificate of acknowledgment by husband and wife, or without a wife, and can be changed to suit the circumstances:

STATE OF NEW YORK, }
COUNTY OF ORANGE. } *ss.*

Be it remembered, that on this day of , A. D. 187 , personally appeared before me, J. Gordon, a notary public in and for said county and State, duly appointed and qualified to take acknowledgments of deeds, etc., A. B. and C. D., his wife, whose names are subscribed to the conveyed instrument as parties thereto, personally known to me to be the individuals described in and who executed the said annexed instrument as parties thereto, who each acknowledged to me that they each of them respectively executed the same, freely, voluntarily and for the uses and purposes therein mentioned. And the said C. D., wife of the said A. B., having been by me first made acquainted with the contents of said instrument, acknowledged to me, on examination apart from and without the hearing of her said husband, that she executed the same freely and voluntarily, without fear or compulsion or undue influence of her said husband, and that she does not wish to retract the execution of the same.

In witness whereof, I have hereunto set my hand and affixed my official seal, the day and year first above written.

J. GORDON, Notary Public.

All the property owned by the wife at the time of her marriage, or to which she acquires after marriage by inheritance, devise, gift or bequest, belongs to and remains her separate estate which she can sell and convey without the consent of her husband. And all property acquired by purchase by husband and wife during the coverture belongs to them in common; and upon the death of the husband, one-half goes to the wife; but during coverture, is under the absolute control of the husband. He can convey the same without the joining of his wife in the execution of the deed. A married woman has no dower in the real estate of her husband, neither has he any courtesy in hers.

SPECIAL LAWS OF NEW HAMPSHIRE.

EXEMPTIONS FROM FORCED SALE.—*Home worth $500, and Personal Property.* Homestead to the value of $500, for the benefit of wife, widow or children. Household furniture to value of $100; books and library in use by the debtor and his family to value of $200; necessary wearing apparel of debtor and family;

necessary bed, bedsteads and bed-clothing; 1 cooking stove and its furniture; tools of his occupation, $100; provisions and fuel, $50; beasts of the plow, not exceeding 1 yoke of oxen or 1 horse; sewing machine, 1 cow, 6 sheep, 1 pig or hog.

MECHANICS' LIEN.—Laborers and persons furnishing materials have a lien on the building and the land on which it is put, to the amount of $15, and for the space of sixty days after the labor was performed or materials furnished.

COLLECTION OF DEBTS.—Arrest for debt can be made upon affidavit of the plaintiff, or his agent, that defendant owes more than $13.33, and conceals his property so that no attachment or levy can be made, or is about to leave the State to avoid the payment of his debts.

Writs of attachment may issue for the following causes: Non-residence; being about to remove from the State; concealment with view to avoid service; removal of property from State, or concealment of the same, with a view to hinder and delay creditors; where debt is contracted out of the State and debtor absconds from there and secretly removes his property into this State; for debt contracted fraudulently or from commission of felony; or where goods were bought and payment is to be made in cash and the same is not done; bond must be in double the debt claimed, with one or more sureties, who must be resident householders of the county where suit is brought. Every species of property, whether it be legal or equitable, is subject to attachment, and constitutes a valid lien on the property for thirty days after judgment, within which period the execution must be levied to preserve and protect the lien.

Assignments in trust, for the benefit of creditors, inure for the benefit of all creditors of the grantor, whether named in the deed of assignment or not; the deed of assignment must be acknowledged and recorded like other deeds. One partner cannot assign all the partnership assets for the payment of partnership debts, but only his own share of them. Assignments made to secure sureties or endorsers, prior to any payment by them, are valid here. Notes, bills, accounts, and every species of contract or claim is assignable, and the assignee can sue on it in his own name.

Garnishment can be issued on attachment, against any person owing the debtor or having his property in possession. The garnishee is entitled to compensation for his trouble and expense; this is payable out of the fund, if any is found in his hands, or if nothing is due from the garnishee, then the plaintiff is bound to pay this sum.

All notes and bills, payable in cash to order or bearer, are negotiable; on demand, are dishonored and overdue 60 days from their date. Grace is allowed on all notes, drafts and bills payable on time, unless expressly excluded by terms of the contract.

The jurisdiction of justice and police courts, extend only to $13.33. The circuit court has jurisdiction beyond that sum, and of all appeals from the justice and police courts. Superior court of judicature has only appellate jurisdiction, and may issue writs of error.

Judgments may be obtained at the first term, unless defendant make affidavit of defense, in which case he is entitled to continuance unless the plaintiff has given him 30 days previous notice to be prepared for trial.

Executions may issue the day judgment is rendered, and are a lien on personal property, when issuing out of a justice's court from the time they are delivered to the officer; when issuing from courts of record, only from the time they are actually levied. Executions from a justice cannot be levied on real estate. Every species of property, real or personal, books of account, debts and judgments, whether the interest in real estate be a legal or equitable title, is subject to execution and sale at law. Redemption after execution sale can be had for one year. Stay of execution is only had when plaintiff is insolvent and defendant furnishes bond to pay the amount of judgment in review.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds must be under seal and attested by two witnesses. The acknowledgment, if made in this State, may be made before a justice of the peace of the county where the land lies, before a court or judge, the court having a seal, or before a notary public; if out of the State, before a commissioner of this State, notary public, or before a court or judge or clerk of a court having a seal, or before the chief officer or mayor of a town or city who has a seal, or before a consul or minister of the United States who has a seal, or a justice of the peace, his official character duly certified by the clerk. The seal must be attached, and the deed recorded in the county where the land lies. No separate acknowledgment is required to be made by the wife, nor need she be examined separate and apart from her husband, but she must join in the deed to bar her dower or homestead.

The following is the form to be used of certificate of acknowledgment of husband and wife:

STATE OF NEW HAMPSHIRE, } ss.
COUNTY OF CARROLL. }

Personally appeared the above-named, A. B. and C. D., his wife, and acknowledged the foregoing instrument to be their voluntary act and deed. Before me, this day of , 187 .

JOHN GARDNER, Commissioner.

No necessity for the certificate to state the wife releases her dower. The above is sufficient. Proof of subscribing witnesses must be made by depositions, and upon due notice to the parties interested. And if the identity of the grantor is denied, it must be proven by deposition.

Married women hold all property owned by them before marriage, or acquired after in any way, except through property of the husband, to their sole and separate use as if *sole*. All their acts in reference to such property are valid and binding upon them and their property. All other contracts void. The wife is entitled to homestead and dower in all the property of her husband, unless she release the same by joining her husband in its conveyance. In most respects the wife is equal to the husband before the law. The husband cannot convey real estate to the wife.

A chattel mortgage of perishable articles which are left in the hands of the grantor, with right to use the same, is void; so is mortgage of stock of goods, the grantor having right to sell; so is any mortgage if unregistered and the chattels left with the grantor, save as between the parties thereto, unless the above provisions are complied with and an oath taken by both parties made on the mortgage, to the effect that the debt accrued therein is just, honestly due and owing.

Wills should be in writing, signed and sealed by the testator, or by some person in his presence, and by his express direction, and attested and subscribed in his presence by three or more credible witnesses.

SPECIAL LAWS OF NEW JERSEY.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1,500 *and Personal Property.* Lot and buildings thereon, occupied as a residence and owned by the debtor, being a householder and having a family, to the value of $1,500. Personal property to the amount of $200, owned by a resident head of a family, appraised by three persons appointed by the sheriff; and the widow or administrator of a deceased person may claim the same exemption of $200 as against creditors.

MECHANICS' LIENS.—Persons who perform labor or furnish materials for the erection and construction of buildings, have a lien on the same for such labor and materials, including the lot on which such buildings are erected; *provided*, the lien is filed in one year after the labor is performed or materials furnished, and the summons issued in the year.

COLLECTION OF DEBTS.—A defendant may be arrested for debt, on affidavit being made that he is either, 1. About to remove his property out of the jurisdiction of the court, for the purpose of defrauding his creditors; or, 2. Fraudulently conceals his property or rights of action; or, 3. He has assigned, removed or concealed, or is about to assign, remove or conceal his property, with intent to defraud his creditors; or, 4. That he has fraudulently contracted the debt or incurred the obligation about which the suit is to be commenced.

Writ of attachment by the creditor or his agent making affidavit, to be filed with the clerk of the court out of which the writ is to issue, stating that the debtor, according to his knowledge and belief, is not a resident of this State; that he owes the plaintiff (specifying the amount), or that the debtor absconds from his creditors. All property of the defendant may be seized under attachment, and his debtors garnisheed, but the real estate seized under attachment cannot be sold for twelve months after seizure.

Every assignment for the benefit of the creditors of the assignor, whither of real, personal, or mixed property, must inure to their mutual benefit without any preference or priority, and all preferences by which one or more creditors are to be first paid, or any other preferences, are fraudulent and void, excepting only creditors holding mortgages and judgment creditors. The debtor making the assignment must attach to the deed of assignment an inventory of all his estate, and a full list of creditors, these to be verified by the affidavit of the debtor.

The said inventory is not conclusive upon creditors or their assignee; the latter can recover any other property belonging to the assignor and not embraced in the schedule.

Notes for the payment of money, payable to the order of any person or corporation, are negotiable and assignable by endorsement, like inland bills of exchange; bills of exchange, for the sum of eight dollars and upwards, drawn upon any person in this State, can be protested for non-acceptance or non-payment, and be governed in every respect by the law governing foreign bills of exchange.

All checks, drafts or bills of exchange (other than those drawn upon banks or banking houses) whether drawn on demand or otherwise, are entitled to three days' grace. Bills of exchange, taken for a pre-existing debt, will extinguish the debt, if such person accepting such bill for his debt doth not take due course to obtain payment thereof, by endeavoring to get the same accepted and paid, and make his protest thereof in case of non-acceptance and non-payment. Notaries public are authorized to make protest of negotiable paper; but for want or in default of a notary, a justice of the peace may make lawful protest. The following are legal holidays, for purposes of protest; Christmas day, first day of January, fourth of July, and any day specially appointed by the Governor for a day of fasting or thanksgiving, and paper falling due on such legal holiday shall become due and may be protested on the day preceding the holiday; notice of protest need not be sent till following such holiday.

Jurisdiction of justices' courts in civil actions, on amounts, or debt claimed or matters in dispute, which does not exceed $100, except in actions of replevin, slander, trespass, for assault, battery or imprisonment, and actions wherein the title to lands come into question. Justices' courts are courts of record. *Court of Common Pleas.*—Concurrent with circuit. Appellate from justice of the peace. *Circuit Courts.*—Have concurrent, civil, original jurisdiction with supreme court, and appellate from the common pleas court. *Court of Chancery.*—Exclusive jurisdiction in all equity and divorce cases. *Supreme Court.*—Has original and appellate jurisdiction of all civil suits at law. *Court of Errors and Appeals.*—Has only appellate jurisdiction, and is the court of last resort.

Judgments constitutes liens on all the lands of the defendant in the county where obtained, if obtained in the circuit or chancery courts; but, if obtained in the supreme court, or docketed there from the circuit or chancery courts, a lien on all the lands of the defendant everywhere in the State. The liens continue during the period of limitation.

Executions may issue immediately after judgment, and at any time within the period of limitations, against the body of the defendant, or against his property, any kind of which can be levied upon. There is no stay of execution, except for a short period on judgments obtained before a justice of the peace, where good security is given, unless an appeal or writ of error is taken. There is no redemption after sale under execution.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—All deeds must be written in the common law form, under seal; an impression on wafer or wax is sufficient, attested by at least one witness, and have the word heirs incorporated to convey a fee. Both husband and wife must join in a deed conveying the estate of either, the wife to relinquish her dower in her husband's estate, and the husband to give his assent to the wife's conveyance. If the deed is acknowledged in this State, it must be done before the chancellor or justice of the supreme court, a master in chancery, a judge of the court of common pleas, or a commissioner of deeds.

If out of the State, before a judge of the supreme, superior, circuit or district court of the State or United States without any seal of such court or judge; before a mayor or other chief magistrate of a city, under the seal of such city; before a master in chancery of New Jersey, or a commissioner of deeds for New Jersey, under his seal; before a judge of the court of common pleas, or any officer authorized by the laws of the State where taken, to take the acknowledgments of deeds, and in the latter cases there shall be annexed a certificate under the great seal of such State or territory, or under the seal of the county court where the same is taken that such officer is such as he claims to be, and as such officer authorized to take the acknowledgments of deeds in such State or territory, and that his signature is genuine.

The following is the form of certificate to be used:

STATE OF NEW YORK, } ss.
COUNTY OF ORANGE. }

Be it remembered, that on this day of , 187 , before me, the subscriber, John Currie, a notary public, personally appeared A. B. and C. D., his wife, who, I am satisfied, are the grantors named in, and who executed the within instrument of conveyance, and I having first made known to them the contents thereof, they did therefore severally acknowledge before me that they signed, sealed and delivered the same as their voluntary act and deed, for the uses and purposes therein expressed.

And the said C. D., wife of the said A. B., being by me privately examined separate and apart from her said husband, did further acknowledge that she signed, sealed and delivered the same as her voluntary act and deed, freely, without any fear, threat or compulsion of or from her said husband.

In witness whereof, I have hereunto set my hand and affixed my official seal the day and year aforesaid. JOHN CURRIE, *Notary Public.*

A married woman can hold, to her sole and separate use, all property, both real and personal, which she owned at the time of her marriage, or which she acquired during marriage by gift, grant, descent, devise or bequest, and the rents, profits and issues thereof shall not be subject to the disposal of her husband, nor liable for his debts. She can be sued with her husband for debts contracted for her own benefit, and which cannot be enforced against her in equity. Widow is entitled to dower in one-third of all the real estate of which the husband died seized, and to the mansion house until dower is assigned her.

All chattel mortgages to be valid as to creditors and subsequent *bona fide* purchasers, must be filed with the clerk or register where the mortgagor resides, and if a non-resident, where the property is situated, or the possession of the property mortgaged must be immediately delivered to the mortgagee, and this possession be continued. And thirty days before the expiration of one year from the first filing of such mortgage, a true copy of same must be again filed with the clerk or register, accompanied with a statement showing the interest of the mortgagee in the property. The same becomes void as to creditors.

All wills shall be in writing, and shall be signed, or acknowledged to have been signed, by the testator, and declared to be his or her last will, in the presence of at least two credible witnesses present at the same time, who shall subscribe their names as witnesses in the presence of the testator.

SPECIAL LAWS OF NEW YORK.

EXEMPTIONS FROM FORCED SALE.—*Home werth $1000, and Personal Property.* Homestead to the value of $1000; but not as against an execution upon a judgment recovered for fraud. Burial plat not to exceed one-fourth of an acre. Personal property, when owned by a householder, is exempt as follows: Spinning wheels, looms and stoves in use in dwelling house, pictures and books in use to the value of $50; a pew in a church, 10 sheep, 1 cow, 2 swines and their necessary food, necessary household furniture and library to value of $250; working tools, professional instruments, a team and necessary food therefor for ninety days, and a sewing machine, except on execution for purchase money for such things.

MECHANICS' LIEN.—The laws on this subject are not uniform throughout the State. Material men and mechanics have lien for labor and materials on land improvements to the extent of their claims. The claim must be filed within thirty days after completion of labor and furnishing of materials; and in the county of New York, and some other counties, within three months. The lien continues for one year.

COLLECTION OF DEBTS.—The defendant is liable to be arrested and held to bail, at any time before judgment, in an action for injury to person or character, or wrongfully taking, detaining or converting personal property; in an action for money received or property embezzled or fraudulently misapplied by a public officer or attorney, or by an officer or agent of a corporation or banking association in the course of his employment as such, or by any other person in a fiduciary capacity; in an action to recover the possession of personal property unjustly detained, where the property has been concealed or disposed of so that it cannot be found by the sheriff; when the defendant has been guilty of a fraud in contracting the debt or incurring the obligation for which the action is brought, or in concealing or disposing of the property for the taking of which the action is brought; or when the action is brought to recover damages for fraud or deceit, and when the defendant has removed or disposed of his property, or is about to do so with intent to defraud his creditors.

The plaintiff is required to give a bond in at least $100, with one or more resident sureties, householders. The affidavit to obtain arrest may be made by any one with knowledge of the facts. Arrest may be made by non-residents.

Writ of attachment may issue on account of non-residence; departure from the State with intent to defraud creditors, or to avoid service, or concealment with like intent; removal or intended removal of property from this State with intent to defraud creditors, or the assignment, disposition or secretion, actual or intended, of property with intent to defraud creditors. The plaintiff gives a bond in at least $250, with one or more resident sureties, householders. Every species of property is subject to attachment and execution at law. Attachment on real estate becomes a lien on filing of notice. Attachments may be made by non-residents.

Assignments for the benefit of creditors must be acknowledged and recorded. One partner cannot assign the firm assets for the partnership. A debtor may prefer his surety or endorse on an existing indebtedness, although not yet matured. All claims on contract are assignable, and the assignee can sue in his own name. No particular form of assignment necessary.

Garnishment can be had either on execution or attachment against any person owing the debtor or having property in his possession.

Acceptors of notes and bills are chargeable only when their acceptance is in writing on the bill; or if on separate piece of paper, when the party who gave the credit saw the paper; or if a promise is made in writing to accept a draft before it is drawn, and the draft is in the hands of any person who gave credit on the strength of the writing.

Justices' Courts have jurisdiction in actions on contract and for damages for fraud in sale of property up to $200, and for recovery of personal property to value of $200. Process returnable in from 6 to 12 days.

The supreme court is a court of general jurisdiction in every county having cognizance of all actions. Process returnable in 20 days.

There are various local courts in the cities with general concurrent jurisdiction with the supreme court. The marine court of the city of New York has jurisdiction in actions on contract where the recovery sought is not more than $1000. Process returnable in six days, and in case of non-resident, plaintiff or defendant, may be in 2 days.

Judgments are liens for 10 years on all real estate owned by the judgment creditor, or subsequently acquired by him, in the county where the judgment is docketed. At the expiration of the ten years, the judgment can be revived by action. Judgments of inferior courts are made liens on real estate, by filing a transcript in county clerk's office.

Execution issues the day judgment is rendered. Personal property is bound from the time of the delivery of the execution to the sheriff, except in the hands of *bona fide* purchasers. All personal property, except such as is exempt by statute (see Exemptions), may be levied upon and sold. All interests in real estate, except a mere equitable interest, is subject to execution and sale. And within one year from the sale thereof, the property may be redeemed on payment of the bid, with interest, at ten per cent. If an execution is returned unsatisfied, the debtor can be examined under oath to discover property liable to execution. And any one owing the debtor, or having property of the debtor in his possession, may be likewise examined for the same purpose.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds must be under seal; a scrawl is not sufficient. There must be a subscribing witness, unless the deed is acknowledged by the grantor. Within the State the acknowledgment must be made by judicial officers generally, by notaries public and commissioners of deeds. Without the State the acknowledgment may be taken before any New York commissioner, or before any officer of the State or territory where made, authorized by the laws thereof to take acknowledgments.

The officer must be authenticated by the certificate of the county clerk under his official seal.

The following is the form of acknowledgment, where the grantor is unmarried:

STATE OF INDIANA, } *ss.*
COUNTY OF JACKSON. }

On this day of , in the year , before me personally came A. B., to me known to be the individual described in and who executed the within (*or* annexed, *or* above) conveyance, and acknowledged that he executed the same for the purposes therein mentioned.

PETER WILSON, *Notary Public.*

The following is the form where husband and wife join in the deed.

STATE OF INDIANA, } ss.
COUNTY OF JACKSON, }

On this day of , in the year , before me personally came A. B. and C. B., his wife, to me known to be the individuals described in and who executed the within (*or* above, *or* annexed) conveyance, and severally acknowledged that they executed the same for the purposes therein mentioned. And the said C. B., on a private examination by me made, apart from her husband, acknowledged that she executed the same freely, and without any fear or compulsion of her said husband. PETER WILSON, *Notary Public.*

Married women can hold real and personal property to their sole and separate use. A wife's obligation may be recovered out of her separate property when given with intent to charge it. Property acquired before or subsequent to marriage is in no cases liable for her husband's debts, but for her own debts only. A widow shall be endowed with one-third of all the lands owned by her husband during his lifetime.

To render a chattel mortgage valid as against creditors and purchasers, there must be actual possession by the mortgagee, or the mortgage or copy must be filed in the town or city where the mortgagor resides. The mortgage must be refiled every year.

Every will must be subscribed by the testator, and shall be acknowledged by him to be his will to each of at least two attesting witnesses, each of whom shall sign his name at the end of the will, at the request of the testator. The witnesses to any will shall write opposite to their names their respective places of residence; if residing in a city the street and number of the house should also be given.

SPECIAL LAWS OF NEW MEXICO.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1000; *Provisions,* $25; *Furniture,* $10; *Tools,* $20. Real estate to the value of $1,000 is exempt in farm, if the heads of the families reside on the same; also the clothing, beds and bedclothing required for the use of the family, and firewood requisite for 30 days, when actually provided and intended for use. All Bibles, Testaments, hymn books, and school books used by the family, and family and religious pictures; provisions on hand to the amount of $25, and kitchen furniture to the value of $10, both to be selected by the debtor; also tools and implements belonging to the debtor that may be necessary to enable him to carry on his trade or business, whether agricultural or mechanical, to be selected by him, and not to exceed $20 in value. Real estate when sold must be first appraised by two freeholders of the vicinity and must bring two-thirds of the appraised value.

SPECIAL LAWS OF NORTH CAROLINA.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1000,*and Personal Property worth* $500. Every homestead, and dwellings and buildings connected therewith, not exceeding in value $1000, to be selected by the owner thereof, or in lieu thereof, at the option of the owner, any lot in a city, town, or village, with the dwellings used thereon, owned and occupied by any resident of the State, and not exceeding $1000 in value. Personal property to the extent of $500 in value.

MECHANICS' LIEN.—All laborers, material men and mechanics have liens on the houses built, improved or repaired by them, and on the lots on which they are built, to the extent of the interest of the party who had the improvements or repairs done. But they must take the necessary steps to enforce this lien, by filing same and bringing suit within ninety days after the work is finished.

COLLECTION OF DEBTS.—The defendant may be arrested and held to bail, on the following grounds: Where, as an attorney, solicitor or agent of any kind, he has collected money and failed to account for it, or professional misconduct or neglect in office; where he has unjustly detained personal property, or where he conceals or disposes of his property with intent to deprive the plaintiff of the benefit of the same; where he has been guilty of fraud in contracting the debt for which the action is brought; where he has removed or disposed of his property, or is about to do so, with intent to defraud his creditors; where he is a non-resident of the State, or is about to remove therefrom, or where the action is for breach of promise to marry. The court, or judge of the court in which the action is brought, must order the arrest of the defendant. No female can be arrested in any action, except for a wilful injury to person, character or property.

Writs of attachment may issue on making affidavit to one or more of the following reasons: 1. Where the defendant or corporation is a non-resident. 2. Where the defendant has absconded, or conceals himself. 3. Where any person or corporation is about to remove any of his or its property from the State. 4. Where any person or corporation has assigned, disposed of or concealed, or is about to dispose of or conceal, any of his or its property, with intent to defraud his or its creditors. 5. Where the defendant has wrongfully converted property to his own use.

Garnishment in this State is not regulated by statute, but is governed by the rules of common law.

Bills and notes for the payment of money are negotiable, like inland bills of exchange, whether expressed to be payable to the order of a person or not. Bills of exchange payable at sight are entitled to grace; but bills and notes payable on demand are not entitled to grace.

Damages on protested bills are as follows: When drawn or endorsed in this State, and on a person outside the State but within the United States, three per cent.; where it is drawn on persons in any other place in North America, or in the West India or Bahama Islands, ten per cent.; when drawn on persons in the Madeira, Canaries, Azores or Cape de Verde Islands, or in Europe or South America, fifteen per cent.; and any other place, twenty per cent. In default of a notary, a justice of the peace or a clerk of a court of record may protest paper. When any check, negotiable or promissory note, is endorsed, the endorser, unless he in the endorsement stipulates to the contrary, becomes surety on the paper, and liable to the holder without any demand on the maker; this rule, however, does not apply to bills of exchange, either inland or foreign.

Assignments for the benefit of creditors, are governed by the rules of common law. The debtor has the right, therefore, to prefer one or more of his creditors, *provided* it is a *bona fide* transaction.

The jurisdiction of the justices' courts extends to $200, the probate court has authority over probate of deeds and general probate business, the superior court has exclusive jurisdiction of all demands over $200, and the supreme court has only appellate jurisdiction.

Judgments are liens on the land of the debtor, from the time they are docketed in the clerk's office when the same are obtained in the superior court, and from the time a transcript from the justices of the peace is filed with the clerk of the superior court. Transcripts of judgment thus docketed may be filed in any county where the defendant has land; and from the time the same is so filed with the clerk of the court, it operates as a lien on defendants lands.

Executions may be levied on real as well as personal property, whether the realty is simply an equity of redemption, or whether it is in the name of a fraudulent vendee; leaseholds of three years, or more duration are treated as real property. Executions from a justice of the peace are a lien on porsonal property from the time of the actual levy. Executions from courts of record issue in six weeks from the rendition of the judgment.

Deeds, Rights of Married Women, Wills, &c.—Deeds must be acknowledged by the grantor, or proved by the subscribing witness, before clerks of the superior courts, or judges of the supreme court, or notaries public, within the State where the grantor or witnesses reside; beyond the State, their handwriting may be proven in this State before either of the above officers, or, where they reside beyond the State, the acknowledgement of the grantor can be taken, or proof by subscribing witnesses can be made, before a special commissioner appointed under the seal of the probate judge having jurisdiction, authorizing such commissioner to take the acknowledgment of the grantor, or examination on oath of the witnesses to the deed, and the proceedings of such commissioner shall be returned to the probate judge issuing the commission, who may adjudge the deed duly acknowledged or proven, and order it registered. Or, the deed may be acknowledged or proven by witnesses before any regular commissioner of this State resident in the State or territory where the grantor or witnesses reside.

Where the grantor and witnesses reside beyond the limits of the United States, the acknowledgment or proof may be taken or made before the chief magistrate of any city where they reside, or any minister, ambassador or consul of the United States, under the official seal of such magistrate or other officer, and then the certificate so made must be exhibited to the probate judge having jurisdiction, who will adjudge the same duly acknowledged or proven, and order the same to be recorded in the proper place in this State.

The wife must join the husband in the execution of all deeds concerning real estate, to bar her dower, and her signature cannot be proven, but her separate acknowledgment must be taken; she must be examined privily and apart from her husband, and must show she does it to relinquish her dower. Where the grantor and subscribing witnesses are dead, the proof of the deed may be made by proving the handwriting of the grantor or the witnesses.

Use this form in taking the acknowledgement of husband and wife:

STATE OF , } *ss.*
COUNTY OF . }

Before me (here insert name and title of officer), this day, personally appeared A. B. and C. D., his wife, grantors named in the foregoing deed of conveyance, and the said deed being also produced and exhibited before me, the said A. B. and C. D. acknowledged the execution thereof by them as their act and deed for the purposes therein expressed; and the said C. D. being by me privily examined separate and apart from her said husband; touching her free consent in the execution of the said deed of conveyance, in her examination declared to me that she executed the same freely, voluntarily and without compulsion or restraint upon the part of her said husband, or any person whatsoever, and did still voluntarily assent thereto; and this she does in relinquishment of her dower in the land mentioned in said deed.

In witness whereof, I have set my hand and affixed my official seal this day of , 187 .

(Signature and title.)

There is no necessity of a seal to a deed, a scrawl is sufficient.

The property acquired by the wife either before or after marriage, either by inheritance, devise, gift or otherwise, shall be and remain her sole and separate property, free from the debts or control of her husband, and she can convey the same with the written consent of her husband. She has dower in all the real estate of her husband, owned or acquired during the coverture, and join in conveyances made by him to release the same.

No chattel mortgage of personal property is valid unless the same is duly recorded in the county where the grantor resides, or the possession of the property is removed from the grantor, and is only authorized on property to the value of $300.

The will must be signed by the testator, or by some other person in his presence and by his express direction, and subscribed in his presence by two witnesses, no one of whom shall be interested in the devise. Or, if found among his papers must be in his own handwriting, and his name subscribed thereto, inscribed in some part thereof, and the handwriting generally known to his acquaintances, and proved by three witnesses to be every part in the testator's own handwriting.

SPECIAL LAWS OF OHIO.

EXEMPTIONS FROM FORCED SALE.—*Home Worth* $1,000, *and Personal Property*.—Every head of a family, resident in Ohio, shall hold exempt from execution, his homestead, not to exceed $1,000. If the homestead exceed $1,000, the property will be partitioned and a homestead of $1,000 set off to the debtor. If he have no homestead, he shall hold exempt real or personal property not to exceed $500, exclusive of general exemptions, which are: Beds and bedstead; 1 stove; 1 cooking stove; fuel for 60 days; $100 of wearing apparel; 1 cow, or instead $35 of household furniture; 2 hogs, or instead $15 of household furniture; 6 sheep, or instead $15 of household furniture; all Bibles and hymn books; family pictures; provisions not exceeding $50, and such other articles of household or kitchen furniture as may be needed, not exceeding $50; a sewing machine; a knitting machine: tools of his trade, not exceeding $100; his personal earnings, and his minor children's, for not more than three months before judgment; all specimens of natural history, if not kept for pecuniary exhibition; a doctor shall hold his horse, saddle, instruments and books, the two latter not to exceed $100, exempt; a drayman, his horse and dray; a farmer, his horse, wagon, and yoke of oxen. Widowers having unmarried minor children, widows and married people having no children, may have the benefit of this act. The wife may claim exemption when the husband will or cannot, but the two may not claim exemption at the same time. Unmarried women may hold $100 of wearing apparel, $25 of books, a sewing and a knitting machine, exempt.

MECHANICS' LIEN.—Material men and mechanics, whether they be contractors, sub-contractors or laborers, may have a lien upon the buildings erected, and the land on which the buildings are erected, if within four months of the completion of the labor or furnishing of the materials they file an account, under oath, of their claim, in the county recorder's office. This account must be itemized. If the work be done or materials furnished under a written contract, such contract, or a copy thereof, must be filed with the account. The lien thus obtained dates back to the commencement of the labor or the furnishing of materials, and extends to two years after the completion of the labor or the furnishing of materials.

COLLECTION OF DEBTS.—Arrest in civil actions can only be made in cases of fraud. The plaintiff may set forth, by affidavit, fraud in the removal or concealment of property, in the contracting of the debt, or of the conversion of the property into money. Escape of the prisoner, without the consent of the creditor, is not satisfaction of the debt, but non-payment of jail fees, which jailer may demand weekly in advance, at the rate of forty cents a day, is constructive consent. This remedy is rarely, if ever, resorted to.

Writs of attachment may be obtained on one or more of the following grounds: 1. When the defendant, or one of several defendants, is a non-resident or a foreign corporation; or, 2. Has absconded with intent to defraud creditors; or, 3. has left the county of his residence to avoid service; or, 4. So conceals himself that service cannot be made; or, 5. Is about to remove his property out of the jurisdiction with intent to defraud his creditors; or, 6. Is about to convert his property into money with like intent: or, 7. Fraudulently or criminally contracted the debt or incurred the obligation.

An attachment on the first ground is only granted on claims founded on judgment, contract or decree. The affidavit in attachment may be made at or after commencement of any suit by plaintiff, his agent or attorney. Bond in attachment is in double the amount of the debt (except when obtained on the first ground, when no bond is required), executed by one or more sureties—it is the practice to have two sureties—need not be householders. There is no duty imposed upon the creditor to publish any notice of attachment on real estate; that is the sheriff's duty. Attachment may be had before the debt is due, when the defendant has disposed, or is about to dispose, of his property with intent to defraud or delay his creditors. Same law as above.

Assignments in trust, for the benefit of creditors, inure to the benefit of all creditors; the deed of assignment, or a copy thereof, must be filed within ten days of its execution, in the probate court of the assignor's county of residence, by the assignee. After all liens and mortgages, the wages of laborers and operatives, performed within six months, and not exceeding one hundred dollars, are to be first paid. Assignment made to secure sureties or endorsers are valid in any case, if for value. Every species of contract or claim is assignable; the holder of it must sue in his own name.

Garnishment can be issued on attachment, and a process analogous to it on execution, against any person or corporation owing the debtor any moneys, or having his property in possession. In no case is the garnishee allowed anything but his costs in the case.

All bills, notes, or other instruments payable to order, bearer, or assignor are negotiable. They must be put in suit in the name of the real party in interest. No damages or attorney's fees can be recovered in an action, save when there is an express and written clause in the note or bill, allowing the recovery of such damages or fees, in case it shall have to be sued upon. Notarial protest is evidence of demand and non-payment, in the manner and at the time stated in the protest.

Justices of the peace have exclusive jurisdiction up to $100, and concurrent jurisdiction with common pleas and superior courts up to $300. They have jurisdiction in actions for trespass on real estate where the damages do not exceed $100, and in actions for forcible entry and detention of real estate. Summons issued by justices of the peace must be returned within twelve days of their issue, and must be served on the defendant at least three days before trial.

Courts of common pleas have original jurisdiction in all civil suits where the amount exceeds the jurisdiction of justices, in suits affecting real estate, in divorce and criminal prosecution, and appellate jurisdiction of cases before justices of the peace and probate judges. The superior courts of Cincinnati, Cleveland and Dayton have the same jurisdiction as courts of common pleas, except in divorce, criminal law, and justices' appeals. The district courts have appellate jurisdiction of common pleas courts. The superior courts in general term review the superior courts' decisions in special term. The supreme court has appellate jurisdiction of district court and general term of superior court decisions, and original jurisdiction in *mandamus, quo warranto, habeas corpus* and *procedendo.*

Service of summons must be made and returned, in common pleas courts, on or before the second Monday after their date. Actions are triable the term after the issues are made up, or if they be made up during a term, at that term.

Judgments of courts of record, execution having issued on them within one year of their rendition, are a lien upon all real estate of the judgment debtor's, situate in the county where the the judgment is rendered, and owned by him at that time, from the first day of the term at which such judgment is obtained, and for five years thereafter. Every issue of execution extends the lien for five years, and a judgment lien may be extended indefinitely. Judgments by confession, and judgments obtained during the same term at which the action is commenced, date from their rendition only. If execution be not issued in one year, the judgment, though still a lien, dates only from actual levy of execution. Judgments are no lien on personal property and on real estate acquired subsequent to the date of judgment. Dormant judgments may be revived by new actions founded on them. Judgments obtained before justices of the peace may be made liens, by filing a transcript of same in the court of common pleas.

In order to prevent the priority of a judgment lien on lands, execution must be issued within one year after the rendering of judgment. Actual levy must be made on personal property to create a lien. Executions from justices of the peace cannot be levied on real estate.

All property, legal and equitable, is subject to execution, except as qualified by the exemption laws. Proceedings in aid of execution may be instituted at any time after judgment and execution by which the debtor, and any one having property of the debtor's, may be compelled to disclose its nature and amount.

Before the return of an execution issued, an order may be granted by the court upon proper affidavit, which will have the force of an attachment, and a copy served on any third party is analagous to the proceedings in garnishment.

Deeds, Rights of Married Women, Wills, &c.—Deeds must be under seal, a scrawl is a seal, and must be signed and sealed in presence of two witnesses, who sign also as attesting the execution of the instrument, and acknowledged in presence of any officer empowered to take depositions. If the grantors be non-residents, their deed, etc., may be executed according to the laws of this State, or according to the laws of the State where it is executed and acknowledged. Mortgages in this State date and become liens only from the time of their entry for record. All other deeds are to be recorded within six months of their execution, in order to become notice as to subsequent purchasers without notice.

This is the form where the grantor is unmarried :

State of Indiana, }
County of Stark. } *ss.*

Be it remembered that on (the date) before me, the subscriber (title of officer) personally came (the name of grantor) the grantor named in the foregoing instrument, and acknowledged the signing and sealing thereof to be his voluntary act and deed for the uses and purposes therein mentioned. Witness my hand and (if the officer have a seal of office he will here state : official) seal, on the day and year first above written.

[seal.] John Harper, *Notary Public.*

The wife must join her husband in a deed or power of attorney, whether the land be in her own right, or she have but a dower interest therein.

This is the form when the grantor is married :

State of Indiana, }
County of Stark. } *ss.*

Be it remembered that on , before me, the subscriber (John Harper, notary public) personally came and his wife, the grantors mentioned in the foregoing instrument, and acknowledged the signing and sealing thereof to be their voluntary act and deed for the uses and purposes therein mentioned. And the said , wife of the said , being by me examined separate and apart from her said husband, and the contents of said instrument by me explained and made known to her, as the statute directs, declared that she did voluntarily sign, seal and acknowledge the same, and that she is still satisfied therewith as her act and deed for the use and purposes therein mentioned. Attestation same as in unmarried form.

A married woman may own property, real or personal, in her own right, without the intervention of a trustee. She may manage it herself, but cannot dispose of it for any term longer than three years, without her husband joining her. She may be sued or sue alone, in actions concerning her seperate property, or upon a written obligation, contract or agreement signed by her, or if she be engaged in any business, and the cause of action grows out of such business, and in all such cases a personal judgment can be had against her, and her separate property will be liable. In no case shall she be required to prosecute or defend by her next friend. If her husband has abandoned her, she will be considered as *femme sole*. The widow shall be endowed with one-third part of all the lands owned by her husband during coverture.

Chattel mortgages of every kind are valid, if the instrument itself, or a true copy thereof, be deposited with the clerk of township where the mortgager resides; or if he be a non-resident, where the property is situate at the time of the execution of the mortgage.

On every mortgage so filed the mortgagee shall make the following statement:

[Form.]

STATE OF ,
COUNTY OF . } *ss.*

, mortgagee, named in this mortgage, being duly sworn, makes oath and says that his claim against , mortgager, of which a true statement is hereto annexed, amounts to the sum of , and that said claim is just and unpaid.

Sworn to before me and subscribed in my presence this day of , A.D.

Every mortgage so filed shall be valid one year, and may be renewed within thirty days of the expiration of the year, by refiling the original mortgage, or a copy of it, with the statement as above. Each renewal is valid one year, and the mortgage may be so renewed indefinitely.

Wills must be in writing and signed by the testator, or by some person in his presence and by his express direction, and attested and subscribed in the presence of the testator by two or more competent witnesses. See form No. 45 on page 815.

SPECIAL LAWS OF OREGON.

EXEMPTIONS FROM FORCED SALE.—*Personal Property*. The following are exempted: Books, pictures, and musical instruments to the value of $75; necessary wearing apparel owned by any person to the value of $100, and if such person be a householder, for each member of his family to the value of $50; the tools, implements, apparatus, team, vehicle, harness or library necessary to enable any person to carry on the trade, occupation or profession by which such person habitually earns his living, to the value of $400; also sufficient quantity of food to support such team, if any, for sixty days. The word team includes only one yoke of oxen, or a pair of mules or horses, as the case may be The following property, if owned by a householder and in actual use, or kept for use by and for his family, or when being removed from one habitation to another on a change of residence: 10 sheep, with one year's fleece or the yarn or cloth manufactured therefrom; 2 cows and 5 swine; household goods, furniture and utensils to the value of $300; also sufficient food to support such animals, if any, for three months, and provisions actually provided for family use, and necessary for the support of such household and family for six months; the seat or pew occupied by a householder or his family in a place of public worship; all property of the State, or any county, incorporated city, town or village therein, or of any other public or municipal corporation of like character. No article of property, or if the same has been sold or exchanged, then neither the proceeds of such sale or the article received in exchange therefor, shall be exempt from execution issued on a judgment recovered for its prize.

MECHANICS' LIEN.—Contractors for material or labor on any building have, from the time work is commenced thereon, a lien on the building and the ground on which it is situated, prior to all other liens on the same premises placed thereon after the commencement of work on the building. Suits must be brought within six months after payments are due under the contract, but no credit given on payments can extend the lien beyond two years from the completion of the work. The lien extends in favor of the workmen to the extent of the contract price; if before payments are due, they give written notice of their intention to hold the owner. And no payments made to the contractor before they are due, under the contract, can defeat this lien.

COLLECTION OF DEBTS.—Arrest in civil actions is unknown here, except in cases of fraud or of absconding debtors.

In actions for debt or tort, the goods of defendant may be attached, whenever the plaintiff, or his agent, shall make and file an affidavit that a cause of action exists against the defendant, and the grounds thereof, and that the defendant is either a foreign corporation or a non-resident of this State, or has departed therefrom with intent to delay or defraud his creditors or to avoid service of summons or keep himself concealed therein with like intent, or has removed or is about to remove his property from the State with intent to delay or defraud his creditors; that he has assigned, secreted or disposed of, or is about to assign, secrete or dispose of any of his property with intent to delay or defraud his creditors, or that the defendant has been guilty of fraud in contracting the debt or incurring the obligation for which the action is brought. The affidavit may be in the alternative as to any of these causes, and may be either positive or upon information and belief. But upon information and belief, the nature and sources of the information upon which the belief is founded must be stated. All property, or right or interest therein, not exempt from execution, may be attached.

The assignment of notes, bills, accounts, and every kind of contract or claim arising out of contract, is valid, and action thereon must be brought in the name of the real party in interest; but the action by the assignee, except in case of negotiable promissory note or bill of exchange, transferred in good faith for a valuable consideration before due, shall be without prejudice to any set-off or other defense existing at the time of or before notice of the assignment.

Garnishment can be issued, either on execution or attachment, against any person owing the debtor or having his property in possession.

As to bills and notes, no person is chargeable as an acceptor of a bill of exchange unless his acceptance is in writing, signed by himself or his lawful agent. Grace is allowed on all bills and notes, unless they contain an express stipulation to the contrary. On bills of exchange drawn or endorsed within this State and payable without the limits of the United States, duly protested for non-acceptance or non-payment, on due notice and demand thereof, the party liable for the contents of such bill shall pay the same at the current rate of exchange at the time of the demand, and damages at the rate of ten per centum upon the contents thereof, together with interest on such contents, to be computed from the date of protest; said amount of contents, damages and interest to be in full of all damages, charges and expenses. On bills of exchange drawn within this State, payable without this State, but within the United States, and protested for non-acceptance or non-payment, the drawer or endorser thereof, due notice being given of such non-acceptance or non-payment, shall pay said bill with legal interest, according to its tenor, and five per centum damages, together with costs and charges of protest.

The jurisdiction of justices of the peace, in actions for the recovery of money or damages only, extends to $250; for the recovery of specific personal property, when the value thereof and the damages for the detention do not exceed $250; for the recovery of any penalty or forfeiture, whether given by statute or arising out of contract, not exceeding $250.

The county court has exclusive jurisdiction in the first instance of probate matters, and has jurisdiction, but not exclusive, of actions at law, and all proceedings therein and connected therewith, when the claim or subject of controversy does not exceed the value of $500, and exclusive jurisdiction of actions of forcible entry and detainer, without reference to the value of the property.

The circuit court is clothed with all the judicial power, jurisdiction and authority not vested exclusively in some other court.

Service of the summons in county and circuit courts, if made within the county where action is brought, must be made ten days before judgment can be obtained; or, if served within any other county in the State, twenty days. Before justices, service must be made not less than five, nor more than twenty days before day set for trial.

Judgments in courts of record are a lien from their rendition, and for ten years thereafter, on all real estate owned by the defendant, or subsequently acquired by him, and situated in the county where the judgment is rendered. No execution can issue on a judgment older than ten years, unless on cause shown.

Judgments create no lien on personal property. Judgments before justice can be made to create lien on real estate by filing a transcript of the judgment in the circuit court.

Executions may issue the day judgment is rendered. They are a lien only from the time actually levied. Executions from justices' courts cannot be levied on real estate. Every species of property, or right or interest therein, is subject to execution, except the exemption. Redemption of real estate sold under execution may be made at any time within sixty days after the confirmation of the sale, but the redemptioner, in addition to the price paid by the purchaser, must pay interest thereon, at the rate of two per cent. per month, from the date of sale to the date of redemption.

DEEDS, RIGHTS OF MARRIED WOMEN, &c.—Deeds must be under seal, but a scrawl with the pen, a wafer, or other adhesive substance, is regarded as a seal. They must have two witnesses; and, to be entitled to record, must be duly acknowledged.

Acknowledgment, if made in this State, may be made before any judge of the supreme court, county court, justice of the peace or notary public; if out of the State, before any judge of a court of record, notary public, justice of the peace, or any other officer authorized by the laws of such State or territory, or country, to take acknowledgment of deeds therein, or before a commissioner of this State. Unless the acknowledgment be before a commissioner, when taken out of this State, there must be a certificate of the clerk or other proper certifying officer of a court of record, under the seal of his office, that the person whose name is subscribed to the certificate of acknowledgment was, at the date thereof, such officer as he is therein represented to be; that he believes the signature of such person subscribed thereunto to be genuine, and that the deed is executed and acknowledged according to the laws of such State, territory or district.

The following is the form of certificate of acknowledgment when the grantor is unmarried:

STATE OF ,
COUNTY OF , } ss.

Be it remembered that on this day of , 18 , before me, the undersigned, a within and for , personally appeared A. B., to me personally known to be the identical person described in and who executed the foregoing deed, and to me acknowledged that he executed the same for the uses and purposes therein expressed.

The following is the form where husband and wife join, the wife releasing dower or conveying her own lands:

STATE OF OHIO,
COUNTY OF BUTLER, } ss.

Be it remembered that on this day of , 18 , before me, the undersigned, a notary public within and for said county and State, personally appeared A. B. and his wife, C. D., to me personally known to be the identical persons described in and who executed the foregoing deed, and to me acknowledged that they executed the same for the uses and purposes therein expressed, and the said C. D., wife of the said A. B., on a separate examination by me made, separate and apart from and without the hearing of her said husband, to me acknowledged that she executed the same freely and voluntarily and without fear or compulsion from any one.

[SEAL.] JOHN MORGAN, *Notary Public.*

In this State married women can hold real or personal property in their own names, and free from control of or liability for the debts of their husbands, but in the case of personal property a schedule must be filed with the county clerk.

Chattel mortgages, to be a lawful lien, must be filed in the county clerk's office, and are in force for one year only from the date when so filed. They may be returned for a further period of one year by the mortgagee, within thirty days next preceding the expiration of the year, making and annexing to the instrument on file an affidavit setting forth the interest which the mortgagee has by virtue of such mortgage in the property therein mentioned. Within thirty days of the expiration of the second year, another affidavit may be made in like manner and with like effect.

SPECIAL LAWS OF PENNSYLVANIA.

Exemptions from Forced Sale.—*Real or Personal Property*, $300. Real or personal property to the extent of $300, besides wearing apparel, bibles and school books and sewing machines in the use of the family, and the arms, accoutrements, and uniform of a soldier. The exemption may be waived in note or contract.

Mechanics' Lien.—These bind houses and lands from the date of the commencement of work on the building (usually the cellar digging); for all work done and materials furnished toward the erection and construction of the building; *provided*, a lien for the same be filed within six months after the work has been done or the materials furnished. Liens may also be filed for alterations or repairs; they bind the property from the date of filing.

The debts of a deceased person are a lien on his real estate for 5 years after his death; the lien may be continued by suit brought within that time. The lien of judgments operates for 5 years from date of entry, when they must be revived by *scire facias*. The lien of a mortgage for purchase money is good from date of mortgage if rendered within 60 days; other mortgages from date of record.

Collection of Debts.—Arrest and imprisonment for debt is abolished in all actions founded on contract, except where such actions arise from breach of a fiduciary relation, and in cases of fraud. In cases where imprisonment still exists, the debtor may be committed to prison until he pays the debt, or gives bond to take the benefit of the insolvent laws.

The property of a non-resident debtor, who is not within the county at the time the writ is issued, may be attached in civil actions. The property of a resident debtor may be attached upon affidavit, that the defendant is justly indebted to him in a sum exceeding $100, and setting forth the nature of indebtedness, and that the defendant is about to remove his property out of the jurisdiction of the court with intent to defraud his creditors, or that the defendant has transferred, assigned or removed, or is about to transfer, assign or remove his property with intent to defraud his creditors, or that he has property, rights in action, interest in any public or corporate stock, or evidences of debt which he fraudulently conceals and refuses to apply to the payment of his debts. Plaintiff must give bond of indemnity in double the amount claimed, with sufficient sureties, to be approved by the court before the attachment issues. Attachments may be issued in the nature of an execution, after final judgment, which is a means of reaching the property of the defendant in the hands or custody of another.

Assignments for the benefit of creditors, must be recorded within 30 days after date, or they become void as to creditors. Preference in assignments are void, and fall into the general fund, except as to wages due laborers, miners and operatives, who are preferred to the extent of $100. One partner may make general assignment of partnership property for benefit of creditors.

A judgment is a lien on all the real estate of the defendant within the county in which it is obtained. Its lien continues 5 years, after which it must be revived or continued by *scire facias*. Does not bind after-acquired property unless levied thereon or revived. An execution binds personal property of the defendant from the time it is placed in the hands of the sheriff, but executions issued by a justice of the peace only bind from time of actual levy. When personal property or any leased premises is taken in execution, the landlord is entitled to one year's rent out of the proceeds of sale.

To stay execution defendant may plead his freehold, that is, allege his ownership of unincumbered real estate, or put in special bail, and thereupon shall be entitled to stay of execution as follows: If under $200, six months; if over $200 and less than $500, nine months; if over $500, twelve months. This does not apply to actions on judgments, mortgages or bail for stay of execution on former judgments.

In tax sales, unseated lands may be sold after one year's taxes are due, but may be redeemed by owner within 2 years on payment of amount of sale, costs, interest, and 25 per cent. penalty. Improved lands may be sold for non-payment of 2 years' taxes, but must be redeemed within one year after notice of sale. In Philadelphia, 2 years are allowed to redeem debts, not of record on a lien on the estate of the deceased person for five years, and may be continued for five years longer by suit commenced within that time. In case the personal estate of a decedent is not sufficient for the payment of his debts, the orphans' court will direct the sale of the realty. The widow and children of a deceased person are entitled to $300 out of his real or personal estate.

Deeds, Rights of Married Women, Wills, &c.—Deeds must be under seal, a scrawl is not sufficient, and should be attested by two witnesses. Acknowledgment of deeds may be taken *in the State*, by justices of the Supreme court of Pennsylvania, judges of the courts of common pleas, mayor, recorder, and alderman of Philadelphia, Pittsburg, Alleghany and Carbondale, the recorders of deeds, the notaries public, and all justices of the peace.

Out of the State acknowledgment may be taken by the mayor or chief magistrate of the city, town, or place where the deed is executed (under the public seal); any justice or judge of the supreme or superior court, or court of common pleas, or of any court of probate, or court of record, or any State or territoy in the United States (certified under the hand of the judge and the seal of the court); by any judge of the United States supreme court, or of any United States district court; by an officer or magistrate of any State or territory in the United States who is authorized by the laws of his own State or territory to take acknowledgments therein. The proof of such authority is the certificate of the clerk or prothonotary of any court of record in such State, under seal of the court, that the officer taking such acknowledgment is duly qualified to take the same; by ambassadors and other public ministers of the United States (under official seal); consuls and vice-consuls of the United States (under consular seal); by any notary public in any State or territory in the United States, or in any foreign country; by commissioners appointed by the Governor in any State, territory or foreign country, whose commissions last five years unless sooner revoked. And, where the person making the acknowledgment is in the military service of the United States, before any person holding the rank of major, or any higher rank, in said military service. Proof of the execution of a deed may be made by the affidavit of a subscribing witness. Powers of attorney relating to real estate must be acknowledged the same as deeds. Acknowledgments taken by notaries public or commissioners of deeds need not be certified.

No deed or contract relating to the real estate by a wife is binding upon her, unless acknowledged substantially as below:

[Certificate of Acknowledgment by Husband and Wife.]

State of Pennsylvania, } *ss.*
County of Lehigh. }

Be it remembered that, on the day of , A. D. 187 , before me (here insert name and title of official), duly commissioned in and for said county, came and , his wife, and acknowledged indenture to be their act and deed, and desired the same to be recorded as such. She, the said , being of lawful age, and by me examined separate and apart from her said husband, and the contents of said deed being first fully made known to her, did thereupon declare that she did, voluntarily and of her own free will and accord, sign and seal, and as her act and deed deliver the same, without any coercion or compulsion of her said husband.

Witness my hand and seal, the day and year aforesaid.

[SEAL.] (Signature and title.)

[Proof by Subscribing Witness.]

State of Pennsylvania, } *ss.*
County of Leaigh. }

Be it remembered that, on the day of , A. D. 187 , before me (here insert name and title of official), duly commissioned in and for said county, personally appeared , one of the subscribing witnesses to the execution of the above indenture, who being duly sworn (or affirmed) according to law, doth depose and say that he did see , the grantor above named, sign and seal, and as his act and deed deliver the above indenture (deed or conveyance) for the use and purposes therein mentioned, and that he did also see subscribe his name thereto as the other witness of such sealing and delivery, and that the name of this deponent, thereunto set and subscribed as a witness, is of this deponent's own proper hand-writing.

Sworn (or affirmed) to and subscribed before me the day and year aforesaid.

Witness my hand and official seal.

[SEAL.] (Signature and title.)

A married woman may hold and enjoy as her own separate property all such as she owned at the time of her marriage, and all such as may descend to or vest in her during her coverture, and such is not liable for any debts or engagements of her husband. A married woman may petition the court for leave to enjoy her own earnings, which will be allowed; her separate estate is, however, liable for necessaries purchased by herself for the use of her family. She cannot make a valid contract except for the improvement of her separate estate and for necessaries. She may make a will of her separate estate, subject to her husband's rights as tenant by the courtesy.

Wills must in writing: and, unless the person making the same shall be prevented by the extremity of his last sickness, shall be signed by him at the end thereof, or by some person in his presence and by his express direction, and in all cases shall be proved by the oaths or affirmation of two or more competent witnesses.

SPECIAL LAWS OF RHODE ISLAND.

EXEMPTIONS FROM FORCED SALE.—*No Home Exempted, but Personal Property.*—Householders are entitled to hold the following exempt from execution: The necessary wearing apparel of the debtor and his family; his necessary working tools, to value of \$200; his household furniture and family stores, to the value of \$300; one cow; one hog and one pig, and the pork of the same; debts secured by bills of exchange on negotiable promissory notes.

MECHANICS' LIEN.—Mechanics have a lien for labor, or labor combined with materials furnished, which, in the case of an original contractor, must be prosecuted within six months, and in case of a sub-contractor or day laborer, within thirty days after commencing the work; but no landlord is bound for the improvements made by the tenant, nor a married woman, under any circumstances, unless the contract is in writing, assented to by them, and is clearly intended to bind them.

COLLECTION OF DEBTS.—The defendant may be arrested in all cases of torts, where the form of the actions, as trover or trespass, or the necessary allegations of the writ, make a *prima facie* case of tort; in actions of debt, convenant and assumpsit, which cover almost all collections. No arrest of females can be had, on original writs, but males may be arrested on original writ in the following cases: 1. In case of claims originating before July 1, 1870. 2. Where the plaintiff, his agent or attorney, makes affidavit, on the back of the writ, "that the plaintiff has a just claim against the defendant, upon which the plaintiff expects to recover, in the action commenced by such writ, a sum sufficient to give jurisdiction to the court to which such writ is returnable; and also," either "that the defendant, or some one of the defendants, is about to leave the State, without leaving therein personal or real estate upon which an execution, that may be obtained in such action, can be served;" or, "that the defendant, or some one of the defendants, has committed fraud in contracting the debt upon which the action is founded, or in the concealment of his property, or in the disposition of the same."

To obtain a writ of attachment, the plaintiff must make affidavit that the defendant owes him justly the claim set forth, and which must be a sum sufficient to give the court jurisdiction; that defendant resides out of the State, or has left the State, and is not expected to return in season to be served with process before the next term of the court; or that he has committed fraud in contracting the debt sued on, or in concealing his property, or in disposing of the same fraudulently, and all the legal interest of the defendant in property can be attached, except what is exempt from execution.

Assignments made for the benefit of creditors are valid whether a preference is shown or not, except where the grantor is imprisoned on execution. Assignments or other conveyances, given as security for past, present or future endorsements, if made in good faith, are valid, subject, of course, to the provisions of the bankrupt act.

Assignees of contracts or claims, other than bills of exchange or negotiable promissory notes, must sue in the name of the assignor, unless they can prove a special promise by the defendant to pay to them.

The usages relating to notes and bills are governed by the common law. Foreign bills drawn or endorsed within this State and returned protested from without the United States, are subject to 10 per cent. damages and interest. The holder of such protested bill may sue the drawers and endorsers jointly. Foreign bills of exchange drawn or endorsed in this State and returned to this State protested for non-acceptance or non-payment, from any place without the limits of the United States, are subject to payment of 10 per cent. damages, besides protest fees. Inland bills drawn or endorsed in this State are subject to 5 per cent. damages, besides protest fees. Bills drawn at sight, payable in this State, are due on presentation, without grace. Notes, for the payment of money, only are assignable and negotiable like bills of exchange. Legal holidays are 4th of July, Christmas day and February 22nd: also, any days appointed by the Governor, Legislature or President of the United States as days of thanksgiving or holidays, Paper maturing on any of those days must be protested the day preceding those holidays, severally, at his election. Foreign bills drawn or endorsed in this State and returned protested from without the State and within the United States, are subject to five per cent. damages and interest. Sight bills are without grace. Other bills and notes have three days' grace, except the last day be Sunday or a holiday they are payable the last secular day preceding. Holidays are July 4, Christmas, February 22, and all duly appointed thanksgiving and fast days. Corporations are authorized to issue promissory notes signed by their proper officers.

The jurisdiction of justice courts extend to $100; the court of common pleas has original jurisdiction in actions for $100 and upwards, and has exclusive jurisdiction on appeals from justice's courts. The supreme court has exclusive jurisdiction in equity causes appellate from the court of common pleas.

Judgments are not a lien on real estate, and only binds the property seized by the attachment.

Execution issues after the rising of the court, or, in the county of Providence, five days after judgment, except on motion, when they may be granted immediately. They are to be levied on property previously attached, before the return day (the first day of the next term), or the attachments are released. But where the property is replevied, and, by the final judgment in replevin, is restored to the officer, it must be levied on within 20 days after it is returned and becomes subject to levy. Executions bind nothing except what they are levied upon. They may be levied upon anything that may be attached on original writ, and executions of justices' courts may be levied on real estate, but no execution can be served by garnishment or trustee process. In such cases, where there has been no previous attachment, the only available mode of procedure is by a new suit on the judgment. Executions may also be served by arrest of the body of a defendant, not exempt from arrest, in actions for tort, or for the recovery of debts incurred before March 31, 1870, or where the defendant was arrested on the original writ or on a writ of *mesne* process, or where proof is made showing, to the satisfaction of the court or some justice thereof, facts which would have authorized an arrest in the first instance, but no female can be imprisoned on a debt less than $50, not under seal. There is no redemption for execution sales.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Every deed of real estate requires a seal (not a scrawl) but not witnesses are essentially necessary to their validity. Within the State, they may be acknowledged before a senator, judge, justice of the peace, notary public or town clerk. Without the State, and within the United States, acknowledgments may be taken by any judge, justice of the peace, mayor or notary public, or any commissioner appointed by the Governor of the State and duly qualified. As it has never been determined how long such an appointment as commissioner, and as some presume to act by virtue of old or uncertain appointment, it is better to resort to some one of the local officials named above—of course, selecting one whose official character could be easily proved. Without the United States, deeds may be acknowledged before any minister or consul of the United States, or any commissioner appointed by the Governor and duly qualified.

The following form is used in taking the acknowledgment of a deed where it is necessary for husband and wife to acknowledge the same, and can easily be used where a single man or woman makes the acknowledgment:

STATE OF RHODE ISLAND, } *ss.*
COUNTY OF PROVIDENCE. }

Be it remembered that, on this   day of   , A. D. 187 , before me, Joseph Perkins, a notary public duly qualified, etc., personally appeared A. B. and C. D., his wife, and the said A. B. acknowledged the foregoing instrument, by him signed, to be his free and voluntary act and deed; and the said C. D., being by me examined privily and apart from her said husband, and having said instrument shown and explained to her by me, declared to me that it is her voluntary act, and that she does not wish to retract the same.

In witness whereof, I have set my hand and seal at Providence, R. I., the day and year above written.

JOSEPH PERKINS, *Notary Public.*

The wife must join in the execution of a deed made by the husband, to relinquish dower; yet the husband alone is required to acknowledge it.

Married women hold real and personal estate, not coming from the husband, free from all interference of the husband's creditors, and free from the husband's interference by means of trustees appointed in the ordinary manner, or by the supreme court on petition. They are not authorized to do business as traders. They may sell their personal estate in the same manner as their real estate, and certain unimportant kinds, such as clothing, books and similar personal articles, except jewels, they may sell as if single. Their other contracts, except their warranties in conveyances of real estate, are utterly void and do not bind their separate estate.

Wills must be in writing, signed by the testator, or by some one in his presence, and by his express direction, and attested and subscribed in the presence of the testator, by two or three competent witnesses.

SPECIAL LAWS OF SOUTH CAROLINA.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1000, *Personal Property* $500. A homestead to the head of each family, his widow or the orphan minors, not to exceed $1000. Also, personal property, as follows: "Household furniture, beds and bedding, family library, arms, carts, wagons, farming implements, tools, neat cattle, work animals, swine, goats and sheep, not to exceed in value in the aggregate $500,—except the homestead cannot be held exempt from execution issued on a judgment obtained for the purchase money of the same, or for improvements made thereon, or taxes due thereon." One-third of yearly proceeds of persons not the head of family is exempt, except as against taxes.

MECHANICS' LIEN.—All persons who furnish materials or perform labor in the erection, improvement or repairing of buildings, have a statutory lien on the same, to the extent of the interest of the party who had the buildings erected or improvements done; *provided*, that within ninety days after he ceases to labor a proper account be filed with the clerk of the court and suit thereon be begun in six months.

COLLECTION OF DEBTS.—A debtor may be arrested upon an order from the court where the action is pending, upon an affidavit that he has removed or disposed of his property, or is about to do so with intent to defraud his creditors, or has been guilty of a fraud in contracting the debt sued for, or is concealing or disposing of the property, for the taking, detention or conversion of which the action is brought; or where the action is brought for damages for fraud or deceit, or for money received and embezzled or fraudulently misapplied by a public officer, agent or officer of a corporation, factor, agent, broker, attorney-at-law, or one acting in any fiduciary capacity, or for misconduct or neglect in office or professional employment, or where he is a non-resident of this State, or is about to remove therefrom; or when the action is for injury to person or character; or for injuring or for wrongful taking, detaining or converting property. No female can be arrested, except for wilful injury to property, person or character.

A writ of attachment may issue for the following causes: 1. When the defendant is a non-resident, or a foreign corporation. 2. Or where he has absconded or concealed himself to avoid service of summons. 3. Or is about to remove his property from the State with intent to defraud creditors. 4. Or has assigned, or disposed of, or secreted, or is about to assign, dispose of or secrete his property, for the purpose of defrauding his creditors.

Debtors, in making assignments, can prefer any, or any class of creditors, and make any provisions for the administration of the property, only cannot retain any advantage or benefit to himself. The assignee must, within ten days, call a meeting of creditors, to appoint an agent of creditors to act with him, who has joint control of the property. If no agent is elected, the assignee is both assignee and agent. Assignments to secure sureties or endorsers, prior to any payment by them, are valid. In fact, assignments, free from fraud, for any purpose, are valid, and can be set aside only in bankruptcy, according to the rules of the bankrupt act. Notes, bills, accounts and all choses in action are assignable. The assignee should sue in his own name.

As to notes and bills, the principles of the common law apply to notes and bills of exchange, and negotiable papers of all kinds, as to endorsement, presentation and protest. No protest is necessary on a bill for less than $100, and all bills, foreign and domestic, payable at sight, are entitled to days of grace. Endorser or acceptor not liable, unless the endorsement or acceptance be in writing on the note or draft, or protest be made for non-acceptance. Drawers and endorsers may be sued jointly and severally. All bills or promissory notes payable to order or bearer under $1, are void.

Justices' courts have jurisdiction to the extent of $100, and have concurrent jurisdiction with the court of common pleas. The court of common pleas has exclusive jurisdiction in all cases appealed from justices of the peace, and original and exclusive jurisdiction in all actions at law or equity where the amount sued for exceeds $100. If the debt recovered in the common pleas court is less than $50, the plaintiff must pay costs. The Supreme Court has appellate jurisdiction of all cases in equity from court of common pleas; corrects errors of law in cases at law from such courts, and has original power to issue writs of injunction, *mandamus*, *quo warranto*, *habeas corpus*, and such other remedial writs as are necessary to give it a general supervisory control over all the courts in the State.

Judgment, as soon as entered, binds all real estate in that county, and can be entered at same time in several counties, but binds personal property only on levy, constructive or actual.

Execution may issue at once after judgment, unless the court open a special day for the entry of judgments, or unless a notice of an appeal is given, and then it can issue, if plaintiff will execute to the defendant a bond, with good sureties in double the value of judgment, to pay all damages sustained by the defendant in case the judgment is reversed. Even then the defendant can still secure the stay of the execution until the appeal is disposed of, if he will execute a counter bond to plaintiff to pay him the debt, costs and damages, if the judgment be sustained. There is no redemption of property sold under execution.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds of conveyance of real estate must be in writing, and signed in the presence of at least two witnesses, and must be recorded in the county where the land lies in thirty-three days after same is acknowledged. If acknowledged in this State, it must be done before a notary public or trial justice; without the State, before a commissioner of this State only. Before the deed can be properly admitted to probate, one of the subscribing witnesses must go before a notary public or trial justice, if he is in this State, or before a commissioner for this State if he is without the State, and make affidavit that he saw the grantor sign, seal and, as his act and deed, deliver that deed, and that he, with the other subscribing witness, naming him, did witness the execution thereof. And the officer before whom such affidavit is made must add this certificate, which must be signed by the witness:

STATE OF SOUTH CAROLINA, } *ss.*
COUNTY OF CHARLESTON. }

Personally appeared before me A. B., and made oath that he saw C. D. sign, seal and deliver the within conveyance, for the uses and purposes therein mentioned, and that he, with E. F., in the presence of each other, witnessed the due execution thereof. A. B.

Sworn to before me this day of , A. D. 187 .
(Signature and title of officer.)

If the grantor has a wife, she should renounce her dower before a notary public or trial justice, if within the State, or before a commissioner of deeds for the State if outside of it, and the officer will use this form:

STATE OF SOUTH CAROLINA, } *ss.*
COUNTY OF CHARLESTON. }

I (here insert name and title of officer), do hereby certify unto all whom it may concern, that G. H., the wife of the within-named C. D., did this day appear before me, and upon being privately and separately examined by me, did declare that she does freely, voluntary, release and forever relinquish unto the within-named John Smith, his heirs and assigns, all her interest and estate, and also all her right and claim of dower, of, in, or to all and singular the premises within mentioned and released.

(Signed by wife.)
Given under my hand and seal this day of , A. D. 187 .
[SEAL.] (Signature and title of officer.)

All the property, both real and personal, belonging to a woman at the time of her marriage, and all which she acquires during coverture by gift, grant, inheritance or devise, shall remain her sole and separate property free from the debts of her husband, and may be disposed of by her, by deed, will or otherwise, in the same manner as if she were unmarried; *provided*, no gift from husband shall injure the just claims of her creditors. She must, as previously stated, relinquish her dower.

Chattel mortgages of perishable goods, of goods, wares, and merchandise, in fact, of any personal property, are valid, if recorded within sixty days in the office of the registrar of *mesne* conveyances in the county wherein the property is situated. In all counties, except Charleston, the clerk of the court of common pleas is *ex officio* registrar.

Wills must be in writing, signed by the testator, or some person in his presence and by his express direction, and attested and subscribed in the presence of the testator by three or more competent witnesses. See Business Form, No. 45, p. 815.

SPECIAL LAWS OF TENNESSEE.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1000, *and Personal Property.* The following property is exempt for garnishment, execution, or attachment: Thirty dollars of the wages of mechanics or other laboring men in the hands of heads of families, two beds, bedsteads and necessary clothing for each, and for each three children of one family, one additional bed, bedstead and clothing, the value of such bedsteads in no case to exceed $25; 2 cows and calves, and if the family consist of 6 or more persons, 3 cows and calves, etc.; 2 horses or 2 mules, or 1 horse and 1 mule, and 1 yoke of oxen; 1 wagon or cart, etc., not to exceed in value $75; 25 lbs. corn; 20 bushels wheat; 500 bundles oats, etc.; 1,000 lbs. pork, or 600 lbs. bacon; a homestead carpet, manufactured by the wife for family use; 6 cords wood, or 100 bushels coal; 1 sewing machine, if used for livelihood, etc.: in the hands of mechanic, who is engaged in the pursuit of his trade, one set of mechanics' tools; a homestead in the possession of each head of the family and the improvements thereon to the value of, in all, $1000. Persons who are not the heads of families are not entitled to the benefit of exemptions.

MECHANICS' LIEN.—Material men, contractors and mechanics who furnish work or materials to aid in the construction or repair of any building or buildings, shall have a lien on the same for 1 year after the work is done, provided notice in writing of said lien be first given to the owner, or his agent at the time said work is begun, or materials furnished. All debts incurred for repairing, fitting, building, navigating, or furnishing steam or keel boats, shall be a lien on such vessels provided suit be commenced within three months from the time the debt is incurred.

COLLECTION OF DEBTS.—Arrest in civil actions is unknown in this State. Writs of attachment on affidavit being made to either of the following causes. 1. Where the debtor resides out of the State. 2. Where he is about to remove, or has removed himself or property from the State. 3. Where he has removed, or is removing himself out of the county privately. 4. Where he conceals himself, so that the ordinary process of law cannot be served upon him. 5. Where he absconds, or is absconding or concealing himself or property. 6. Where he has fraudulently disposed of, or is about to fraudulently dispose of his property. 7. Where any person, liable for any debt or demand, residing out of the State, dies, leaving property in this State. (Code, § 3155.)

Bond, with good security, must be given in all cases before an attachment can issue. And all property, both real and personal, legal and equitable, of the debtor, can be seized.

All assignments for the benefit of creditors inure for the benefit of only those creditors of the grantor named in the deed of assignment; the acceptance of the creditor is presumed, unless proof to the contrary is made. Assignments can be made to secure endorsers or sureties. Assignments, like other deeds, must be acknowledged and recorded.

Garnishment can issue on executions or attachments, and holds all the property of the defendant in the hands of the garnishee from the date of the service of garnishment to his answer. The garnishee is entitled to the payment and privileges of a witness and his costs.

Every bill, note, or bond, whether sealed or not, whether payable to order for value received or not, shall be negotiable as inland bills of exchange by the custom of merchants. And the holder of any such instrument may maintain a joint action against the maker and any one or more of the endorsers, or a joint and several action against any one or more of the endorsers. The holder of a bill of exchange, drawn or endorsed in this State upon any person or corporation of or in any other State, territory or place, and which is protested for non-payment, may recover from the drawer or endorser, besides the principal and interest, damages as follows: Three per cent., if drawn on any person or corporation in the United States or territories; fifteen per cent., if in any other place in North America; and twenty per cent. on any person in any other part of the world. Days of grace are not allowed on bills payable at sight. The certificate of a notary public in or on his protest is *prima facie* evidence of the facts stated therein.

The jurisdiction of justice courts, extends, against makers of notes and acceptors of drafts, to the extent of $500. On accounts, obligations, contracts, and other evidences of debt, $250. Damages and replevin suits, $250. The circuit and equity courts have general jurisdiction, and circuit courts have jurisdiction appellate from justices of the peace on all cases before them. The supreme court has appellate jurisdiction only.

Executions may issue from a justice after two days, and from a court of record after 30 days from date of judgment. An execution from a justice is a lien only on personal property from the day of its teste, and it becomes a lien on real estate only from the day of its levy thereon. The lien on real estate, under an execution from a justice, can be enforced only by an order of sale from the circuit court, which is made upon the return of the execution, with the levy thereon, and all the papers into the circuit court. The legal interest of the defendant in all kinds of personal or real property, also in stock of a corporation, can be levied on under an execution. All judgments before a justice of the peace can be stayed for eight months, upon entering good and sufficient security on the justice's docket for debt, interest and costs, if same is done in two days after judgment. No stay allowed on judgment obtained in court of record. Real property sold under execution can be redeemed in two years by the debtor, or by a judgment creditor of the debtor. In case the debtor does not redeem until other judgment creditors redeem, he shall pay all the judgments which have secured a lien by redemption. The legal title only can be subjected to an execution at law. An equitable interest in lands can only be reached by bill in chancery.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds are valid without being under seal. Not good as to strangers, unless duly acknowledged by the grantor, proved by two witnesses under oath and recorded. Deeds must be acknowledged, if the grantor is in the State, before the clerk or legally appointed deputy clerk of the county court, or before a notary public. If before a notary public, the clerk of the county court where he received his appointment shall certify as to his official capacity.

If the grantor is without the State, but in the United States or territories—1. Before any court of record, or before the clerk of any court of record in any of the States of the Union; or, 2. Before a commissioner for Tennessee, appointed by the Governor, in any State or territory; or, 3. Before a notary public of such State or territory.

If the grantor is beyond the limits of the Union and its territories—1. Before a commissioner for Tennessee appointed in the country where the acknowledgment is made. 2. Before a notary public of such country. 3. Before a consul, minister or ambassador of the United States in the country where the acknowledgment is made.

The certificate of the officer before whom the deed is acknowledged must be under seal, unless acknowledgment is made in the State before a justice or judge of some court, and then the certificate of the clerk of the county court, certifying to the signature, etc., of the justice, or of the clerk of the court certifying to the signature of the judge, must be under seal.

The following is the form of the certificate necessary where the grantor makes the acknowledgment in person and in this State:

STATE OF TENNESSEE, }
COUNTY OF HARDIN. } *ss.*

"Personally appeared before me, clerk (or deputy clerk) of the county court of said county, the within-named bargainer, with whom I am personally acquainted, and who acknowledged that he executed the within instrument for the purposes therein contained.

"Witness my hand, at office this day of , A. D. 187 ."

[SEAL.]

(Signature and title.)

As the wife has no dower in land granted in fee by the husband, it is not necessary for her to join in the deed, but if a trust deed is given, then the wife must relinquish dower by joining in the deed. When the land conveyed is the separate estate of the wife, the husband must always join her in the deed. In any deed where the wife has to acknowledge the same, the certificate of the officer or court before whom it is taken must contain this additional clause: "And C. D., wife of the said A. B., having appeared before me, privately and apart from her husband, the said A. B., acknowledged the execution of the said deed to have been done by her freely, voluntarily, and understandingly, without compulsion or constraint from her said husband, for the purposes therein expressed."

It is not necessary, to the validity of a deed, that it should be signed in presence of witnesses, where the grantor makes the acknowledgment in person. But unless grantor does acknowledge, it must be signed in presence of witnesses—two are sufficient, who may probate the same before either of the above-named officers, and in such case the following form must be used:

STATE OF MAINE, }
COUNTY OF WALDO. } *ss.*

Personally appeared before me, John Campbell, commissioner for Tennessee, etc., C. and D., subscribing witnesses to the within deed, who being just sworn, deposed and said, that they are acquainted with A. B., the bargainer (or as the case may be), and that he acknowledged the same in their presence, to be his act and deed upon the day it bears date (or stating the time as proved by the witnesses). Witness my hand, at office, this day of , A. D. 187 .

JOHN CAMPBELL, *Commissioner for Tennessee.*

A married woman can hold real and personal property to her sole and separate use, without or through a trustee. She can, if over twenty-one years of age, and own the land in fee, or equitably, convey same without her husband joining with her by deed or will. And if settled upon her after marriage for her sole and separate use, at any age. A note or any other obligation, made by a married woman, will not bind her separate estate, unless it was executed with the express intention to bind the same; or unless it was given for necessaries for herself or her minor children.

Wills must be in writing, signed by the testator, or some other person in his presence and by his express direction, and subscribed in the presence of the testator by two witnesses, no one of whom is interested in the will.

SPECIAL LAWS OF TEXAS.

EXEMPTIONS FROM FORCED SALE.—*Home worth $5000, and Personal Property.* To every citizen, householder, and head of a family, not to exceed 200 acres of land (not included in a city, town or village), or any city, town or village lot or lots, not to exceed $5000 in value at the time of their designation as a homestead, and without reference to the value of any improvements thereon. Also, all household and kitchen furniture, all implements of husbandry, all tools and apparatus belonging to any trade or profession, and all books belonging to private or public libraries; five milch cows and calves; 2 yoke of work oxen; 2 horses and 1 wagon, 1 carriage or buggy; 1 gun; 20 hogs; 20 head of sheep; all provisions and forage on hand for home consumption; all saddles, bridles and harness necessary for the use of the family; and to every citizen, not a head of a family, one horse, bridle and saddle, all wearing apparel, all tools, apparatus and books belonging to his or her private library.

MECHANICS' LIEN.—Any person or firm who may labor, furnish material, machinery, fixtures and tools to erect any house, improvement, or any improvement whatever, shall have a lien on such article, house, building, fixtures or improvement, and also on the lot or lots or land necessarily connected therewith, to secure payment for labor done, material and fixtures furnished for construction or repairs. Such person or firm shall, within six months after such debt become due, file his contract in the office of the district clerk of the county in which the property is situated, and have the same recorded in a book kept for that purpose by the clerk. If the contract, order or agreement be verbal, a duplicate copy of the bill of particulars must be made under oath, one to be filed and recorded by the clerk as provided for written contracts, the other to be served on the party owing the debt. When the contract or account is filed and recorded, they must be accompanied by a description of the property against which the lien is claimed. The filing and recording fixes the lien from the day it is filed. The lien, if against land in the country upon which said improvements have been made, shall extend to and include fifty acres; if in a city, town or village, it extends to and includes such lot or lots upon which said improvements are situated. The lien may be enforced against the land and improvements, or the improvements alone. The purchaser having a reasonable time to remove the same. The sale to be upon judgment and order of sale. This lien extends as well to homesteads as to other property; also, to all boats navigating the waters of this State. All actions to enforce liens must be brought within two years.

COLLECTION OF DEBTS.—Arrest for debt is unknown here. Writ of attachment may issue for the following causes, viz. : When the defendant is not a resident of the State, or is about to remove himself or property out of the State, or has abandoned the country, or secretes himself so that the ordinary process of law cannot be served on him, or is about to remove his property beyond the county in which suit has been or is to be instituted, or is about to transfer or secrete, or has transferred or secreted his property, for the purpose of defrauding his creditors, so that the plaintiff will probably lose his debt. Attachment bond must be double the amount claimed, with two or more approved securities. Affidavit made to facts claimed as ground of attachment. Everything, except *choses* in action and property exempted by law, belonging to the defendant in execution, may be levied upon and sold as his goods and chattels. An attachment levied upon real estate is a lien thereon from date of levy.

An assignment in trust, for the benefit of creditors generally, inure for the benefit of all the creditors of the grantor, whether named in the deed of assignment or not; but a failing debtor may prefer his creditors. Assignments can be made in this State to secure sureties or endorsers prior to any payment by them.

Notes, bills, accounts and every species of contract or claim are assignable here, and the assignee can sue in his own name. An assignment proves itself in Texas, and can only be put in issue by a plea of *non est factum*. A parol assignment is good here, but must be proven.

Garnishment may be issued upon attachment, judgment, or upon original suit, upon filing proper bond and affidavit. May be issued either by district or justice court. Defendant may replevy property seized in hands of garnishee by filing proper bonds. Garnishee is entitled to his reasonable costs.

As to notes and bills, acceptors are chargeable, either upon written or verbal acceptance. A holder of a bill of exchange drawn by merchants, resident in this State, upon their agents or factors out of the State, having fixed the liability upon the drawer or endorser, are entitled to recover and receive ten per cent. damages, and all costs of suit thereon accruing. An assignee can sue any assignor of any bill or note, but cannot sue any two or more of them in the same suit, unless they are joint assignees. When suit is brought against a remote assignor by an assignee, he cannot only set up any defense he may have against the plaintiff, but any he may have against any of the intermediate assignors. Three days of grace are allowed here upon all bills of exchange and promissory notes assignable by law. A notarial protest or copy of record, certified to under the hand and seal of the notary public, is admitted in all the courts of this State as evidence of the facts therein set forth.

The jurisdiction of justice courts, extends, against makers of notes and acceptors of drafts, to $500. On accounts, obligations, contracts and other evidences of debt, $250. Damages and replevin suits, $250. The circuit and equity courts have general jurisdiction, and circuit courts have jurisdiction appellate from justices of the peace on all cases before them. The supreme court has appellate jurisdiction only.

Judgments and decrees in any court of record shall be a lien on the debtor's land from the time the same is rendered in the county where the debtor resides; if rendered in any other county than where debtor resides, from the time when a certified copy of the same is registered in the county where the land lies. But this lien only exists for twelve months. Such judgment or decree does not give a lien on the debtor's equitable interest in land, unless within sixty days after rendition of same a memorandum of the same is registered in the county where the land lies. A lien on the legal title of the debtor in real estate can also be fixed under an execution from a justice of the peace, by filing the execution, with the levy of the same, and all the papers in the case before the justice, with the circuit court from which an order of sale issues.

Executions in district court issue immediately upon the adjournment of court, unless court is in session twenty days after rendition of judgment, or the defendant is about to remove his property out of the county when they can issue sooner. In justice court ten days after rendition of judgment. Executions are not liens on any property in this State until levied. No stay laws here, except in justice court for three months' time. Everything except *choses* in action and property exempted by law belonging to the defendant in execution, may be levied on and sold as his goods and chattels. No redemption laws here.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds, mortgages and deeds of trust are not required to be under seal. Proof or acknowledgment of every instrument of writing for record may be taken before some one of the following officers: When acknowledged or proven within this State, before some notary public, district clerk or deputy clerk, or judge of the supreme or district court in this State; when acknowledged or proven without this State, and within the United States or their territories, before some notary public, commissioner of deeds for this State, or before some judge or clerk of a court of record having a seal; when acknowledged or proven without the United States, before some public minister, *charge d'affaires*, consul or consular agent of the United States, or notary public; in all cases the certificate of such acknowledgment or proof shall be attested under the official seal of the officer taking the same, and the deed recorded in the county where the land lies.

The following is the form of the certificate where the husband and wife join in the deed:

STATE OF TEXAS, }
COUNTY OF TRAVIS. } *ss.*

Before me personally appeared and , his wife, parties to the foregoing attached , bearing date the day of , A. D. 187 , both of whom are known to me, who acknowledged severally that they had signed, sealed and delivered the same for the purposes and considerations therein stated. And the said having been examined by me privily and apart from her husband, and having had the same fully explained to her, she, the said , acknowledged the same to be her act and deed, and declared to me that she had willingly signed, sealed and delivered the same of her own free will and accord, without fear or compulsion on the part of her said husband, and that she wished not to retract it.

Witness my official seal and signature at my office, this day of . A. D. 187 .

(Signature and title.)

[Certificate when the Grantor is Unmarried.]

STATE OF TEXAS, }
COUNTY OF TRAVIS. } *ss.*

Before me, JOHN SMITH, clerk of the district court in and for said county, personally appeared , who is to me known, and acknowledged that signed, executed and delivered the foregoing deed for the purposes therein specified.

Witness my official seal and signature, at my office, in the city of Austin, this day of , A. D. 187 .

(Signature of officer.)

Deeds may be authenticated for record by affidavit of one or two attesting witnesses. Two witnesses required to every deed unless acknowledged.

Married women can hold real estate or personal property to their separate use. A married woman can bind herself on a note, draft or endorsement, when for necessaries for herself or children, or for the benefit of her separate property. All property acquired by husband and wife during marriage is their *common property*, except that acquired by gift, devise or descent, which is his or her separate property. The husband's consent is necessary to the alienation of the wife's separate property. The husband cannot alienate the homestead without the consent of the wife. The widow is entitled to the use of one-third of the real estate for her life.

A chattel mortgage is valid here between the parties thereto, but void as against creditors and *bona fide* purchasers without notice, unless recorded in the county where the mortgagor resides.

Wills must be in writing, signed by the testator or by some other person in his presence and by his direction; and, moreover, if not wholly written by himself, be attested by two or more credible witnesses above the age of fourteen years, subscribing their names in his presence.

SPECIAL LAWS OF UTAH.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1000, *and Personal Property. To each member of the family* $250. To the head of the family is allowed a homestead not exceeding in value $1000, to be selected by the debtor, and personal property to the value of $700 or more, according to the value of articles exempt by statute; aside from the homestead each member of the family is allowed $250. No property shall be exempt from sale on a judgment received for its price, on a mechanic's lien, or a mortgage thereon.

SPECIAL LAWS OF VERMONT.

EXEMPTIONS FROM FORCED SALE.—*Home worth $500, and Personal Property.* Homestead to the value of $500, and products, such suitable apparel, bedding, tools, arms and articles of furniture as may be necessary for upholding life; 1 sewing machine kept for use, 1 cow, the best swine, or the meat of 1 swine, 10 sheep, and one year's product of said sheep in wool, yarn or cloth; forage sufficient for keeping not exceeding 10 sheep and one cow through one winter; 10 cords of firewood, or 5 tons of coal; 20 bushels of potatoes, such military arms and accoutrements as the debtor is required by law to furnish; all growing crops, 10 bushels of grain, 1 barrel of flour, 3 swarms of bees and hives, together with their produce in honey; 200 lbs. of sugar, and all lettered gravestones; the bibles and other books used in a family; one pew or slip in a meeting-house or place of religious worship; live poultry not exceeding in amount or value the sum of $10; the professional books and instruments of physicians, and the professional books of clergymen and attorneys-at-law, to the value of $200, and also 1 yoke of oxen or steers as the debtor may select, with sufficient forage for the keeping of the same through the winter; or in lieu thereof, 2 horses kept and used for team work not to exceed in value $200, with sufficient forage for keeping same; also pistols, side-arms and equipments personally used by any soldier of the United States and kept by him or his heirs as mementoes.

MECHANICS' LIEN.—Material men and mechanics have a lien for labor and material in building, repairing, fitting or furnishing any vessel until eight months after such vessel is completed. It may be secured by attachment, and has precedence of all other claims. They also have a lien upon a building, and the lot on which it stands, for erecting or repairing such building. The lien continues three months after payment comes due, but does not attach until the person claiming it has filed and caused to be recorded, in the town clerk's office, a written memorandum, by him signed, asserting such claim.

COLLECTION OF DEBTS.—No female can be arrested on any process in an action founded on contract. No resident citizen of this State, or any of the United States, can be arrested on any process issued on any contract, unless the plaintiff, his agent or attorney file, with the authority signing the writ, an affidavit, stating that he has good reason to believe, and does believe, that the defendant is about to abscond or remove from the State, and has property secreted about his person or elsewhere to the amount of $20, or sufficient to satisfy the demand in suit; or file an affidavit stating that the defendant neglects or refuses to pay over on demand money which he holds for the plaintiff in a fiduciary capacity.

In actions of contract, writs of attachment may issue against the goods, chattels or estate of the defendant; and in actions founded on tort, for want thereof, against the defendant's body.

Assignments, for the benefit of creditors, are regulated by statute. To protect the property in the hands of the assignee, it must be for the benefits of all the creditors. Choses in action may be assigned, but the assignee cannot sue in his own name, unless there has been a special promise to pay him, or the demand is what is known as "negotiable paper."

In actions on contract a person having goods, effects or credits of the defendant in his hands, may be summoned as trustee in the suit, and he is required to attend and disclose. Judgment is rendered against him in favor of the plaintiff for the amount of his indebtedness or liability to the defendant, to the extent of the judgment against the defendant. This process cannot be sustained unless the debt due the plaintiff from the defendant, as well as that from the trustee to the defendant, exceed $10. It does not reach debts due on a contingency, or due on a judgment where the judgment debtor is liable to an execution on the judgment.

As to notes and bills, &c., a promissory note payable on demand is considered overdue at the expiration of sixty days from date, and presentment and demand of payment must be made within that time to charge the endorser. All negotiable paper, except that payable on demand or at sight, is entitled to three days of grace. Negotiable paper may be endorsed for collection and sued in the name of the agent or attorney, though he is not the real party in interest, and holds it for collection merely.

Judgments are not a lien. Real estate and certain articles difficult of removal are attached by leaving a copy of the original writ in the clerk's office. Execution may issue from county court twenty-four hours after the rising of the court, and by a justice of the peace two hours after judgment is rendered. They are returnable in sixty days, and must be issued and placed in the hanas of the officer within thirty days after judgment, to hold personal property attached on *mesne* process, and within five months to hold real estate so attached. Real estate set off on execution (there is no power to sell real estate on execution) may be redeemed within six months, otherwise it passes to the creditor. Personal property taken on execution is sold to the highest bidder.

A justice of the peace has jurisdiction in all actions of a civil nature where the matter in demand does not exceed $200, except actions for slander, false imprisonment, and replevin for goods and chattels where the value thereof exceeds $20, and where the title to land is concerned. A justice also has jurisdiction in actions of trespass on the freehold where the sum demanded does not exced $20. The county courts have jurisdiction of cases appealed from the justices' courts, and of all actions where the justices have not jurisdiction. The municipal courts of Burlington, Rutland and St. Albans have concurrent jurisdiction with the county courts, to the extent of $500. Suit may be brought in the town where either party resides, and if neither party resides in the State, in any town in the State.

Process, returnable before supreme or county court, must be served at least twelve days before the session of court to which it is returnable.

Writs, returnable before a justice, must be served at least six days before, and not over sixty days from, the return day; if against a party in another county, twelve days must intervene between day of service and return day; and in any case, if the defendant is a corporation, thirty days must intervene.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds must be under seal (not a scrawl), signed in the presence of two subscribing witnesses, acknowledged before a proper officer, and recorded in the clerk's office of the town where the land lies. In this State, deeds may be acknowledged before a justice of the peace, a notary public, or a *master in chancery*. Acknowledgments out of this State, may be taken before a justice of the peace, notary public, commissioner from Vermont, or such officer as is authorized to take acknowledgment of deeds in that place.

[Form of Certificate of Acknowledgment.]

STATE OF , } ss.
COUNTY OF . }

At this day of , A. D. 187 , personally appeared (and his wife), the signer and sealer of the above-written instrument, and acknowledged the same to be his (or their) free act and deed.

Before me. (Signature and title.)

Married women cannot make contracts. They may in some instances change their separate property so that it may be reached in equity. Her real estate, and the rents and profits thereof, are exempt from attachment for the husband's debts; and also the husband's interest in the same during coverture, except for debts for necessaries for wife and family, or for labor or materials furnished upon such real estate. A married woman may dispose of her property by will. The widow is entitled to dower, during her natural life, of one-third of the real estate of which her husband died seized, during his natural life unless she shall be barred. Chattel mortgages do not protect the mortgagee against *bona fide* purchasers or attaching creditors if the property is allowed to remain in the possession of the mortgagor.

Wills must be in writing, and signed by the testator or by some other person in his presence and by his express direction, and attested and subscribed by three or more credible witnesses in the presence of the testator, and of each other.

SPECIAL LAWS OF VIRGINIA.

EXEMPTIONS FROM FORCED SALE.—*Homestead and Personal Property to the Value of* $2000. In case of a husband, parent, or other person who is a householder and head of a family, the law exempts from distress or levy divers enumerated articles of household and personal use, furniture, bedding, etc., ranging in value from fifty to five hundred dollars, according to the condition and size of the family.

Besides the foregoing, every householder or head of a family is entitled to a homestead exemption of two thousand dollars, to be set apart out of any property which he may select.

MECHANICS' LIEN.—All artisans, builders, mechanics, lumber dealers and others performing labor or furnishing materials for the construction, repair or improvement of any building or other property, are allowed a lien upon such property for the work done and materials furnished. It must be asserted by suit within six months from the time the lien is secured.

COLLECTION OF DEBTS.—Arrest, in civil actions, is permitted, when the plaintiff, by affidavit, shows to the court in which the suit is pending, or to any judge or justice of the peace, that he has cause of action or suit against the defendant, and that there is probable cause for believing that the defendant is about to quit the State, unless forthwith apprehended.

The defendant may be discharged from arrest by giving good bail, the condition of the bail bond being, in substance, that in case judgment is rendered for the plaintiff, the defendant will, if thereto required, within four months after the judgment, discover and surrender whatever estate he may then have, for the satisfaction thereof.

Writs of attachment may be issued: 1. Against the estate of a non-resident defendant. 2. Against the estate of any defendant who is removing or intends to remove the specific property sued for, "or his own estate or the proceeds of the sale of his property, or a material part of such estate or proceeds, out of the State, so that process of execution on a judgment," when obtained, will be unavailing. 3. Against the estate of a debtor, whether the claim be payable or not, when the debtor intends to remove or is removing, or has removed his effects out of the State so that there will probably not be therein sufficient effects of the debtor to satisfy the claim, should only the ordinary process of law be used to obtain such judgment. 4. Against the estate of a tenant liable for rent, who intends to remove or is removing, or has, within thirty days, removed his effects from the leased premises, so that there will not be left on such premises property liable to distress, sufficient to satisfy the rent to become payable—not exceeding one year's rent in all. 5. Against steamboats and other vessels, for materials, supplies, work, etc., furnished and done, and damages for certain torts and breaches of contract.

The foundation of the attachment in each case is the affidavit of the plaintiff or of his agent, setting forth not only the particular ground of the attachment, as above given, but also divers particulars as to the amount of the claim, whether due or not, etc. If the plaintiff desires that the property to be attached shall be taken into the possession of the officer, the plaintiff, or some one for him, must give bond, with good security, in a penalty equal to, at least, double the amount sued for, conditioned to pay all costs and damages occasioned by the suing out of the attachment. The sureties must either reside, or must have estate equal to the penalty of the bond, within the jurisdiction of the court. No bond is necessary, except in the case above specified. Every species of property, legal or equitable, is liable to seizure and sale, under attachment.

Assignments, for the benefit of creditors, with preferences, are allowed by the law of this State. Bonds and notes, not negotiable, are assignable, and the assignee may sue upon them in his own name. Open accounts may also be assigned; but suit must be brought upon them in the name of the original creditor.

Process of garnishment may issue, either on execution or attachment, so as to reach debts due to the defendant.

Every promissory note or check for money payable in this State, at a particular bank, or at a particular office thereof, for discount and deposit, or at the place of business of a savings institution or savings bank, or at the place of business of a licensed broker, and every inland bill of exchange payable in this State, is deemed negotiable, and may, upon being dishonored for non-acceptance or non-payment, be protested, and the protest be in such case evidence of dishonor, in like manner as in case of a foreign bill of exchange. The protest, both in the case of a foreign bill and in the other cases above mentioned, is made *prima facia* evidence of what is stated therein, or at the foot or on the back thereof, in relation to presentment, dishonor and notice thereof. Damages are recoverable on bills of exchange—three per cent. if the bill be payable out of Virginia and within the United States, and ten per cent. if payable without the United States.

The jurisdiction of justice courts extends to $50. Civil jurisdiction of the county courts is confined chiefly to matters of probate and guardianship; with perhaps a few unimportant exceptions they have no jurisdiction of suits for the collection of debts. Circuit and corporation courts have general jurisdiction in all civil actions. Process in these courts is commonly made returnable to rules —held on the first Monday in each month—and two rule days, at least, must intervene between service and trial.

Judgments are a lien on all the real estate of, or to, which the defendant is or shall be possessed or entitled at or after the date of the judgment, or the commencement of the term at which it is rendered. They create no lien on personal estate.

Executions may issue within a year, and a *scire facias* or action may be brought within ten years after the date of the judgment. Executions create a lien upon the personal property of the debtor from the date of the delivery of the writ to the officer, whether the property consists of chattels or of choses in action. As to the latter, however, the lien does not take effect against an assignee for valuable consideration without notice, nor against a person making payment to the judgment debtor without notice. Real estate cannot be sold or levied on under execution. An execution debtor may be required to discover, under oath, his whole estate, real and personal, and to convey and transfer, for the satisfaction of the execution, his personalty and any realty which he may have out of the State.

If execution be issued within the year, other executions may be issued, or a *scire facias* or action may be brought within ten years from the return day of an execution on which there is no return by an officer, or within twenty years from the return day of an execution on which there is such return.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds may be admitted to record as to any party thereto, when proved, as to such party, by two witnesses, or acknowledged by him, before the court of the county or corporation in which it is to be recorded, or before the clerk of such court, in his office. Also, upon a certificate of his acknowledgment within the United States, before a justice of the peace, a commissioner in chancery of a court of record, a notary public or any commissioner appointed by the Governor; or, upon the certificate of the clerk of any county or corporation court in this State, or of the clerk of any court out of this State and within the United States, that the deed was acknowledged by such person or proved as to him by two witnesses, before such clerk or before the court of which he is clerk, or upon certificate, under the official seal of any minister plenipotentiary, *charge d'affairs*, consul general, consul, vice-consul, or commercial agent, appointed by the Government of the United States to any foreign country, or of the proper officer of any court of such country, or of the mayor or other chief magistrate of any city, town or corporation therein, that the said writing was acknowledged by such person or proved as to him by two witnesses, before any person having such appointment, or before such court, mayor or chief magistrate.

[Form of Certificate of Acknowledgment in case of a party other than a Married Woman.]

STATE OF , } *ss.*
COUNTY (OR CORPORATION) OF . }

I, , a justice of the peace (or commissioner in chancery of the court, or notary public), for the county (or corporation) aforesaid, in the State (or territory, or district) of , do certify, that E. F. (or E. F. and G. H., etc.), whose name (or names) is (or are) signed to the writing above (or hereto annexed), bearing date on the day of , has (or have) acknowledged the same before me, in my county (or corporation) aforesaid.

Given under my hand, this day of , A. D. 187 .

(Signature and title.)

The acknowledgment of a married woman must be certified by two justices of the peace, or by some one of the other functionaries authorized to certify the acknowledgment of other persons.

The certificate must be to the effect following:

STATE OF , } *ss.*
COUNTY (OR CORPORATION) OF . }

I, , a commissioner appointed by the Governor of the State of Virginia for the said State (or territory, or district) of , or and , justices of the peace, or I, , a commissioner in chancery of court (or notary public) for the county (or corporarion) of , in the State (or territory, or district) of , do certify that E. F., the wife of G. H., whose names are signed to the writing above (or hereto annexed), bearing date on the day of , personally appeared before me (or us), in the county (or corporation) aforesaid (or, if it be a commissioner, in the State, territory or district aforesaid), and being examined by me (or us), privily and apart from her husband, and having the writing aforesaid fully explained to her, she, the said E. F., acknowledged the said writing to be her act, and declared that she had willingly executed the same and does not wish to retract it.

Given under my hand (or our hands) this day of , Anno Domini. (Signature.)

Married women can hold real or personal property to their separate use through a trustee. To bind the separate estate of a married woman by her contract, the intention so to bind it should be expressed on the face of the contract. The widow is entitled to one-third part of all the real estate owned by her husband during coverture, unless she has barred or relinquished the same.

Chattel mortgages are unknown in this State, though their equivalent is found in deeds of trust of personal property, by which personal property of any description may be conveyed for the benefit, and thus made available for the security of creditors. Such deeds are not effective, as to other creditors and subsequent purchasers for value without notice, except from the time of their admission to record in the proper clerk's office.

Wills should be in writing, and signed by the testator, or by some one in his presence and by his express direction, in such manner as to make it manifest that the name is intended as a signature, and, moreover, unless it be wholly written by the testator, the signature shall be made, or the will acknowledged by him in the presence of at least two competent witnesses, present at the same time, and such witnesses shall subscribe the will in the presence of the testator, but no form of attestation shall be necessary.

SPECIAL LAWS OF WASHINGTON TERRITORY.

Exemptions from Forced Sale.—*Home worth* $1000 *and Personal Property.* To each householder being the head of a family, a homestead worth $1000, while occupied by such family. All wearing apparel, private libraries, family pictures and keepsakes ; to each householder, 1 bed and bedding, and 1 additional bed and bedding for every two additional members of the family, and other household goods of the coin value of $1500 ; 2 cows and their calves, 5 swine, 2 hives of bees, 25 domestic fowls, and provisions and fuel for 6 months. To a farmer, 1 span of horses and harness, or 2 yoke of oxen, and 1 wagon, with farming utensils not exceeding $200 coin value. To attorneys and clergymen, their libraries valued at not to exceed $500, with office furniture and fuel. Small boats and fire-arms kept for use, not exceeding $50 in coin value ; parties engaged in lightering, 2 lighters and 1 small boat valued at $250 ; the team of a drayman.

SPECIAL LAWS OF WEST VIRGINIA.

Exemptions from Forced Sale.—*Home worth* $1000, *and Personal Property.* Homestead to the value of $1000, is exempt, where the property of that value is demised or granted by debtor, being a husband or parent, and resident in the State, as a homestead ; and where he, previously to contracting the debt or liability has placed a declaration of his intention to keep the property as a homestead on the land records of the county in which the real estate is situate. Personal property to the value of $300 is also exempted, provided debtor is a resident and a parent.

Mechanics' Lien.—A mechanic or workman, or any person who shall perform any labor upon or furnish material to erect, repair, alter or improve any building, has a lien on the same, which can be enforced by suit in chancery in six months ; *provided*, he filed his account under oath with the clerk of the county court in thirty days after the work was done or material furnished.

Collection of Debts.—The debtor may be arrested in an action pending against him, until he give security that he shall answer such interrogatories as shall be propounded to him, or filed within four months after judgment and perform the requirements of the judgment or decree. But before the order for arrest will be made, the plaintiff must make affidavit—1. That the claim is just and that the defendant is about to leave the State, to reside permanently in another State, without paying the debt for which the action was brought. 2. Or that he fraudulently contracted the debt for which the action was brought 3. Or that he fraudulently conceals his property or rights of action. 4. Or that he has removed or is about to remove his property beyond the State with intent to defraud his creditors. 5. Or that he has converted or is about to convert his property into money or securities, or that he has assigned or removed his property with like intent. And the plaintiff will also be required to give bond and good security, to indemnify the defendant in case the order of arrest was maliciously made.

Writ of attachment may issue upon the plaintiff giving bond, for the same causes that an order of arrest will be made, and the following additional causes: 1. That the defendant is a non-resident, or a foreign corporation. 2. Or that the defendant has left or is about to leave the State with intent to defraud his creditors. 3. Or that he conceals himself, so that a summons cannot be served.

Assignments, for the benefit of creditors, are not regulated by statute; the debtor can prefer one or more of his creditors, if the transaction be not tainted with fraud.

As to notes and bills, every note or check made payable at a particular bank of discount and deposit, or at any savings bank, and every inland bill of exchange, is negotiable, and may be protested, and the protest is evidence of the same facts as in case of foreign bills of exchange. Bills of exchange, drawn or negotiated in this State, duly protested, entitle the holder, in addition to the usual protest fees, to the following damages: Three per cent. if payable out of this State and within the United States, and ten per cent. if payable out of the United States. Paper payable on Sunday, Christmas day, 1st of January or 4th of July must be protested on the day previous and notice of dishonor given on the day following such holiday. Any paper not negotiable as above stated, is subject, in the hands of the holder, to all equities existing against the assignor; the equities, however, must have existed before the defendant had notice of the assignment of the papers.

The jurisdiction of justice courts extends in civil actions to $100, exclusive of interest. The circuit courts, is appellate from inferior courts, and has original and general jurisdiction of all matters at law where the amount exceeds $50. The supreme court of appeals has appellate jurisdiction from inferior courts where the amount exceeds $100.

Judgments are a lien on the real estate of the defendant from the first day of the term, if rendered in a court of record; but to make this lien available against a purchaser for value, and without actual notice, an abstract of the judgment must be filed in the recorder's office of the county where the land lies ninety days after the rendition of the judgment or before the deed to the real estate is delivered to the purchaser. Judgments of justice's courts also give a lien on real estate if an abstract of the same is recorded in the proper county.

Executions are a lien on personal property from the date the same is placed in the hands of the officer, and may be levied on any property of the defendant not exempt by law. Executions cannot be stayed, except when obtained before a justice, and only then for a limited time, not more than four months, upon defendant giving security. No redemption of property sold under execution.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds must be in writing and under seal; a scrawl will answer for a seal if deed be made by an individual, but not if by a corporation. They must be acknowledged before a recorder, prothonotary, clerk of any court, a justice of the peace, notary public, commissioner of deeds, or proved by two witnesses before the recorder of the court in the county where the same is to be recorded. If acknowledged out of the United States, before a minister plenipotentiary, *charge'd affaires*, consul-general, consul, vice-consul or commercial agent, or before the proper officer of any court, or before the mayor of any city or town, under the official seal of such officer. The wife must join with the husband in the deed to relinquish her dower.

The following is the prescribed form of certificate of acknowledgment:

STATE OF WEST VIRGINIA, } *ss.*
COUNTY OF WOOD. }

I, (giving the name and official character of the officer), do certify that A. B. and C. D., his wife, whose names are signed to the writing above, bearing date on the day of , A. D. 187 , have this day acknowledged the same before me: and C. D., the wife of the said A. B., personally appeared before me, in the county aforesaid, and being examined by me, privately and apart from her husband, and having the said writing fully explained to her, she, the said C. D., acknowledged the said writing to be her act, and declared that she had willingly executed the same and does not wish to retract it.

Given under my hand, this day of , A. D. 187 .

(Signature and title.)

A married woman has dower in all the real estate her husband is seized of during coverture, and she must join her husband in the execution of all deeds to the same. She may hold her separate property free from the control and debts of her husband, and may convey the same as if she were unmarried; *provided*, her husband joins in the deed with her. Her separate property is bound for her debts contracted before marriage, and her husband is not liable for such debts. She may deposit her separate funds in bank, and withdraw the same on her own check. Where the husband acquires any of the wife's separate property, by ante-nuptial contract or otherwise, he becomes liable for her debts contracted before marriage to the extent of the property so acquired by him, but no further.

Chattel mortgages are governed by the common law; and the mortgage will be void unless possession of the mortgage chattels is delivered to and continuously remains with the mortgagee.

Wills should be drawn and attested according to form No. 45, p. 815.

SPECIAL LAWS OF WISCONSIN.

EXEMPTIONS FROM FORCED SALE.—*Farm of Forty Acres, or House and Lot in Village or City, and Personal Property.* A homestead, consisting of land not exceeding 40 acres, used for farming purposes; or in lieu of the above, at the option of the debtor, a lot in any town or city not to exceed one-fourth of an acre. Family Bible, pictures, school books and private library; church pew; all wearing apparel; usual household furniture, not to exceed $200; gun or rifle, not to exceed $50 in value; 2 cows, 10 hogs, yoke of oxen and horse or mule; 10 sheep and wool therefrom, and necessary food for said animals and for the debtor's family for one year; wagon and other farming utensils not to exceed $50; also, all insurance money arising from the destruction of property exempt from execution; also, the earnings for the past sixty days of persons who have families to support.

The tools, implements, and stock in trade of a mechanic or miner, or other person, not exceeding $200 in value; library or implements of any professional man not exceeding $200 in value. All sewing machines kept for use; any swords, plate, books, or other article presented by Congress or the members thereof.

MECHANICS' LIEN.—All persons who perform labor upon or furnish materials for the building, improving or repairing of buildings, have a lien thereon for the same, which must be enforced by filing a petition for the lien in six months in the circuit court and an action to foreclose in one year.

COLLECTION OF DEBTS.—In civil actions a defendant is liable to arrest in the following cases: 1. In an action for the recovery of damages, on a cause of action not arising out of contract, where the defendant is not a resident of the State, or is about to remove therefrom, or where the action is for injury to person or character, or for injuring, or for wrongfully taking or converting property, and in actions to recover damages for the value of property obtained by the defendant under false pretences. 2. In an action for a fine or penalty, or for money or property embezzled or fraudulently misapplied by a public officer or an attorney, or by an agent of any corporation in the course of his employment as such, or by a factor or agent, or any other person in a fiduciary capacity, or for any misconduct in office or professional employment. 3. In an action to recover possession of personal property unjustly detained, where the property, or part thereof, has been concealed, so that it cannot be taken by the sheriff; but no female can be arrested, except for wilful injury to person, character or property. 4. When the defendant has been guilty of fraud in contracting the obligation for which the suit is brought.

Writ of attachment may issue on the plaintiff giving bond, and making affidavit that his debt is just, and that one or more of the following reasons for attachment exists: 1. That the defendant has absconded or is about to abscond from the State, or is concealed therein, to the injury of his creditors. 2. That he has assigned, disposed of, or concealed, or is about to assign, dispose of, or conceal his property, with intent to defraud his creditors. 3. That he has removed or is about to remove his property from the State with the same intent. 4. That he fraudulently contracted the debt upon which the action is brought. 5. That he is a non-resident. 6. That the defendant is a foreign corporation; or, 7. That he has fraudulently disposed of his property with intent to defraud his creditors. Attachment cannot issue unless debt exceeds $50.

All assignments for the benefit of creditors are void, as against creditors, unless the assignee is a resident of the State and gives bond, to the value of the property assigned, for the faithful performance of his trust.

All notes or certificates of deposit, payable to any person or his order, are negotiable. Bills of exchange, payable at sight, are entitled to grace; but when payable on demand they are not entitled to grace. Protested bills of exchange, drawn or negotiated in this State, entitle the holder to the following damages: If drawn on any person residing out of the United States, or in some one of the United States which adjoins this State, five per cent.; if drawn on a person in some one of the United States, but which is not adjoining this State, ten per cent. Legal holidays are January 1st, February 22d, July 4th and December 25th. Paper maturing those days, or on Sunday, must be protested the day previous. And when any of those days fall on Sunday, then the Monday following is a legal holiday, and paper maturing on that Monday must be protested the Saturday preceding.

Judgments are a lien on all real estate in the county where obtained, and in the county where a transcript is filed and docketed in the circuit court clerk's office, and the lien remains on such real estate for ten years.

A transcript from a judgment before a justice may be also docketed and filed in the circuit court clerk's office, and likewise becomes a lien, same as a circuit court judgment.

Execution may issue at any time within five years after rendition of judgment as of course, and where an execution was so issued within that period, then an alias may be issued at any time within twenty years from the date of the judgment; but when no original execution within the first five years, then an alias will only be granted on affidavit that the judgment is unsatisfied. Executions are of three kinds—against the property, against the person of the debtor, and for the delivery of personal or real property detained by the defendant. Execution gives a lien on personal property only from the time of actual levy. Real estate sold under execution can be redeemed by the debtor in two years from the date of sale, or by his creditors in two years and three months from that time.

DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds must be in writing, and it is only necessary that they be in the form of a quit claim, as no covenant is absolutely necessary or implied; not necessary to be under seal, a scrawl will answer, and must be executed in the presence of at least two witnesses, and must be acknowledged in the State before any judge or court commissioner, clerk of circuit or county court, justice of the peace or notary public. But if acknowledged out of the State, may be acknowledged before any person authorized to take the acknowledgment of deeds under the laws of the State where taken, or before a commissioner of deeds. But unless the acknowledgment is taken before a commissioner of deeds, or a notary public, there must be attached to the deed a certificate of the clerk of a court of record, under seal of his office, that the person who took the acknowledgment was at the date thereof such officer as he represents himself to be, that he believes the signature of such officer to be genuine, and the acknowledgment is according to the laws of the State where taken.

A married woman must join in the execution of a deed to her husband's property to bar her dower. She can do this by an attorney duly appointed.

The form of certificate of acknowledgment may be the one in use in the State where taken.

All the wife's separate real and personal property whether owned by her at the time of her marriage or acquired by her after in any way, remains the sole and separate estate of the wife, free from the control and debts of her husband. She can convey the same as if *sole*, and without the written consent of her husband. She is liable for all debts contracted by her before marriage, and after on account of her separate property, and can be sued for the same. She can sue without joining her husband, but if sued he must also be sued.

She has dower in all the real estate of her husband, owned by him during coverture, unless she relinquishes the same.

A chattel mortgage is not valid as to third parties, unless the property be delivered to the mortgagee and remain in his possession, or the mortgage be filed with the clerk of the town where the mortgagor resides, or where the property is situated, if the mortgagor is a non-resident.

No will made within this State, except such non-cupative wills as are mentioned in section number six, of chapter sixty-six of the Revised Statutes, shall be effectual to pass any estate, whether real or personal, nor to change or in any way affect the same, unless it be in writing, and signed by the testator, or by some person in his presence, and by his express direction, and attested and subscribed in the presence of the testator by two or more competent witnesses, and if the witnesses are competent at the time of attesting the execution of the will, their subsequent incompetency, from whatever cause it may arise, shall not prevent the probate and allowance of the will, if it be otherwise satisfactorily proved.

SPECIAL LAWS OF WYOMING.

EXEMPTIONS FROM FORCED SALE.—*Home worth* $1500, *and Personal Property.* A homestead consisting of a house and lot in a village or city, or land not exceeding 160 acres, the value not in either case exceeding $1500, is allowed to a householder occupying the same. Also the following property of a householder, being the head of a family, is exempt. Wearing apparel, family Bibles, pictures, school books, cemetery lots, bedding, furniture, provisions, and such other articles as the debtor may select, not exceeding in value $500. Tools, team, or stock in trade of a mechanic, miner, or other person, kept and used for the purpose of carrying on his business or trade, not exceeding $300, are exempt. Library, instruments, and implements of any professional man, worth not more than $300. The person claiming exemption must be a *bona fide* resident of the territory.

SPECIAL LAWS OF ONTARIO, CANADA.

EXEMPTIONS FROM FORCED SALE.—The bed, bedding and bedsteads in ordinary use by the debtor and his family. The necessary and ordinary wearing apparel. One stove and pipes, 1 crane and its appendages, 1 pair of andirons, 1 set of cooking utensils, 1 pair tongs, 1 shovel, 1 table, 6 chairs, 6 knives, 6 forks, 6 plates, 6 teacups, 6 saucers, 1 sugar basin, 1 milk jug, 1 tea pot, 6 spoons, 15 hives of bees, all spinning wheels and weaving looms in domestic use, 10 volumes of books, 1 saw, 1 gun, 6 traps, and such fishing nets and seines as are in common use. All necessary fuel, meat, fish, flour and vegetables actually provided for family use, not more than sufficient for the ordinary consumption of the debtor and his family for 30 days, and not exceeding in value the sum of $40. One cow, 4 sheep, 2 hogs and food thereof for 30 days. The tools and implements or chattels ordinarily used in the debtor's occupation to the value of $60.

EXEMPTIONS FROM FORCED SALES.—*On Free Grants and Homesteads in the Possession of Actual Settlers*, in the Algoma and Nippissing Districts, and certain lands between the River Ottawa and the Georgian Bay, are exempt from seizure, while in personal property, beds, bedsteads, bedding, and wearing apparel of the debtor and his family, household furniture, provisions, farm stock, tools, and implements to the value of $60, are exempt from seizure.

MECHANICS' LIEN.—Mechanics, laborers and material men have a lien on buildings and on the land on which said buildings are situate, for work or materials furnished for erecting or repairing same. Lien can be secured by filing a statement of the claim in the registrar's office within 30 days after the completion of the work. It will cease to hold good after the expiration of 90 days.

THE COLLECTION OF DEBTS.—Defendant is liable to arrest on affidavit by the plaintiff that he is a concealed debtor, or is about to abscond from the province with the design and intent to defraud him out of his just debt.

Writ of attachment may issue for any debt or damages arising upon any contract, express or implied, or upon any judgment where affidavit or affirmation is made before the judge of the county court, a justice of the peace, or the clerk of a division court, where the debtor absconds, or is about to abscond from the province, leaving property liable to seizure under execution for debt in any county of Ontario, or shall attempt to remove his, her, or their property, either out of the province, or from one county to another therein, or from Ontario to Quebec, or shall keep concealed in any county of Ontario to avoid service of process. Such judge, clerk or justice of the peace, shall, on such affidavit being made, forthwith issue a warrant under his hand and seal, directed to any constable of the county, or directed to the bailiff of a Division Court, within which the same was issued, empowering said constable or bailiff to attach, seize, take and safely keep all such effects and estate of said absconding or concealed debtor, wherever found within said county, and shall within twenty-four hours after said seizure, call to his aid two freeholders, who shall, after being sworn, value and appraise the said effects so seized, when the said bailiff or constable shall forthwith return said inventory with the property, to the clerk of the Division Court within which such warrant was issued. Proceedings may be conducted to judgment and execution in any case commenced by attachment. Defendants, against whose effects, &c., a warrant is issued, may tender a bond to their creditors, with sureties (in double the amount of the sum claimed) prior to judgment and obtain a release of the goods. No real estate is liable to seizure under Division Court writs of attachment.

The jurisdiction of Division Courts (of which it is provided that there shall at no time be less than three, nor more than twelve, in a county, each to be held once every two months, or oftener at the discretion of the judge) extends to claims of debt, account or breach of contract, or covenant, or money demand, whither payable in money or otherwise, where the amount or balance claimed, does not exceed $100, and in all torts to personal chattels, to and including the sum of $40. Summons to be served 10 days before sitting of court. Personal service of summons necessary where claim exceeds $8. No unsettled account to a greater amount than $200 shall be sued for in any Division Court, in which case judgment shall be in full discharge of all demands. No debt due for liquors, drunk in a tavern or ale-house, or any gambling debt, or any claim touching the title to real estate, or involving any right to custom or toll, or for seduction, or breach of promise of marriage, is suable in a Division Court. Trial by jury is accorded in cases of tort or trespass where claim exceeds $10, and in all other cases where amount exceeds $20. Debtor removing to another county may be served with summons from the Division Court where the debt was contracted, summons in this case to be mailed to the Clerk of the Division Court where the debtor may reside to be served by the bailiff of said Court, who will, through the Clerk of his Division, return the original of said summons duly endorsed with affidavit of service to the issuing clerk. Writ of execution may be issued and judgment debtor's goods be levied on by the same means. Executions are returnable within 30 days from date of issue, and affect personal property only; if returned *nulla bona*, a transcript of the judgment, if for $40 or upwards, from the clerk of the Division Court, attested by the seal of said court, may be filed in the office of the clerk of the County Court where such judgment was obtained, or in the county where the judgment debtor's lands may be situate, and when thus filed shall become a judgment of the said County Court and issue execution on said lands. Division Court judgments are made payable in ten, fifteen, or twenty days, more or less, at the discretion of the judge (but not for more than 50 days from the service of summons, unless plaintiff consents), but execution may issue forthwith on sufficient evidence, adduced by plaintiff, to satisfy the judge that the said plaintiff will be in danger of losing the amount of said judgment by delay till the day of payment before issuing execution.

On return of execution endorsed *nulla bona*, judgment summons may issue citing judgment debtor to appear in court for examination under oath by the judge touching his ways and means of payment, what disposition he may have made of his property, the circumstances under which he contracted the debt, &c., on which the judge may order defendant to pay a stated sum per month on said judgment until the same be paid, and in default of such payments, or if guilty of fraud in contracting the debt, may commit said defendant to the common jail of the county for a period not exceeding forty days. Such imprisonment shall not, in any case, operate as a satisfaction or extinguishment of the debt, but the party imprisoned may be released forthwith on payment of the debt and costs. The judge in his discretion may suspend any judgment, order, or execution given, on being satisfied that any defendant is unable, from sickness or other sufficient cause, to pay or discharge the debt and damages recovered against him, or any instalment thereof, until it shall appear by the like proof that such temporary disability has ceased.

Wherever any goods, chattels, deeds, bonds, pro. notes, books of account, valuable securities, or other personal property, shall be wrongfully taken or unlawfully detained, the owner, person, or corporation, who by law can now bring an action of trover or trespass for personal property, shall have and may bring an action of replevin for the recovery of said goods, with accrued damages for unlawful caption and detention. Judgment holds good for 10 years.

The jurisdiction of County Court extends, in cases of debt contract, to $200; where the amount is ascertained by the signature of the defendant, to $400; in all matters of tort relating to personal chattels, where the sum does not exceed $200. The Superior Law Courts have concurrent jurisdiction with the County Court. The above amounts may be sued for in the Superior Courts, but all concerned will only be liable to pay and receive County Court costs and fees. County Court writ of summons may be served on defendant in any county in the province, but suit must be brought in the county where the defendant, or one or more of them resides, or where the contract was made payable. The County Court jurisdiction also extends to the relief of persons entitled to an account of the dealings and transactions of a partnership (the joint stock or capital not having been over $800) dissolved or expired, seeking such account, or to a creditor upon the estate of any deceased person, such creditor seeking payment of his debt, not exceeding $200, out of the deceased's assets not exceeding $800; or to a legatee under the will of any deceased person, such legatee seeking payment or delivery of his legacy, not exceeding $200 in value, out of such deceased person's assets, not exceeding $800; or to a residuary legatee, or one of the residuary legatees of any deceased person seeking an account of the residue and payment, or appropriation of his share therein, the estate not exceeding $800; or to an executor or administrator of any such deceased person seeking to have the personal estate, not exceeding $800, of such deceased person administered under the direction of the Judge of the County Court for the County within which such executor or administrator resides; or to a legal or equitable mortgagee whose mortgage is created by some instrument in writing, or judgment creditor having only registered his judgment; or person entitled to a lien for security for a debt, seeking foreclosure or sale, or otherwise to enforce his security, when the sum claimed does not exceed $200; or to any person entitled to redeem any legal or equitable mortgage, or any charge or lien, seeking to redeem the same, where the sum actually remaining due does not exceed $200. Injunctions to restrain the committing of waste or trespass to property by unlawfully cutting, destroying, or removing trees or timber, may be granted by the Judge of any County Court, which injunction shall remain in force one month, unless sooner dissolved on an application to the Court of Chancery. Judgment in a County Court is not a lien on real estate owned by defendant.

Jurisdiction of Superior Court extends to claims of over $200 damages, and over $400 (secured claim) to any amount. Judgments in the County Court do not hold real or personal estate until the execution is in sheriff's hands.

The jurisdiction of a justice of the peace is limited to $40, in actions for wages between masters and servants. Garnishment may issue to recover money due debtor.

DEEDS, MORTGAGES, CHATTEL MORTGAGES, &c.—Conveyances of real estate must be in writing, sealed by the grantor, and subscribed by him or his attorney duly authorized, and attested by two witnesses. Deeds must be under seal, a scrawl will not answer. Deeds and mortgages of real estate are proved by affidavit of one of the witnesses to said deed or mortgage, said affidavit being engrossed on what is called a memorial, setting forth a digest of the principal details of the deed; this memorial shall be under the hand and seal of the grantee or the grantor, and is left for permanent record with the registrar of the county in which the property conveyed is situate. To illustrate: John Smith, and Mary his wife, convey property to Robert Bell; each will sign the deed in the order named, and John Gordon and Peter Ross will witness deed. In this case the affidavit on the memorial will read as follows:

County of York. } John Gordon, of Toronto, in the said county of York, gentle-
To wit: } man, in the within Memorial named, maketh oath and saith, that he was present and did see the Indenture to which the said Memorial relates, duly executed, signed, sealed and delivered, by the therein named John Smith and Mary his wife, and that he is a subscribing witness to the execution of the said Indenture, and that he, this deponent, also saw the said Memorial duly signed and sealed by the therein named Robert Bell, for registry thereof. Which said Memorial was attested by him this deponent, and another subscribing witness, and that both said instruments were executed at the city of Toronto, in the said county of York.

Sworn before me at Toronto, in the said County of York, this ninth day of November, A. D. 1878.

SAMUEL HILL,

A Commissioner for taking affidavits in the Queen's Bench, in and for the said County of York. } JOHN GORDON.

Within the province the affidavit to execution of deed may be taken on said memorial before the registrar of the county or his deputy, or before any judge of the Court of Queen's Bench of Ontario, or any judge of a county court, or any commissioner of the said Court of Queen's Bench, in Ontario. Out of the Province, proof of deeds, conveyances, or wills, may be made by affidavit (or declaration when said declaration is by law permissable) sworn before the mayor or chief magistrate of any city, borough, or town corporate in Great Britain or Ireland, under the common seal of such city, borough or town corporate, or before the chief justice or judge of any court of Queen's Bench in Quebec, or of the supreme court of any British colony, or before the mayor of any city, borough, or town corporate in any foreign country, or any consul or vice-consul of Her Majesty resident therein. Deeds, conveyances, judgments, &c., must be recorded in the county where property is situate, and bind lands according to priority of registration. A wife must join in a deed with the husband, in selling his real estate, to relinquish dower, and he must join with her in selling her separate real estate, acquired previous to, or subsequent to marriage.

No chattel mortgage is valid as against the rights of third parties (if the goods remain with the grantor) unless said instrument is duly filed in the office of the clerk of the county, in which the property so mortgaged is situate, and it shall cease to be valid as against creditors, if not refiled before the expiration of the first year, together with a statement exhibiting the interest of the mortgagee in the property thereby claimed. Every chattel mortgage is void as against creditors, unless accompanied with an affidavit of the mortgagee, sworn before a commissioner of the court of Queen's Bench or common pleas, that the mortgagor is justly and truly indebted to the mortgagee in the sum mentioned in said mortgage, and that it was executed in good faith and for the express purpose of securing the payment of the money so justly due, and not for the purpose of protecting the goods and chattels mentioned therein against the creditors of the mortgagor—and in case of an absolute sale, that the sale is *bona fide* and for good consideration (naming the sum) and not for the purpose of holding the goods against the creditors of the bargainor.

The husband's property is not liable for debts contracted by his wife previous to her marriage, free from all liability for her husband's debts.

For form of wills and mode of attestation, see Form No. 45, p. 815.

RULES FOR COMPUTING PERCENTAGES, PROFITS, &c.

RATE PER CENT.—*To find the Gain or Loss when the Cost and Rate per Cent. is given.*—*Rule.* Multiply the cost by the rate per cent. and point off two places to the right as cents. *Example.*—Bought flour for $500.00, and sold it at an advance of 12 per cent. How much did I gain? 500 multiplied by 12 per cent. equals $60.

TO FIND THE RATE PER CENT. WHEN THE COST AND SELLING PRICE ARE KNOWN—*Rule.* Find the difference between the cost and selling price, the difference will be the gain or loss; then annex two ciphers to the gain or loss so found and divide by the cost, the result will be the rate per cent. *Example.*—Sold a drove of cattle for $10.000, which cost me $8,500. What per cent. did I gain? *Ans.*—$10,000—8,500 equals $1,500; 150,000 divided by 8,500 equals 17 11-17 per cent.

TO DETERMINE THE COST WHEN THE SELLING PRICE AND THE RATE PER CENT. OF THE GAIN OR LOSS ARE GIVEN.—*Rule.* Annex two ciphers to the selling price and divide by $1.00 increased by the rate per cent. of gain or loss. *Example.*—A cargo of coffee was sold for $25,000, realizing a gain of 25 per cent. What was the cost? *Ans.*—1 plus 25 equals 1.25. 2500.00 divided by $1.25 equals 20,000.

TO FIND THE COST WHEN THE LOSS OR GAIN AND THE RATE PER CENT. ARE GIVEN.—*Rule.* Annex two ciphers to the gain or loss and divide by the rate per cent. *Example.*—A lot of ice was sold at a profit of $3,000, the percentage of the profit being 15. What was the cost? *Ans.*—3000 divided by 15, equals $2,000.

TO FIND THE RATE WHEN THE COST AND GAIN OR LOSS ARE GIVEN.—*Rule.* Annex two ciphers to the gain or loss and divide by the cost. *Example.*—A wine merchant sold a lot of wine which cost him $650, and gained $130. What was the gain per cent.? *Ans.*—13000.00 divided by 650 equals 20 per cent.

SPECIAL LAWS OF NEW BRUNSWICK.

EXEMPTIONS FROM FORCED SALE.—There is no homestead law in this province. The wearing apparel, bedding, kitchen utensils, and tools of his trade or calling, to the value of $100, of any debtor, are exempt from levy or sale under execution.

MECHANICS' LIEN.—No house or other property in the province can be held liable for debts due parties for furnishing materials for constructing or repairing same.

COLLECTION OF DEBTS.—A person not having privilege may be arrested and held to bail or committed to prison on mesne process, in any cause of action within the jurisdiction of the Supreme or any County Court, if an affidavit be first made by the plaintiff or his agent of the plaintiff's cause of action, and that the amount thereof not being less than $20 is justly due to the plaintiff, and that such arrest is not made for the purpose of vexing or harassing the debtor. When the cause of action is not a debt certain a judge's order must be obtained.

In actions in justices' Civil Courts and Parish Courts, a person may be arrested on the plaintiff's making an affidavit of his cause of action, and that after giving full credit for all payments and offsets the defendant is indebted to him in a sum not exceeding $20 nor less than $2, as the case may be, and that he is afraid of losing his debt, and that he, the defendant, is of the age of twenty-one years.

Members of the legislature, judges, and witnesses attending trial, are exempt from arrest, and in actions brought in justices' Civil Courts. Females also are exempt from arrest. No person can be arrested under an execution issued on a judgment in the Supreme or County Courts, *but* arrest may be made on a judgment obtained in justices' Civil Courts, the City Court of St. John, the town of Portland Civil Court, the city of Fredericton Civil Court, and in Civil Courts held by Police or Stipendiary Magistrates, and in Parish Courts, to the amounts for which such courts respectively have jurisdiction.

Arrest and imprisonment may be had and allowed for: 1. Default in the payment of a penalty or sum in the nature of a penalty other than a penalty in the nature of a contract. 2. Default in payment of any sum recoverable on summary conviction. 3. Default in payment of County, City, Town, Parish or District rates. 4. Default by an attorney or solicitor in payment of a sum of money, when ordered to pay the same in his character of an officer of the Court making the order. 5. Default by a trustee or person acting in the fiduciary character, and ordered to pay by the Court of Equity any sum in his possession or under his control.

Decrees of the Court of Equity may be enforced by execution either against the goods or body. A debtor in custody may on notice apply, and on making requisite disclosure be discharged, but if any property appears on disclosure it may be attached.

The real or personal property within the province of any defendant, which by law is liable to be taken in execution, may in respect of any cause of action upon a contract be attached and held as security to satisfy the judgment to the amount of the attachment. A person at the time of entering into a contract, may (except in the case of a negotiable instrument) agree and stipulate as part of such contract, that in respect thereof the property of the contracting party shall not be subject to attachment. Before any writ of attachment can issue the plaintiff or some one on his behalf must make affidavit of his cause of action, and of the amount due, and (except in case of negotiable instrument, or when the cause of action arose prior to April 8th, 1874) that no agreement was made that an attachment should not issue, and also that the demand is not secured by mortgage or otherwise, and that the attachment is not sued out to vex, or to harass, or to hinder, delay, or defraud any creditor, and either: 1. That the defendant is a non-resident of the province, and the contract was made or is payable in the province, or that the plaintiff is a resident of the province, or, 2. That the defendant is a resident of the province, and that plaintiff is apprehensive that unless attachment is issued that he may lose his demand. In cases of a contract other than a contract for the payment of money, no attachment shall issue unless upon an order of the Court or a judge thereof.

Garnishment may issue to arrest money due the debtor from third parties. The sheriff having an execution may seize and take any money, or bank or Dominion notes, bonds, specialties or other securities for money belonging to the person against whom the execution is issued.

A justice of the peace has jurisdiction in actions of debt when the sum demanded does not exceed the sum of $20, and in actions of tort to real or personal property where damages claimed do not exceed $8, but they have not jurisdiction over civil actions where the Queen is a party, or where the title to land comes in question.

There is a Court in each parish (except when there is a resident Police or Stipendiary Magistrate) called "The parish of (*name of parish*) Civil Court," where the jurisdiction goes as high as $40 in actions of debt, and $16 in actions of tort, but has no jurisdiction over civil actions when the Queen is a party, or where the title to land comes in question.

There is also "The City Court of St. John," and "The Town of Portland Civil Court," having jurisdiction in actions of debt to the amount of $80, and $20 in actions of tort. There is also the City of Fredericton Civil Court, having jurisdiction in actions of debt to the amount of $80, and in actions of tort to the amount of $32, but no jurisdiction over civil actions where the Queen is a party, or the title to land comes in question.

The names of the several Courts are: Supreme Court, Circuit Court, Equity Court, Divorce and Matrimonial Court, County Courts, Probate Courts, St. John City Court, City of Fredericton Civil Court, Small Debt Court of Fredericton, Town of Portland Civil Courts, Parish Courts, Justices' Civil Courts.

Judgments obtained in the Supreme and County Courts bind the lands of the debtor, on the party obtaining it filing a memorial of the judgment in the office of the Registrar of Deeds for the County in which the lands lie. Memorial must be renewed every five years. Execution placed in the sheriff's hands for the purpose of being executed will also bind the lands.

A debtor may obtain a full discharge from his debts by making an assignment of his property and complying with the other stipulations required by the Dominion Insolvent Act which is in force in this Province.

ON DEEDS, RIGHTS OF MARRIED WOMEN, WILLS, &c.—Deeds must be under seal; a scrawl is not sufficient, and one witness only is required by law. Before the registry of any conveyance the execution of the same shall either be acknowledged by the person executing the same, or be proved by the oath of a subscribing witness in the manner following, that is to say:—If the execution of such conveyance be acknowledged in the province, then such acknowledgment may be taken before a judge of the Supreme or any County Court, or a member of the Executive or Legislative Council, or before any Registrar or Deputy Registrar of Deeds, or any Notary Public appointed, and resident in the province, and certified under his hand and official seal, or before any justice of the peace of the County in which the conveyance is to be registered. If the execution of such conveyance be proved in the province, such proof may be taken by and before any of the officials hereinbefore in this section mentioned, except a justice of the peace: provided always, that in cases where the subscribing witness or witnesses to any such conveyance is dead or without the province, then the execution thereof may be proved before the Supreme Court, or some Circuit or County Court, by the ordinary legal proof. If such acknowledgment or proof be taken out of the province, the same shall be taken by or before some one of the officials following, that is to say:—Any commissioner for taking affidavits and administering oaths under Chapter 36; or before any commissioner authorized by the Lord Chancellor to administer oaths in Chancery in England; or before any Notary Public certified under his hand and official seal; or before the Mayor or Chief Magistrate of any city, borough, or municipality or town corporate, or the seal of such Mayor or Chief Magistrate, or before any Judge of the Court of Queen's Bench, or Common Pleas, or Baron of the Exchequer in Great Britain or Ireland, or Master in Chancery in England or Ireland, or any judge or Lord of Session in Scotland, the handwriting of any such judge, baron, or Lord of Session being authenticated under the seal of a Notary Public, or before a judge of any Court of Supreme jurisdiction in any colony belonging to the Crown of Great Britain and Ireland, or any Dependancy thereof; or before any British Minister, Ambassador, Consul, Vice-Consul, Acting Consul, pro-Consul, or Consular Agent of Her Majesty, exercising his functions in any foreign place; or before the Governor of a State, and certified under the hand and Seal of office of such Minister, Ambassador, Consul, Vice-Consul, Acting Consul, pro-Consul, Consular Agent or Governor. If the conveyance be by a corporation, proof of the Corporate Seal shall in all cases be sufficient.

A conveyance, or power of attorney for the same, by a married woman, of all her right and interest in land jointly with her husband, shall be valid if executed without compulsion from him, and the person authorized by law to take acknowledgments of conveyances in other cases certifying thereon that he has examined her apart from her husband, and that she acknowledged that she executed the conveyance freely.

A wife's property acquired before marriage is in no case liable for her husband's debts. The husband's property is liable for the wife's ante-nuptial debts on judgment being obtained against him.

Mortgages on chattel property are valid, and require to be registered, but not every year. Bills of sale require to be registered in the Record Office. For Wills, consult Form No. 45, page 815.

SPECIAL LAWS OF QUEBEC.

EXEMPTIONS FROM FORCED SALE.—Personal property exempt from forced sale being used and owned by the debtor: Bed, bedding and bedstead; necessary apparel for himself and family; set of table and stove furniture; all spinning wheels and weaver's looms in use in the family; 1 axe, 1 gun, 1 saw, 6 traps, fish-nets in common use, and 10 volumes of books; fuel and food for 30 days, worth \$20; 1 cow, 4 sheep, 2 hogs, with necessary food for 30 days; tools and instruments used in his trade to the value of \$20; 15 hives of bees, and wages and salaries not yet due; besides certain other properties granted by the courts.

SPECIAL LAWS OF NOVA SCOTIA.

EXEMPTIONS FROM FORCED SALE.—There is no homestead exemption law in this Province. Nothing is exempt from forced sale except personal property to the amount of \$40.

MECHANICS' LIEN.—No law exists to enforce a mechanics' lien in the Province. Creditor to secure himself on property must get a bill of sale on chattels, &c., and have it recorded in County Registrar's office.

THE COLLECTION OF DEBTS.—Defendant is liable to arrest under execution if the amount is \$1 or upwards; and on affidavit by plaintiff that defendant is a concealed debtor, or is about to abscond from the Province with the intent and design to defraud him out of his just debt, capias may issue and arrest ensue for sums of \$4 and upward.

Writ and attachment may issue under the Absconding Debtor's Act against defendant's property for sums of \$20 and upwards. A book account is outlawed in 6 years; a bond in 6 years; a note in 6 years, and a judgment in 4 years. Jurisdiction of a justice of the peace is limited to \$20; two justices may render judgment for \$80. The largest judgment obtainable in the County Court is \$500; the amount of judgment obtainable in the Superior Court is unlimited. Money cannot be seized under execution. Judgments bind defendant's real and personal estate as soon as obtained.

The husband's property is liable for debts contracted by his wife previous to marriage, and as to his wife's estate acquired previous to marriage, the husband has full control except over entailed property.

Miscellaneous Facts and Processes relating to Metallurgy, Gold and Silver Mining, Treatment of Ores, &c.

In mining operations a knowledge of the following facts, calculations, &c., is of great utility.

In Measures of Earth, Rock, &c.

25 cub. ft. of sand = 1 ton. 13 cub. ft. of quartz, unbroken in lode = 1 ton.
17 cub. ft. of clay = 1 ton. 20 cub. ft., broken from lode = 1 ton cont. meas.
18 cubic ft. solid earth = 1 ton. 27 cubic ft. of loose earth = 1 ton.

Table for the Conversion of English and Metric Units.

1 Meter = 3·2807 feet.
1 Foot = 0·3048 m.
1 Liter (vol. of 1 kilog. water) = 0·2202 gal.
1 Gallon (vol. of 10 lbs. water) = 4·541 liters.
1 Kilog. per sq. meter = 0·2048 lbs. per sq. ft.
1 Kilog. per sq. mm. = 1422·28 lbs. per sq. in.
1 Lb. per sq. in. = 703·0958 kilogs. per sq. m.
1 Gram = 15·4323 grs.
1 Grain = 0·0648 gram.
1 Kilogrameter = 7·2331 ft.-lbs.
1 Foot-pound = 0·1383 kgm.
1 Atmosphere = 14·7 lbs. per sq. in. = 10·333 kilogs. per sq. meter = 29·922 in. or 760 mm. of mercury = 33·9 ft. or $10\frac{1}{3}$ meters water.
1 Kilogram = 2·2046 lbs. av.
1 Pound av. = 0·4536 kilog.
1 Deg. Centigrade = 5-9 deg. F.—32°
1 Deg. Fahrenheit = 9-5 deg. C. + 32°
1 Calorie (kilog. water raised 1° C.) = 424 kilogrameters = 3·9683 heat-units.
1 Heat-unit (lb. water raised 1° F.) = 772 ft.-lbs = 0·252 cal.

For additional items consult pp. 126 and 576.

Chapman's Tests for the Hardness of Gold or Silver Ores.

Hardness = 1.5 yields with difficulty to the nail.
Hardness = 2.5 does not yield to the nail, does not scratch a coin, but is easily scratched by it.
Hardness = 3.5 scratches a copper coin easily, but is scratched by it with difficulty.
For Table showing quantity of Gold to the ton of Ore, &c., see page 667.
There are in minerals *eight* shades of white, *nine* of grey, *six* of black, *five* of blue, *twelve* of green and yellow, *fifteen* of red, and *eight* of brown, besides clear, dark, light, or pale in these shades.
Metals have five degrees of lustre, splendent, shining, glistening, glimmering, dull.

Hardness of Minerals, beginning with the softest.

1. Talc ; common laminated, light green variety.
2. Gypsum, a crystallized variety.
3. Calcareous spar ; a transparent variety.
4. Fluor-Spar ; crystalline variety.
5. Apatite ; transparent variety.
5, 5. Scapolite : crystalline variety.
6. Feldspar ; white cleaveable variety.
7. Quartz ; transparent.
8. Topaz ; transparent.
9. Sapphire ; cleaveable varieties.
10. Corundum.
11. Diamond.

THE HARDNESS OF PRECIOUS STONES IS IN THE FOLLOWING ORDER, BEGINNING WITH THE HARDEST.

1. Diamond.
2. Ruby.
3. Sapphire.
4. Topaz.
5. Hyacinth.
6. Emerald.
7. Garnet.
8. Amethyst.
9. Agate.
10. Torquoise.
11. Opal.

IN THE SCOUR OF WATER-COURSE BEDS.

¼ ft. per second will scour fine clay.
½ " " " " sand.
¾ " " " coarse sand.
1 " " " fine gravel.
2 ft. per second will scour round shingle 1 in. diam.
3 ft. " " angular stone, size of an egg.
3 ft. " " conglomerate.

VALUE OF GOLD ACCORDING TO FINENESS.—Pure gold, 1000 fine, is worth $20.67 per oz.; gold 500 fine, is worth $10.33; 600 fine, $12.40; 700 fine, $14.49; 800 fine, $16.53; 900 fine, $18.60. At the mint in San Francisco, the charge for melting, assaying and refining is 14 cents per oz. The charge for coining is ½ per cent. No deposits are received at the mint in less sums than $100.

The value of a ton of pure gold is $602,799.21. The value of a ton of silver is $37,704.84. The weight of $1,000,000 in gold coin is 3,685.8 lbs. avoirdupois. The weight of $1,000,000 in silver coin is 58,929.9 lbs. avoirdupois. For other facts relating to the weight of the precious metals consult pp. 127-331.

AMOUNT OF METALLIC SILVER OBTAINABLE FROM THE FOLLOWING SIMPLE SUBSTANCES:

Chloride of silver, three-quarters, or nearly seventy-five per cent. Sulphide of silver, three-quarters, or seventy-five per cent. Bromide of silver, one-half, or fifty per cent., generally a little more. Iodide of silver, three-sevenths, or forty-three per cent. Oxide of silver, nine-tenths, or ninety per cent., generally more. Carbonate of silver, three-fourths or seventy-five per cent. generally more. Nitrate of silver, two-thirds, or nearly sixty per cent.

TABLE OF SOME OF THE PROPERTIES OF VARIOUS METALS.

Names arranged in the order of their

Ductility.	Mallebility.	Power of Conducting Heat.	Power of Conducting Electricity.
Gold.	Gold.	Silver.	Silver.
Silver.	Silver.	Copper.	Copper.
Platinum.	Copper.	Gold.	Gold.
Iron.	Tin.	Tin.	Zinc.
Nickel.	Platinum	Iron.	Iron.
Copper.	Lead.	Lead.	Tin.
Zinc.	Zinc.	Bismuth.	Lead.
Tin.	Iron.		Antimony.
Lead.	Nickel.		Bismuth.

TO DETERMINE THE PROPORTION OF GOLD IN A MIXTURE OF GOLD AND QUARTZ.—To find the specific gravity of a lump of gold, quartz or auriferous quartz, divide the weight of the lump in air by the weight of an equal amount of water. To find the weight of an equal amount of water, deduct the weight of the lump in water from the weight of the lump in air. When the lump is to be weighed in water, it should be suspended by a horse-hair so as to hang into the water; keeping, of course, all other parts of the scales clear of the water.

Phillips gives the following rule for ascertaining the amount of gold in a lump of auriferous quartz:

"The specific gravity of the gold—19,000.

"The specific gravity of the quartz—2,600.

"These numbers are given here merely for convenience in explaining the rule; they do not accurately represent the specific gravities of all quartz and quartz gold. (The quartz gold of California has not, on an average, a specific gravity of more than 18,600.)

"1. Ascertain the specific gravity of the lump. Suppose it to be 8,067.

"2. Deduct the specific gravity of the lump from the specific gravity of the gold; the difference is the ratio of the quartz by volume: 19,000—8,067 = 10,933.

"3. Deduct the specific gravity of the quartz from the specific gravity of the lump; the difference is the ratio of the gold by volume: 8,067—2,600 = 5,467.

"4. Add these ratios together, and proceed by the rule of proportion. The product is the percentage of gold by bulk: 10,933+5,467=16,400. Then as 16,400 is to 5,467, so is 100 to 33,35.

"5. Multiply the percentage of gold by bulk by its specific gravity. The product is the ratio of the gold in the lump by weight: 33,35×19,00= 643,65.

"6. Multiply the percentage of quartz by bulk (which must be 66.65 since that of the gold is 33,35) by its specific gravity. The product is the ratio of the quartz in the lump by weight: 66,65×2,60=173,29.

"7. To find the percentage, add these two ratios together, and proceed by the rule of proportion: 633,65+173,29=806,94 Then, as 806,94 is to 633,65, so is 100 to 78,53. Hence, a lump of auriferous quartz, having a specific gravity of 8,067, contains 78,73 per cent. of gold, by weight.

Gold-bearing quartz is always found near granite and slate, so that it is labor lost to search for gold where the primary granite is covered, thousands of feet deep, with stratified rocks, as in the coal beds of Pennsylvania, or the blue limestone of south-western Ohio. The probabilities are that gold will be found where granite, slate, and quartz are found together. It is well established that all native gold either is or was at one time embedded in quartz, hence the common saying, "quartz is the mother of gold." Placer gold appears to have been liberated by the crumbling of quartz; and wherever gold is found in granite, or other rocks, the theory is that it has been communicated from neighboring quartz while all were in a condition of fusion.

The poorest quartz that is worked yields $10 per ton, some yields $4000 per ton, but the richest vein, on an average, will possibly not be over $100.

Gold is usually found in metallic condition, but never free from silver. The proportion of silver in the gold of the Comstock lode is from 30 to 45 per cent., in that of the Gold Hill lode, N. T., 47 to 50 per cent. Gila River and Australian gold contains from 3 to 5 per cent. Up to July 2, 1878, the entire product of the two mines known as the California and Consolidated Virginia may be divided as $45,000,000 gold, and $55,000,000 silver. The color of gold varies according to the proportion of silver it contains, 60 per cent. of silver imparts a white color to the alloy.

In gold mining, the precious metal not being found in ore, is eliminated from the containing quartz or alluvium by very simple mechanical or chemical processes; in silver mining, the metal is found in many varieties of ore, each of which must be reduced by intricate chemical processes varied by the character of the mineral under treatment.

The business of mining resembles a lottery; in Mexico, the Count Regla obtained for many years $5,000,000 per annum from them; Count Valenciana $1,250,000, and the Marquis del Apardado got $4,000,000 in six months from a mine. In the United States, among those who have been lifted into notable prominence by successful mining operations may be mentioned John

Mackey, chief owner of the Consolidated Virginia mine, whose wealth is estimated at about $80,000,000 ; Hon. William Sharon, of Nevada, supposed to be worth about $90,000,000 ; James G. Fair, supt. of the Consolidated Virginia and California mines, estimated wealth about $50,000,000 ; Hon. J. P. Jones of Nevada, worth about $70,000,000, and many others. All are highly gifted with practical sagacity in mining matters, and as a general rule worked their way upwards through many reverses. The miner who would attain success must qualify himself by toiling to obtain the knowledge necessary for his guidance in emergencies. Let him not dispense with it after the fashion of the miner who once brought a specimen of a supposed very rich gold ore to a San Francisco assayer for examination. On being informed that it was nothing but iron pyrites, and not worth a cent a ton, the astounded miner exclaimed in the direst dismay : "Great Creation ! there is an old woman up our way who owns a hill of it, and I married her !"

The silver mines of Potosi are so notably rich that $47,000,000 have been coined there since 1845. On the opposite side of the chain are the celebrated silver mines of Guantajaya, once famous for the large lumps of silver formerly found there, one of which weighed 800 lbs.

A Peruvian legend of questionable veracity narrates the finding of a large lump or nugget of native gold weighing 400 lbs. at the mine of San Juan de Oro, on the headwaters of the Amazon river, during the reign of Charles the Fifth.

From time immemorial the mines of Peru have been fabulously rich in silver products. This was the inciting cause of the barbarous enormities and rapacity of the Spaniards at the time of their conquest of the country, in murdering the inhabitants and plundering the tombs of the Inca kings, the royal repositories, and ancient temples. From one temple, that of Cusco, the robbers obtained $11,000,000.

By a parity of what we must regard as retributive justice, much of the vast wealth obtained by these enormities from the helpless natives in Spanish South America and the West Indies, was in turn pillaged from the freebooters by armed vessels under the English flag. These mutual plunderings extended over a long succession of years, and during the reign of various monarchs.

In Peru, the immense silver-bearing deposits of the Cerro de Pasco mines have been worked since 1630. They are situated on the eastern side of the western Cordillera of the Andes, at an elevation of 14,000 ft. above tide level, and in consequence have hitherto been difficult of access, but under the new conditions created by the construction of the Trans-Andean railway (one of the wonders of South America), an output of 20,000 tons of ore per day is spoken of as a possible amount. At present there are 80 stamps at work, each with an estimated capacity of crushing 5 tons of ore per day, but 200 or 300 head are looked forward to as a small number at an early day. The ore will average about $30 per ton, and the anticipated annual production of the mines is $100,000,000. From $250,000,000 to $500,000,000 of free milling ores will be left above drainage level by the new tunnel lately constructed ; these ores it is proposed to excavate by means of steam shovels, and load directly into railway trucks, which deliver them at the top of the mill. The water power is supplied from a stream issuing from a lake near the mines, and is utilized by six double turbine water wheels, manufactured by James Leffel & Co., Springfield, Ohio. Four of these turbines are of 30 ins. diam., each developing 200 horse-power, and two of 23 ins. diam., developing 100 horse-power each. The mineral railway, undoubtedly the highest in the world, is 7 miles long, and cost $1,200,000, the object of the road being to transport ores from the mines to water-power for milling purposes. The rolling stock, bridges, rails, &c., of the road, were transported from the coast, nearly 200 miles distant, on the backs of mules, over almost impassible roads. Nothing weighing over 300 lbs. could be carried ; even the cylinders of the locomotives were brought in sections.

The silver mine of Potosi is sugar-loaf in form, 9 miles round, 16,000 ft. above the level of the sea, and 2700 above the plain. The upper part has 5000 adits for mines. South America, per Humboldt, yields per annum $43,500,000 worth of silver; at the present time the yield is much greater. One mine is a third of a mile deep, and 8 miles in length, employing 3000 miserables. In Peru over 40 districts are famous for their vast mineral wealth in gold and silver.

In Russia, the immense mines of Siberia are government property, and are worked by miserable unfortunates who have been banished by a cruel despotism for crimes which are in many cases merely imaginary; the wretched exiles, when once consigned to their gloomy depths, are never permitted to emerge into the light of day, but death, more merciful than the tyrant, soon ends the strife, for few survive the ordeal more than 9 years.

The "wealth of the Indies" is no poet's dream; there the mines are indigenous, and the accumulation of the precious metals has been such that it is usually estimated that Nadir Shah, in 1740, carried away not less than 1600 or $2,000,000,000. In Jahomqueir's auto-biography, he relates that a golden platform around his throne weighed 40 tons. His throne and crown were worth $20,000,000. On his marriage he presented his queen with as many lacs of rupees as amounted to $49,000,000, and with a necklace of 40 beads which cost him $10,000 per bead. He spent besides $10,000,000 on the tomb of his father Akbar, one of the wonders of India. The province of Berar, on one occasion, furnished above $20,000,000 in gold.

The ceiling of the pavilion of the Peacock Hall in Delhi was orginally covered with silver filigree work, but in 1799 the Mahrattas, after the capture of the city, took the silver down and melted it, the value of the same being estimated at $1,000,000. Here was the famous peacock throne, so called from its having the figures of two peacocks standing behind it, their tails being expanded, and the whole so inlaid with sapphires, rubies, emeralds, and other precious stones of appropriate colors, as to represent life. The throne itself is 6 ft. long by 4 ft. broad; it stood on six massive feet, which, with the body, were of solid gold, inlaid with rubies, emeralds and diamonds. It was surrounded with a canopy of gold supported by 12 pillars, emblazoned with costly gems, and a fringe of pearls around the borders of the canopy. Between the peacocks stood the figure of a parrot, life size, carved from a single emerald. On either side of the throne stood a chatta, or umbrella (one of the Oriental emblems of royalty) made of crimson velvet, embroidered and fringed with pearls. The handles were 8 ft. long, of solid gold, and studded with diamonds. The cost of this superb work of art was estimated at $25,000,000.

The Melbourne *Herald* thus describes the "Welcome nugget," weighing 184 lbs. Troy, and worth $42,000, found at Ballarat, Australia, on the 9th June, 1858, at a depth of 190 ft. below the surface of the earth: "A large, misshapen, irregular lump of gold, water-worn and rounded upon each of the numerous edges presented by a surface completely and more or less honeycombed. Its total length is about 20 inches, its greatest breadth about 12 inches, and its greatest depth about 8 inches." Other nuggets varying in weight from 10 to 45 ozs. had previously been taken from the same claim.

Another nugget weighing 145 lbs. was found at Korong, Australia, during the summer of 1857, in the form of a solid mass of virgin gold, 2 ft. 4 ins. long., 10 ins broad, and from 1 to 2 ins. thick, estimated value $35,000.

Victoria, in Australia, is world renowned from the discovery of its immense gold fields in 1851, which in 1852 produced the enormous amount of $70,000,000.

A nugget weighing 161 lbs. avoirdupois (including about 20 lbs. of quartz), of an estimated value of $29,000, was found in Calaveras Co., California, in November, 1854.

Perhaps not less than from 1800 to 2000 nuggets, weighing 1 lb. or more each, have been found from time to time in California. Of these probably less than 140 weigh over 20 lbs. each. Nuggets weighing from 1 to 7 ozs. have been found in immense numbers.

Colorado presents a confluence of wonders in the form of mineral deposits, which it would require a volume to describe.

In the Silver Cliffs, near Rosita, in what is known as the Hardscrabble district, the newly discovered mine, worked by Powell, Edwards and Hafford (named the "Racine Boy"), yields a return of 875 ozs. of silver to the ton. The low grade pans out 100 ozs. and upward. The mine is at present (Nov. 1878) not over 10 ft. deep and almost 25 ft. wide, but yields, with a very small force of men, between $2000 and $3000 per day. So far the mine has yielded nothing but horn silver, a chloride carried in decomposed porphyry full of seams; the ore is found in deposits without any crevice veins or distinct walls. Volcanic upheavals seem to have burst the primary granite, and to have forced through chimneyed passages masses of eruption bearing molten precious metals. The silver has been cooled amid a mixture of porphyry, manganite, feldspar, gypsum, and other mineral substances more or less decomposed and unstratified. Four miles south-east of the Silver Cliffs is the great "Maine mine," which made a very poor man a millionnaire in one year.

In Leadville, a notable mining region, high up in the Colorado mountains, the mineral is found in layers, one above another, with a regular and continuous dip into the ground. Some of the mines have disclosed the existence of two or three deposits underlying the first mineral vein struck by a shaft, and many singular variations from the usual form of mineral deposits have been observed here, presenting a notable contrast to the prevailing type in California and the other parts of Colorado. The mineral carries 100 ozs. of silver per ton and upwards, in high grade ores, and from 25 to 60 ozs. in low grade ores, while the percentage of lead varies from 30 to 70. The ores lie in a sand or soft rock and are easily dug out with pick and drill, the quality improving with the increase of depth.

On September 3, 1878, a miner, while prospecting about half a mile in the gulch on Bald Mountain, discovered a mine of marvellous richness. The ore is of similar character, but of a much higher grade, than the ore above noted, much of it running as high as 3000 ozs. per ton. A mining expert estimated the value of the mine at $1,000,000; the owner asserted that he refused $250,000 for it, yet six weeks previously he had not money enough to buy a pair of boots!

Mention is made of a prospector who, while recently exploring on the west side of Bodie Bluff, laid bare with few strokes of his pick an 8 inch vein of white quartz, almost filled with solid gold, and that the samples assayed $40,000 per ton in gold and $1500 in silver!

Recent examinations of the Arizonia mining region by Prof. Cox of Ind., has demonstrated that the mining property of South Arizonia, once developed, would supply the world with precious metals. Three shafts in the Tough Nut Mine, in the Tombstone district, averaging 10 ft. deep, show a solid body of ore, which, at the low average of $700 to the ton, will yield $2,400,000. He was present when assays were made of ore from this mine going from $1,000 to $27,000 per ton. The conditions as regards timber and water are vastly superior to similar surroundings in the mining regions of Colorado and Nevada.

For several years, mining under the most unfavorable conditions has been progressing on Silver Islet, a storm-beaten ledge, situate about ¾ mile from the main land, and exposed to the full sweep of 200 miles of Lake Superior tempests. The locality is on the Canadian shore, 17 miles north of Cape Royale, and 7 miles east of Thunder Cape. The ore, when first discovered, appeared as streaks of shining white, from 3 to 10 ft. under water, and proved to be worth from $1400 to $7000 per ton, the general average being $1500, of the kind known as "packing ore," being sufficiently rich to be shipped in barrels and smelted without further treatment. The workings, which penetrate 1000 ft. under water, are protected by means of a system of breakwaters, cribs, coffer dams, &c., ballasted with rocks and clay, erected at immense cost and with much difficulty. On many occasions furious storms have utterly wrecked the works, sweeping away cribs, rocks, buildings, &c., leaving nothing but ruin and desolation behind, causing incredible expense to reclaim and maintain the mine. The richest deposit was found March 20, 1878. For the week ending September 28, 1878, the yield was $43,000 ; Oct. 5, $73,000 ; Oct. 12, $69,000; Oct. 19, $103,000; Oct. 28, $80,000. The richness of ore increases with the depth: 50 head of stamps crush 60 tons daily.

The Homestake Mine, Black Hills, has an 80 stamp mill, crushing 175 tons of ore per day, yielding $900 per ton; another 80 stamp mill is to be finished by spring. The cost of mining and milling varies from $2.50 to $3.50 per ton ; daily profit $1000. It is estimated that 10 years' supply of ore is in sight, and that 500 stamps could be supplied.

The mines on the Comstock lode yielded, during the 23 years following their discovery, $500,000,000 in gold and silver bullion, and have wasted $250,000,000 more.

In North America, the mineral wealth of the United States, Mexico, and the British possessions, is absolutely incalculable. Notwithstanding the enormous yield of the mines during late years, the discovery of new fields of astonishing richness is at the present time (1878) a matter of almost daily occurrence. It is asserted, on good authority, that during 30 years prior to Jan., 1878, there have been created in the countries west of the Missouri River, and mostly on United States territory, bullion values to the amount of $1,948,000,000. Of this sum about $1,586,000,000 has been composed of gold, very little silver having been produced prior to 1861, when the Comstock deposits, discovered 3 years before, began first to turn out this metal in notable quantity. Of the $36,000,000 turned out by the Comstock lode in 1877, 43 per cent. has been gold. Of the base bullion made in Eureka district last year (1877), valued at $12,000,000, over 16 per cent. was gold. The bullion from Nevada is nearly 40 per cent. gold. Since the beginning of 1861, the production of gold for the entire Pacific coast has been $876,000,000; of silver, $372,000,000. During 1877, the bullion values consisted of about $51,000,000 gold, and $49,000,000 silver.

The following tabulated statement is interesting, as showing the gradually increasing product of the mines on the Pacific coast during the 4 years noted in the table:

	1873.	1874.	1875.	1876.
California	$18,025,722	$20,300,531	$17,753,151	$19,000,000
Nevada	35,254,507	35,452,233	40,478,369	49,300,000
Oregon	1,376,389	609,070	1,165,046	1,200,000
Washington	209,395	155,535	81,932	100,000
Idaho	2,343,654	1,880,004	1,554,902	1,700,000
Montana	3,892,810	3,439,498	3,573,609	2,800,000
Utah	4,906,337	5,911,278	5,687,494	5,600,000
Arizona	47,778	26,066	109,093	1,400,000
Colorado	4,083,268	4,191,405	6,299,817	7,000,000
Mexico	868,798	798,878	2,408,671	2,200,000
British Columbia	1,250,035	1,636,557	1,776,953	1,500,000
Total	$72,258,693	$74,401,055	$80,889,037	$91,800,000

The product of 1876 will be swelled to $93,000,000 by adding the sum of $1,200,000 to represent the yield of Wyoming, Dakota and New Mexico.

As illustrative of the fluctuating value of mining property, it may be mentioned that during the early part of September, 1878, the stock of the

Sierra Nevada and Union Consolidated Mines, which had been selling at $4 per share, took a sudden leap to $190, being equivalent to the fabulous amount of $30,000,000 additional capital, each mine having 108,000 shares. No ore had previously been found below the 1,800 foot level, but an incalculable quantity of rich ore had been found by still deeper penetration. Some specimens are reported to have assayed thousands of dollars to a ton, and one notable specimen not less than $10,000.

The Gwin Mine in Calaveras Co.,Cal., is 1400 ft. deep, runs 80 stamps, and yields $60,000 to $70,000 per month, of which amount one-half is clear profit.

Of the quartz mines in Soulumne Co., one, the Confidence, from a gross product of $611,853, paid to the owners $195,000 in dividends, besides paying in full for equipment.

The yield of the Gilpin Co. (Colorado) mines, for the year 1876, was $2,105,037, and the product of the Boston and Colorado Smelting Works at Black Hawk, Col., derived from Gilpin Co. ores, was $2,061,244, coin value.

As evidence of the absorbing interest pervading the public mind regarding the vast mining industries of the country, it may be noted that during the last two weeks of 1878 no less than 20 mining companies were incorporated in San Francisco, with an aggregate capital of over $200,000,000.

On the Pacific coast the productive capacity of the mines is greatly curtailed by dry seasons and a short water supply, as a full allowance of this element is indispensable in hydraulic mining, and for the operation of the ore-crushing mills wherever steam power is not available.

Among the serious obstacles in mining at profound depths may be mentioned the influx of water and the high temperature of the mine. In cases where the workings are kept above the adit level the water will pass away through this channel by its own gravity, and no pumps will be required; but when the excavations penetrate deeper than this the water must be elevated by pumps or other machinery up to that point. In causing the water to make its exit through the adit level an enormous saving is effected, for otherwise the water would have to be pumped to the summit of the shaft, frequently at a vast expense. It sometimes happens that a single adit is made to drain a chain of mines, as in the west of Cornwall the "great adit," as it is called, which extends, including its branches to various mines, over 30 miles, and conveys away a torrent of water resembling a small river. In addition to draining off the water, the adit subserves the important use of ventilating the mine by causing a circulation of air, and the passage may be still further utilized as a tram-way for the conveyance of ore and rubbish from the interior excavations, the outflow of the water being effected through a channel beneath the tram-way. The water is raised by the pumping machinery from the "*Sump*," or bottom of the engine shaft, which is generally sunk below the deepest level of the mine, so as to form a pit into which the water may flow before being pumped up

In reference to the temperature of mines, the solar heat, as a general rule, exerts no influence at a greater depth than from 50 to 100 ft. At Paris, as determined by Poisson, a thermometer placed at a depth of 76 ft. remains stationary all the year round. By penetrating into the earth beneath the point affected by the solar heat, we find a regular and rapid increase of temperature. In Cornwall, with a surface temperature of 50°, the temperature of the rock in the Dalcoath mine, at a depth of 1381 ft., is 75.6°; the temperature of springs at a depth of 1440 ft. is 82°; in the United Copper Mines, Cornwall, the temperature of the rock at 1201 ft. is 88°; in the Guanaxato Silver Mine, Mexico, with a surface temperature of 68.8°, the temperature of springs at a depth of 1713 ft. was 98.2°. The last noted instance indicates 1° of heat for every 45.8 ft.; observations recorded in England give 44 ft. for a change of 1 degree; in Saxony it is considerably greater, being nearly 65 ft. to a degree; and a few observations in the United

States indicate 54 ft. to a degree. According to Kupffer, the average for the various countries where observations have been made, is 36.81 ft. to a degree, but this rate of increase is manifestly too rapid; for assuming it to be true, a heat sufficient to boil water would be found at a depth of 5962 ft., or slightly more than a mile, at 48 miles a temperature of 7000°, sufficient to melt all known rocks, and at the centre of the earth it would amount to 577,000°.

The deepest artesian well in the world is at Pesth, Hungary, being 3250 ft. deep, or about twice the depth of that in Paris. It sends up a jet of boiling water 42 ft. high.

Of the rocks encountered by miners, it may be noted that the crystalline rocks are the granitic series of quartz, feldspar, mica, gneiss, syenite, porphyry, green-stone, basalt, and compact lavas, all in varieties.

Quartz is the base of all the silicious compounds in nature, and is distinguished by the hardness of the bodies, as crystals, gritty sand, &c. It cannot be cut with a knife, and strikes fire with steel. It is 96 or 97 parts silica in 100, and 2 or 3 of clay and lime.

Syenite is a middle rock between granite and porphyry, composed of feldspar and hornblende, or quartz and mica.

Feldspar is composed of lamina or plates. Its constituents are silica and alumina, with some potash. Abounds in granite, syenite, gneiss, and porphyry. When large crystals of feldspar appear in granites they are called porphyritic. Feldspar, next to quartz, is the most abundant stone, being a constituent of granite and other rocks ; it scratches glass, gives out sparks with steel, is of a vitrified nature, and when crumbled forms the basis of clay. Feldspar is white, red, or gray, and consists of 64 in 100 parts of silex, 19 of clay, 2 of lime, 13 of potash, and 1 of oxide of iron.

Mica, the other equal part of granite, is 47 silica, 22 clay, 14.5 potash, 15 oxide of iron, and 1.75 oxide of manganese. Mica is occasionally found in large plates, is tough, flexible, elastic, semi-transparent, and sometimes used as a substitute for glass. When decomposed by the atmosphere or worn down, it mixes with the clay of the feldspar or the sand of the quartz.

Porphyry is stone, with a compact base, intermixed with crystals. The base is trap, and the crystals feldspar or quartz.

Serpentine is so called from its variegated colors, usually green; composed of 32 silica, 37½ magnesia, half alumina, 10½ lime, with iron and carbonic acid 15.

Curved gneiss proves that it was once fluid; it is in slaty layers or plates, formed of feldspar, quartz and mica, separated by thin layers of mica, it contains in its veins all the metals, and follows the sinuosities of the granite.

Hornblende is 42 silica, 30 oxide of iron, 12 clay, and 11 lime.

Augite is 54 silica, 22 lime, 12 magnesia, and 10 oxide of iron.

The *Schistose* strata are inclined from 52 to 70 degrees in mountains.

Magnesian Limestone contains about 20 magnesia, 30 lime, 48 carbonic acid, clay and oxide of iron. It renders dilute nitric acid milky, and effervesces little in acids.

Mica slate is mingled with quartz in masses ; clay slate has quartz in layers.

Carbonate of lime, forming one-eighth of the crust of the globe, contains 56 parts in 100 of oxygen.

Portland stone is coarse grit, cemented with earthy spar.

Emery is a mineral containing 86 alumina, 3 silica, and 4 iron.

Corundum is a stone, which in crystals is a six-sided prism, called adamantine spar.

The hardness of rocks is a surprise to many, but all wonder will cease when we consider the effects of heat, combined with the pressure of superincumbent rocks during millions of years, in forming rocks of primary graywacke from sand, and primary slates from clay. In exploring or prospecting for mineral veins, it is well to remember that gold is not confined to one class of rocks. In Mariposa, Cal., some gold-bearing quartz veins are in granite, but the largest and richest are in slate ; the noted Oneida, Keystone, Eureka and Springhill veins are also in slate, together with the most valuable veins in Amador. The vein of the Eureka had a thickness of 6 ft. at its "outcrop" on the surface of the ground; and down to a depth of 1300 ft., to which it has been worked, the thickness and value has constantly increased with the sinking. In the Calaveras district, rich gold-bearing quartz veins are found both in limestone and granite; in Tuolumne the richest veins occur in granite; in the Alta district the "wall-rock" is serpentine, with white talc in the richest deposits.

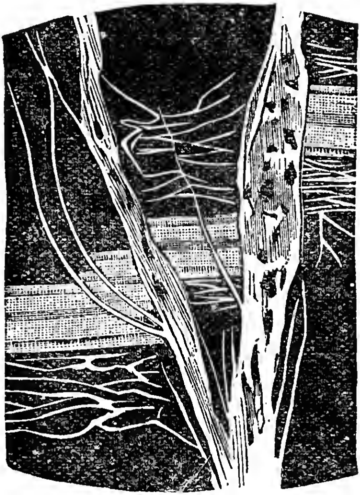


Fig. 1.

Ground plan of the intersection of lodes in the Himmelfahrt mine.

The engraving, sketched by Weissenbach, shows the appearance presented by the intersection of two veins in the Himmelfahrt mine, near Freiburg, Germany.

Metallic ores exist in four ways : 1. In irregular masses. 2. In fissures or veins crossing the strata and filled with the ore, combined with some matrix. 3. In regular interstratified layers or beds, and 4. Intermixed in small fragments among the rocks.

A knowledge of geology and geometry is of the utmost value to the practical miner to aid him in ascertaining the location of mineral deposits, and to operate to the best advantage in obtaining possession of them. The instruments used are : 1. The magnetic compass ; it is used to determine the direction of a metallic deposit in places where the influence of iron is absent. 2. The graduated semi-circle or clinometer, which is used to measure the dip or angle of the lode. 3. The chain or cord, to measure distances between two points. 4. A plane table or plate whenever the proximity of iron nullifies the action of the compass.

In exploring for mineral veins, abundant experience has shown the primary importance of the following suggestions : 1. That they are more numerous in mountainous and hilly districts than in the level territory. 2.

That the richest lodes occur about the junction of the crystalline and stratified rocks, and are more abundant in the former than in the latter. 3. That their situation is frequently determined by the color of the land, which is often influenced by the decomposition of part of the mineral components, and scattered fragments of the vein intermingled with the soil. 4. In cases where the location of the bearing is partially ascertained, the lode may frequently be found by sinking a shaft through strata into the underlying rock, and thence driving a drift or tunnel at right angles to the bearing of the lode. 5. The best proof of the existence of a lode is the discovery of its outcrops ; this sets every doubt at rest. For further information, see *Prospecting for Quartz*, page 452.

Gold-bearing quartz veins, in California, generally run from north north-west to south south-east, with a steep dip to the eastward. The diffusion of gold through the quartz is very unequal, and the lodes vary from a line to 50 ft. Two ounces of gold to 1 lb. of rock is a rarity greatly admired by quartz miners, for that proportion is held to be exceedingly rich in the precious metal.

Mineral veins are usually graded into species, of which the prevailing forms are : 1. The *Rake vein*, which extends downwards to unknown depths, is frequently many miles in length, and is the prevailing type of the mineral veins most highly valued by miners. Beginning at the "outcrop" it perforates the strata downwards almost to their plane of stratification. It also intersects or penetrates the granite rocks. The inclination or "dip" of these veins varies from a few degrees to a vertical direction. 2. The *Interlaced vein*, which is composed of many small veins grouped together like irregular net work, is frequently surrounded by granite rocks, and more usually bear the ores of tin than any others. 3. The *Pipe vein*, which appears like an irregular shaft filled with ore, is usually found *between* the strata. This class of veins present a great variety of sizes, and the angle of inclination is generally less than the dip of the rake vein. 4. The *Dilated or Flat vein*, which in its extension is subject to varying contractions and expansions, is found in flattened masses in horizontal positions like seams of coal, but differs from a coal bed by great variation in thickness within the distance of a few feet wherever breaks or interruptions occur. The best mineral deposits are often found at these faults. 5. The *Accumulated vein*, usually found filling large vacancies in the earth, is a great irregular mass of ore, apparently isolated from all other mineral deposits. Veins of this class occur interposed between the stratified rocks and also in the granite.

As to the nature and origin of the *spaces* occupied by metallic veins, they are : 1. The cracks and fissures made in rocks. 2. Openings between their layers, especially in Schistose or slaty kinds. These crevices or fissures are produced in great numbers where a region of rock is undergoing uplift or where a folding of the strata is in progress, owing to earthquakes or other movements of the earth's depths. The mineral contents of these crevices may have been charged : 1. When the fissures or crevices were filled from either side or below, and did not descend to regions of liquid rock, being not connected with igneous ejections. These include all banded mineral veins, and nearly all those filled with quartz or granite. The intense heat, acting on the moisture present, would inevitably decompose the rocks ; then their mineral matter sooner or later would be swept into the crevices, and, in combination with emanations from the deeper parts, form metallic lodes. Also, 2. Where the rents or fissures descended to regions of liquid rock and were filled from below. In this case the mineral contents of the vein have been brought up in some state of combination as solutions or vapors. The veins of silver ores in Nevada and many others thus originated in connection with subterranean disturbances.

Werner's theory is that open fissures in the earth's crust were filled with crystalline and metallic matter by aqueous infiltrations from above, and that the substances of mineral veins have been precipitated from a chaotic menstruum into fissures in the earth while it was in some nascent condition.

Dr. Hutton contends that the contents of mineral veins, like those of dikes, were formerly molten, and while in this condition were injected from below by mechanical force.

Dr. Buckland and M. Neckar propound the theory that the contents of some metallic lodes were deposited in crevices and fissures in the earth's crust by the condensation of mineral exhalations from immense subterranean fountains of intensely heated matter.

Sir R. Phillips contends that metals are generated by long continued galvanic action between mixed rocks, and are the *Aura* of rocks, combined with oxygen, nitrogen and hydrogen, whose actions and reactions are electricity. The results are a matrix, a compound of some of the peculiar aura with oxygen and hydrogen ; exhalations from the lower parts of the vein are also to be considered. Ores and crystallizations are therefore direct products of the oxygen and hydrogen rendered active in electricity, and of the exudations and aura of the rocks and strata. Proximity is not essential to electrical influences ; the walls of fissures may be affected by excitements from a distance.

It is asserted that a hole drilled into auriferous quartz in the Urals, and intended to be used for blasting, but never so used, was examined 40 years after it was made, and found to be full of fine crystals of gold.

From the present known existence of electro-currents in many Cornish veins, and the analogy between voltaic combinations and the arrangement of matter in mineral veins, Mr. Fox and M. Becquerel reason that the formation of many metallic lodes are due to electro-chemical agencies.

When *wide* fissures or fractures of strata are filled with stones or earth, they are called *faults* or *dikes*, but when charged with mineral contents they are called veins. The tests of a probable mine are metallic ores or sand at the outcrop, mineral waters, trees or grass discolored, and the products of boring.

The best systems of minerals are those of Berzilius, and the chemical arrangement of Mohs ; Naumann unites them. As a writer on the mineral kingdom, mines, furnaces, the treatment of ores, &c., Emanuel Swedenborg occupies a high rank.

Of late years among works of notable utility to miners may be mentioned, *Phillips' Elements of Metallurgy ; Dana's Manual of Mineralogy ; Randall's Quartz Operator's Hand-Book ; Silversmith's Practical Hand-Book for Miners ; Kustel's Processes of Silver and Gold Extraction.* Most of the engravings of furnaces and some of the amalgamating pans described in this book are taken from the last noted work, which may be regarded as absolutely indispensable to every progressive miner. Due acknowledgments are also rendered to other standard authors, successful miners and experienced mill-men, for much of the valuable information presented in these pages.

The superficial appearance of the outcrop of veins often indicate the metals they contain. The presence of fluorspar indicates metallic associations wherever found. A brown powder at the surface indicates iron, and often tin ; a pale yellow powder, lead, and green, copper. Gold and silver are found in primary and transition rocks, porphyry, quartz, syenite, and the lowest sandstone, occasionally in coals, and abundantly in the sands of rivers. Platina, palladium, rhodium, osmium, and iridium are found almost wholly in the sands of rivers. Mercury is found in slate, limestone, and coal strata. Copper in primary and transition rocks, syenite (sometimes sandstone), coal strata, and alluvial ground. Iron is found in every kind of rock, tin in granite, gneiss, mica-slate, and slate, lead and zinc in primary and transition rocks (except trap and serpentine), porphyry, syenite, the lowest sandstone, and occasionally in coal strata. Gold is yellow, copper, red, iron, grey, lead, blue, cobalt and manganese, grey; all the others are white.

Fig. 2 represents the transverse section of a mineral vein, in which, in mining nomenclature, A A represents the "*country*," or rock composing the sides of the vein, C C is the *vein*, D, *hanging-wall*, C, *foot-wall*, D D, *selvage*, G, *vugh*, F, *horse*. Waste rock or rubbish is termed *deads* or *attle*; workings in a mine by persons of whom no record remains are termed *old men*; an opening left for letting down ore is called a *pass*; the place at which a lode divides in two is named *point of horse*; the lowest workings in a mine or level are called *bottoms*; the appearance of a mineral lode at the surface is called an *outcrop*; the amount of slope of a mineral vein measured from a horizontal line is termed a *dip*; a horizontal or nearly horizontal working in a mine is called a *drift*, *gallery*, *level*, or *gunny*; the substance in which ore

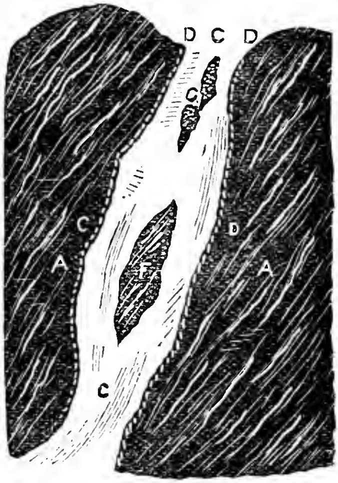


Fig. 2.—Transverse Section of a Vein.

is found embedded is termed the *matrix*; a cavern or fissure in which water falls and disappears is called a *swallow*; the ascending air-current from a mine is termed an *upcast*, the downward current is called a *downcast*, &c., &c. Most of these terms, together with a vocabulary of similar technicalities, derive their origin from the Cornish miners.

Metals are always found as alloys, sulphurets, oxides, or salts. Gold, platinum, and columbium, are found only as alloys. Silver, mercury, copper, iron, antimony, arsenic, and cobalt, in the four states. Lead and zinc in the three last. Tungsten, uranium, litanium, chromium, and tantalium, only as oxides. In density, the order of metals is platina, gold, silver, mercury, lead, copper, tin, iron, zinc.

Few metals are found pure or native, but in ores, gangues or compounds, combined with oxygen or acids; often two or more resulting metals, with sulphur, arsenic, &c., in veins of rocks, the foreign bodies being called *mineralizers*, as sulphur is to lead, forming sulphuret of lead, called galena.

The age of metals is estimated by that of the containing rocks; the age of the latter it is not possible to determine even approximately. In treating of geological epochs, Dana remarks : "If time, from the commencement of the Silurian formations (those resting on the granite) included 48 millions of years, which some geologists would pronounce much too low an estimate, the Paleozoic part, according to the above ratio, would comprise 36 millions, the Mesozic, 9 millions, and Cenzoic, 3 millions. It should be noted, however, that as rocks are formed of earth, and as metals are found mainly in veins and crevices of rocks, that they must be of more recent origin than the latter.

The above noted estimate of geological time will doubtless astonish many who have been led, by a mistaken apprehension of the true meaning of Genesis, to suppose that only about 6000 years have elapsed since the creation. For further evidence on this subject, see *Geological Facts; Age, Origin, and Ultimate Duration of the Earth*, on page 728. The adamantine facts of geology render very slight homage to the cherished errors of the world, and have struck fearful blows at the old explanations of Genesis, but time is a powerful remodeller. Already nearly 300 centuries attest the eternal verity of the grand truths for the propagation of which Bruno suffered death and Galileo endured imprisonment, for their alleged inconsistency with the Jewish cosmogony, which, in describing an apparent truth, speaks of "the rising of the sun and the going down of the same" according to appearances as presented to the senses.

The world has witnessed with astonishment the disgraceful treatment accorded to Sir James Y. Simpson, by infamous bigots, who insisted that his humane use of anæsthetics to mitigate the pains of women in labor was neither more nor less than a direct contravention of the primeval curse, which affirmed that "in sorrow she should bring forth children." It is safe to say that the bigots did not belong to the female sex. At this day such absurdity would not be tolerated a single hour.

The popular outcry which at one time denounced the use of the lightning conductor as a flagrant defiance of heaven is also silenced forever. Railroads and telegraphs have been similarly denounced. These insanities are now numbered with the things of the past.

It is notoriously true that in Scotland the fanning mill was fiercely assailed as an ungodly machine, and the inventor was subjected to persecution by arrogant lunatics who asserted that nothing could be either good or useful which contravened the passage which reads:—"The wind bloweth where it listeth." Now millions use fanning mills during their lifetime without ever thinking of such an objection.

The science of geology is as yet in its infancy, but its teachings have met with very general acceptance among intelligent observers. It is sophistry to affirm that what is new, must, for that reason, necessarily be false, for of the disclosures unfolded by the stony facts of geology we are compelled to affirm that they must be true, though at variance with the beliefs of a thousand generations.

A high authority has classified the placers of California as follows :—

1. A coarse, boulder-like drift, the result of abrasion and powerful currents in a great body of water.

2. A river drift or coarse alluvium, ancient and modern.

3. Alluvial deposits on flats and broad surfaces, not confined to river channels.

4. Lacustrine deposits made at the bottoms of former lakes and ponds. They are found in extensive, basin-shaped depressions in the surface of metamorphic rocks. These depressions have evidently been filled with deep quiet water, from which thick strata of clay, fine sand, and volcanic ashes have been deposited upon the auriferous layer at the bottom.

In the gullies and ravines the auriferous dirt is generally a very stiff clay, abounding in coarse gravel and stones, and is usually as wide as the stream of water during the wet season. In a ravine where the extreme width of the stream does not exceed 5 ft., as a general rule the pay-dirt will not be more than a foot deep, with a bed of barren dirt on top. Where the channel of a stream in a small ravine has slightly changed, the pay-dirt may be buried under 6 or 8 ft. of alluvial soil. The gold will not lodge on the smooth or steep bed rock of a gully ; the richests spots will be found where the bed is level, and where the strata of the rock are almost vertical and present many jagged points to detain the gold, the largest pieces being usually found near the bed rock in the deepest part of the stream.

In alluvial workings, near rivers and streams, the various companies who work neighboring claims often club together and construct a large flume, into which the stream is conducted by means of a strong barricade or wing dam of rocks, timber, mud, &c., which causes a diversion of the current, leaving the bed of the river nearly dry, thus affording access for working it to good advantage. The stream affords plenty of water for mining pur-

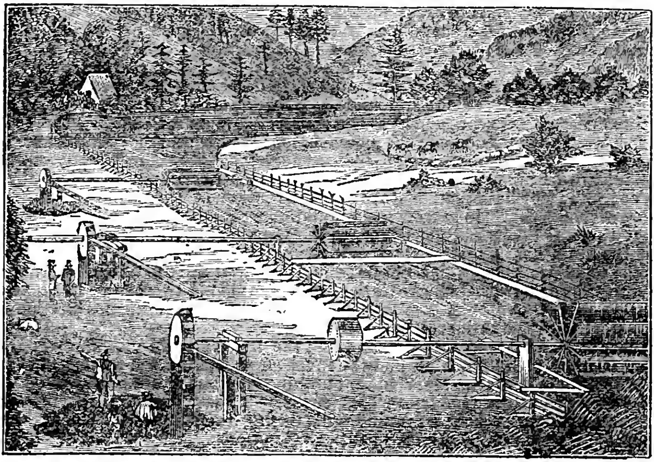


Fig. 3.—FLUME MINING.

poses, together with ample power for operating under shot wheels for working pumps to rid the claims of the surplus water which accumulates in the workings. See Fig. 3, representing flume mining.

For *Placer Mining, Board Sluice Process*, see page 453 ; for *Hydraulic Mining, Long Tom Process*, &c., see page 454; for *Gold Assay by Smelting Process; Gold Assay with a Horn Spoon; Assay of Rock containing Pyrites ; Silver Assay by Smelting; Assay of Argentiferous Galena; Silver Assay with Testing Tube* ; *Test for Iron or Copper Pyrites*, see page 451; for *Prospecting for Quartz; Prospecting a River Bar; Prospecting in a Gully; Prospecting in Flats; Prospecting with a Knife*, &c., see page 452.

In order to thoroughly dispel the common illusion that a mine is merely a vast excavation in the earth, exposed to the open air, rain, storms, &c., like a quarry, it may be well to enlighten the reader by presenting a few facts relating to some of the silver mines on the Comstock lode in Nevada. At the main shaft and hoisting works of the Consolidated Virginia Mining Company, we find a great mass of buildings, resembling a vast manufactory, containing engine and boiler houses, machine shop, blacksmith shop, carpenter shop, and numerous offices connected with the works. Around the buildings are enormous piles of timber and lumber, resembling the surroundings of an immense saw-mill with its accumulated stock. This timber is used for supports, &c., in the mine, and it is safe to say that more timber has been absorbed by these mines than there is in all the houses in San Francisco.

The main shaft appears as an opening in the floor, about 5 ft. in width, and 20 ft. in length, with a depth of 2000 ft., and is securely cribbed by means of substantial timbers. This opening is divided into four compartments by means of partitions running from the top to the bottom of the shaft; three of these four compartments are used for hoisting purposes, and in these the hoisting cages pass up and down to and from the various levels, after the manner of an elevator through the various stories of a high building. The fourth compartment is occupied by the tanks and pump column; an iron pipe from 12 to 16 ins. diam., through which the water is forced from the lower levels of the mine to the surface by means of the massive pumping machinery. The cages in the different divisions work independent of each other; one may be going down while the other is going up, or one may be at rest while the others are in motion.

The motive power for hoisting is supplied by powerful engines at the opposite end of the building, about 50 or 60 ft. distant from the shaft, and the hoisting is effected by means of a flat cable, some 5 or 6 ins. wide, $\frac{3}{4}$ ins. thick, and braided of the best quality of steel wire. This cable is wound and unwound on an enormous reel situated near the engine, and the great iron wheels and pulleys which sustain the cables are supported on what is termed the gallows frame, a huge structure composed of massive upright and cross timbers constructed directly over the mouth of the shaft. The positions of the cages in the shafts are indicated to the engineer by means of a hand moving over a dial in the engine room, and the signals for elevating and lowering the cages are struck on bells near the engineer by parties in the cages or levels below.

The entire machinery of the works is driven by a compound condensing engine of 600 horse-power; the engine has two cylinders, the first 24 x 48 ins., and the second 48 x 48 ins. in size. The main shaft of engine is 14 ins. diam., and weighs 15,000 lbs. On this shaft is a fly wheel (which is also a band wheel, carrying a belt by which the batteries are driven) 18 ft. in diam., and weighing 16½ tons. On the extreme end of the main driving shaft is coupled a shaft 11 ins. diam., extending into the amalgamating room, and driving the pans, agitators, &c. Engine weighs about 50 tons; there are 8 boilers, each 54 ins. diam. and 16 ft. in length. The smoke stacks are 4 in number, 42 ins. diam. and 90 ft. high.

In the new stamp mill of this company (100 ft. long and 58 ft. wide) there are 60 stamps, each weighing 800 lbs., the whole requiring one car load (1800 lbs.) of ore to be sent out from the shaft every 5 minutes during the day and night. The stamps are driven by a belt from the main band and fly wheel; the belt is 24 ins. in width, and 160 ft. in length; speed 3600 ft. per minute. This runs the counter-shaft in front of the batteries, and from the pullies on this counter-shaft there are belts 14 ins. wide and 60 ft. long, which run each battery of 10 stamps. The batteries are fed by the Tulloch self-feeders, one feeder being required for every 5 stamps, and two men only are required to oversee the whole, without any handling of the ore. There are 32 amalgamating pans, each pan holding about 2000 lbs. of pulp from the batteries, and there are 8 settlers to each pair of pans. The monthly loss of quicksilver alone in the mills of the company is estimated at from $60,000 to $80,000. The owners have to-day 11 mills, ranging from 15 to 80 stamps, making altogether a battery force of 375 stamps, the largest stamp capable of pulverizing 5 tons of ore every 24 hours. The whole human force employed in these mills numbers 622 men, when the mills are running to their full capacity.

From 500 to 700 men are employed and divided into three shifts, each shift working 8 hours. One shift goes on at 7 a.m., one at 3 p.m., and another at 11 p.m. Order is respected in every thing ; there are superintendents, foremen, engineers, miners, timbermen, watchmen, pumpmen, pick-boys, &c. Each employee in the mine has his duties assigned him, which must be performed, and each is confined to his own level, and there only.

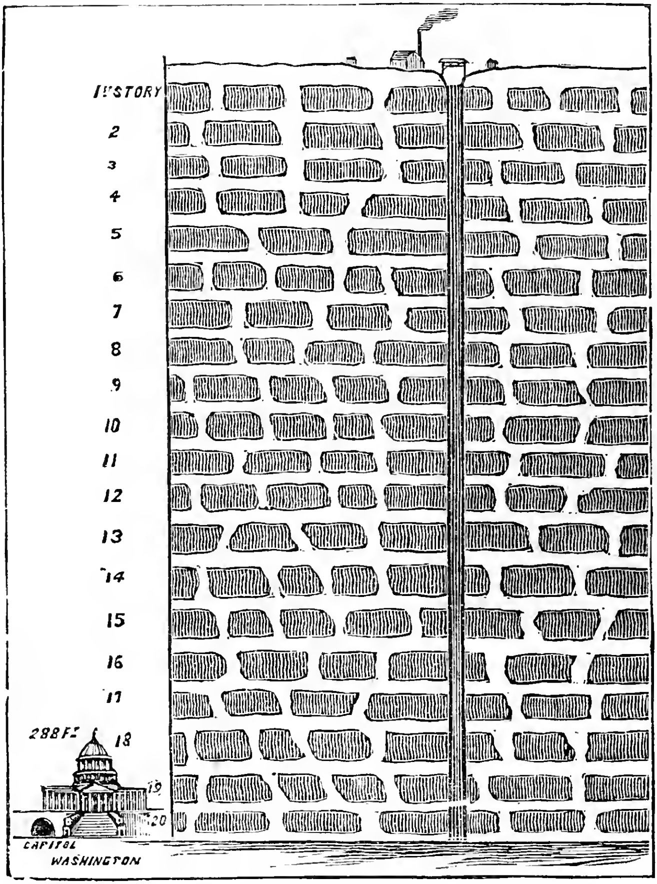


Fig. 4.—Diagram Illustrating Height of Mines.

To describe the mine, we will in imagination compare it to a house of enormous altitude and vast dimensions on the earth ; this house would require to be 2000 ft. high, with 20 stories or floors, each 100 ft. apart. It is safe to say that such a building was never constructed, and never will be in this world. To an observer in Wall street, or on Broadway, New York, Trinity Church presents an imposing spectacle, but our imaginary building, representing the Consolidated Virginia mine, would be nearly 7 times higher! In the mines on the Comstock lode there are 200 miles of drifts, galleries, cross-cuts, shafts, winzes, &c., and as one mine connects with another, there are what might be called streets, 3 miles long. The main workings are all lighted with lamps and candles which are always kept burning. Quite a number of engines are in operation in the lower levels hoisting timber to the miners, elevating ore at the winzes, operating Burleigh drills, and driving fans or blowers (like those used in a foundry) to supply fresh air to the workmen who are panting with the heat in distant parts of the mine. These engines are run by compressed air, furnished by powerful compressors at the surface, as owing to the high temperature at these profound depths steam

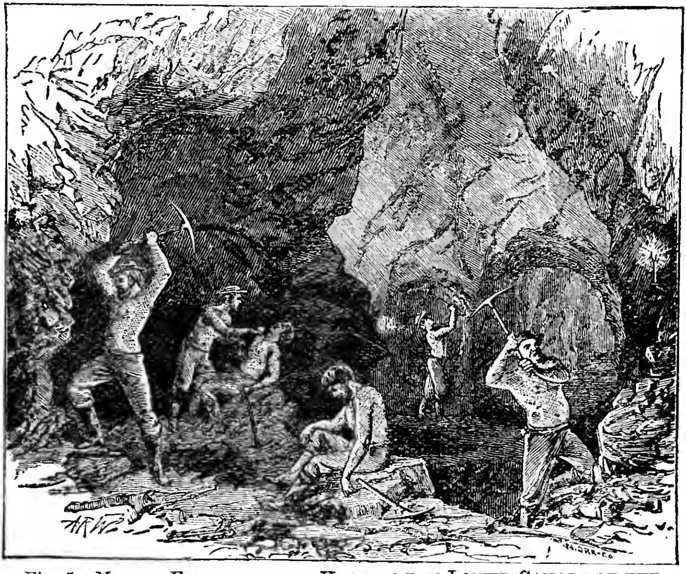


Fig. 5.—Miners Fainting from Heat in the Lower Canals of the Comstock.

engines could not be tolerated a single hour. When at work the miners are naked to the waist, and some from the middle of the thighs to their feet. The only garments worn are a pair of thin pantaloons or overalls, stout shoes, and a light hat or small felt cap to protect the head from the falling sand. Notwithstanding all this many faint outright from the effects of the heat.

One month's supplies for this mine may be estimated as follows, viz.: 500,000 ft. of timber, 550 cords of wood, 350 boxes of candles, 2 tons of giant-powder, 100 gals. of coal-oil, 200 do. of lard oil, 800 lbs. of tallow, 20,000 ft. of fuse, 37 tons of ice, 3000 bush. charcoal, 1½ tons of steel, 5 tons of round and square iron, 4 tons of hard coal, 50 kegs of nails, &c. Monthly wages, \$90,000. Miners receive \$4 per day; engineers, carpenters, machinists, blacksmiths, &c., from \$5 to \$7 per day.

The Savage and Hale and Norcross mines on the Comstock lode have shafts 6 x 20 ft., and 2500 ft. deep. The Savage Company intend to sink their present shaft to a depth of 4000 ft. Their great hoisting cable of steel wire is 4000 ft. long, weighs 25,190 lbs., and is wound and unwound on a cone-shaped reel 15 ft. long, with a diam. of 22 ft. at the large end and 13 ft. at the small one. The reel is suspended on a cast-iron shaft 16 ins. in diam., the ends of which revolve in ponderous bearings sustained by foundations of cut stone resting on the solid rock. The engines for driving the huge reel are two in number, of 200 horse-power each, and are capable of hoisting from 480 to 500 tons of ore every 24 hours. The hoisting car used on the lower incline is made wholly of iron and steel, runs on an iron track, and holds about 5 tons of rock. The incline begins at the foot of the vertical shaft, 1300 ft. below the surface, and runs to the lower levels of the mine. The hoisting cages on the mines of the Comstock are all supplied with safety appliances, which operate instantaneously in arresting the descent of the cage in the event of the cable breaking.

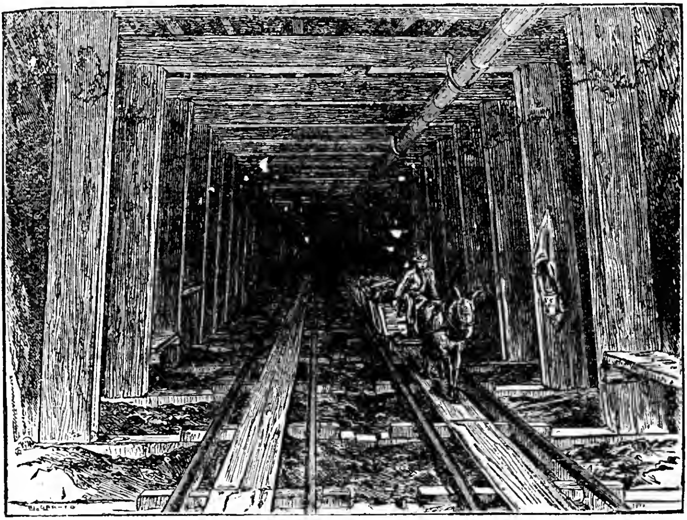


Fig. 6.—Sutro Tunnel.

As showing the vast sums of money disbursed by capitalists when full confidence exists of obtaining remunerative returns from mining operations, it may be interesting to note the following items regarding the outfit of a mine which has not as yet produced a cent's worth of ore. The works will be, when finished, a boiler house 102 ft. long, 50 ft. wide, containing 10 boilers, 54 ins. diam., 16 ft. long; one main hoisting room, 151 ft. long, 40 ft. wide, 48 ft. high; a carpenter shop, 50 ft. wide by 100 ft. long, for framing the timbers for the shaft, a machine shop, 50 x 100 ft., and a blacksmith's shop, 40 x 60 ft.

At the shaft is a double cylinder, high pressure, direct-acting engine, both cylinders being connected with one shaft carrying two reels for winding the ropes. It is of 1200 horse-power, and capable of hoisting 10 tons of ore from a depth of nearly, if not quite, one mile. The crank shaft weighs nearly 40 tons, and is one piece of wrought iron. The intended piston speed is 960 ft. per minute, which will take a "cage" through the shaft at railway speed. The cables used in the shaft are made of annealed steel wire, 7 inches wide and $\frac{3}{4}$ ins. thick, and are wound on the reels like a ribbon on a spool. The reels are 15 ft. diam., will hold 4000 ft. of cable, and each is fitted with powerful brakes and safety appliances to regulate the movements of the cages. The engine foundations are solid masonry, 56 ft. long, 38 ft. wide, and 22 ft. deep, to which the engines are bolted with 80 3-in. and $3\frac{1}{2}$-in. bolts, reaching the bottom of the stone work. The piston rods and all the valve rods are of steel, and the valves of hard brass.

The pumping engine is a horizontal compound condensing engine, direct acting. The cylinders are of the following dimensions : The initial cylinder is 33 ins. diam. and 12 ft. stroke. The expansion cylinder is 66 ins. diam. and 12 ft. stroke ; engine shaft 20 ins. in diam., about 18 ft. long, and has a fly-wheel on each end 30 ft. in diam., and each wheel weighs 30 tons. The engine and line of pumps for 1200 ft. weigh 749 tons. The cost price of engine and pumps before erection was $300,000. It is to drive two lines of 14 inch pumps of 10 ft. stroke. Its web of cams, rods, cut-off gear, air-cushions, drop-weights, &c., display the highest skill in workmanship.

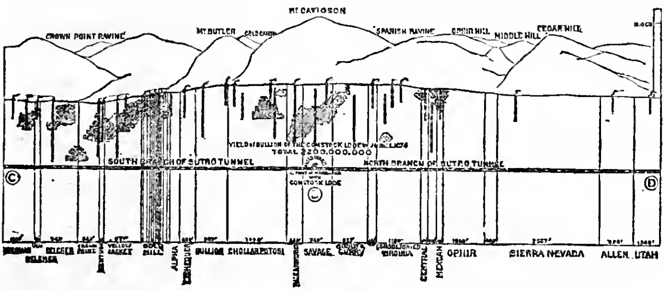


Fig. 7.—Longitudinal Section of the Comstock Lode, showing the different Mining Claims located thereon, the Ore bodies extracted, and the intersection of the Sutro Tunnel with the Lode at B., etc.

The Sutro tunnel, a work without a compeer in mining enterprises on this continent, was begun October 19, 1869 ; the object being to penetrate the mines on the Comstock lode at a point nearly 2000 ft. below the surface of the earth, and thus form an outlet for the drainage and rapid transit for the miners and their supplies, together with quick transportation for the ore and mineral matter taken from the mines. It enters the mountains in the valley of the Carson river, at the town of Sutro, $3\frac{1}{2}$ miles below Dayton, $1\frac{1}{2}$ miles from the river, 150 ft. above the river bed, and strikes the 1640 ft. level of the Savage mine at a point 20,018 ft. from the mouth of the tunnel. The work was prosecuted day and night with a result of from 13 ft. to $16\frac{1}{2}$ ft. per day, until on July 8, 1878, a connection was made with the above noted shaft. A wire-tramway, running from the Carson river to the mines, will soon be in operation through the whole length of the tunnel, with an outfit of rolling stock capable of transporting 1000 miners from the village of Sutro to the mines in 15 minutes. During the past years, nearly 3000 miners have been employed in these mines, and hours have been consumed at each shift in sending down the men in cages, a dozen or so at a time.

The mines on the Comstock lode, and all other mines in the district, are compelled for all time, to pay the Tunnel Company $2 per ton for every ton of ore extracted and sent to the mills for reduction. The rates established for transportation is 25 cents per ton per mile over the 4 miles of main tunnel, and 25 cents each way for persons. Ice, now sold to the mining companies at $20 per ton, can be supplied in unlimited quantities by the Tunnel Company from its ponds on the Carson river, at less than $1 per ton. Cordwood, now sold in Virginia city at $12 per cord, can be passed through the tunnel, elevated nearly 2000 ft. through the main shaft, and laid down for $8 per cord.

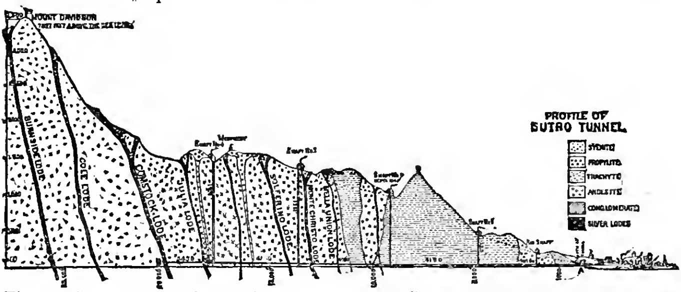


Fig. 8.—Geological Cross Section of the Country from the entrance of the Sutro Tunnel to and beyond the Comstock Lode; also the Four Shafts on the Tunnel Line.

The notable sanitary uses subserved by the tunnel has already dissipated the poisonous gases in the lower drifts of the Savage mines, and lowered the temperature of the 2000 ft. level from 120° to 90° Fahr. A covered steam-tight drain is to be constructed the entire length of the tunnel (under the railroad track) to form an outlet for the drainage of the mine. Much of the water in the workings stands at a temperature of 160° Fahr., and if this was passed through the tunnel in an open channel, no living thing could exist, owing to the hot, confined vapor. It is further intended to utilize this water as a source of power for moving the long trains of cars used in transporting the miners, together with their necessary stores, timber, ore, &c. The discharge of this water has heretofore been effected at an annual cost of $3,000,000. The drainage must pass through 10 pumps and tanks, through 2000 ft. of iron pipe, from 12 to 16 ins. diam., before reaching the surface. The great iron pump rod, 2000 ft. in length, and hung at several points with immense balance bobs to prevent it from being torn asunder by its own weight, is kept continually swaying up and down at its round of duty. Henceforward this drainage will only require to be elevated to the tunnel level in order to find an outlet. The Tunnel Company have so far expended on the tunnel, with the immense shafts, buildings, machine shops, engines, &c., connected therewith, the vast sum of $3,200,C00, and the projected branches and extensions towards the various mines will still absorb a large additional sum. In carrying out this wonderful enterprise the obstacles presented by nature were of the most formidable discription and well nigh insurmountable, but they were finally overcome by the untiring energy and indomitable perseverance of Mr. Sutro, who brought to the execution of this herculean task, an iron will, and a rare combination of executive abilities.

Many rich deposits of marvellous extent have been found on the Comstock lode, but on the 1500 foot level has been discovered what appears to be the central mass, a body of ore unparalleled in extent and value by any thing hitherto known. This has enjoyed world-wide fame under the name of the "Big Bonanza" (a Mexican term denoting a large and rich body of ore—prosperity. Borrasca is the very opposite of bonanza, and signifies barren-rock—bad luck—adversity), and measures 900 ft. in length, 550 in depth, and from 30 to 200 ft. thick.

The immense chasm, rent, or fissure in the rocks, which is filled by the "vein-matter," or gangue (pronounced *gang*) forming the Comstock lode, extends from the east country rock (prophylite) to the west country rock (syenite), a distance of from 1000 to 1200 ft. The gangue is composed of quartz, porphyry and clay, which incloses the ore. This chasm, known to be about 4 miles long and about 1200 ft. wide, was undoubtedly formed during ages inconceivably remote, by means of volcanic action, and immense fragments of rock appear to have broken away from the edges of the chasm, fallen into the crevice, and thus prevented its closing. In mining nomenclature these are termed "horses;" they still remain in the vein, and the ore, quartz, &c., has filled up all the space around them. Some of the "horses" are of great extent, being from 50 to 100 ft. in length, with proportionate thickness, while others are at least 1000 ft. in length, and from 300 to 400 ft. thick. The fragments from the west side of the crevice are syenite, those from the east side are prophylite, usually termed porphyry by the miners.

The charging of this enormous crevice with what now forms the mineral contents of the Comstock lode, is manifestly the work of subterranean forces combined with hot mineral water, steam, gases, &c., from boiling springs beneath, which have filled up the vein with its rich sulphurets and other ores of silver. Traces of hot springs are everywhere visible on the neighboring hills to the eastward of the vein, and the noted steamboat springs, only a few miles distant, are even now in full blast, engaged in the formation of a metallic lode by the emission of hot mineral water, steam, and enormous volumes of heated gas, through a crevice over a mile in length. Who will not say that here we find one of the instrumentalities of creative power in the very act, as it were, of replenishing the earth with the gifts of a beneficent Providence?

The action of boiling springs is due, 1. To the access of subterranean waters to heated rocks, producing steam, which seeks exit by upward vents: 2. To cooler superficial waters descending channels to where the steam prevents further descent, and gradually accumulating until the channel is filled to the top: 3. To the heating of these upper waters by the steam from below, to near the boiling point, when the lower portion of these upper waters becomes converted into steam, and the eruption, or jet of water results.

The dynamics of volcanic force is an interesting study. The roar of Niagara is a gentle zephyr compared with the bellowing of a volcano. The power required to rupture a battery of steam boilers is as nothing compared with the inconceivable energy necessary for the upheaval of mountains, the rending of rocks, the raising of islands from the ocean's bed, and forcing out the melted lava from beneath the gneiss and granite. Very frequently large fragments of these rocks are broken off and thrown out with the lava: Cotopaxi, nearly 20,000 ft. high, has projected a stone 109 cubic yds. in volume to the distance of 9 miles, and has thrown matter 6000 ft. above its summit. This of itself would require a force of nearly 1500 atmospheres, or 22,500 lbs. to the square inch! In 1660, the amount of lava ejected by Mount Etna was 20 times greater than the whole mass of the mountain, and in 1669, when 77,000 persons were destroyed, the lava covered 84 square miles. In the eruption from Skaptar Jokul, in Iceland, during 1783, two streams of lava flowed in opposite directions, one of them 50 miles long and 12 broad, and the other 40 miles long and 7 broad; both having an average thickness of 100 ft., which was sometimes increased to 500 or 600 ft.; twenty villages and 9000 inhabitants were destroyed. The seat of volcanic power must be deeply seated beneath the earth's crust, where the heat is extremely intense; lava ejected over 100 years ago from Jorullo, in Mexico, 1600 ft. high, is not yet cool. The lava thrown out of Etna in 1819, was in motion 9 months later at the rate of a yard a day, and lava from a previous eruption of the same mountain was in motion after the lapse of 10 years.

Not only do very many mountains and mineral lodes owe their origin to volcanic action, but numerous islands as well. The Sandwich islands, of which Hawaii, the largest, contains 4000 square miles of surface and rises 18,000 ft. above the ocean; Teneriffe, 13,000 ft. high; the Madeira; Iceland, Sicily, Bourbon, St. Helena, Java, Sumatra, Tristan d'Acunha, Faroe and Azore islands, with much of Celebes, Japan, &c., are mainly composed of lava and rocks, as sandstone and limestone, upheaved by volcanic action. Such are some of the effects of that tremendous power which in the hands of Omnipotence has played so important a part in the formation of the habitable globe.

During the most ancient times, and in the divinely framed language of inspiration, silver is used as the primary symbol to denote truth. Truth is as an ocean, vast and inexhaustible. Of a verity the symbol is in this instance true to its original, for such a thing as an exhausted silver mine has never been known within the memory of man. Pliny speaks of silver-mines being worked during his time to the depth of a mile and a half. The old Spanish mines, opened long before the time of Hannibal, are still worked with enormous profits; the Hungarian mines, worked by the Romans long prior to the Christian era, are still productive; the South American silver mines have yielded great profits during 300 years. The silver mines in the Hartz mountains, and at Freiberg, Germany, discovered during the 11th century, and worked constantly ever since, yield a steady increase. The Mexican silver mines have yielded, since the Spanish Conquest up to 1860, $2,039,100,000, and are even now enormously rich. In Sweden and Norway, silver mines worked before the discovery of America are still yielding profitable returns. The Cerro de Pasco mines, Peru, discovered in 1630, from which 5,000,000 lbs. of silver have been taken in 45 years, are still productive. The entire silver yield of Spain is at present about 100,000 lbs. troy per annum. In Bolivia, S. A., the annual production of silver is at present about 450,000 lbs.; here are situated the famous mines of Potosi, formerly belonging to Peru, which are said to have yielded $1,200,000,000. Of the silver lode mining districts of Mexico and South America, the Sierra Madre mines have yielded $800,000,000; Veta Madre, $235,934,636; Rio Grande, $650,000,000; Royas, $85,421,015; Valencia, $31,813,486; Santa Anna, $21,347,210; Biscania, $16,341,000. The Russian mines in the Urals, according to Marshall, yielded in 10 late years, 65,330 lbs. of gold, 412,246 lbs. of silver, and 6067 of platina, from the serpentine rocks.

According to approximate estimates by the best American and German authorities, the total product of all the gold and silver mines in the world, from the year 1500 to 1874, is as follows: Pounds of gold, 17,000,000, valued at $6,450,000,000. Pounds of silver, 364,000,000, valued at $8,175,000,000. Total pounds of gold and silver, 381,600,000,000, valued at $14,625,000,000. In 1810 the annual supply of bullion to Europe was estimsted at $40,000,000, of which one-third was used for manufactures; at the present day the annual supply is much greater. The wealth of France is about $ 40,300,000,000.

Among civilized nations the greater part of this enormous mineral wealth is absorbed by the coinage. The British mint has 8 melting furnaces, 2 cranes, and 2 pouring machines. The furnaces are used three times per day, and as each pot is about 420 lbs. they melt 10,080 lbs. in a day of 10 hours. The gold pots are about 100 lbs. and melt it in an hour. The gold bars are rolled cold to the thickness of the coin, and the silver bars hot. The 8 presses in the mint strike 60 blows per minute, and produce 3600 coins per hour for 10 hours, or at least 30,000 per day, making 240,000 for the 8 presses. Good steel dies make 300,000 to 400,000 impressions before wearing out.

A lb. troy of gold yields $46\frac{29}{40}$ sovereigns, a lb. troy of silver yields 66s. (the alloy is extra), and there are 107,520 halfpence in a ton of copper, worth £224. Griffin estimates the wealth of the United Kingdom at $39,200,000,000.

The ores of silver, tin, copper, lead, &c., are generally found in what are called "*lodes*," which resemble deep fissures in the earth, filled up with ore and vein stuff. There are no ores of gold, but it is found to pervade simliar lodes in quartz rock. These lodes are known to penetrate the earth to profound depths, and most frequently assume the form of a wedge, with the thin

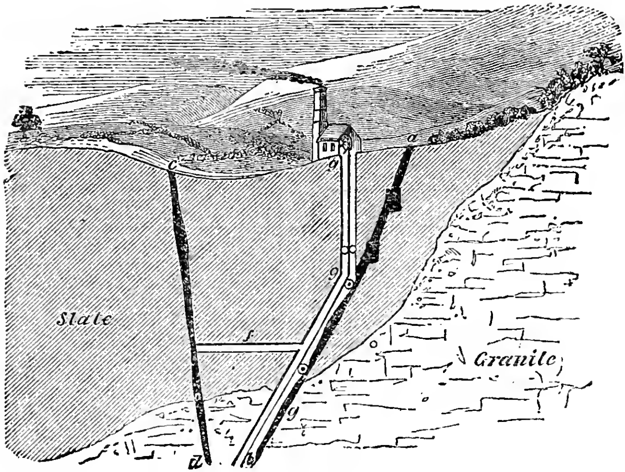


Fig. 9.

end uppermost, widening as it descends downwards to an unknown distance. In some cases these lodes enter the earth with a slight incline, and they are known to extend to a distance of several miles in a horizontal direc-

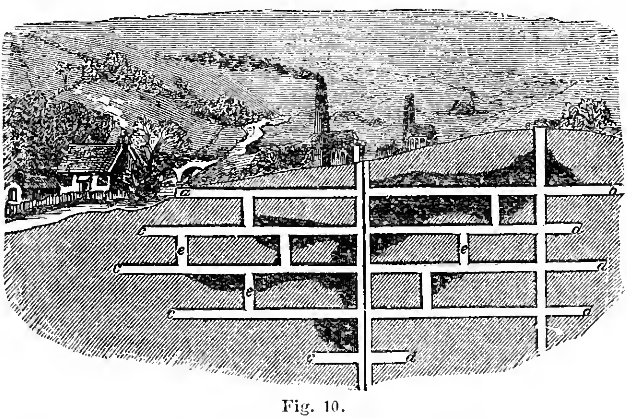
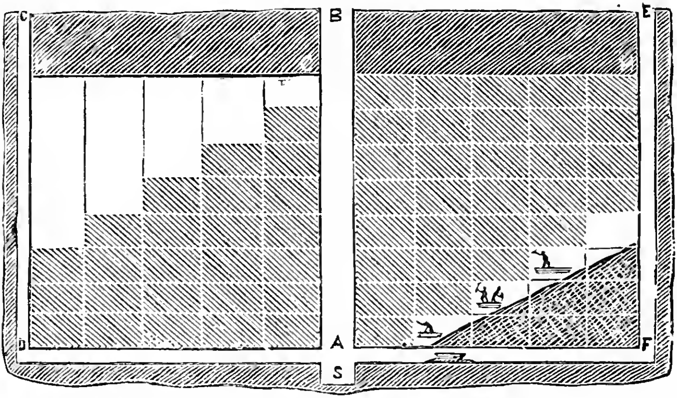


Fig. 10.

tion, with a width ranging from less than 1 inch to many feet. Fig. 9, reproduced from *Weale's* admirable series, represents two lodes, the first, *a*, *b*, to the right, enters the earth at an angle ; *c*, *d*, represents a lode underlying to the left ; *f*, represents a cross-cut ; *ggg*, a shaft, at first perpendicular, afterwards upon the lode.

Fig. 10 represents a longitudinal section of a mine in which the shaded part represents the excavations penetrated by two perpendicul shafts, *a b*, the adit level, c *d*, *c d*, *c d*, other levels, usually 10 fathoms or 60 ft. below each other ; *c e*, winzes, or small shafts connecting two levels, and used for the purposes of ventilation and exploration.

A shaft may be vertical or inclined. It is styled a tunnel when it forms with the horizon an angle less than 45 degrees.



UNDERHAND STOPING. Fig. 11. OVERHAND STOPING.

Fig. 11 represents the process of *stoping* or *exploitation* in veins of the Rake species, by which the ore is extracted from the workings. Stoping may be classified under two heads: 1st. Overhand stoping ; as shown on the right side of the figure, by which the ore is extracted by working from below upwards. Overhand stoping is the method in general use in this country ; by this method of working in ascending steps, the ore, as detached, falls by its own gravity. 2nd. Underhand stoping ; as shown on the left of the cut, by which the mineral is taken from the vein by working in descending steps from above downwards.

In the cut, B A is the hoisting shaft, C D and E F are air shafts, S is the sump or well at the bottom of the shaft, and D F a tunnel, level, or gallery in the mine. Imagine the ore in the vein to be laid out in rectangular masses as exhibited in the cut ; these steps or benches, generally 15 or 20 ft. long, 6 or 8 ft. high, and as wide as the vein, form in consecutive succession the ground from whence the ore is extracted by stoping or working in steps. The miners, in overhand stoping, use temporary stages from which they attack the vein by means of drills, picks, &c. ; the ore and rubbish are blasted down and piled behind the miners on a strong scaffolding of timbers, from whence the ore is discharged through suitable apertures called *mills* or *passes* (located at proper distances apart) to the level below, to be conveyed by cars, &c., to the mouth of the level, or to the hoisting shaft, for elevation to the surface. The worthless rubbish is sorted out and used for filling material to occupy the vacancies and to support the mine. When this material is deficient it must be supplied from the surface, especially when the ore deposits are of great extent and the vacancies large. The filling should be tamped solid. In the vicinity of the working shaft and other suitable places, pillars of vein stone may be allowed to remain with good results. In Mexico, very extensive mines are wholly sustained by pillars of ore, the number, size, distance apart, &c., of which are clearly defined by law.

The first process in opening a mine is to find the lode, then a hole is usually driven straight down into the earth so as to strike the lode, as represented in Fig. 9. This is termed "sinking the shaft," which is then carried down upon it as shown in the cut, although it frequently happens that the shaft is carried down on the lode from the surface. As the shaft descends the adit level is driven; this is merely a tunnel dug from the nearest valley or water-course right into the mountain or hill in which the lode is located, so that all the water above the level will flow away of itself. In going deeper other levels are driven to the right and left, extending to great distances from the shaft, but always following the direction of the lode, and these levels are interpenetrated at suitable distances by smaller shafts, called *winzes*, which are of great use in promoting proper ventilation in the mine. As the workings are extended other shafts are dug from the surface as necessity may require, but they should be at least 300 ft. apart; and where a mine has more than one lode, a gallery or level, called a "cross-cut," is driven to it as shown at *f*, in Fig. 9. The size of shafts vary according to the duty required. To accommodate pumping and winding machinery for elevating the "kibbles," or buckets of ore, by steam power, it should be from 6 to 8 ft. in width and from 14 to 20 ft. in length. Square shafts are usually lined in whole or in part with timber, and circular shafts are generally built up with stone. For a depth of from 50 to 100 ft. the elevation

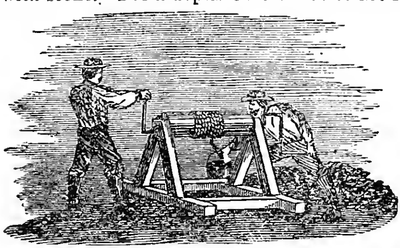


Fig. 12.—WINDLASS.

of the ore may be effected by means of a windlass, as shown in Fig. 12; in sinking a "winze" from level to level, but not penetrating to the surface, the same means are used, but in deeper excavations it is usual to raise the ore by what is styled a "whim," worked by horse-power, as shown in Fig. 13, in which the cable which elevates the ore is wound around a vertical drum.

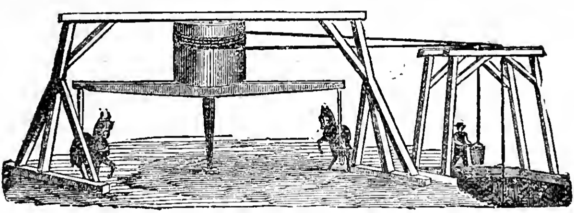


Fig. 13.—HORSE WHIM.

The next illustration, Fig. 14, represents an ingenious miner's hoisting power constructed by Reynolds, Rix & Co., of San Francisco, who claim that it will do the work of a steam engine at one-tenth the expense, as one horse can easily hoist by it 1000 lbs. at a depth of 500 ft.

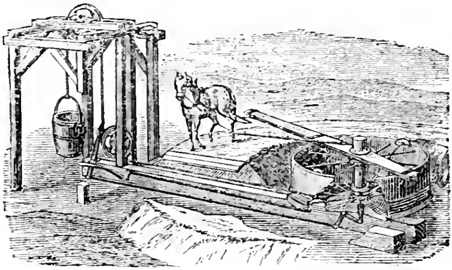


Fig. 14.—Miner's Hoisting power.

For deep mines the horse whim is generally superseded by reversible winding engines, Fig. 15, in which the chain or wire-rope passes around a horizontal drum, which is driven with great rapidity by steam-power, but this costly machinery is seldom applied to mines unless it is settled beyond a doubt that they will become of permanent value.

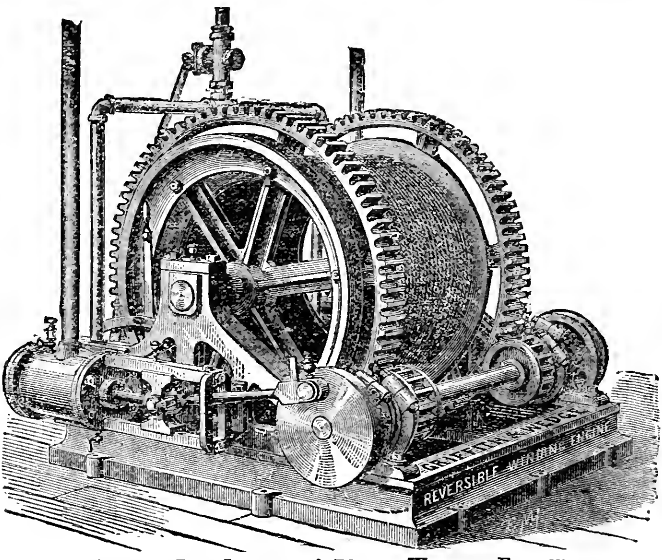


Fig. 15.—The Griffith & Wedge Winding Engine.

Water-power, if available, can also be used to good advantage for lowering into the mine timbers, tools, supplies, &c., and for elevating ore, pumping, &c.

Fig. 16 represents a "kibble," or large iron bucket used in raising the ore ; it will hold a ton, more or less. Fig. 17, at *a*, represents a contrivance running on wheels (on rails or guides of wood or metal) called a "skip," *bb*, represents the guide, *cc*, timbers of the shaft, *dd*, rock through which

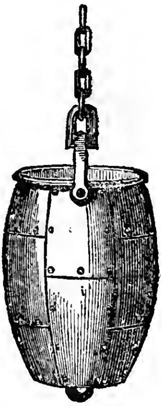


Fig. 16.—A KIBBLE.

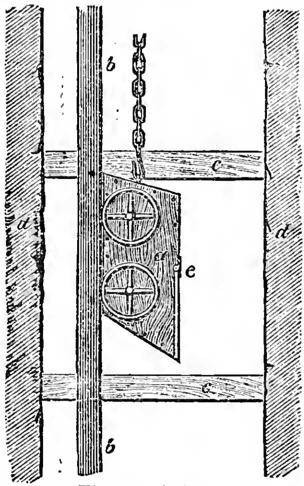


Fig. 17.—A SKIP.

the shaft is sunk. The skip has the lower end of one side hinged like a door, and will hold 2 tons or more if required. Formerly these contrivances were elevated by means of hemp ropes or iron chains, which in many cases caused dreadful accidents through frequent breakages. Of late years wire ropes have displaced the ropes and chains of former times, the tensile strength of wire rope being much greater, and its tendency to rupture being much less than that of ropes or iron chains, which are liable to part quite suddenly without the slightest warning, often causing fearful loss of life. Wire ropes never break without giving previous warning.

Fig. 18.

Fig. 19.

Fig. 18 represents the manner of timbering tunnels when the rock is of a soft, crumbling nature, with a liability to cave inward, the cross pieces on the tunnel bed being placed against the vertical posts to enable them to withstand the inward pressure. Fig. 19 represents the method of timbering where the tunnel is composed of solid rock on the one side and loose material on the other.

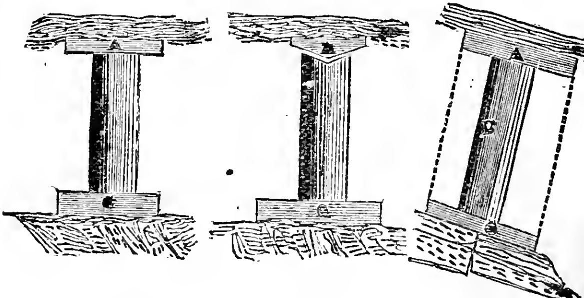


Fig. 20. Fig. 21. Fig. 22.

Figs. 20, 21 and 22 represent the underground timbers of a mine ; the first two show the position of timbers to sustain a vertical pressure from above, the third figure represents an inclined timber to sustain both vertical and side pressure.

In the lofty excavations on the Comstock lode such supports as the above noted would be utterly inadequate, hence the plan of timbering in square sets was contrived and adopted. This consists of square 14-inch timbers framed and put together in the form of cribs, as shown in Fig. 23, four by five or six feet in size ; these cribs are piled one upon another to any desired height, and firmly framed together so as to fill up and support the roof and sides of any sized cavity or excavation, while the interior vacancies may be packed solid with waste rock. They also serve to sustain the stulls or timbers (frequently in very lofty positions) which are occupied by the miners while at work extracting the ore.

A tunnel is to be regarded as a shaft when it forms with the horizon an angle exceeding forty five degrees (45°). A common size for tunnels is 3 ft. wide at the top, $3\frac{1}{2}$ to 4 ft. wide at the bottom, and 6 ft. high, but the size is quite often determined by the size of the vein in which it is driven, the size of the one being generally made to conform to that of the other. As a rule, shafts and tunnels should be wrought in the lode.

The item of timbering the various shafts, tunnels, excavations, &c., of mines is one of immense cost, but it is of paramount importance that the work be efficiently performed by competent workmen, otherwise loss of life and serious damage to the works will certainly result. The timber should be left as round as possible, be stripped of its bark, and to ensure safety against rot, be kept well saturated with water by means of little spouts or pipes in connection with the cisterns.

In some mines the pillars of rock, ore, &c., left standing at suitable distances for the protection of the mine, preclude the necessity for props of timber. In addition to the above, the refuse rubbish which accumulates in the mine after the extraction of the ore, is piled up against the supports to fill up the excavations so as to sustain the immense masses overhead.

In mining operations, penetration is effected by means of rock drills, manual tools, gunpowder, fire, nitro-glycerine, &c.; the hand tools for drilling and blasting are, a sledge, borer, claying-bar, scraper, needle or nail, and a tamping-bar. The borer is of iron, tipped with steel, shaped like a stout chisel, and well tempered. The hole being drilled, a cartridge is inserted in it, or a quantity of gunpowder is rammed in and fired. To increase the force of the powder, the upper part of the aperture above the powder is (after the fuse is properly inserted) filled with sand or clay, which is rammed down hard by means of a *tamping bar*, formed of hard wood, or of iron with a copper tip, which is struck with a heavy hammer. In many instances lamentable accidents have occurred by the use of iron or steel tamping bars causing premature explosions by striking fire against the sides of the hole; hence the necessity for the use of wooden, or copper-tipped tamping bars, which never, under any circumstances, strike fire by concussion against the rocks. The hole being tamped, the projecting end of the safety-fuse is ignited, and while the combustible matter which fills the interior of the fuse is slowly burning towards the end inserted in the powder, the men withdraw to a sheltered place to avoid danger from the flying rocks projected by the explosion. As nearly as can be computed the amount of powder employed in blasting should be just enough to split the rock; in some cases this is effected by the action of fire without blasting.

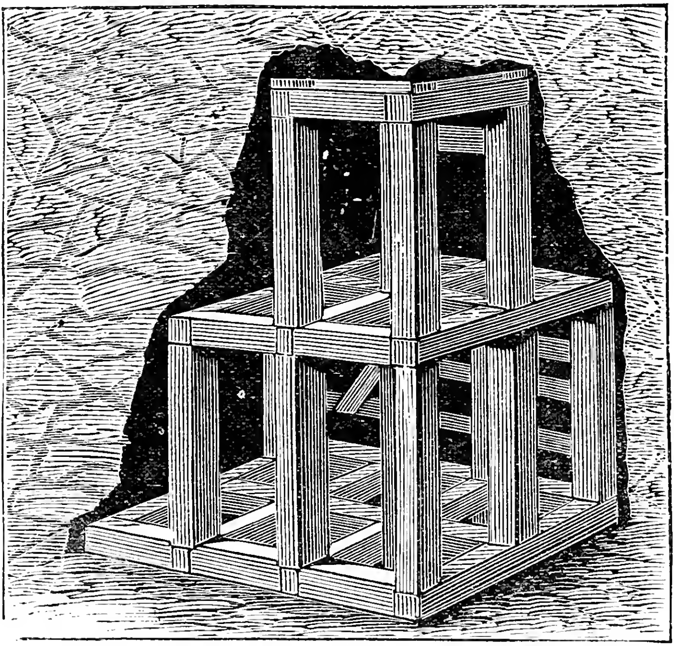


Fig. 23.--Timbering of Mines on the Comstock Lode.

In using nitro-glycerine for blasting in mines, the advantages are, that it requires a smaller hole than gunpowder; it dispenses with tamping, as water only is used (to fill the holes), in which it is easily ignited; it is much cheaper than gunpowder, and has, taken volume for volume, twelve times greater explosive force. See page 666. Lastly, it can, with proper precautions, be easily manufactured on or near the spot where it is required for use, the main conditions being, that syrup of glycerine shall be slowly dropped in a compound formed of equal quantities of nitric and sulphuric acids contained in a strong vessel surrounded by ice, with a thorough agitation of the mixture after each addition of the syrup. The nitro-glycerine, of an oily composition, is removed from the surface and repeatedly washed with clean water. It is liable to explosion during the process of manufacture, if not kept cold.

The disadvantages of nitro-glycerine are, that it is poisonous, and exhales poisonous vapors after being exploded, thus rendering its use impossible in confined workings under ground; it explodes at a temperature of 300° Fahr.; when pure it explodes by concussion alone, and when impure it is liable to spontaneous explosion.

In quartz mining the grand primary step in beginning should be to determine, beyond doubt, the value of the vein or mine. In "prospecting" a vein of the Rake species, a shaft should be sunk on it to a depth of at least 100 ft. and a tunnel driven to correspond. If the ore on being worked yields favorable results, the inference is that it is safe to invest money on a large scale in the erection of suitable machinery for extensive mining operations.

QUARTZ MACHINERY.

Among the appliances for this purpose may be mentioned ore-breakers, stamp batteries, grinders, amalgamators, concentrators, separators, crucibles, retorts, &c. The ore-breaker is used for crushing mineral substances into fragments small enough to be passed into the stamp batteries.

The following cuts represent the Blake Ore Breaker, a machine widely known as having earned for itself the highest character for efficiency wherever it has been brought into use.

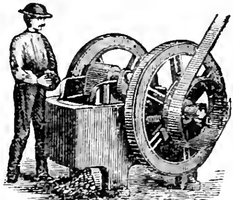


Fig. 24.—Breaker at Work.

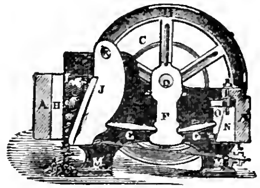


Fig. 25.—Sectional view of Breaker.

Its principal features are a heavy frame, in which are set two upright jaws, one of which is usually fixed, while the other has a slight vibratory movement imparted by a rotating shaft. These jaws are wide enough apart at the top to receive the ore to be broken, but converge towards each other below, so that at the bottom the opening is only wide enough to permit the fragments to pass when broken to the required size. The working parts are made enormously strong and massive to withstand the strain and wear to which they are subjected in crushing rocks and minerals, some of which will yield only to a pressure of 13½ tons (27,000 lbs.) to the square inch. One of these machines, weighing 11,600 lbs., and requiring 6 horse-power, with a feed opening of 15 x 9 ins. area, will reduce 100 to 150 tons of rock per day to a size suitable for the batteries. These machines are made of various sizes; some of them will take in a stone weighing half a ton and reduce it to fragments in 5 seconds. The crank should make about 180 revolutions per minute. For macadamizing purposes, a 15 x 9 machine will produce 100 cubic yds. of road metal per day, the fragments being 1¼ ins. in diam. and less. The distance between the jaws at the bottom, which limits the size of the fragments, may be regulated at pleasure, and the wearing parts, when worn out, may be replaced by new plates at slight cost.

There are other ore breakers in the market, as Alden's, Bullock's, &c., which give very good results, and are in every respect reliable machines.

THE STAMP BATTERY.

Fig. 26 presents a view of the method of wet-crushing by stamp batteries, with a row of Hepburn and Peterson's amalgamating pans in front. In the rear is the engine which supplies the motive power to operate the stamps, which are raised by cams secured to the horizontal shafting shown in front of the vertical stamp stems. The liquefied mass of ore passes from the batteries through the perforated sheet-iron, or wire screens, into the sluice boxes displayed in front of the batteries. The battery comprises the frame (usually formed of strong timbers), stamps, mortars, stamp-stems, cams, cam-shaft, tappets, shoes, dies, guides, and screens.

In operating on a large scale, mortars are usually arranged to accomodate three, four, five, or six stamps each, but mill men of long experience prefer the five-stamp mortar, and round instead of square stamps. The cam-shaft is a round bar of iron, usually about $4\frac{1}{2}$ ins. diam., turned, finished, and with the cams secured on it by means of keys, is frequently used to operate from 5 to 60 or more stamps standing in line. The lift of the stamps is effected by the cams operating on tappets which project from the stamp stems. The latter are of wrought iron, turned, finished, and fitted into the stamp head, which is formed of the toughest cast-iron, and armed with a "shoe" formed of the best cast-steel or white iron, on the lower part, next the mortar die. The shoes may be removed and replaced by new ones when they are worn out. The mortar dies should be formed of the same material as the shoes, and well secured on solid timber foundations with one die under each stamp. The stamp guides are usually formed of the hardest wood procurable, and are fastened by iron bolts to the cross ties of the battery timber frame.

The screen in general use for working ores by the *wet* process, is formed of the best Russia sheet-iron, perforated by punches ranging in size from the number nine to the number one sewing needle. In working ores by the *dry* process, the screen is generally made of wire, ranging in fineness from 900 to 10,000 meshes to the inch.

The capacity of a stamp weighing 650 lbs., with 90 12-in. drops in a minute, is equivalent to the reduction of $2\frac{1}{2}$ tons of hard, tough ore in 24 hours, and the power used is nearly $\frac{1}{2}$ horse-power per ton of ore. To obtain the best results in feeding the rock into the battery, the rule among practical mill men is to grade the supply of rock so that the blows of iron to iron will be heard every 10th or 15th stroke of the stamp, and the weight of water to rock required for the reduction of gold or silver ore is as $4\frac{1}{2}$ to 1.

In constructing a stamp-mill, the primary object should be to secure a site of at least 21 or 22 ft. elevation, in order to so arrange the different floors that the material under manipulation shall pass by its own gravity from one stage of the process to another, and the location should, if possible, be in close proximity to the mine from which the mineral products are obtained. The foundations under all the machines must possess absolute stability : if the bed-rock, owing to its depth, is not available for foundation purposes, brick or stone work, or timber mud-sills must be substituted. For stamp batteries, vertical timbers, strongly bound together, resting on the bed-rock, or otherwise properly secured, will be found in every respect to form the best possible foundation for the mortars. The vertical position gives easier access for making repairs, the removal of defective timbers, &c., together with less concussion from the blows of the stamps than when the foundation timbers occupy a horizontal position.

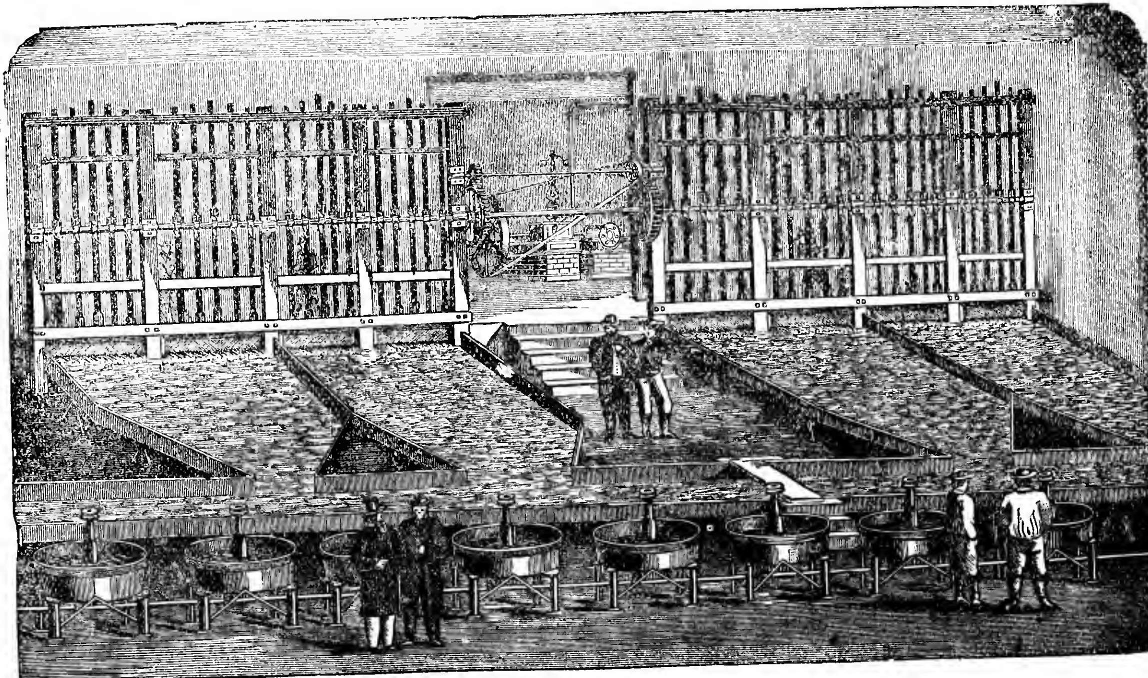


Fig. 26.—Engine and Stamp Battery, with Hepburn's and Peterson's Pans.

The entire appliances of the mill, consisting of the batteries, rock-breaker, grinders, amalgamators, concentrators, &c., are operated by means of shafting, which transmits the power to the various machines by means of pulleys, belts, or gearing, the prime mover being either water or steam power.

In the arrangement of a SILVER MILL, the *rock breaker*, or *ore crusher* is the first in order, and the *stamp batteries* follow at a distance of 12 or more feet, the feed floor of the latter being 10 ft., more or less, below the floor of the ore crusher. The rock fed into the batteries being triturated sufficiently fine to pass through No. 4 or No. 5 perforated Russia iron screens, the fluid mass passes from the stamps into the settling tanks, which are generally placed so that their tops are level with the upper side of the battery frame sills.

The *tanks* should be arranged in successive series in order to accord ample space for the water to deposit the suspended ore before passing off. A good size for tanks is 5 × 7 ft., with a depth of 3 ft., which will afford capacity for between 4 and 5 tons of crushed ore.

Next in order, near the tanks, follow the *grinders* and *amalgamators*, with their upper rims level with the tops of the tanks. After passing the tanks the ore is worked in charges, and reduced in these machines to a slimy mass, and one of these contrivances, with muller 4 ft. diam., requiring about 5 ft. fall and 7 ft. run, the muller making 75 revolutions per minute, will reduce 5 tons of ore in 24 hours with 5 horse-power.

The *separator* follows in close proximity to the grinder and amalgamator, its sides being frequently under the platform of the latter, and sometimes removed from under it and slightly elevated above it. Wheeler and Randall's Conoidal Separator, 7 ft. diam., with a capacity for working 10 tons of ore per day with 1 horse-power, requires of itself 4 to 5 ft. fall and 9 ft. run, including platform.

The *concentrator* is the next in order, receiving the ore as it passes from the separator, the denser and richer portions flowing off at the sulphuret pipe into the tank, and the less valuable part passing away at the discharge end. The Tabular Concentrator requires about 3 ft. fall and 10 ft. run, and is capable of working from 5 to 10 tons of ore per day with one-half of a horse-power.

The appliances of a GOLD MILL include the rock breaker, stamps, grinder and amalgamator, separator, &c., as noted above in the description of a silver mill, with the sole exception that they are subject to greater modification of arrangement, which is determined in every case by the character of the gold and the rock to be operated upon.

The various machines, as arranged in the silver mill just described, may be rendered available for operations on gold where the latter is fine and equally diffused through the rock, only a larger number of concentrators and amalgamators should be used, the latter just after the stamp batteries, and as amalgamators only.

Amalgamators, grinders and separators should not be employed where the gold is quite coarse and clean in the rock.

What is known as the "continuous process" is the one best adapted for working rock where the gold is coarse and coated.

Where the gold in the rock is largely combined with sulphurets, the best method is to use the concentrators and amalgamators immediately after the batteries, the approved way being to reduce the concentrated portions of the rock in the grinders and amalgamators, work in separators, and lastly, treat by means of another series of concentrators.

The best authorities prefer amalgamating in the batteries, but this must be done with the utmost care, for if too little quicksilver be added the amalgam will become dry and granular, and flow away with the current of crushed ore; if too much be added the resultant amalgam will liquify and be carried off by the stream. The practical rule is to feed the quicksilver into the batteries in small quantities, and feed frequently, sprinkling or expressing it through buckskin or other porous material, so that the amalgam, after emerging from the screens, may be indented by a slight pressure between the fingers; if the consistency is such that it will retain the finger marks it is just right. The quantity of quicksilver required varies with the amount of gold in the ore; 1 oz. of quicksilver to 1 oz. of gold is a common allowance; when the gold is very fine, $1\frac{1}{4}$ to $1\frac{1}{2}$, and even 2 ozs. to 1 of gold may be added.

In amalgamating in the battery, the sides of the enclosure containing the stamps is fitted the entire length of the battery with amalgamated copper plates from 3 to 5 ins. wide, arranged with a pitch of 35° or 40° toward the dies. One of the plates is placed at the feed side and the other at the discharge side of the stamps, and the amalgamation is effected by rubbing quicksilver on the plates, as described on page 454. With ore containing heavy gold, from 60 to 70 per cent. may be saved in the battery by the amalgam plates, but with light gold, from 300 to 400 fine, not so much, as it is liable to become entangled with the light scum of foreign matters and pass away with the current.

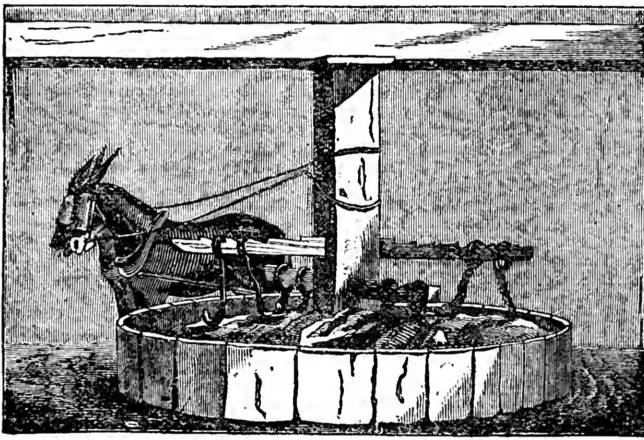


Fig. 27.—Mexican Arastra.

Amalgamation of Gold in the Arastra.—The arastra is composed of a circular granite-paved bottom, from 6 to 20 ft. in diam., surrounded by a wooden enclosure over 2 ft. high, with a vertical wooden shaft in the centre, provided with two or more projecting arms to which mullers (composed of large blocks of granite) are attached by means of chains, as shown in Fig. 27. This primitive, but effective machine is operated by mules when water-power is not available; the mullers making from 6 to 10 revolutions per minute, with a capacity of grinding from $1\frac{1}{2}$ to 2 tons of rock (the fragments being broken as small as a hen's egg, or less) in 24 hours. Of the arastra, Mr. Kustel, a high authority, writes as follows:

"When in motion, the arastra is charged with 200 lbs. of ore, with some water. One-quarter of an hour afterward the balance of the whole charge, from 400 to 500 lbs., is introduced. As soon as the ore is turned into mud 1 or 2 ozs. of quicksilver are pressed through a dry cloth over the thick pulp. A sample is taken from time to time with the horn spoon, washed, and examined. When free gold is perceived, after the amalgamation has gone on for some time, some more quicksilver may be added. The first charges require a little more quicksilver. After 4 or 5 hours the pulp is diluted with water and discharged. The next charge is treated in the same way, and so on till 100 or 150 tons are worked through. The quicksilver must be used always in proportion with the gold—1 or $1\frac{1}{2}$ ozs. to 1 oz. of gold. The amalgam imbeds in the crevices of the bottom, and must be always dry. The use of too much quicksilver makes the amalgam thin, causes an imperfect amalgamation, and a loss in quicksilver, which is often found beneath the bottom rock." When the reducing and amalgamating process is finished the slime is washed off, and the amalgam cleaned up, squeezed, and retorted.

AMALGAMATION OF GOLD BY THE PAN PROCESS.—In this process the ore, as it comes from the stamps, is still further reduced by being thoroughly ground (with sufficient water to form a thin paste) in iron pans, in combination with quicksilver. Some maintain that the process is accelerated by means of heat, applied by passing steam into chambers underneath the pulp, or into the charge in the pan, but extended experiments do not confirm this view. The quicksilver is generally added as the pans commence running, and, to avoid excessive trituration of the quicksilver, the addition is often made with the muller slightly elevated, after the grinding of the ores. After the process is finished the charge is withdrawn and washed, leaving the amalgam in the separators. With the Wheeler & Randall grinders and amalgamators (4 ft. muller), the proportions of the charge is, ore 2000 lbs., quicksilver, 30 to 70 lbs., revolutions of muller, 60 to 65, time of reducing, generally about 3 hours.

The pan process, if well conducted, will secure as much as 95 per cent. of the gold detected by a fire assay, but it is not well adapted for treating raw ores containing the compounds of sulphur, iron, bismuth, tellurium, antimony, arsenic, lead, or zinc, until such ores have been roasted or smelted, and the pernicious substances thoroughly expelled.

TREATMENT OF GOLD ORES BY THE CHLORINATION PROCESS.—In this process the effective agent is chlorine gas, evolved by heating sulphuric acid, per-oxide of manganese, and salt in a leaden generator. The auriferous ore, after being well pulverized, roasted, cooled, and wet with water, is placed in wooden tubs about 7 ft. diam. and 25 or 30 ins. deep, provided with false bottoms. The chlorine gas is conveyed from the generator under the false bottom by lead pipes, and permeates the whole mass in a few hours, transforming the gold into a terchloride of gold. When the greenish tinge of the gas becomes visible on the surface of the mass, the tub is covered close by a wooden cover for the space of 10 or 15 hours, after which it is removed and clean water is poured on the ore, which leaches through it and carries off the dissolved gold through a discharge pipe below into glass vessels. The addition of sulphate of iron, in solution, is used to precipitate the gold, which falls in the form of a black-brown powder, and may be collected, melted, and run into bars. Ores containing lime and talc should be roasted with salt before being treated by this process, and in every case the gas should be purified from muriatic acid by being forced through clean water before being used. Any silver in the metallic state present in the ore treated by this process, is transformed into chloride of silver, which is soluble only in a hot solution of salt, but the chloride of gold is soluble in water, as described above.

RETORTING OF GOLD AMALGAM.—The retorts in common use are cone-shaped cast-iron vessels with circular bottoms. The cone is attached to the upper part by a clamp and wedge (the joint between being luted with clay) and is provided with an exhaust pipe in syphon shape, the shorter arm of which is screwed into the cover, while the longer one passes through a vessel filled with cold water (or a wrapping of wet cloths may be used instead) during the time of operation. The interior of the retort should be dusted with whiting, meal, or any other suitable substance, to prevent the amalgam from adhering, and then filled not over two-thirds full, this precaution being necessary to prevent the apparatus from rupture by the choking of the exhaust pipe, or from any other cause. Apply the heat first of all to the upper part of the retort and the short arm of the pipe, then to the lower part, increasing the heat gradually to all parts, but never going much higher than a bright cherry red.

The quicksilver, volatilized by the heat, passes over and down the long arm of the pipe, through the condenser, and into the receiver, which is usually a vessel filled with water.

CRUCIBLES.—Crucibles are used for melting metals, compounding alloys, reducing ores, assaying, &c. For full directions for making crucibles, consult pp. 491 and 502.

INGOT MOULDS.—These are formed of cast-iron with a trough-shaped cavity, slightly wider and longer at the upper part than at the lower, so as to permit the easy dislodgement of the ingot. This is further promoted by oiling the interior of the mould previous to use.

In estimating the capacity of an ingot mould, it is usual to rate each cubic inch for gold at $125, and for silver at $4.25.

FLUX.—In metallurgy or chemistry a flux is a substance or mixture used to promote the fusion of metals or minerals. *Black flux* is used by introducing slowly in small portions, into a crucible heated to a very dull red heat, a compound of either equal parts of cream of tartar and nitre, or two parts of cream of tarter and one of nitre. *White flux* is compounded of one part of cream of tartar and two parts of nitre.

METALLURGY OF SILVER.

The methods in common use for the extraction of silver from the ore may be classified as follows: 1. Amalgamation of unroasted ores in iron pans. 2. Amalgamation of roasted ores in barrels, iron pans, steam tubs, &c. 3. Patio process of amalgamation in heaps. 4. Smelting with lead ores, or lead, and final separation of the silver by cupellation.

AMALGAMATION OF UNROASTED ORES IN IRON PANS.—This method, known among miners as the "wet process," is in quite extensive use for grinding the unroasted ore (after passing through the stamps and settling tanks) with water into an impalpable slime. The limited capacity of the first pans proved a barrier to extensive operations by the wet process, the small quantity of ore operated on, and the long time required to work the charge, being serious drawbacks to rapid progress. Figures 28 and 29 present a view of the common iron pan, in which *a* is a wooden cross in which wooden blocks, *b*, with iron shoes, *c*, are fastened by the bolts, *d*; each shoe has a pin, *e*, fitting into the wooden block, in order to prevent its moving; on the shaft, *g*, is the yoke, *f*; the two ends of the yoke fit in the holes, *h*, of the cross, *a*, but not too tightly, so that the muller can descend as the shoes wear away. Steam is passed into the slimy charge of ore through the pipe, *l*; *k k* are discharge pipes; *m* is a false bottom of iron, formed in one piece, and 2 inches thick. In these pans the muller revolves with a grinding action, like a millstone, reducing the previously pulverized ore to the finest slime, and intermixing the quicksilver with the mass.

The Wheeler & Randall Excelsior Grinding and Amalgamating Pan, represented by Fig. 28, takes high rank as an efficient machine. It is of cast-iron, has the conoidal form, the centre rising as high as the rim, and moulded so that its vertical section forms the tractory curve, or curve of equal wear, securing perfect uniformity in the wearing of the shoes on the muller and the dies. The muller is propelled by a centre shaft, the upper part of which is a screw to which the muller is attached, and is propelled by gear

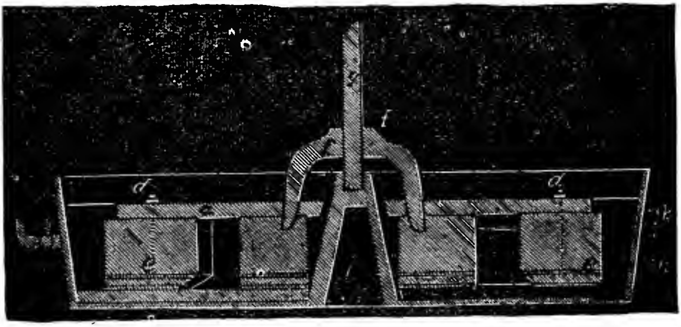


Fig. 28.—Common Amalgamating Pan.

Fig. 29.

wheels on the under side of the pan. The muller is attached by a large nut and secured to its place by a key which enters a slot cut upon one side of the screw. The bottom is provided with a steam chamber or false bottom ; the distance between the muller and the dies is regulated by a screw on the outside of the pan, which, by means of a bent lever at the bottom, raises the vertical shaft, lifting the muller from the surface when required.

In charging, the muller is raised a little, so as to revolve freely, water is admitted through the hose or pipe, the ore, as it comes from the stamps and settling tanks (ores containing much antimony should be roasted) is shovelled in, and steam is introduced through the steam chamber in the bottom, or directly into the pulp, the latter method giving the higher temperature. Keep the heat at or near 200° Fahr., turn off the steam if the pulp becomes too thin, and allow it to thicken by the evaporation of the water while the temperature is maintained by means of the steam chamber. Do not pass the exhaust steam, charged with oil from the engine, direct into the pulp, as

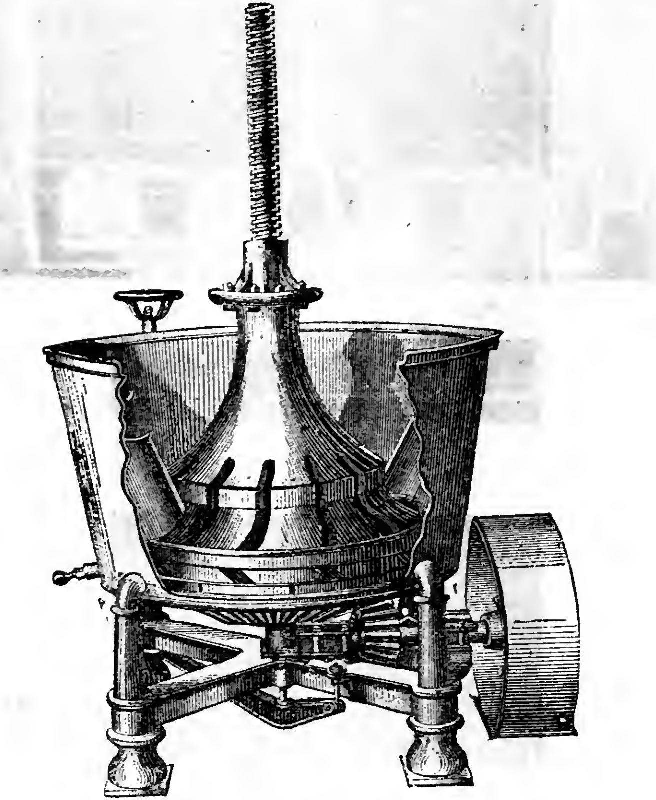


Fig. 30.—Wheeler and Randall's Amalgamating Pan.

it prevents amalgamation ; use live steam from the boiler for this purpose, but the former may be used in the steam chamber if desired. The pulp, if too thick, causes a waste of power, if too thin it will not amalgamate well.

After commencing to grind, the muller should be gradually lowered ; in 2 hours the ore should be reduced to a fine pulp ; at this period quicksilver is supplied by pressing it through canvas, so as to scatter it through the pulp in a finely divided state; the muller is then slightly raised from the bottom, to avoid grinding the quicksilver, which would flour it, and the action is continued for 2 hours longer.

The proportions used to charge one of these pans with 4 ft. muller, are: ore to the charge, 2000 lbs., quicksilver, 30 to 70 lbs., varying with the quality

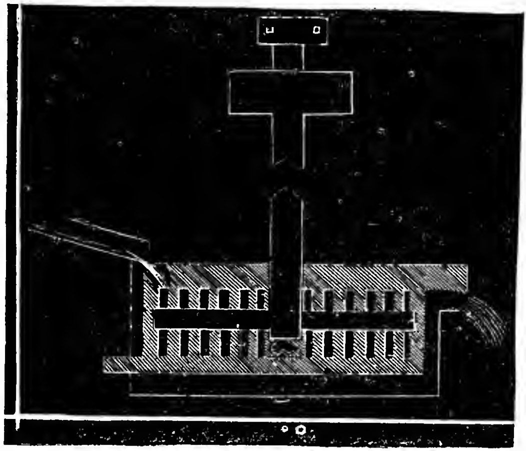


Fig. 31.—Agitator.

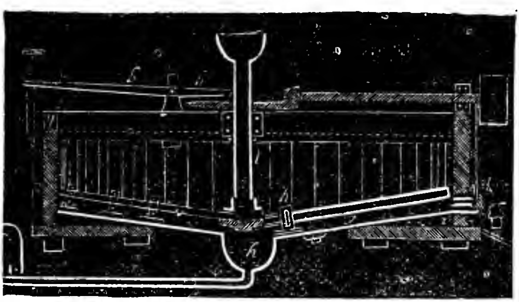


Fig 32.—Wheeler's Agitator.

of the ore; revolutions of muller per minute, 60 to 65. Many chemical compounds have been used in treating raw ores containing sulphide of silver, in order to promote the decomposition of the ores, but their use was more prevalent of late years than at the present time. A number of practical receipts for making them will be found below.

The grinding and amalgamating being completed, the pulp is diluted with water and discharged into the separator, when it is thoroughly washed in plenty of clean water. During the first twenty minutes but little water should be added to the slime in the separator; after that time it may be filled nearly to the brim by a small stream of pure water kept running for 30 minutes or more if necessary; then one after another, beginning with the highest, draw the plugs from the holes and allow the pulp to run off slowly, clean water being allowed to flow into the machine at the same time. In the conoidal separator (capacity, 10 tons of ore in 24 hours) the amalgam is deposited with the quicksilver in the bowl and spiral groove at the circumference. The bulk of the quicksilver is withdrawn through a hole in the bottom of the bowl, and is treated by being washed, squeezed, and retorted. In silver amalgam containing lead, squeezed at a temperature of 144°—180° Fahr., the lead passes off with the mercury, but if squeezed at a lower temperature, it will remain in the bag. The pulp is conveyed from the separator into agitators, or other inventions used for the purpose of collecting the stray amalgam or quicksilver which may be discharged along with the coarser sand from the separator.

The agitator is usually a tub, 2 or 3 ft. in diam. and about 12 ins. high, fitted with an upright, on which are arranged 4 projecting arms carrying stirrers. See fig. 31.

Wheeler's agitator, represented by fig. 32, is about 8 ft. in diam.; the sides are formed of wooden staves from 25 to 30 ins. high, and the bottom is composed of cast-iron, dipping towards the centre, ending in the cavity *h*, for the accumulation of the quicksilver; this is always kept full, and when the pans are discharged the surplus quicksilver passes away by the syphon shown in cut. The tailings pass away continually through a pipe $\frac{3}{8}$ths of an in. in diam. and 4 in. from the bottom, shown at *k*, and the lower pipe, *l*, 1 in. in diam., is the discharge pipe when the agitator requires to be cleaned; another discharge hole is represented at *o*.

Chemicals used in Various Mills in Treating Silver Ores by the Pan Process.—The following practical receipts are transcribed from Guido Kustel's valuable work, entitled, "*Processes of Gold and Silver Extraction.*" The allowance in each case is for 1 ton of ore. *a.* Chloride of copper, 13 lbs.; common salt, 60 lbs. *b.* Chloride of iron, 13 lbs. *c.* Sulphate of iron, 1 lb.; sulphate of copper, 8 lbs.; common salt, 60 lbs. *d.* Sulphuric acid, 3 lbs.; sulphate of copper, 2 lbs.; salt, 15 lbs. *e.* Sulphuric acid, 2 lbs.; alum, 2 lbs.; sulphate of copper, $1\frac{1}{2}$ lbs. *f.* Sulphate of copper, 18 ozs.; sulphate of iron, 16 ozs.; sal ammoniac, 8 ozs.; common salt, 2 lbs. *g.* Alum, $1\frac{1}{2}$ lbs.; sulphate of copper, $1\frac{1}{2}$ lbs.; salt, 40 lbs. *h.* Muriatic acid, 30 ozs.; peroxide of manganese, 8 ozs.; blue vitriol, 10 ozs.; green vitriol, 10 ozs. *i.* Common salt, 15 lbs.; nitric acid, 1 to 2 lbs.; sulphate of iron, 1 to 2 lbs. *k.* Common salt, 25 lbs.; blue vitriol, 2 lbs.; catechu, 2 lbs.

Note.—a, b, c, are calculated for ore containing 250 to 500 ozs. of silver in sulphurets. All chemicals, except salt, are used in solution. The salt is charged half an hour before the chemicals are put in. These chemicals are not well adapted for treating ores containing sulphur, arsenic, or antimony; they should be roasted.

Description of the Machine.—A, Driving shaft; B, Cylinder; C C, Levers to stuffing boxes; D, Lever for pressing upper shoes upon the cylinders; E E, Upper shoes or dies; F, Inside of cylinder; G, Concave bottom of casing; I I, Outside of casing.

Instructons for using Beath's Amalgamator and Separator.—Two of the amalgamators being in operation with one separator, each amalgamator is to be charged with 800 or 1000 lbs. of ore as it is collected from the batteries; at the same time add sufficient water to keep it at a thick, pulpy consistency; you then add fom 10 to 50 lbs. of quicksilver, according to the character and richness of the ore. The machines are kept in operation until the reduction and amalgamation are complete, which time will vary from 2 to 4 hours, according to the character of the ore being reduced.

After the ore is sufficiently reduced and amalgamated, the pulp is discharged into the separator, and the machine is immediately re-charged without stopping.

After the pulp is received by the separator, it is to be thinned with water to a consistency that will allow the quicksilver and amalgam to precipitate and still retain sufficient body to keep the coarser particles of the pulp suspended in the water with the slum.

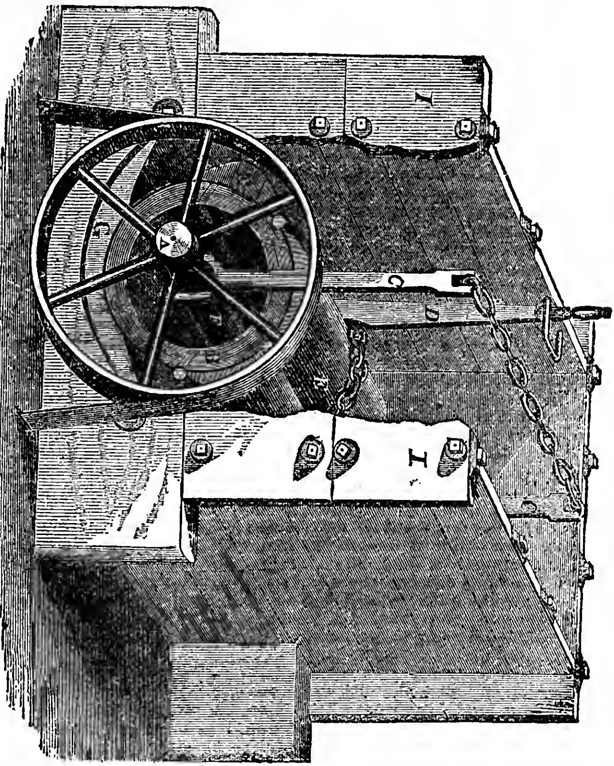


Fig. 33.—Beath's Amalgamator.

Roasting of Silver Ores.—Argentiferous ores are more productive when roasted than when worked raw. The volatile components of the ores must be expelled by heat, and this is effected in two ways, viz.: in *heaps* or in *furnaces*. By the former method the ore, generally as it comes from the mine, is piled in alternate layers with fuel, the bottom layer being of wood piled in angular form in order to permit free circulation of air. For the upper layers coal or wood may be used, the proportion of ore to fuel varying from 1 to 6, to 1 to 18 ; fine ores, or ores abounding in sulphur requiring less fuel than coarse ores, or ores poor in sulphur. Antimonial or or arsenical ores, with little or no sulphurets, should contain an addition of

2 or 3 per cent. of calcined green vitriol before being roasted. The fire is ignited through vertical openings extending downwards through the heap to the ground layer; these apertures are closed when the fire is thoroughly kindled, and the smouldering process is continued for weeks and months, the sulphur in the ore supplying fuel to the fire, while the intensity of the heat may be controlled to any extent by closing or opening the draft holes or chimneys. It sometimes occurs that ores similarly inter-stratified with fuel are roasted in inclosures resembling kilns, provided with side openings. The roasting process transforms the silver into a chloride, easily decomposed by the quicksilver, and therefore rapidly amalgamated.

The leading reactions which take place in roasting silver ores with salt, are mainly as follows: In submitting iron pyrites and other sulphurets to a red heat in contact with air, they become, in a great measure, transmuted into sulphates, part of the sulphur becomes sulphuric acid, which combines with the metallic oxides, while another portion disappears as sulphurous acid. As this part of the process requires a low degree of heat, no decomposition of the salt will take place, but on the formation of the sulphates and the disappearance of all odor of sulphurous acid, the temperature must be increased and the decomposition of the salt will begin. This takes place in two ways:—

First.—In roasting, the sulphates of iron and other sulphates give off vapors of sulphuric acid, which, in union with salt forms sulphate of soda, while the chlorine escapes in a gaseous form and combines with any native metals in the mass under treatment, decomposing the sulphurets in such a manner that one part of the chlorine gas combines with the sulphur as chloride of sulphur, which exhales, while the other part forms a coloride with the liberated metal.

Second.—By the other method of decomposition the salt and sulphate mutually decompose each other. The sulphate of silver, being compounded of sulphuric acid, oxygen, and silver, being heated in contact with common salt (which is composed of chlorine and sodium), the silver combines with the chlorine, the result being chloride of silver, while the oxygen and sodium forming soda, is, with the sulphuric acid, converted into sulphate of soda. When the vapor of water is present, during these various reactions, muriatic acid is formed in addition. The quantity of sulphurets and earthy matters present in ores should be determined by inspection previous to roasting them. A surplus of lime in the ore, will, by combining with sulphuric acid, form sulphate of lime, which will remain unchanged throughout the process. To effect decomposition in such ores, sulphates or quartzose ores must be added in quantity sufficient to change all the lime into sulphate. Talcose ores must be treated in a similar way, the primary use of the sulphurets in the ore being to decompose the quantity of salt required for chlorination.

Guido Küstel, in his admirable work on the "*Processes of Silver and Gold Extraction*," writes; "In Freiberg (Germany) it was the rule to subject only that ore to roasting which contained enough sulphurets to give 25 to 30 per cent. of matt (sulphide of iron) when assayed for that purpose. If less matt was obtained, the ore had to be mixed with other ore, or so much iron pyrites was added that the required quantity of sulphurets was obtained. The second class ore of the Ophir and Mexican claims in the Comstock lode, consisting of pure decomposed quartz, contains silver sulphurets, with a small proportion of iron pyrites, yielding from 6 to 8 per cent. of matt. The roasting with salt, however, gives a satisfactory result, which must be attributed chiefly to the pure quartzose condition of the ore.

"If the ore contains an abundance of sulphurets, the roasting must be performed without salt, for about two hours, till the greatest part of the sulphur is driven off, otherwise it would bake, and cause an imperfect roasting.

"The quantity of sulphurets has a great influence on the result of roasting. Ore like that of the Ophir or Mexican mines, containing silverglance, polybasite, brittle silver ore, native silver and gold, some iron, and but little copper pyrites, will give a good result by roasting, even when less attention is paid to the time and diligent stirring, than, for instance, with the so-called 'base-metal ore,' which abounds in copper pyrites, zinc-blend, sulphuret of lead, etc. The presence of base metals causes a higher loss in silver. The chloride of silver is not volatile, except at a high temperature. But it has been observed that, in the presence of base-metal chlorides, the chloride of silver volatilizes also. The increased heat increases the volatilization, but decomposes the base-metal chlorides. By keeping a low heat, the loss of silver is less if the zinc-blend is not argentiferous, the latter requiring a higher heat to effect decomposition. But in roasting at a low heat, the base-metal chlorides remain in the ore, and cause more loss of quicksilver in the subsequent amalgamation, and require more metallic iron in the barrels; besides, the bullion contains a great deal of base metals. In treating such ore in the roasting-furnace, the application of steam is advantageous, creating hydrochloric acid by the decomposition of chlorides, at the same time becoming a decomposing agent for the sulphurets. The hydrogen of the steam decomposes also the chloride of silver, which, upon being reduced to a metallic condition, by its affinity for chlorine, in turn decomposes the hydrochloric acid. The silver may thus change repeatedly from metallic condition to the chloride, while the base-metal chlorides are reduced to oxides, and in that state do not interfere with the amalgamation."

Roasting, Calcining, and Chloridizing Silver Ores in Furnaces.—Of the many furnaces, and for this purpose, the reverbatory kind is by far the best. The interior surfaces should be constructed of the best fire brick, placed edgeways, the exterior walls may be of stone or common brick, and the whole structure should be throughly braced with iron rods and well-seasoned previous to being used. The reverberatory furnace is constructed either with one, or two hearths, as may be desired; the calcining and chloridizing being effected on the lower hearth, while the roasting and sulphatization is done on the upper one. On the upper hearth the pulverized ore is placed to a depth of from 2 to 4 ins., the heat is maintained at a low temperature, not over a brown or dull red, with frequent stirring of the ore, and the supply of air should be abundant. To promote oxidation and control the temperature, a jet of steam should be used. When the ores contain arsenic, powdered charcoal in small quantities may be used to good advantage, and if the ores are poor in sulphur, from 2 to 3 per cent. of the sulphate of iron may be added. The roasting and sulphatizing will be completed in from 4 to 5 hours, when the ore is permitted to drop through an aperture in the upper hearth on to the lower one, where for some time it is kept at a temperature but slightly higher than that previously noted, but is afterwards raised and maintained at a cherry red, and should never exceed a bright red, the ore being stirred meanwhile, during the calcining and chloridizing processes. When the calcination is effected, which will be in from 4 to 5 hours, a melted and well pulverized mixture of common salt, and 7 parts of cold calcined ore, are added to the hot ore on the hearth (calculated at 15 parts), and the whole mass is completely intermixed by vigorous stirring. This latter, called the chlorination process, will usually occupy about 15 or 20 minutes.

Amalgamation in Dr. Veitch's Steam Tubs.—The primary difference between this process and the last noted consists in the employment of tubs instead of barrels and the use of steam directly in the pulp. The tubs are about 4 ft. deep and 4 ft. diam. The bottom is made of cast-iron with three circular apertures for the reception of cast-iron perforated plates; below are the steam-chambers. The holes are about 2 ins. apart, and very small. In the centre of the tub is a vertical shaft, suspended in a box outside of the tub. There are three arms attached to it, each having three arms of copper or iron plates hanging perpendicularly in concentric lines. The movable cover has an orifice in connection with a flue by which the steam and some quicksilver are conveyed into cooling tanks.

In operating, the steam is projected through the perforated plates into the pulp, and impels the quicksilver in spray, or globules of every size, in a stream through the entire mass, causing an intimate blending between the ore and the mercury. The nine iron plates (or if there is much copper in the ore, copper plates should be used) pass through the ore edgeways, with a circular motion, and agitate the pulp, the decomposition of the chlorides meantime progressing very rapidly by means of the heat and impact against the plates, which present a surface of nearly 3600 sq. ins. of surface to 600 or 800 lbs. of ore. If the ore has been properly roasted amalgamation will be effected in 5 hours. Argentiferous ores, intended to be treated either by this, or the barrel amalgamation process, should be free from metallic gold, or it must be extracted previous to roasting the ore, for subsequent to roasting, the gold is not, like silver, in a soluble state, but in a metallic condition, usually coated with an oxide (especially if in contact with sulphuret of lead), which renders the amalgamation of the gold extremely difficult.

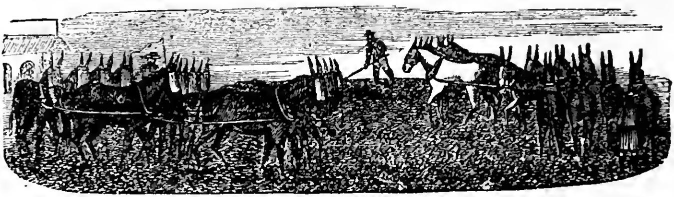


Fig. 34.—AMALGAMATION BY PATIO PROCESS.

AMALGAMATION BY THE MEXICAN OR PATIO PROCESS.—The Spanish word *Patio* denotes a yard. The ores best adapted to this treatment are, ruby silver, brittle silver ore, polybasite, stromeyrite, iodyrite, silverglance, and chloride of silver. Silver ores containing gold are unfit for treatment unless that metal has been previously extracted by some other process. Argentiferous zinc-blend, pyrites, and a few other combinations cannot be treated unless perfectly roasted. Silver ore combined with antimony and copper should be slightly roasted previous to treatment. Argentiferous lead ores and gold ores are utterly unsuitable for treatment.

The amalgamating yard is levelled off, paved with granite blocks or bricks, encompassed by high walls, and is generally left exposed to the atmosphere. Over this pavement, the silver ore (previously dissolved to an impalpable slime, by means of arastras, stamps, or other machinery) is deposited and spread to a depth of from 7 to 12 ins., and surrounded by low, close curbs. Next, salt, in quantity to conform with its quality and the richness of the ore, is added to the mass and thoroughly intermixed by being turned with shovels and trodden by horses, mules, or oxen. See fig. 34. The chemical action of the salt produces chloride of silver and desulphurizes the sulphides. The mass is then allowed to rest one whole day.

Magistral, *i. e.*, copper pyrites, roasted and pulverized, are added to the mass one hour after the treading, turning, &c., begins, the quantity varying with its quality, the temperature of the season, and the richness of the ore, the primary effect of the magistral being to revive the silver by depriving it of chlorine.

The next addition is quicksilver, which is usually added in three charges to the ore by being sprinkled through cloth, buckskin, canvas, &c. ; after the first charge the mass is thoroughly mixed, and formed into heaps of about one ton each, smoothed off, and let stand 24 hours. Then during the morning, every other day, the treading, turning, and heaping processes is repeated for the space of 5 to 6 hours. The second charge of quicksilver is added and the treatment repeated, and by washing a sample of the mixture it is determined whether or not the first charge has been properly blended with the mass. The third charge is added after the due incorporation of the second, in order to absorb any stray particles of silver, and to render the amalgam more suitable for separation.

Lime is added to cool, and magistral to heat, as the temperature of the ore may require. With too much heat the quicksilver becomes pulverulent and of a dark shade, with scattered brown spots upon its surface ; with too little it retains its natural appearance and fluidity. With the proper temperature the amalgam will present a grayish white tint and yield easily to gentle pressure. An excess of quicksilver, magistral, or lime, is inimical to the process ; an overplus of salt will cause a loss of quicksilver but no further injury.

For ore valued at $50 per ton, a proper proportion of the above noted ingredients would be, to each ton : salt, of prime quality, 80 lbs. ; magistral (containing 10 per cent. of the sulphate of copper), in summer, 20 lbs., in winter, 10 lbs. ; quicksilver, first charge, 14 lbs., second charge, 5 lbs., third charge, 7 lbs. ; lime, more or less, 15 lbs., as may be required. The time of treatment varies from 12 to 60 days, according to the state of the weather, etc.

The separation is effected by washing the mass with plenty of water in a capacious, deep, circular vessel, essentially the same in principle as the common separator or settler, whereby the lighter portions are caused to flow slowly away, leaving the amalgam to be gathered last of all by itself, to be removed and retorted at the refining works.

SMELTING OF ORES.—This is effected by various contrivances, such as "Cupola" and "Reverberatory" Furnaces, "Backwoods hearths," "Scotch and American hearths," &c., the object being to reduce the ores to the metallic state by means of fire, assisted by fluxes of limestone or lime, carbonate of soda, iron, and fluor spar. Lead ore, granulated lead and litharge are used as fluxes for gold and silver. The size, form, capacity, &c., of the furnace may be made to conform to the requirements in each case : the Castilian furnace is of an annular shape, while the McKenzie Cupola is more of an elliptical form. The fuel and ore are intermixed in proper proportions in the cupola, being introduced through the charging door, several feet above the bottom of the cupola. The furnace is vertical in position, about 15 ft. in height, with an interior area through its largest horizontal section of about 12 sq. ft., varying more or less according to size. See page 684 for details of furnaces, modes of operating, blast, &c.

The fire, urged by the blast, consumes the fuel, and imparts its heat to the ore, which is arranged in alternate layers with the fuel. The fluxes, which have an affinity for some part of the mineral under treatment, either induce its dissipation or form with it a fusible compound or slag, which being lighter than the metal, is frequently separated from it, either by being drawn off from the surface, or permitted to rest until the metal is withdrawn from below. The kind of flux to be used depends largely upon the variety at hand and the character of the ores and gangues to be treated. If the gangue of the ore is composed of different earths, with the oxides of base metals, litharge, quartz and carbonate of soda may be used as fluxes. If quartz forms the gangue of the ore, lime, the oxides of the base metals, and carbonate of soda may be used, while such fluxes as metallic iron and litharge, lime, and carbonate of soda are well adapted for the treatment of ores containing much sulphide.

A primary condition in almost every form of smelting silver ores is the use of lead in one or more of its various forms; if lead is not combined with the ore under treatment it must be added thereto. In smelting silver ores the notable uses subserved by lead and its compounds, are these, viz.: On the fusion of lead with the sulphate, oxide, or sulphide of silver, the latter is reduced to the metallic state, and forms an alloy with excess of lead; in fusing sulphate of lead with sulphate of silver argentiferous lead is formed; a blast of air directed upon a fused compound of silver and lead has an oxidizing effect on the lead, but effects no change on the silver; lead has a greater affinity for silver than for any of the inferior metals; under treatment in the furnace, the sulphide or sub-sulphate of lead and the sulphate of lead react upon each other, and absorb the silver, if any be present. Further; three parts of sulphate of lead and one part sulphide of lead react on each other and produce litharge. Again; sulphide of lead and copper, antimony, zinc, or metallic iron in a fused state, react upon each other and produce, on the one basis, sulphide of iron, and on the other, metallic lead, &c. Similar results will take place if the sulphide of lead at the same time contain the sulphide of silver, and the lead and silver combine together in an alloy, while the iron or other metals noted is formed into a sulphide.

In smelting ores containing gold and silver it is not necessary to change or vary the process by reason of the presence of the former metal.

TREATMENT OF SILVER ORES BY SILESIAN PROCESS IN A CUPOLA FURNACE.—The raw argentiferous galena and the necessary iron-flux are first broken into small pieces and thoroughly mixed, when they are passed into the cupola so that they will occupy the rear of the chamber, while the fuel is placed in the front part. The blast is applied so that a gradual fusion results and the cupola hearth becomes overspread with molten lead and floating slags, owing to the reactions of the sulphur and iron combined with oxygen. At proper intervals, the lead, all ready for cupellation, is withdrawn through an orifice in the bottom of the furnace and the floating slags through a higher aperture; the more valuable portion of the slags, or matt, being composed of the sulphide of iron and lead with silver in minute quantity, are put through an additional treatment of roasting and fusion. The proper proportions of a charge are: argentiferous galena, well broken, 100 parts; broken slag from iron forge, 14 parts; cast-iron, 12 parts; coal, 126 parts.

IN THE RAMMELSBERG PROCESS of Cupola treatment the ores of argentiferous galena loaded with a large surplus of impurities and foreign matter, are first treated either in HEAPS in the open air or in REVERBERATORY FURNACES. In *Heaps*, ores rich in sulphides of zinc, copper, and iron are thoroughly intermixed with galena, and graded according to the dimensions of the blocks, the largest below and the smallest at top, in a fabric erected to a height of several feet upon a thick substratum of wood. The whole is covered with a layer of granulated roasted ore, to exclude an excess of air. The wood being kindled, ignites the sulphides throughout the ore, which in a heap containing about 150 tons, will keep smouldering away for from 4 to 6 months. This constitutes the first roasting, which is to be followed by a series of roastings, to continue until the volatile components of the ore are expelled.

In the *Reverberatory Furnace* the ore is first roasted in the usual manner to the proper degree of oxidation. The furnace door is then closed, the heat raised, and the charge fused. The silicates of lead, lime, &c., are generated, and with the sulphate, oxide, and sulphide of lead are spread upon the floor of the furnace, cooled off, and broken into lumps about the size of oranges, the dimensions best adapted for treatment in a cupola furnace.

In charging the cupola the right proportions are: roasted ore, 140 parts;

highly silicious slags, 40 parts ; litharge, 1 to 2 parts. The ore, intermixed with the slags, and pieces of old cupels, should be reduced to the size of ordinary potatoes, and well mixed. Apply a vigorous blast, fuse and treat the slags, matt, and lead as noted under the preceding process.

Cupola Treatment of Silver Ores.—*Mexican Process.* The ore, uncontaminated with lead, and largely composed of sulphide of iron and quartz, sulphide of silver, &c., is well mixed with half its weight of charcoal and roasted in kiln-like enclosures exposed to the atmosphere. Sometimes dry wood is substituted for charcoal, and the roasting is accomplished in circular structures with an interior diam. of 4½ ft. ; height the same, built of adobe, or sun-dried brick, with a capacity (including fuel) of 1 ton of ore each. The roasted ore (from these kilns), with the proper fluxes, being thoroughly mixed, the cupola is charged in the following ratio ; charcoal, 50 to 75 parts ; roasted ore, as above described, 75 parts ; litharge, 100 parts ; matt of former operations, 25 parts ; lead slags, 16 parts ; cupel bottoms, 16 parts ; native carbonate of soda, 16 parts. The blast being applied, fusion takes place, and the metal drawn off at stated periods is cast into ingots ready for cupellation, while the matt secured is finally returned to the furnace to aid in the fusion of future charges of ore.

Amalgamation by the Foster-Firmin Process.—In this process the quicksilver is atomized by steam, compressed air, water, or other equivalent medium, and forced, after the manner of the well-known sand blast, through a stream of falling ore which may be either wet or dry. While in the act of entering the amalgamator the ore is impinged upon by a stream of mercury which escapes from a small receptacle at the rear of the hopper (containing the ore) through an inner pipe. The flow of ore and mercury is broken up and carried forward by steam or air pressure. The ore which flows into the amalgamator is discharged into the washer, where it is heated by steam and worked for a short time until it is mulched sufficiently to flow evenly. Water is then injected into the chamber at the bottom of the washer, when the bulk of the mercury is withdrawn and the waste flows into the first settler of the series, and the water passes on until it finally escapes from the lower settler. The mercury is deposited in the central conical space in the vessels, from which it is removed occasionally through the discharge cocks. One of the settlers is provided with amalgamated copper plates, which are vibrated by the action of the water, thus effecting the arrest of the fine particles of gold or mercury carried in the water as it passes between them, while any gold leaf which may float on the surface is retained by partition.

The inventors claim that with their apparatus they have obtained the entire quantity of metal contained in the ore and have recovered from 98 to 100 per cent. of the mercury used, the whole operation from the commencement to the production of the amalgam being completed within one hour, at a very low cost, thus rendering the working of poor ores profitable. During a recent public trial of this apparatus, silver ore was passed through a single amalgamator at the rate of 3000 lbs. per hour ; 99 per cent. of silver and 97½ per cent. of the mercury were recovered within an hour. During another similar trial ore was passed through at the rate of 3,600 lbs. per hour, 97.88 per cent. of mercury and silver together were recovered in 45 minutes, and within half an hour (1¼ hour from the start) 97 per cent. of the silver was crucibled ; subsequently an additional quantity of amalgam was collected and treated, bringing up the result to fully 99 per cent. of silver and 99½ per cent. of mercury recovered.

Barrel Amalgamation of Silver Ore.—The following account of the treatment of silver ores by barrel amalgamation, at Halsbruecke, near Freiberg, is from *Phillip's Metallurgy*, and closely resembles similar methods now used in Nevada :—The usual components of the ores there treated are sulphur, antimony, arsenic, silver, copper, lead, iron, and zinc, which are more or less mixed with various earthy minerals, besides sometimes containing small quantities of bismuth, gold, nickel, and cobalt. In the selection of these ores, they are so assorted as not to contain above 7 per cent. of lead, or 1 per cent. of copper, as from combining with the mercury added these metals give the amalgam a pasty consistency, and thereby render the treatment extremely difficult and expensive. The mixture of the different ores obtained from the mines is so arranged that the charges of the furnaces shall contain 75 to 80 ounces of silver to the ton of mineral; it is also essential that they should contain a certain proportion of sulphur. This usually exists in the form of iron pyrites, which, on being roasted, gives rise to the formation of the sulphate and oxide of iron necessary to the success of the subsequent operations. If, as is sometimes the case, the amount of pyrites naturally occuring in the ores is not sufficient for these purposes, addition is made either of this mineral, or, in some instances, of ready-formed sulphate of iron.

The ore, when thus prepared, is laid on a large floor, 40 feet in length and about 12 in width, and on the top of it is thrown about 10 per cent. of common salt, which is let drop from an upper room through a spout placed in the floor for that purpose. The heap, when it has been thus made up of alternate strata of ore and common salt, is well mixed by being carefully turned over, and is subsequently divided into small parcels called *roast-posts*, each weighing from 3½ to 4½ cwts. The salt annually employed for this purpose at the Halsbruecke works amounts to 300 tons, and is supplied by the Prussian salt-mines.

The mixture of ore and salt is now roasted in reverberatory furnaces provided with fume-flues for the reception of any pulverulent matters which may be mechanically taken over by the draught. The prepared charge is spread on the bottom of the hearth, where it is at first very gently heated, for the purpose of expelling the moisture, which to a greater or less extent it variably contains. During the process of drying, which usually occupies two hours, the charge is kept constantly stirred by a log iron rake, and when this operation is considered sufficiently advanced, the heat is so far increased as to cause the ignition of the sulphur, and to render the ore red-hot.

The furnace is kept at this temperature for about four hours, during which time the metals become oxidized, and sulphurous acid gas is rapidly given off, whilst the ore is by constant stirring prevented from becoming agglutinated in masses. The temperature is now still further raised, and sulphurous acid is again given off, together with vapors of chloride of iron and hydrochloric acid. The hydrochloric acid generated at this stage of the operation is due to decomposition of the chloride of iron, by the action of oxygen and watery vapor. This last firing, which occupies about three-quarters of an hour, is continued with constant stirring until a sample taken from the furnace ceases to evolve any odor of sulphurous acid, and has for its object the decomposition of the sea-salt by the metallic sulphates produced. During this process the ore increases considerably in volume, and assumes a deep brown color. When the roasting is terminated the charge is raked from the furnace to the floor of the establishment, from whence, after having been allowed to cool, it is removed for the purpose of being passed through a set of fine sieves, by which the finer powder is separated from the agglutinated lumps. These are broken down to a proper size, and after being mixed with a fresh quantity of sea-salt are again roasted in the usual way. The finer particles are, on the contrary, taken to a pair of heavy mill-stones, where they are reduced to the state of an impalpable powder. At the Halsbruecke works there are 14 roasting-furnaces, and as many pair of granite mill-stones, which, together, are capable of preparing and grinding about 70 tons of ore per week. The ore, after passing through the mill, which makes from one 100 to 120 revolutions per minute, is sifted through a dressing apparatus, which renders it as impalpable as the finest flour.

The amalgamation of this prepared ore is performed in 20 wooden casks, arranged in four rows, and each turning on cast-iron axles, secured to the ends by means of bolts. These barrels, which are 2 ft. 10 ins. in length, and 2 ft. 8 ins. in internal diameter, are made of oak staves 3½ ins. in thickness, and are further strengthened by iron hoops and binders. On one of the ends of each tun is placed a toothed wheel, which works into another toothed wheel, mounted on an axle, which receives its motion directly from a water-wheel. Above each of the tuns so arranged is placed a wooden case, into which is thrown the prepared mineral, and which is furnished with a leathern hose, for the purpose of introducing the powdered ore into the different barrels. With this view, each cask is furnished with a circular opening, and an iron or wooden pin, which is employed for running off, at the termination of the process, the argentiferous amalgam.

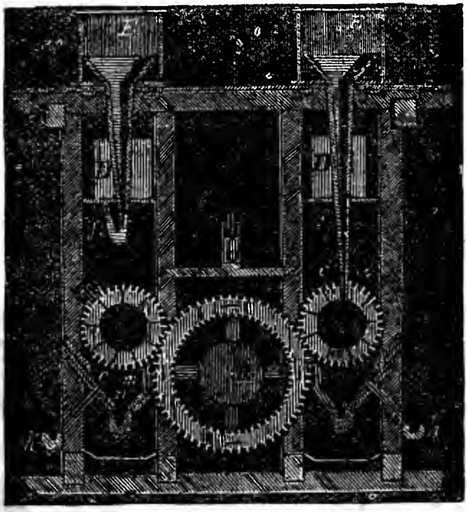


Fig. 35.—Barrel Amalgamation.

The basins, situated immediately above each tun, are of such a size as to exactly contain the amount of water necessary for one charge. Below the tuns, and a little above the surface of the ground, are placed triangular troughs, destined to receive the various elaborated products at the termination of the operation. At the commencement of the operation, 3 cwts. of water are run into each barrel from the reservoir, after which 10 cwts. of the finely-ground and sifted ore are introduced through the hose. To this are added from 78 to 100 lbs. of wrought-iron, cut into fragments of about an inch square, and three-eighths of an inch in thickness, and which, in proportion as they become dissolved by the action of the substances by which they are associated, are replaced by fresh pieces. The casks are now tightly closed by screw-stoppers, and as soon as they have all been charged, the apparatus is thrown into gear by the means of a screw, and the sliding block, which cause the tuns to rotate with a rapidity of from 18 to 20 turns per minute. At the expiration of two hours the machinery is again stopped, and the tuns are opened for the purpose of examining the state of the metalliferous paste which they contain. If the charge is too firm, a little water is added; but if, on the contrary, it is found to be too liquid, a small quantity of powdered ore is thrown in. When this has been attended to, 5 cwts. of mercury are poured into each cask, and the tuns, after being securely closed, are again thrown into gear, and kept constantly revolving for 16 or 18 hours, at the rate of from 20 to 25 turns per minute. During this time they are, however, twice examined, for the purpose of seeing whether the paste which they contain be of the proper consistence; for if it be too thick, the particles of mercury are not sufficiently brought into contact with the silver contained in the ore, and if too much water has been added, they remain at the bottom of the cask, and are not sufficiently mixed with the different constituents of the charge. In the first case it is necessary to add a small quantity of water, and, in the second, a little powdered ore. After the introduction of the mercury, the temperature of the casks becomes considerably raised by the chemical changes constantly going on within, so that, even in winter, it sometimes stands as high as 104° Fahr.

At the expiration of 20 hours the amalgamation of the silver is ordinarily complete, and the tuns are now entirely filled with water, and again made to turn 2 hours, with a velocity of only 8 revolutions per minute. The amalgam is by this means separated from the slimy matters with which it was mixed, and collects in one mass at the bottom of the tuns. When this aggregation of the amalgam has been accomplished, the different casks are successively thrown out of gear, and are stopped with their apertures immediately over the spouts. A small peg in the bung is now removed, and the liquid amalgam flows out and is received in the triangular spout; the workman closely watches this period of the operation, and the moment any of the earthy matters begin to flow from the orifice, it is again tightly closed. The mercury is now run off through the iron tube, into the gutter, by which it is conducted into a receiver prepared for that purpose.

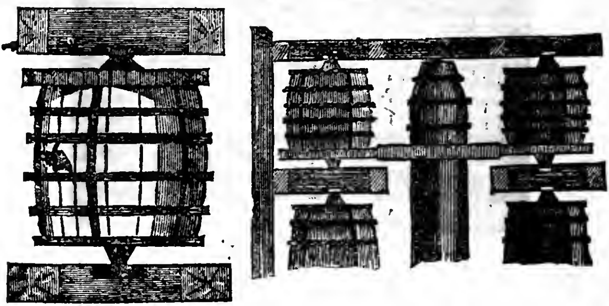


Fig. 36.—Barrel Amalgamation.

The casks are now turned with their apertures upward, and as soon as the bungs have been removed, they are again brought back to their former position, and the muddy residuum is discharged into a spout from which it flows into large reservoirs situated at a lower level. This residuary ore is found to be stripped of its silver to within about $5\frac{1}{2}$ ozs. to the ton, and is therefore often subjected to another amalgamation. The emptying and discharging of the casks occupies about two hours, and the whole process is therefore finished in less than 24 hours. In 14 days 160 tons of mineral are treated in this establishment, every 5 tons of which require an expenditure of 15 lbs. of metallic iron, and 2 lbs. $12\frac{3}{4}$ ozs. of mercury: so that every pound of metallic silver produced is obtained at an expense of 0.95 of an ounce of mercury.

During the first 2 hours that the casks are set in action, and before the introduction of the mercury the sesquichloride of iron contained in the ore is decomposed by the metallic iron present, and converted into protochloride. If, instead of operating in the way described, the mercury were immediately introduced into the casks, it would, by reacting on the prochloride of iron, become partially converted into calomel, which, not becoming again reduced during the subsequent stages of the operation, would be productive of a considerable loss of this valuable metal. This inconvenience is, however, completely avoided by the action of the metallic iron, as the protochloride thus formed is entirely without action on metallic mercury. The chloride of silver contained in the roasted ore is held in solution with the chloride of sodium, and, becoming reduced to the metallic state by the constant agitation with the metallic iron, combines with the mercury to form a liquid amalgam. The chlorides of lead and copper are decomposed at the same time as the chlorides of silver, and enter into the composition of the amalgam produced.

When the residual earthy matters are drawn off from the casks, the pieces of metallic iron are retained by means of a grating, whilst the slimes, after being run into proper receivers, are conducted into *pug-tubs*, where they are constantly kept stirred with a large quantity of water.

These tubs are furnished with openings at various distances from the bottom, by which the muddy water is successively drawn off, whilst a certain quantity of amalgam is found collected at the bottom of the vessel. This is collected at the close of the operation, and added to that obtained by tapping directly from the amalgamation tubs, as before described.

The mercury and amalgam obtained from the casks is afterward filtered through close canvas bags by which the liquid quicksilver is separated from the pasty amalgam, which is retained by the closeness of the web, whilst the mercury passes through into reservoirs prepared for that purpose. The pasty amalgam which is retained in the bags consists of a mixture of six parts of mercury and one part of an alloy composed of about 80 per cent. of silver, and 20 of a mixture of copper, lead, bismuth, antimony, gold, nickel, zinc, and some other metals. This mixture is subsequently heated in a distillatory furnace, and is thus freed from the adhering mercury, whilst the non-volatile constituents of the alloy are obtained in the solid form.

Mr. Kostel remarks: "The amalgamation in barrels is not adapted to ore containing gold. Unroasted ore has been tried with chemicals unsuccessfully. The construction of the barrels does not differ much in the different works of Nevada Territory. They have a cylindrical shape, the diameter and depth being nearly equal. The staves are 3 or 4 inches thick. There are two sizes in use. The smallest, capable of receiving from 1000 to 1200 pounds of ore, are 32 inches each way; the larger, receiving a ton of ore, measure from 44 to 48 inches in the clear.

Ayer's Process of Treating Silver Ores.—By this process the ore, as received from the mine, is subjected to the action of intense heat in a furnace, and afterwards thrown, while still hot, into alkali water or brine, which has the effect of crumbling it into small pieces; the fragments are subjected to additional reducing processes, and afterwards amalgamated.

Fig. 37 represents Kent's method of arranging barrels for amalgamating. The amalgamation is effected by the rotary motion of the barrels, after which the mass is discharged through large spouts into the agitator below, where the amalgam accumulates at the bottom. The following is Mr. Kent's account of his improved process of treating gold and silver ores.

"By this 'improved mode of preparing ores,' the ore is not only desulphurized in the best and cheapest manner, but the base metals are converted into soluble *chlorides*, which are *not* readily decomposed by heat, and may be subsequently removed by washing the prepared ore, or by the water used in the process of amalgamation, and the gold is thus left free and bright, and in the best possible condition for combining with the mercury used in that process.

"To effect this object, the crushed ores or tailings are simply mixed with a solution of common salt, and made into cakes, lumps, or bricks, which are then calcined in a common kiln, such as is used for burning lime or bricks. In this process, the sulphur in the ore is oxidized by the oxygen of the atmosphere, and the sulphuric acid thus produced immediately combines with the soda in the salt, forming sulphate of soda, and liberating the muriatic acid, which in its turn attacks the base metals, forming chlorides of copper, zinc, antimony, etc., together with chloride of silver, and leaving metallic gold. All the acid used in the process is prepared in the process itself, and the chemical changes are produced in the nascent state, which is the most favorable condition for effecting them, and the sulphur being thus combined with the soda, a smaller proportion escapes into the atmosphere than when ores are simply roasted alone.

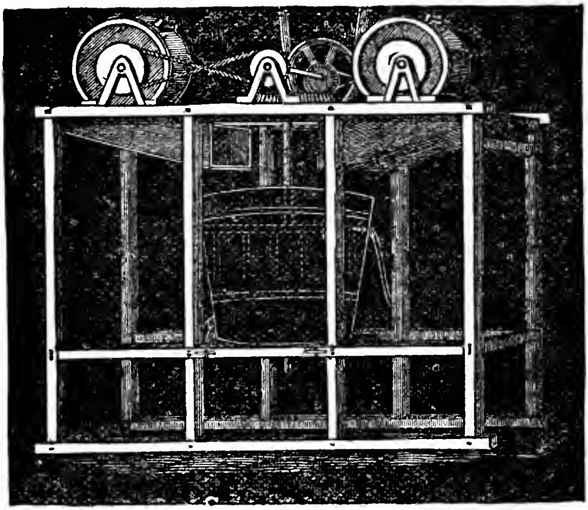


Fig. 37.—KENT'S AMALGAMATING BARRELS.

"By the application of the salt in solution, one bushel will make sufficient for a ton of ore; and by making the ore into bricks, which may be done with one machine, at the rate of 25 tons per day, the use of expensive reverberatory furnaces, as used at Freiberg, is avoided, and 25 tons of gold or silver ore, in a common lime-kiln, or 1200 tons in a brick-kiln composed of the caked ore in the form of bricks, may be calcined at one operation, in the cheapest and best manner, without *any* furnace at all, by the passage of a current of hot air through the interstices of the brick so formed.

"After the chemical decomposition of the ore is thus effected, it becomes so soft that it may be ground with common burr-mills, at the rate of 40 bushels per hour, for amalgamation in barrels, or it may be ground and amalgamated at the same time, by the use of the Washoe pans. When two different kinds of ore are mixed together, in suitable proportions, before caking, which is sometimes of very great advantage, and the calcination and amalgamation are done in the best manner, about five times as much gold or silver as from crude ore, or from seventy-five per cent. to the full assay value, may be obtained."

EXTRACTION OF SILVER BY HOT PROCESS IN COPPER KETTLES.—This process is mainly used in South America, on ores rich in native silver, or in the chloride, iodide, or bromide of silver, which are first finely pulverized and concentrated by washing, and then placed in kettles fitted with copper bottoms where they are boiled with a considerable volume of water. From 10 to 15 per cent. of salt is then introduced into the boiling mass and thoroughly stirred. Next, quicksilver, of less weight than that of the silver present, is added to the pulp, with continued stirring, adding more quicksilver whenever a test discloses the slightest dryness in the amalgam. Lastly, the amalgam and gangues are separated by washing; the amalgam is squeezed, retorted and refined, while the gangues, if desired, may be submitted to the Patio process.

In the *Parke Process*, lead containing silver is fused in massive cast-iron pots, and melted zinc is added and well intermixed. The fire is then withdrawn from under the pot, and the mixture is allowed to rest for a brief period, while the silver and zinc, separating from the lead, rise to the surface of the molten metal, and are skimmed off as long as the alloy continues to rise. Next, the scum alloy combined with some lead is heated in a liquation retort; the silver and lead fuse. and are then in large proportion conducted into prepared moulds. The alloy thus obtained is afterwards cupelled, and the alloy of zinc and silver remaining in the retort is submitted to distillation in order to effect a partial separation, while the silver thus obtained is deprived of its impurities by cupellation. The proportions used in charging the pot are: argentiferous lead, 6 to 7 tons; quantity of silver to the ton of lead, 10 to 15 ozs.; estimated quantity of zinc to each oz. of silver, 1.5 to 2 lbs. The alloy should be stirred from 10 to 15 hours after the addition of the zinc, and the proportion of silver (to the ton of alloy) when ready for cupellation should be 1000 ozs.

The *Liquation Process* is based on the principle that an alloy of lead and copper, melted together, separate if slowly cooled, but cohere in intimate union if quickly cooled. A compound of copper and lead, if slowly heated to near the melting point, will also separate, and the silver, if any be present, will go with the lead. In practice, an alloy of copper and silver, or copper matt (as it comes from the smelting furnace) containing silver, is melted with about four times its weight of lead in a cupola, and cast in annular plates, which are rapidly cooled. These circular plates are termed liquation cakes, and are arranged in a liquation furnace, on their edges, with alternate layers of charcoal. The latter being lighted, the heat is raised to a degree slightly less than the melting point of copper, when the silver and lead fusing, are conducted to a receiver, while the copper, in a honey-combed condition, remains in the original form. If the separation proves defective the cakes may be submitted to the further treatment of a higher degree of heat in the sweating furnace. The separation of the silver from the lead is finally effected by cupellation.

The following mixtures of ores and fluxes are noted in Mr. Kustel's excellent work, as possessing reliable proportions for smelting purposes.

No. 1. Mixture for Ores without Roasting, and before Litharge is Obtained from the Manipulation.—Silver ore, 100 lbs.; Granulated lead (or 200 lbs. lead ore), 85 lbs.; Soda ash, 25 lbs.; Iron, 25 lbs.; Lime (and 25 lbs. slag, when obtained), 3 lbs.

No. 2. Mixture for Roasting Ore.—Silver ore, 100 lbs.; Granulated lead, 85 lbs.; Soda ash, 20 lbs.; Iron, 8 lbs.; Lime, 3 lbs.

No. 3. Mixture of Silver Ore after Products of Smelting are at Hand.—Silver ore, 100 lbs.; Granulated lead, 25 lbs.; Litharge, 75 lbs.; Hearth, 10 lbs.; Soda ash, 15 lbs.; Charcoal, 5 lbs.; Iron, 8 lbs.; Lime, 3 lbs.; Slag, 25 lbs.

When the melting is executed with an addition of lead ore, Nos. 2 and 3 do not require granulated lead, but it is always very useful to add sufficient litharge. The quantity of flux required depends much on the quality of the ore. If the slag is too thin it is not necessary to use so much soda-ash. The mixture is introduced with a shovel when the furnace is at a white heat, and spread about 5 or 6 ins. deep, to about half the length of the flux, between the door and the crucible. The door is closed, and the firing continued so that the flame reaches the end of the flux. The ore will soon begin to melt and run into the crucible, when a new charge must be introduced as soon as the melting ore makes room for it. Stir the charge thoroughly with a long iron bar, and continue the process until the crucible is filled. Use the furnace illustrated on page 983.

TREATMENT OF SILVER ORES BY SOLUTION.—*Augustin's Process.* The principle on which this process is based is the solubility of chloride of silver in a hot concentrated solution of common salt. The ores, which should be free from zinc, antimony and arsenic, are first submitted to dry crushing by stamps, and further pulverized by grinding in suitable mills, after which they are roasted in a reverberatory furnace at a low temperature, with a free admission of air. A thorough, uniform roasting, at a dull red heat, promotes the formation of various sulphates of the different metals present. This object being attained the heat is increased to a cherry red, by which the aforesaid sulphates (with the sole exception of the sulphate of silver) are decomposed. The sulphate of silver is next converted into chloride of silver by adding common salt, previously melted, ground, and intermixed with cold ore, to the hot ore in the furnace, with which it is thoroughly incorporated by vigorous stirring

The apparatus for the hurried portion of the process consists of the following, arranged in the order of mention, viz. : 1 spacious heating reservoir, a set of dissolving tubs, 2 large settling cisterns, 4 precipitating tubs to each dissolving tub, and 2 roomy receptacles, all arranged on descending steps. The aforesaid tubs are nearly circular in form, and are arranged with filters composed of straw and broken sticks, covered with cloth. Each tub is divided into two unequal divisions by means of a vertical partition placed on the filter.

The chloridized ore being placed into the largest divisions of the dissolving tubs, a hot salt solution, sufficient in quantity to completely saturate the ore, is conducted into the tubs from the heating reservoir aforesaid, and allowed to remain one hour. The outlet cocks of the heating reservoir and tabs are now opened, and the hot salt solution is permitted to filter through the ore in the tubs, and pass off through the smaller compartments through apertures at first above the level of the ore, and afterwards through orifices near the base of the tubs, into the large settling cisterns above noted. The current is shut off when it is ascertained by a piece of clear copper that no trace of silver exists in the filtrate.

The next step is to place copper (copper cement) in each of the upper two precipitating tubs in the different classes of four, and wrought scrap iron in each of the corresponding lower two, and conduct the chloride solution slowly from the settling cisterns by filtering it through the various precipitating tubs into the large receptacles below. The chemical effect is to precipitate the silver by means of the copper in the upper tubs, and the copper in solution, if it be present in the ore at first, is precipitated by the iron in the lower tubs. The silver is removed every three days from the precipitating tubs and refined, while the filtrate in the large receptacles is pumped into the heating reservoir for future operations.

The ore, previous to roasting, should contain at least 20 per cent. of sulphur, and the proportions of the charge to the furnace, should be, of ore for roasting and calcining, 500 lbs.; melted salt, pulverized, 35 lbs. ; roasted ore, cold, and mixed with the salt, 220 lbs. ; time of roasting on upper hearth of furnace, 4 to $4\frac{1}{2}$ hours ; calcining on lower hearth, 4 to $4\frac{1}{2}$ hours ; time occupied in chloridizing, from 15 to 20 minutes ; heat of salt solution, 131° Fahr. The depth of copper in the precipitating tubs should be about 6 ins., of iron in do. (provided the ore contains copper in quantity worth saving), 6 ins. The time for dissolving and precipitating will occupy 20 to 24 hours ; solution of salt run through each tub to 1000 lbs. of ore, 200 to 250 cubic feet.

TREATMENT OF SILVER ORES BY SULPHURIC ACID.—*Freiberg Process.* The argentiferous copper matt, as it comes from the furnace, is thoroughly pulverized, roasted and chloridized as in the last described process, in tubs, and submitted to the action of hot sulphuric acid. By this means the copper and iron (if any is present) are dissolved, while the silver remains intact. The copper solution is conducted into vats, and crystallized into sulphate of copper, while the intact remainder, containing the silver, is smelted with lead and cupelled.

TREATMENT OF SILVER ORES BY SOLUTION.—*Ziervogel's Process.* The ore, of the class described under Augustin's process, is effectually pulverized, roasted and calcined to decompose the sulphates of iron and other inferior metals, the sulphate of silver only remaining unaffected. The test of complete calcination being a slight blue color given out by a small quantity of the roasted ore when thrown into water. The process is predicated on the solubility of sulphate of silver in hot water, the sulphatized ore being treated in every way as the chloridized ore in Augustin's process, with the sole exception that pure water, at a temp. of 149° Fahr., is used instead of the hot salt solution.

TREATMENT OF SILVER ORES BY THE RAMMELSBERG PROCESS.—Argentiferous granulated copper ore is placed in tubs exposed to the atmosphere, and submitted to the action of hot sulphuric acid, which is slowly flowed over it in a small stream, converting it into sulphate of copper. The solution of dissolved copper is conducted through an arrangement of troughs, in which it is deposited in the shape of rough crystals, while the liquid portion is returned and reheated, to be again poured over the ore in the tubs. The next step is to wash the rough crystallized salt deposited in the troughs, conduct it into vats, and allow it to recrystallize. The silver present in the ore will be found in the dissolving tubs, and is finally smelted with lead and cupelled for its silver.

PATTINSON'S PROCESS.—1st. This process is founded on these facts: If a melted alloy of silver and lead is stirred while cooling slowly, crystals of lead form and sink, which may be removed by a drainer. A large portion of the lead may thus be separated from the silver. 2nd. Cast-iron pans, capable of holding about 5 tons each, provided with fire-places, are arranged in a series, as A, B, C, D, E, F, G, in a straight line. 3rd. The metal of ores containing silver and lead as it comes from ordinary smelting works, is melted, for instance, in pan D, and then allowed to cool very slowly. The metal, while cooling, is stirred, especially near the edges of the pan with an iron bar. As soon as crystals form and sink to the bottom they are taken out with an iron drainer, raised to a temperature somewhat higher than that of the metal bath. From one-half to two-thirds of the charge is thus removed to pan E, and the balance taken to pan C. Other charges of D are similarly treated, and disposed of in like manner, except that the crystals of E go to F, and the balance to D, and the crystals of C go to D, and the balance to B. Thus, after successive meltings and drainings, the alloys, rich in silver, pass to A, while the lead, almost entirely deprived of silver, goes to G. The alloys obtained in pan A are then subjected to cupellation. 4th. The lead of an alloy treated by this process often contains less than $1 in silver to the ton. The silver of the enriched alloy should not exceed $600 to the ton.—*Quartz Operator's Hand-Book.*

TO PURIFY MERCURY.—Quicksilver, to be in prime condition for amalgamating purposes, should be free from impurites and foreign substances, as zinc, bismuth, lead, &c., which impair its power for combining with the precious metals. To effect this the impure quicksilver should be distilled in a common covered retort, or if this is not available a retort may be readily improvised by using a common quicksilver flask and an iron pipe bent in the shape of a syphon, the short leg of the pipe being inserted in the flask in the orifice at the top, while the long leg, a yard or more in length, extends downwards below the bend, and must, while in operation, be kept cold by means of wet cloths and cold water. Fill the retort two-thirds full with the impure quicksilver, apply the heat first of all to the short leg of the syphon and the upper part of the retort, then to all parts of the flask alike, keeping the discharge end of the syphon in cold water, within the receiver. Keep the heat regular and do not hurry the distillation.

Lastly, treat the distilled quicksilver, in thin sheets, by frequent agitation with 2 parts of puro water and 1 part nitric acid, maintaining meanwhile a temperature of 120° Fahr. for several hours. The operations may be repeated until the impurities are removed, when the quicksilver may be poured off for use.

To Restore Quicksilver when "Floured," or "Sickened."—When quicksilver becomes inoperative through being "floured," or "sickened," or in a state of minute division, or in the scum form, the trouble may be rectified by the addition of 1 part of sodium to 2000 or 2500 parts of quicksilver by weight. With a very slight degree of heat sodium and quicksilver combine with a powerful affinity for each other, forming sodium amalgam, which possesses an energetic chemical attraction for the precious metals and some other substances. Its use is of unquestionable value in extracting gold or silver from sweepings, in the treatment of gold-bearing quartz in batteries, barrels, pans, arastras, &c., or in amalgamating silver ores in which the silver has been reduced to a metallic condition.

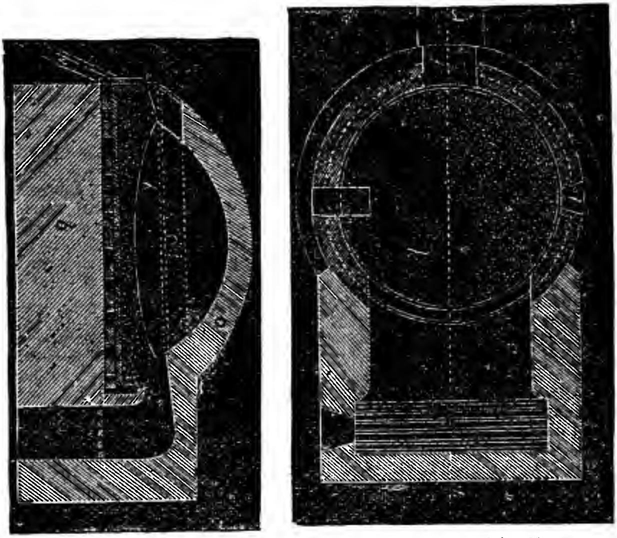


Fig. 38. Cupellation Furnace. Fig. 39.

Cupellation of Gold and Silver.—This process is based on the refractory nature of these precious metals and their affinity for lead in a state of fusion, conjoined with the well known tendency of the latter metal to oxidize while being subjected to the action of heat. The alloy, composed of lead, gold, and silver, or lead and gold or silver, is fused in a furnace constructed with apertures for the admission of a blast of air, and the exit of the litharge, vapors, &c., dissipated by the heat. Figs. 38 and 39 represents a furnace of this kind. The iron pan is 4 ft. in diam. with a throat, *f*, 16 inches long and 12 wide for the escape of the litharge, which falls upon the cast-iron plate, *g*. The pan is filled with wood-ashes, marl, bone-ashes, or a combination of pulverized limestone and clay, well beaten together. The bars of lead are passed in at *i*, where a fire-tile is placed inclining slightly inward, and the blast, introduced at *l*, is directed on the surface of the fused alloy on the hearth. This connects the melted lead into an oxide of lead or litharge, which is partially absorbed by the porous substance of the cupel and partially dissipated by the heat. If copper, or other inferior metals be present in the alloy, they will also be oxidized. The base metals being thus dissipated, absorbed, and oxidized, the gold (and silver, if any is present) will remain a brilliant mass on the hearth of the furnace in a nearly pure condition. If any lead remain it can be removed by the humid method of assay.

REFINING OF GOLD AND SILVER.—If, after cupellation as above described, the metal obtained be an alloy of gold and silver, it is submitted to, 1st. *Quartation:* This consists in the alloying of one part of gold with three parts of silver. 2d. *Granulation:* This is performed by passing the prepared melted alloy through the fine meshes of an iron sieve into water, or upon a bundle of wicker or small branches lying in the water. *Parting:* This is effected by submitting the granulated metal to the action of boiling nitric acid or concentrated sulphuric acid. For this purpose use a glass vessel and 149 parts nitric acid of specific gr. 1.32 to 100 parts of silver. This dissolves the silver and any base metals that may be present out of the alloy, leaving the gold pure. *Reduction:* In this process the gold is removed from the dissolving vessel and further treated by boiling in nitric acid, then washed, dried, and melted in a crucible with a flux of nitre and cast into ingots. The silver in the parting solution may be precipitated by means of copper plates or by a solution of salt. In the former case the precipitate is purified by washing in water, then pressed, melted with saltpetre and pulverized borax, and cast into ingots ; in the latter case the chloride of silver is melted with a flux of carbonate of soda or other suitable flux, then run into bars.

FLUXES FOR REDUCING PHOTOGRAPHIC WASTES.—1. *Black Flux*—Cream of tartar 8 ozs., saltpetre 4 ozs. Place the mixture upon an iron pan and ignite it with a red-hot coal. When the combustion is completed, the black mass should be powdered and sifted while still hot, and placed in a closely-stoppered bottle to prevent the absorption of moisture from the atmosphere. Is both a fusing and reducing agent. 2. *Fluxes for Chloride of Silver*—Common rosin, finely pulverized and intimately mixed with the chloride, is an excellent flux. Pulverized castile soap, molasses, or sugar, are also reliablo fluxes for chloride of silver. 3. *Flux for Reducing the Ashes of Paper Clippings and Filters*—Carbonate of potash 8 ozs., carbonate of soda 2 ozs. Mix the ashes (previously powdered and sifted through a fine flour sieve, to cleanse them from impurities and foreign matters) thoroughly with their own weight of the flux; fill a Hessian crucible about three-quarters full of the compound; scatter a thin layer of salt over the mass, and place on the fire. 4. *Flux for Developer Drainings*—When these have been prepared by adding a solution of salt (after the black powder has been thoroughly dried), it may be mixed with its weight of the following flux, placed in the crucible, and submitted to the fire: carbonate of potash 10 ozs., saltpetre 2 ozs. An excellent flux. 5. *Flux for Collodion Film Ashes*—Carbonate of potash 16 ozs., carbonate of soda 2 ozs. Use 4 ozs. of flux to every 5 ozs. of ashes, and proceed as with the last. 6. *Flux for Roasted Sulphide of Silver*—Carbonate of potash 7½ ozs., carbonate of soda 5 ozs. Use 14 ozs. sulphide to 16 ozs. of flux, and treat as before described. 7. *Flux for Toning Bath Precipitate*—Gold precipitate (dry) 8 ozs., saltpetre 6 to 7 ozs. Fill the crucible not over half full, bring to a bright red heat, and the gold obtained will be nearly pure. 8. *Flux for Chloride of Silver*—Carbonate of potash 8 ozs., powdered rosin 1 oz. Mix the chloride (well dried) with half its weight of the flux, tamp the crucible nearly three-quarters full, with a thin layer of salt on top, and submit to the fire. 9. *Flux for Old Collodion Films*—Saltpetre 8 ozs., carbonate of potash 4 ozs. Use half as much flux as ashes. To obtain the best results from these fluxes, they must be kept in well-stoppered bottles.

DESCRIPTIONS OF FURNACES USED IN ROASTING ORES.

Figs. 40 and 41 represents the ground plan of a furnace used for roasting silver-ores in which *a* is the hearth-bottom, composed of the hardest bricks, placed compactly edgewise. The ore to be roasted is introduced at the aperature, *e*, Fig. 41, and after being treated is discharged through the orifice, *b*, Fig. 40, in the hearth of the furnace. The space between the arch and bottom near the bridge, *g*, is 21 ins., converging to 8 ins. near the flue, *c*. The flue is conducted, either directly or through dust-chambers, into a chimney, the capacity of which for a single furnace should be from 16 to 18 ins. sq. and from 25 to 30 ft. high, and the bridge, *g*, should be formed of material sufficiently refractory to withstand the action of the fire and the friction of the hoes used in turning the mass of ore.

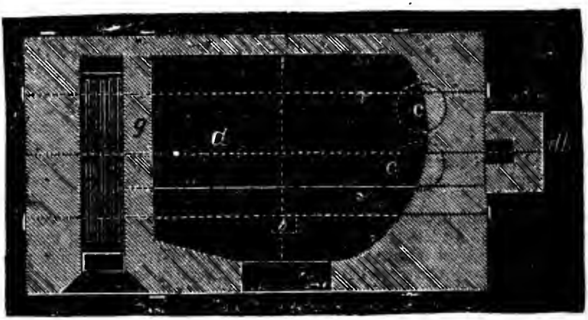


Fig. 40.

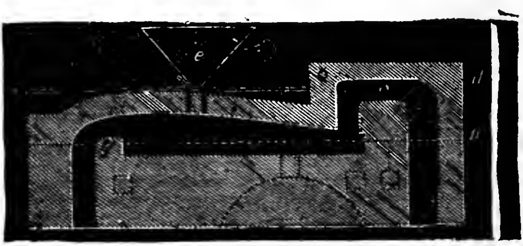


Fig. 41.—Furnace for Roasting Ores.

Figs. 42, 43 and 44 is a plan of a furnace suitable for the smelting of silver ores, for refining silver, or melting retorted amalgam; the cast-iron pan, *a a*, 15 ins. deep and 37 ins. diam., is lined with fire-proof material to form the hearth, and is supported by fire-bricks to permit access of air under and around the bottom and sides in order to temper the heat. The fire-proof material is formed of old fire-brick pulverized and mixed with one-third its bulk of good clay, or of 3 pts. pulverized white quartz (pure) with 1 pt. clay; is beaten with rammers so as to project 6 ins. above the verge of the pan, and is finally moulded into proper shape with a curved tool. The flue-plate, d, is first lined with a floor of fire-brick, and finally coated with a mortar of the fire-proof material carefully smoothed down. The ore is passed in at k, whence it descends to the hearth, $f\,f$; the slag is discharged at the orifice, o, and the metal and matt at the tap-hole passing through the hearth, represented at b, Fig. 43. The ore, carried by the draft into the dust chamber, p, is removed at intervals through the aperture, b. The fire-place, H, is adapted for coal: the capacity of the chimney should be from 18 to 20 ins. square inside, 40 to 50 ft. high, and lined with fire-brick.

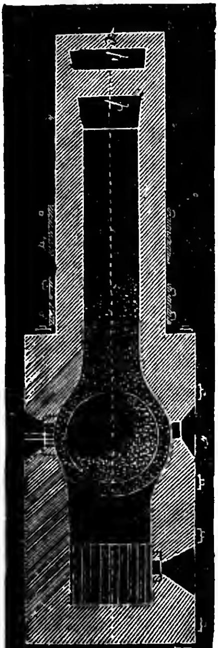


Fig. 42

FURNACE FOR TOASTING ORES.'

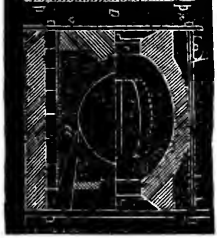


Fig. 43.

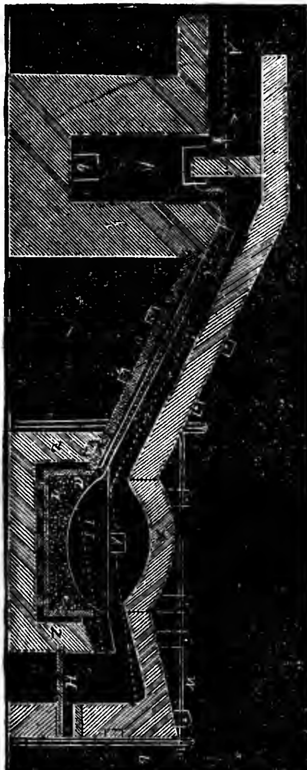


Fig. 44.

Fig. 45 represents a reverberatory roasting furnace in which the stirring is performed by the iron stirrers, n, and mechanically by the rotation of the hearth. The iron hearth-stone, $a\ a$, is 12 ft. in diam. with sides, b, 10 ins.

high, composed of fire-tiles ; the bottom, 4 ins. thick, is formed of fire-bricks ; the ore is introduced through the funnel, *p*, and discharged through the opening, *d*, 39 ins. long and 4 wide, with a hinged iron door, into the funnel, *e*, which carries it outside the furnace. The cog-wheels by which the hearth is rotated, and the balls and rollers on which it rests, are shown at *g* and *h*.

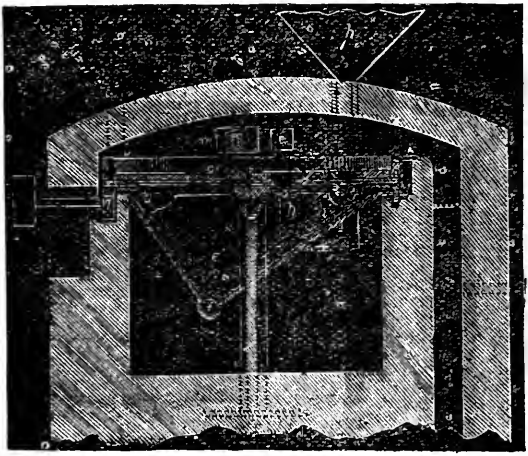
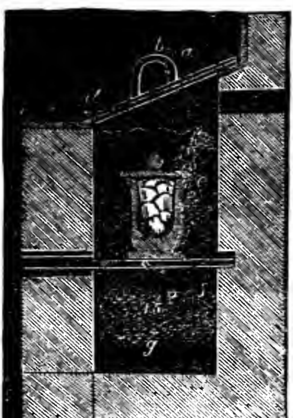


Fig. 45.—Furnace for Roasting Ore.



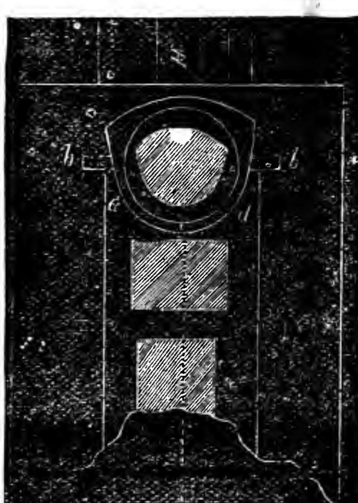


Fig. 46. Furnace for Operating Crucible. Fig. 47.

Fig. 46 represents a furnace adapted for operations with a crucible. The crucible is supported on a piece of fire-brick on the grate, composed of movable iron rods; *a*, is a sliding door at the top; the furnace is 15 ins. square and is lined with fire-brick.

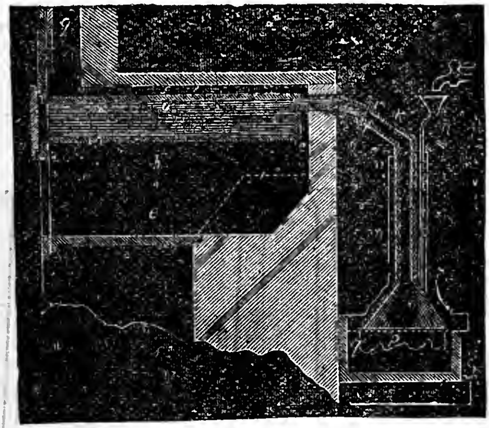


Fig. 48.—FURNACE FOR DISTILLING MERCURY.

Figs. 47 and 48 shows the plan of a furnace used for the distillation or retorting of the quicksilver from the various gold and silver amalgams obtained in the treatment of ores. Fig. 47 represents a front view; the cover, *a*, Fig. 48, of the retort being removed. The retort has two wings, *b b*, Fig. 47, by which it is supported on brick work so as to leave three ins. clear on each side; it is formed of cast-iron, 4 ft. long, 11 ins. wide, and 9 ins. high. The fire has a full sweep over the whole surface of the retort both above and below; the fire-place is fitted with grates 2 ft. long, and may be made longer if required, to conform to the kind of fuel used. The condensing pipe, *k*, is terminated by a funnel, *l*, while a constant stream of cold water is kept flowing around the pipe. The funnel is wrapped around with cloth, *p*, which reaches into the water. The water in the vessel, *a*, should be kept at a level about half an inch below the funnel.

Figs 49, 50, and 51, represent furnaces employed by the Colorado Gold and Silver Separating Co. in treating ores by the Hagan process.

DESCRIPTION OF THE FURNACES.—A, Furnaces; B, Blast-holes; C, Delivery-openings; D, Perforated steam pipes; E, Superheated chamber; G, Flue, 6×8; J, Dampers; L, Bridgewall of Furnaces; M, Flue, 18×18; N, opening, 24×24; O, Ash-pits; P, Stone walls to save brick; Q, Brick walls; R, Wood furnaces; S, Coalfurnaces; T, Pipes for for superheated steam over furnaces; M, Grate-bars; V, Steam pipes for controlling the action in the reducing chamber.

WORKING DIRECTIONS.—Fill the furnace with ore broken 6 to 8 inches square, put fire under, and work very moderately for 24 hours; then make the fire strong, and let the ore remain in 48 hours longer. At the expiration of that time, commence to draw out, taking out 2 tons per hour, at the same time putting in a like quantity; thus keeping the furnace always full, and bringing the ore gradually from a temperature of about 300° at the top to a temperature of about 900° as it falls to the bottom of the furnace.

Let in steam at the bottom of the furnace, for 10 minutes, each time before taking out ore, which cools it. After taking the ore out of the furnace, it should be run through some grinding process to bring it down to find sand. It should then be run through the second process, which should have a strong wood fire and good supply of hydrogen gas, as the time running through would be very short ; after which it should be put in some amalgamating process, such as Beath's, which grinds to fine powder as it amalgamates, and clears off the oxides at the same time.

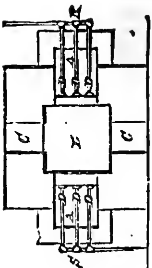


Fig. 49.

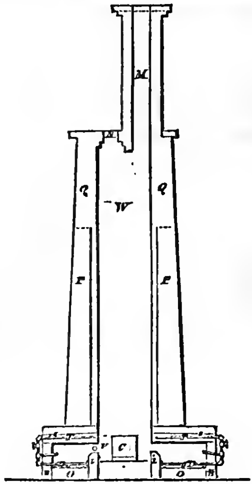


Fig. 50.

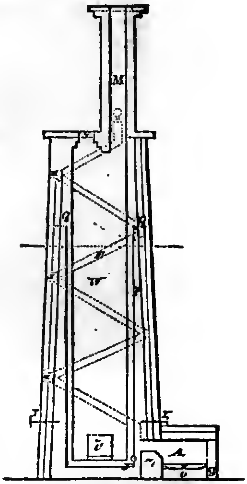


Fig. 51.

"The following is an explanation of the *rationale* of the Hagan process for disintegrating and desulphurizing gold and silver ores. Superheated steam is introduced into the fire in such a manner that, in a gaseous form, the steam impinges upon the ignited coals or wood without admixture of atmospheric air, and thus effects the decomposition of water into oxygen and hydrogen gases. The oxygen unites immediately with the carbon of the burning coals or wood, while the liberated hydrogen passes from the fire and burns in the presence of the oxygen of the air. The hydrogen flame and the resulting gases being brought into contact with the heated gold and silver ores, the sulphur, arsenic, antimony, etc., are dissolved, and are carried off with the products of combustion. The powerful effect of the flame of hydrogen, in dissolving pyritous sulphur, arsenic, antimony, etc., and in attacking oxygen, is well known, but the expense of producing it has hitherto prevented its application to the disintregration and desulphurization of gold and silver ores. Not until the invention of Dr. Hagan's cheap and simple method of decomposing water and thus furnishing hydrogen gas and flame abundantly, has it been at all possible to apply it to this purpose ; but now so economically can this powerful agent be produced that the cost of treating ores by it is only one dollar per ton.

"The treatment of gold and silver ores by the Hagan process requires a furnace of very simple and inexpensive construction, which may be built of materials at hand in every miner's locality, costing not over $2000, for working

50 tons per day. The ores are fed in at the top of the furnace as they come from the mine, and are drawn out at the bottom as soon as they become disintegrated and desulphurized, and thus the operation is kept up, day and night, uninterrupedly, the ore requiring 48 hours to pass through.

"The ores thus treated become soft and friable, and their character will be destroyed, so that they will crumble into powder under slight pressure. The sulphurets of iron, copper, and other base mineral compounds, will be converted into oxides. The finest particles of metallic gold will be liberated from their inclosing matrix, and the silver ore will be put in a chemical condition suitable for perfect amalgamation, so that both the silver and gold may be easily separated without the great waste and losses attending the old methods of working the ores.

"When properly manipulated, the ores can be made to render all the precious metals they contain, or, say, within five per cent. of the assay—whereas by the ordinary method, the miners of Colorado have only obtained $25 per ton from ores actually containing from $100 to $500 or more per ton."

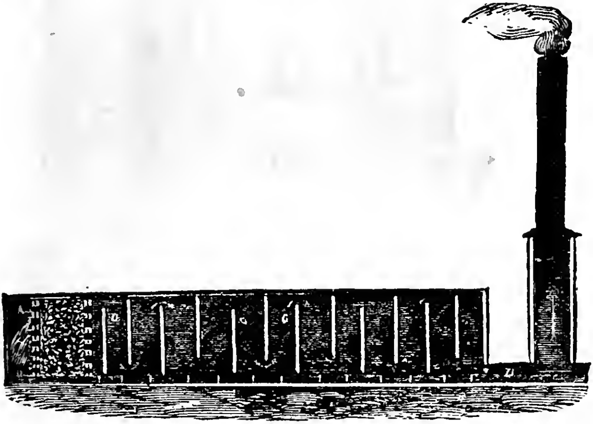


Fig. 52.—Furnace for Extracting Quicksilver.

Fig. 52 represents furnace used for the extraction of quicksilver from the cinnabar at the New Almaden mines. It is constructed of bricks with a capacity for holding from 60,000 to 110,000 lbs. of ore, according to its grade. The fuel used is wood, fed into a lateral furnace which supplies heat to the chambers containing the ore, but separated from them by a wall pierced with numerous apertures formed by the omission of bricks at proper intervals. The heat is conducted among the ore and through all the chambers exhibited in the diagram, until the mercury is thoroughly condensed, while the draft is conducted through inclined stacks to the top of a distant eminence where the deadly emanations of the furnace are discharged. The furnaces rest upon double arches of brick-work and the whole is arranged with effective appliances for securing the condensed quicksilver. The ore is hand-broken to remove the barren rock ; no flux is employed, the lime associated with the ore being all-sufficient for the decomposition of the sulphurets.

The metal begins to run in from 4 to 6 hours after the heat is applied, and the process is complete in about 60 hours. The mercury is conducted by iron pipes through various condensing chambers, and finally discharged, in a pure condition, into large kettles.

Fig. 52 represents Bruckner's furnace for roasting ores. The contrivance is formed of an iron cylinder suspended by chains, which by means of a rotary motion mixes and stirs the ore while under treatment. These furnaces are made of two sizes, one 6 ft. long to contain 800 lbs., and the other 9 ft long to hold 1400 lbs., the first noted requires three-fourths of a horse-power to drive it and the other one horse-power. They are eminently suitable for localities difficult of access as they can be transported on the backs of mules.

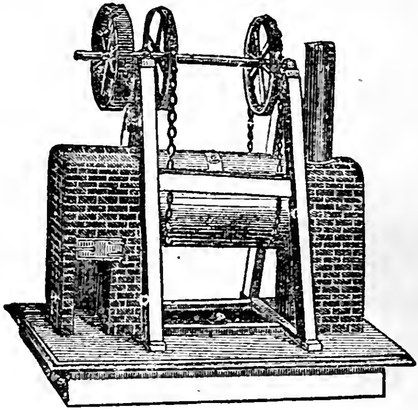


Fig. 53.—Bruckner's Furnace.

Monnier's Desulphurizing Process.—This process is adaptable to cupriferous or nickeliferous ores, as also where gold and silver occur with the sulphides of copper and iron, one of the primary features being the utilization of the eliminated sulphur for the manufacture of oil of vitriol by the conversion of the sulphurous fumes into sulphuric acid. The extraction of the silver, copper, nickel, or cobalt, as either of these metals may be present in the ore under treatment, is effected by means of sulphate of soda, the gold remaining in the residue and desulphurized oxide of iron in a state permissive of easy amalgamation. The ore, mixed with sulphate of soda, is first pulverized by means of ore-crushers so as to pass through a sieve with 20 holes to the inch, and afterwards calcined in a muffle-furnace 80 ft. in length and 6 ft. wide, the hearth of the muffle (upon which the ore is placed) being built of tile $4\frac{1}{2}$ ins. thick; the heated gases traverse the entire length of the furnace from the fire-chamber to the end of the structure underneath, without communicating with the muffle. Access to the ore is gained by side-doors along one side of the furnace, through which it is turned and stirred once every hour, being gradually worked onwards from the rear end of the furnace towards the front, where it is recharged through a hopper into the muffle towards the front, where it is charged.

The ore is thus gradually heated, and, by the presence of the sulphate of soda, most of the sulphur is eliminated and a large amount of sulphates of the oxides of iron and copper (silver, nickel and cobalt) produced. When the charge reaches the front of the muffle, in the immediate vicinity of the fire box, and where the temperature is most elevated, the sulphate of the oxide of iron is decomposed, producing oxide of iron, some *bi* sulphate of soda, and *completely* converting the copper (silver, nickel and cobalt) into soluble sulphates. This stage of the operation requires care in the management of the temperature, since, by too low a degree of heat the iron may not all be converted into insoluble oxide, or, by too great an elevation of temperature, some of the other metals may be rendered insoluble by a deprivation of their sulphuric acid. If it be the object of the operation to manufacture oil of vitriol as well as to extract the metals, the register, placed at the end and above the fire-box, must be regulated so as to admit the quantity of atmospheric air requisite to the oxidation of the sulphur in its passage through the length of the muffle—the exit pipe for the sulphurous acid gas leading from the rear end of the muffle, close to the charging funnel, into the oil of vitriol chamber. The ore thus calcined is lixiviated with

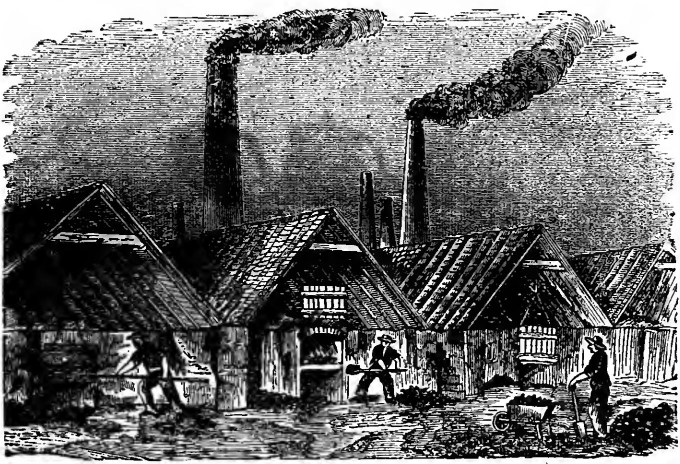


Fig. 54.—FURNACES USED IN MONNIER'S PROCESS.

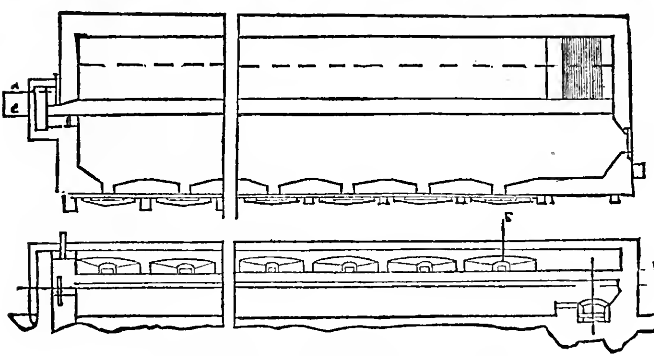


Fig. 55.—SECTIONAL DRAWING OF FURNACE.

water to extract the sulphates of copper, silver and soda (cobalt and nickel), and the insoluble residue consists of oxide of iron and earthy matters, and contains, if the ore treated has been auriferous, all the gold. The method of lixiviation [see Fig. 56] is the same as that practiced in soda works for what is called "black ball;" that is to say, the calcined ore is placed in a series of tanks [A. A. A.] having false bottoms, serving as filters. The warm water, introduced at the top, percolates through the mass, dissolving the sulphates, and, passing through the filter, is raised through a leaden pipe (placed vertically through the ore and communicating with the space under the false bottom or filter) into another similar tank charged with the calcined ore, and thus through the series, becoming more and more saturated with the soluble salts. If the residue [collected in agitator, C.] after

Fig. 56.—Lixiviating Tubs, Monnier's Process.

lixiviation contains only oxide of iron and gangue, it is thrown away; but should the ore treated have been auriferous, the insoluble residues contain the whole of the gold, *perfectly free from sulphur*, which may easily be extracted by first re-grinding the mass in a Behr mill, and then passing it through a series of three Tyrolean amalgamators. The preliminary grinding requires but small power as the calcined ore is very friable. With three amalgamators the operation is perfect, as has been demonstrated on a large scale in North Carolina. The solution containing the sulphates is treated according to the metals present. If cobalt and nickel are present in sufficient quantities, the operation becomes exceedingly complicated. The liquor containing the sulphates of soda, copper and silver is treated as follows: the silver is first precipitated by means of plates of copper, and subsequently this added copper, as well as that existing in the ore, is removed from the solution by cast-iron, after which it is evaporated to dryness to recover the sulphates of soda, which may thus be repeatedly used for the calcination of fresh ore. The metallic copper and silver so obtained are separately worked in the usual way. The copper is so pure that it requires only a single fusion to produce ingots of the first quality. The precipitation is made in a reverberatory furnace of peculiar construction. In a wooden trough (54 feet long, 10 feet wide and 2½ feet deep) is a leaden pan (of 10 pounds to the square foot) of the same dimensions, the bottom of which is covered by a two-inch floor of wood, and the sides of which are protected by a nine-inch brick wall, extending one foot above the sides of the leaden pan, and the whole covered with a low arch and well braced. Along one side and above the leaden pan is placed a number of working doors, through which the copper is removed after precipitation. The plates of cast-iron (2 feet long, 1½ feet wide and one inch thick) are placed across the furnace, at intervals of one foot, so as to form partitions. At a distance of two feet from the end of the furnace is constructed the fire-box, which connects by an arch with the arch of the precipitating furnace, and the gases from which are discharged from a stack in the latter arch. The liquid to be precipitated is then introduced into the furnace to the height of the leaden pan, and removed after the precipitation of the copper by means of a large plug at the bottom of the furnace. The fire is very moderate, the object being to create a reducing atmosphere, to prevent the oxidation of the protoxide of iron, the presence of which would cause a loss of cast-iron. The evaporator is of similar construction, except that the arch is close to the upper edge of the leaden pan, so as to compel the heat to travel as close as possible to the surface of the liquid to be evaporated, but at a distance of ten feet from the fire box commences gradually to raise, in order that the fire may be admitted at about 3 ft. above the solution. The furnace is kept constantly full of water, in order that the leaden sides may not be melted. When nearly full of sulphate of soda, the fire is extinguished, the mother liquid removed, and the three working doors at the bottom opened. The solid and semi-fluid sulphate is discharged upon a wooden floor, and as soon as consolidated is placed upon the top of the furnace to dry. The dry sulphate, as above stated, is mixed with the fresh ore, ground, and used repeatedly in the desulphurization. The precipitating and evaporating furnaces might be constructed of brick, but the difficulty in preventing leakage through the brick, and cost of material, will nearly counterbalance the expense of the lead, which preserves at all times its value. In the old method of manufacturing sulphuric acid from pyrites containing a small quantity, the residue has been submitted to a smelting process. In this method water does the work, and an ore containing not more than 3 or 4 per cent. of copper (which has hitherto been refused by smelting works in this country) can be successfully and profitably treated. A residue, with no greater content of copper than above given, and perfectly free from sulphur, is worthless to smelting establishments in this country; but by the application of the process we have described, the whole is extracted by water at but small cost, saving concentration and waste of ore, and enabling mines scattered over the country, now considered valueless, to become profitable and dividend paying.—*Abridged from Miner's Hand-Book.*

BLOW-PIPE ASSAY, FLUXES, HYDROSTATIC WEIGHING, CUPELLATION, &c.

In the oxy-hydrogen blowpipe, 2 volumes of hydrogen to 1 of pure oxygen generates the greatest heat and light ever produced. The most refractory substances are fused, melted, and dissipated immediately. Before it opal and flint dissolve into enamel; quartz and rock crystal are reduced to glass; the diamond and gold are volatilized; brass wire and platina burn with a green flame; emerald, blue sapphire, lapis lazuli, and talc are converted into glass; copper melts without burning, and iron evolves a brilliant light.

The common blowpipe is simply a bent, tapering tube of brass, from 7 to 10 ins. long, with a very minute orifice for the breath to escape. Small and simple as it is, however, it is of paramount utility to every miner and mill-man, as by its use every effect of the most intense furnace heat may be produced by concentrating to a point the flame of a candle or lamp by urging it with the breath upon a small particle of any substance. By this means the identity and value of most mineral substances may be ascertained and established by an operation requiring less than 30 minutes to perform it. A blow-pipe should be of brass, with an ivory or horn mouth-piece to secure ease of operation; a chamber to retain the condensed moisture from the breath, and a platinum tip, or point, to withstand immersion in the acids required to ensure cleanliness.

Besides the blow-pipe, the assayer requires the following apparatus: 1. An assay or blow-pipe balance. 2. A small hammer with slightly rounded face and a transverse sharp edge at the other extremity. 3. A square, smooth piece of steel to use as an anvil. 4. A small porcelain or agate mortar, in which to pulverize the assay. 5. A mixing scoop, in which to mix ore with fluxes. 6. A small magnet to test ores for iron, &c. 7. A small magnifying glass. 8. A small drill to perforate cavities in the charcoal in which the paper tubes containing the ore is to be placed. 9. A small cylinder to make paper tubes in which to pack and melt the assay. 10. Cupels made of bone ash. 11. A cupel holder made of copper or brass. 12. A variety of fluxes, charcoal, &c. 13. A steel forceps, or cutting pliers, for separating small fragments of minerals. 14. A small file, and glass tubes in lengths from 24 to 36 ins., with apertures about three-sixteenths of an in. in the clear. They are cut with the file into lengths of 4 and 8 ins., of which the shorter are open at both ends, and ready for use. By heating the 8 in. pieces over an alcohol lamp, with the fingers over each end, until they become red-hot, and then drawing them, they will part in two pieces, each with one end closed, a most convenient form for many operations.

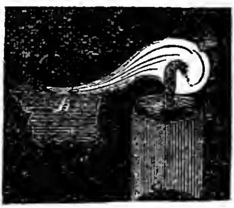


Fig. 57.—Reducing Flame.

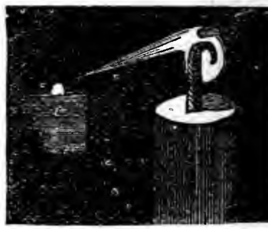


Fig. 58.—Oxidizing Flame.

To obtain the best results from the blow-pipe in treating refractory minerals, &c., it is necessary that the blast should be continuous. To effect this, breathing and blowing should go together. This may be difficult to a beginner, but is soon perfected by practice in breathing through the nostrils and blowing through the instrument with the mouth at the same time. The mode of operating with the blow-pipe is exhibited by Figs. 57 and 58.

The blow-pipe flame is formed of two cones; an *inner*, of a blue tint, producing a most vehement heat, just beyond the verge of the blue flame. This is called the *reduction flame*, and should entirely envelope the assay, as shown in Fig. 57. The *outer*, called the *oxidation* flame, is represented by Fig. 58, and in this case the assay should be placed just beyond the verge of the outer flame, exposed to the action of the atmosphere. To produce the former, the point of the blow-pipe must just touch the flame as shown at *a*, Fig. 57; to produce the last noted, the point of the blow-pipe must be inserted a little into the flame, as shown at *a*, Fig. 58. The exact adjustment of the blow-pipe, to produce the desired effect in each case, is well exhibited in the engravings. The flame may be supplied by a spirit lamp; a candle with a large wick, or by a lamp with a large wick fed with olive oil.

To sustain the mineral under treatment in the flame, a platinum wire or forceps may be used, or a piece of sound charcoal made from pine wood, with a slight cavity for the assay (to prevent it from blowing away by the blast), will answer every purpose. For many minerals charcoal is the best support obtainable, as the carbon of the coal renders great assistance to the reducing process. Where no better can be had, mica, and the mineral kyanite, may be used as supports for the assay.

The specimens of minerals, &c., selected for treatment in the blow-pipe flame should be very little, if any, larger than those represented in the cuts. With many kinds of a refractory character very *thin* specimens should be selected, as thereby fusion is greatly promoted, where otherwise it would be impossible. The size of the whole assay should be less than the bulk of a small pea.

Many minerals are absolutely infusible without a flux to aid reduction. The substances in common use as fluxes, are: *carbonate of soda, borax, bi-sulphate of potassa*, and *salt of phosphorus* or *microcosmic salt*. The carbonate of soda should be free from sulphuric acid, as any contamination will induce a reddish tint in the glass obtained by the fusion of silica. To obtain the full energy of borax it should be vitrified by melting, on a sheet of iron or in a crucible, common borax into a clear, transparent glass, which is subsequently pulverized and set away in glass stoppered bottles for use as required. This *must be kept* where it will not absorb damp or moisture, which ruins it for use. To prepare *bi-sulphate of potassa*, mix in a porcelain cup 2 ozs. pulv. sulphate of potassa and 1 oz. sulphuric acid; heat over an alcohol lamp until the mixture assumes a quiet, clear, transparent appearance. It is then removed from the fire and poured on a piece of sheet iron. It is used for testing ore for bromine and iodine. To prepare *salt of phosphorus*, dissolve 16 parts of sal-ammoniac in a small quantity of boiling water, then add 100 parts of crystallized phosphate of soda, *boiling gently* the whole, then set off to cool. The salt of phosphorus is deposited in small crystals. Too much heat while boiling will cause decomposition.

The fluxes should be carefully pulverized and mixed with the powdered mineral in the mixing scoop previous to being inserted in the paper tubes and placed on the charcoal. Tough silver ore may be treated in small pieces, and three times as much lead as silver should be used. Proportion of borax should be about 60-1000ths, but more may be added if necessary. Soda, when used, may preferably be added in small successive quantities. The paper tubes for receiving the assay are formed by cutting note paper into strips 1½ ins. by 1, and winding the strips around the small wooden cylinder (above noted) so as to form a tube, in which the assay is packed previous to placing it on the charcoal. One part of the tube should project a little over the cylinder, and this projecting part should be turned down so as to close one end.

In addition to the apparatus above noted, the assayer should have on hand a quantity of fine platinum wire (bent at one extremity into a circle one or two lines in diameter) for holding the assay during the operation; also, *platinum foil*, for enveloping minerals that decrepitate. The following chemicals, etc., will also prove useful in many cases as reliable tests:

1. *Tin-foil*, for using with various per-oxides of metals to reduce them to protoxides. By touching the assay, previously heated in the reducing-flame, with the extremity of the tin-foil, a very small quantity of a metallic oxide may at once be detected. 2. *Anhydrous bisulphate of potash*, used for detecting lithia. It should be kept (well pulverized) in a bottle where it will not absorb moisture. 3. *Saltpetre* is used in detecting manganese. It developes the peculiar amethystine color when the amount of this mineral is too small to color glass without this re-agent. The heated globule is touched with the point of a crystal, just at the instant of suspending the blast. The fused mass swells, foams, and either turns immediately colored, or becomes so soon, upon cooling. 4. *Boracic acid* and *iron wire* is used for testing for phosphoric acid. 5. *Nitrate of Cobalt* (pure) in solution, is used for distinguishing alumina and magnesia. Use a platinum wire inserted in cork stopper to apply a drop when required for use. 6. *Gypsum* and *fluor*, as tests of each other. Two parts of calcined gypsum and one of fluor, when intermixed and heated, fuse into a clear glass, presenting a milk-white en-

amel on cooling. 7. *Oxalate of Nickel*, or *Nitrate of Nickel*, is used to detect potash. It should be free from cobalt, for which it may be tested by treating it with borax ; the result should give a brown, not a blue bead.

The behavior of different minerals before the blow-pipe is various. Some are so refractory as to be wholly infusible ; some specimens melt only at the edges ; others are easily fused, while some are dissipated wholly or in part. Kobell's scale for representing the various degrees of fusibility by figures, is as follows: 1. *Gray Antimony.* 2. *Natrolite.* 3. *Cinnamon Stone* (Var. of garnet). 4. *Black Hornblende.* 5. *Feldspar.* 6. *Chrondrodite.* The fusibility, when equal to that of natroline. is represented by 2 ; or if like hornblende, by 4, etc.

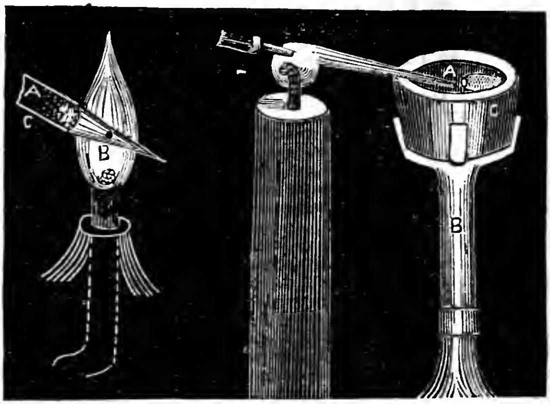


Fig. 59. Fig. 60.

The test tubes above noted are used to determine the presence of water and other volatile components of various ores. The mode of operation is exhibited by Fig. 59, in which A represents the tube, B the mineral under treatment in the flame of a spirit lamp, and C the aqueous or volatile products as usually condensed on the upper part of the tube. Acid fumes may be detected by inserting a strip of litmus or other test paper in the upper part of the tube ; the fumes, if acid, will turn the paper red.

CUPELLATION. The object of this process is to separate gold and silver from lead, by absorbing and oxidizing the base metal while the other is left pure. Fig. 60 represents the manner in which this process is performed by the blow-pipe. A is the assay under treatment, C is the cupel, and B is the cupel holder. A circular perforation, about ¼ in. each way, is made in a firm piece of charcoal ; in this cavity place some moistened bone-ashes, pressed down smooth; dry, and on this place the assay, and submit to the action of the outer flame. Under this treatment fusion takes place ; the lead is eliminated as an oxide and is absorbed by the bone ashes, while the silver is left as a small brilliant globule in the cavity.

As usually performed, the assay is treated in a cupel made of bone-ashes (or in a small hollow on charcoal, containing bone-ashes, as above noted), where the air has free admission. The assay being melted, the action of the atmosphere effects the oxidation of the lead, which disappears in the porous cupel, being absorbed by the bone-ashes.

The specific gravity of a mineral is determined by the blow-pipe balance, which is adapted for hydrostatic weighings, as represented by Fig. 61, where A is the balance whose scales are suspended by threads of unequal length. To obtain a density by the balance, the mineral *a* must be placed in a sling suspended by a hair or a filament of silk from the small hook below the scale *b*. The ore, thus suspended on the thread, is weighed and

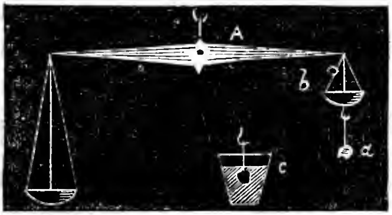


Fig. 61.—HYDROSTATIC BALANCE, &c.

the contents noted. The mineral, still suspended, is next immersed about ½ in. below the surface of the water, in the glass vessel *c*. All adherent bubbles of air are carefully wiped away from the ore ; it is now weighed a second time, and the loss by immersion calculated. By the specific gravity, or density of a mineral, is understood its weight as compared with that of an equal bulk of distilled water, at the temp. of 60° Fahr.

The preceding instructions cannot fail to prove of immense utility to the operator in proceeding with the practical tests noted in the following elaborate details relating to minerals, etc.

HOW TO IDENTIFY AND TEST METALLIC ORES : CONDENSED SYNOPSIS OF THE CHEMISTRY, GEOGNOSTIC SITUATION, &C., OF METALS.

Characteristics of Metals.—Metals are distinguished by the properties of fusibility, malleability, ductility, tenacity, elasticity, crystalline texture, and brilliancy, combined with the quality of conducting heat and electricity.

GOLD.—This metal is seldom found in its native purity ; it is found only in its metallic state in combination with other metals, generally in veins pervading primary and secondary rocks, as granite, slate, hornstone, quartz, limestone, sandstone, gneiss, mica-slate, mica, and sometimes in graywacke and tertiary strata ; also in veins of silver, copper, antimony, zinc, lead, iron ore, barytes, &c. The attrition of the elements operating on the containing rocks and metallic lodes during uncounted ages, has washed thousands of millions into the beds of streams, the margins of rivers, and alluvium or drift deposits. In the primary rocks it is found mainly in schistose or slaty fissures.

In external appearance gold is of a golden or orange yellow color, passing into grayish or brass yellow, and is the heaviest of metals except platina. It is the most ductile, tenacious, and malleable of all the metals. On being struck with a hammer it will flatten out : iron and copper pyrites, and yellow mica, which resemble it, will crumble under this test. Internally it is bright yellow, shining, glistening and metallic. It has equal axes like the cube, has no cleavage, has a hackly fracture, and often exists crystallized in cubes, octohedrons, rhomboidal dodecahedrons, and tetrahedrons.

Gold is fusible with the blow-pipe (use the reducing flame with carbonate of soda for flux), melts at 2590°, is soluble in nitro-muriatic acid, which is simply 2 parts muriatic acid and 1 part nitric acid, and remains unaltered by exposure to simple acids, air, or moisture. Nitric acid (aqua fortis) will dissolve any suspected brass filings in gold dust. Specific gravity 19.26 to 19.5.

IN SOLUTIONS OF GOLD (Peroxide), *Ammonia* produces a yellow precipitate (aurate of ammonia or fulminating gold); *Ferrocyanide of Potassium* produces an emerald green color; *Oxalic Acid* produces a precipitate of metallic gold; *Protosulphate of Iron* produces in concentrated solutions an instant precipitate of metallic gold. In dilute solutions a blue coloring is first perceived, followed by a brown-colored precipitate; *Potassa* (in heated solutions), after a time produces a trifling reddish-brown precipitate, consisting of teroxide of gold mixed with terchloride of gold and potassa. *Protochloride of Tin*, to which a drop of nitric acid has been added, imparts a reddish purple color to very dilute solutions; in concentrated solutions a red-purple precipitate (purple of Cassius) is formed. *A Bar of Metallic Zinc* precipitates metallic gold in the form of a brown coating.

PLATINUM.—This metal is mainly found in alluvium or drift, sometimes in granite, syenite, &c., combined with gold, silver, copper, iron, lead, &c., but always in the metallic state in round grains and rolled pieces about the size of peas, and like large iron filings.

In color platinum is steel-gray, nearly resembling silver, but not quite so bright. In lustre it is shining and glistening; in structure it is sometimes lameller; is malleable and ductile; with hardness almost equal to that of iron.

Platinum is infusible in the hottest furnaces, but melts readily before the reducing flame of the compound blow-pipe at a temp. of 3080°. Dissolves in nitro-muriatic acid, and is unaffected by exposure to air, moisture, or simple acids. Specific gravity 20.98.

IN SOLUTIONS OF PLATINUM (Peroxide), *Potassa* produces a yellow crystalline precipitate, consisting of the double chloride of platinum and potassium; the addition of hydrochloric acid favors its formation; it is insoluble in acids, but dissolves in potassa with the aid of heat; it is very slightly soluble in water, and insoluble in strong alcohol; *Chloride of Tin*, in presence of free hydrochloric acid, imparts to solutions of bichloride of platinum a deep-brown color without producing any precipitate; *Subnitrate of Mercury* produces a yellowish red precipitate.

SILVER.—This metal is found native, as also combined with muriatic acid and sulphur in primary and secondary slates. Great quantities exist in the metallic state combined with gold, copper, arsenic, and lead, in rocks composed of mica-slate, gneiss, clay-slate, graywacke.

Native Silver occurs in primitive and secondary rocks, irregular quartz, &c., with the ores of copper, silver, cobalt. In color it is white, sometimes a tarnished gray, or reddish shade. It occurs in plates and spangles, and crystallized in tubes, octohedrons, rhomboidal docahedrons and tetrahedrons, dentiform, capillary, ramose, reticulated, rarely large, and generally disseminated. When broken it appears fine and hackly, with a bright, shining lustre. Its color and malleability are prominent characterlstics.

It is composed of silver with a little iron, antimony, copper, or arsenic, is soluble in nitric acid, is fusible into a globule, and melts at 1873° Fahr. Oxide of silver with borax in oxidizing flame, before the blow-pipe, forms a white opaque glass; in reducing flame, with carbonate of soda, readily reduces to metal. Specific gravity 10 to 10.5.

Antimonial Silver, composed of silver, 84 parts; antimony, 14 parts; occurs in granite and clay-slate, combined with the other ores of silver; is found in curved laminæ, also in grains, in cylinders. Is massive; yields to the knife; has a conchoidal fracture; and is fusible under the blow-pipe (evolving antimonial vapors) into a button of silver. The characteristics are, the antimonial vapor, a silver or tin-white color, the want of ductility, and not giving a blue globule with borax.

Sulphuret of Silver, composed of silver, 85 parts ; sulphur, 15 parts ; a very productive ore ; occurs in the primary and secondary rocks ; is of a dark, lead-gray color ; frequently with an iridiscent tinge, and exists in tubes and octohedrons ; also ramose, reticulated, amorphous, lamelliform, and in plates. The characteristics are, malleability ; imperfect cleavage ; flat, conchoidal fracture ; can be cut with a knife ; has less specific gravity than native silver, and fuses with intumesence and a sulphurous odor under the blow-pipe. Specific gravity, 7.

Brittle Sulphuret of Silver, composed of silver, 66.5 parts ; antimony, 10 parts ; sulphur, 12 parts ; iron, 5 parts ; arsenic and sulphur, 5 parts ; is a very rich ore, and occurs in the primary rocks with other ores of silver. It exists in crystalline structure and diffused ; also in hexahedral prisms, and is of a dark, lead-gray hue, or bluish-gray, passing into iron-black. The structure is foliated ; crystals mostly intercept each other, with a dull, metallic lustre. The ore is soft and brittle ; the fracture is conchoidal. Soluble in nitric acid, and fusible, with the emission of sulphur, antimony and arsenic, into a globule of silver surrounded by a slag. The characteristics, compared with other ores, are its dark color and brittleness ; from sulphuret of silver it differs in its lack of malleability. Specific gravity, 7.

Sulphureted Antimonial Silver (*Red Silver*), composed of silver, 60 parts ; antimony, 20.3 parts ; sulphur, 14.7 parts ; oxygen, 5 parts ; is an excellent ore, and is found in primary rocks, mainly in mica-slate, granite and porphyry. It possesses a metallic adamantine lustre ; structure is imperfectly foliated, has a red color of various tints, passing into lead-gray and grayish-black ; the powder is crimson red. It exists in masses and grains, also dentritic, capillary, membranous, and crystallized in hexahedral prisms, terminated by hexahedral prisms ; also in double six-sided pyramids ; is translucent, opaque.

The characteristics are, malleability, differs from sulphuret of arsenic in leaving a globule of silver, and in possessing greater specific gravity. Is fusible, with emission of antimonial fumes. Sulphuret of mercury volatilizes under the blow-pipe. The red oxide of copper is readily reduced to the metallic state by the blow-pipe ; specular oxide of iron is rendered magnetic by the same process. Specific gravity, 5.20 to 6.68.

Muriate of Silver (*Horn Silver*), composed of muriate of silver, 88.7 parts; oxide of iron, 6 parts ; alumine, 1.75 parts ; sulphuric acid (oil of vitriol), 0.25 parts ; an excellent ore ; is found in the primary rocks, with other ores. In color is pearl gray, greenish or reddish-blue, yellowish or greenish-white and brown. In lustre is glistening and wavy. Is malleable ; feebly translucent ; becomes brown by exposure. Exists massive, investing other minerals, amorphous, reniform, and crystallized in tubes, octohedrons, and acicular prisms.

The characteristics are, the emission of muriatic acid fumes before the blow-pipe ; fusibility in the flame of a candle ; softness ; yields to the knife and to pressure. Abraded on damp or wet zinc it leaves a film of silver. Muriate of mercury volatilizes before blow-pipe without leaving a film of silver. Specific gravity, 5.5.

MERCURY.—This metal rarely occurs in its native state. By far the greater part is found in the form of

Sulphuret of Mercury (*Cinnabar*), composed of mercury, 84.5 parts ; sulphur, 14.75 parts. It occurs mainly in new red sandstone ; occasionally in limestone, mica-slate, graywacke, gneiss, deposits of bituminous shale, combined with black mineral resin, alluvium, clay, gray sandstone and limestone, and in rocks of the coal formation. In color it is scarlet or carmine, shading off into cochineal red and lead-gray, occasionally with a yellow tint. Is translucent or opaque. Occurs massive and crystallized in acute rhomboids;

certain kinds with a yellow tint; is sometimes found in thin plates or tubular crystals. Lustre is adamantine, varying to metallic; occasionally shining silky. The fracture is granular or fibrous.

The characteristics are, the emission of sulphur vapors, while the compound volatilizes before the blow-pipe. This test determines the difference between this ore and red silver ore, arsenate of cobalt, red oxide of copper, and sulphuret of arsenic. Specific gravity, 8.

COPPER.—Copper is found in primary and transition rocks, syenite, sandstone, coal strata and alluvial ground. It occurs in beds and large blocks. The ores of copper are the following:

Native Copper is nearly pure, and is found in the veins of primary and secondary rocks. In color is copper-red, brownish-black; tarnished externally; is malleable, fusible at 2548° Fahr., and soluble in acids. Occurs dentritic, reniform, capillary, amorphous; also crystallized in tubes and octohedrons. Specific gravity, 8.5.

Gray Copper, composed of copper, 52 parts; iron, 23 parts; and sulphur, 14 parts; is found with other ores of copper. In color is steel-gray, verging into black, with brownish streak. Is brittle, with metallic lustre, and small crystals. Specular oxide of iron gives out arsenical fumes when heated; is magnetic, and softer than arsenical iron. Gray copper ore is fusible but very refractory. Specific gravity, 5.

Copper Pyrites, composed of copper, 40 to 35.3; iron, 40 to 33; sulphur, 20 to 35; a very valuable ore; is found in beds and veins in primary and secondary rocks as well as in other prominent formations. The color is brass-yellow, with metallic lustre; lamellar structure; tessular cleavage, and uneven fracture. Is the most abundant ore of copper; yields to the knife. It occurs dendritic; stalactical; amorphous; in concretions, and crystallized in tetrahedrons and dodecahedrons. Is fusible, and tinges borax green. Iron pyrites does not tinge borax green. Lacks malleability. Native gold is malleable and native bismuth is lamellated. Specific gravity, 4.3.

Sulphuret of Copper, composed of copper, 76.50 parts; sulphur 22,; iron, 0.50; is found located same as the last noted ore. Exterior color is blackish steel-gray, occasionally iridescent; internally is lead-gray. Has lamellar structure; conchoidal fracture; is easily sectile, with brilliant faces; crumbles readily, and has equal axes like the cube.

The characteristics are, fusibility, with the emission of sulphur fumes; is also soluble in hot nitric acid. Is distinguished from gray copper ore by being softer, also by the latter decrepitating before the blow-pipe. A very productive ore. Specific gravity, 5.

Blue Carbonate of Copper, composed of oxide of copper, 70 parts; carbonic acid, 24 parts; water, 6 parts; is found in the primary and secondary rocks. The color is blue, fracture irregularly foliated, generally showing broad fibres. Occurs massive; diffused; stalactical; incrusting, and crystallized.

The characteristics are, solubility in nitric acid with effervescence, is refractory without a flux; fused with borax yields a green glass; does not become magnetic under the blow-pipe, and is insoluble in water. Copper melts at 2548°.

Red Oxide of Copper, composed of copper, 88.5 to 91 parts; oxygen, from 11.5 to 9 parts; is found with other ores of copper. Is of a red color, lamellated structure, metallic, adamantine lustre; is brittle, translucent, easily sectile; has irregular and conchoidal fracture. Is found amorphous and crystallized in octahedrons and cubes.

The prominent characteristics are, easy reduction and solubility; is soluble in nitric acid with effervescence and in muriatic acid without. Oxide of copper fuses in the oxidizing flame, before the blow-pipe; in the reducing flame forms metal; with borax, in the oxidizing flame, colors the glass green; in the reducing flame, brown-red. Specific gravity, 4 to 5.9.

IRON.—Occurs both in primary and secondary rocks. The principal ores from which iron is extracted are the following:

Brown Hematite.—This ore is found in primary rocks and occasionally in secondary formations. It yields a superior iron. In color it is brown, yellowish, or blackish-brown; on the outside resembling black glazed earthen-ware. It yields to the knife; is fibrous in structure, with silky and resinous lustre. It occurs stalactical, tuberous, nodular, and amorphous. A variety of this ore has a compact structure, devoid of lustre, with yellowish-brown streak, and conchoidal or earthy fracture.

Specular Oxide of Iron (*Iron Glance*), composed of iron, 69 parts; oxygen, 31 parts; yields an excellent malleable iron, and occurs mainly in primary rocks, associated with magnetic iron, red hematite, quartz, &c.; occurs also in secondary rocks. In color is steel-gray, with a highly polished surface; often tarnished. Occurs crystallized in pyramidal dodecahedrons, hexahedral tables; also massive, disseminated, in concretions. Has a cherry-red streak, lamellar structure; brilliant lustre; is slightly attracted by the magnet; infusible; and insoluble in acids. Affords a red powder on being heated, and becomes magnetic. Specific gravity, 5.52.

Red Hematite, composed of oxide of iron, 90 parts; silica, 2 parts; lime, 1 part; yields a first-class iron for drawing and rolling; is found mainly in primary rocks; frequently in lead mines. In color is blood-red; also steel-gray. Yields readily to the knife; occurs massive, and in plates; also reniform, globular, and pulverulent. It adheres to the tongue; the fracture is uneven and earthy. Is infusible, but becomes magnetic. Specific gravity, 4.75.

Spathic Iron (*Clay Iron Ore*), composed of oxide of iron, 58 parts; carbonic acid, 35 parts; oxide of manganese, 4.25 parts; magnesia, 0.75 parts; lime, 0.05 parts; yields an iron well adapted for steel making; is found principally in carboniferous limestone, arranged in thick formations; also in veins in granite, mica-slate, clay-slate, gneiss, and graywacke; associated with ores of silver, lead, and cobalt, but seldom in nickel or bismuth; more frequently with galena, iron pyrites, antimony ore, and copper ore. In other veins it is associated with brown, red, and black iron ore, quartz, and calcareous spar; occurs also filling up amygdaloidal cavities in trap-rocks.

The colors of the ore are, yellow, brown, white, and black. It yields to the knife, is easily broken; the structure is foliated or lamellar, with shining, vitreous lustre, and white, or yellowish-brown streak. It occurs massive, disseminated with pyramidal impressions; also in granular distinct concretions; nodular and crystallized. Crystals are usually small, and exist in groups.

The chemical tests are: effervescence with muriatic acid; is infusible, blackens, and becomes magnetic. Heated with borax, it makes an olive-green glass. It may be distinguished from earthy minerals by its weight, from other iron ores by its crystalline foliated cleavage, and from blende by its yielding magnetic iron. Specific gravity, about 4.

Magnetic Oxide of Iron (*Iron Sand*), composed of oxide of iron, 85.50 parts; oxide of titanium, 14 parts; oxide of manganese, 0.50 parts; an excellent ore, yielding from 50 to 90 per cent. of the best bar iron, is generally found imbedded in trap-rocks, and styled mountain ore. The color is iron-black; is found in octahedral crystals, also in minute grains. The powder is black; the fracture conchoidal; intensely magnetic, and infusible by the blow-pipe.

Peroxide of iron remains unchanged in the oxidizing flame of the blow-pipe; in the reducing flame, blackens and becomes magnetic; with borax, in the oxidizing flame, forms glass bright-red while hot, pale dirty-red when cold; in the reducing flame, forms glass varying from bottle-green to black-green; with carbonate of soda, on charcoal, reduces to metal as a dark magnetic powder. Specific gravity, 6.22.

Tests for Iron.—Prussiate of potash added to iron dissolved in an acid causes a blue precipitate, and an infusion of galls a black precipitate.

LEAD.—The principal ore from which the great mass of the lead of commerce is obtained is the sulphuret of lead, or *galena.* It is composed of lead, sulphur, lime, and silex, and is often combined with ores of silver, and frequently with ores of zinc, copper, and iron. It occurs in beds, veins, and imbedded masses in primary and secondary rocks; frequently in the latter, and very often in limestone; also in alluvial deposits.

The shades of color are bluish-gray, lead-gray, and on the outside blackish-gray. Is soft; yields to the knife; has a lamellated structure; metallic lustre, very brittle, and opaque Submitted to heat, it first decrepitates, with the emission of sulphur fumes, then melts into a globule of lead; blende, molybdena and graphite, which resemble this ore, are infusible.

Tests for Lead.—Oxalic acid produces in neutral solutions of oxide of lead a white precipitate. Glauber's salts and an infusion of galls, give to a solution of this metal a white precipitate. Oxide of lead, in oxidizing flame before the blow-pipe, turns first blue, then fuses to a glass of orange color; with carbonate of soda, on charcoal, in the reducing flame, reduces to metal; with borax, forms glass yellow while hot, colorless while cold.

TIN.—The regular ore from which this metal is extracted is:

Oxide of Tin (Tinstone), composed of tin, 77.5 parts; oxygen, 21.5 parts; oxide of iron, 0.25 part; silica, 0.75 part; usually occurs in primary rocks in veins, traversing gneiss, granite, mica-slate, porphyry, and clay-slate, and is generally found with iron pyrites, chlorite, quartz, topaz, fluor, &c. The metal obtained from ores thus located is called *block tin.* The *grain tin* of commerce is obtained from the *stream tin* ore found in alluvium and drift.

The colors are black, brown, green, red, white, and yellow. It is brittle, gives sparks with steel; has a lamellar structure, with adamantine or resinous lustre, and grayish-white streak. Occurs in crystals, and in masses from the size of grains to that of the fist.

On a chemical test it decrepitates, but by the blow-pipe it may be reduced to the metallic state on charcoal. It may be distinguished from spathic iron by the latter leaving an iron button under the blow-pipe. Blende cannot be reduced, and is not so hard. Specific gravity, 6.7 to 7.

Tests for Tin.—In solution of tin oxide, *phosphate of soda* produces a white precipitate. A *bar of metallic zinc* precipitates tin in small grayish-white metallic spangles. To a solution containing the metal, present a perfectly clean sheet of iron, the result is metallic tin. Oxide of tin, in the oxidizing flame, before the blow-pipe, presents a dirty-yellow color; with carbonate of soda, in reducing flame, on charcoal, reduces to metal; with borax forms a clear glass.

ZINC.—One of the ores of zinc is:

Blende (*Mock Lead, False Galena, Black Jack*), composed of zinc, sulphur, iron, and silica; is found in veins of primary and secondary rocks, usually united with iron and copper, with galena. It is frequently used after roasting in the preparation of brass, but is usually too much disseminated in its gangue to make its extraction profitable.

The colors are brown, yellow, and black. It is brittle, yields to the knife, has a foliated structure, with shining, adamantine lustre. It occurs massive, disseminated, lamelliform, in granular concretions, and crystallized. It decrepitates when heated; evolves the smell of rotten eggs when thrown into oil of vitriol; is infusible, and does not tinge borax green. Specific gravity, 3.7 to 4.

Calamine, composed of oxide of zinc and carbonic acid, is found in veins, often associated with oxide of iron. and occasionally with galena; is also found in beds, nests, filling up or lining hollows, in conglomerate rock and secondary limestone.

The colors are sometimes nearly white, at others gray, greenish, or brown-yellowish. Is easily sectile. Occurs compact, amorphous, pseudomorphous, crystallized, and cupriferous. In chemical tests it dissolves with effervesence in heated nitric acid, or muriatic acid, and is infusible. Oxide of zinc, in the oxidizing flame, before the blow-pipe, exhibits a whitish-green color; while hot this oxide is slightly yellow—when cold is white: with borax forms glass, which in an intermittant flame becomes milky; in the reducing flame, on charcoal, reduced to metal, which readily sublimes.

Red Ore of Zinc, composed of oxide of manganese and oxide of zinc, is found in primary and transition rocks, limestone, and iron mines. It is brittle; yields to the knife; has a foliated structure and shining lustre, becoming dull by exposure. The color is red; it occurs massive and disseminated. In chemical tests it dissolves with effervescence in strong acids. Is distinguishable by its weight and infusibility. Specific gravity, 6.22.

MANGANESE.—This metal in its metallic state is of no avail in the arts. The ore, which subserves all required uses without preparation, is called

Black Oxide of Manganese.—It is composed of manganese, oxygen, and water; is found in imbedded masses and veins in primary rocks, and often with ores of iron. The color is of a dark steel-gray, with metallic lustre, black streak, and conchoidal earthy fracture. It occurs massive, in fibrous concretions, and crystallized. In a chemical test is decomposed by being thrown into water, and turns the water green. On exposure to the air absorbs so much oxygen that it falls into powder. Is infusible alone, but with borax yields a purple globule; becomes brown by heat; with borax, in the oxidizing flame, much oxide employed, the glass is black; little oxide employed, the glass is of an amethyst color—in the reducing flame, and on charcoal, this latter globule becomes colorless, and so remains if quickly cooled; with soda in the oxidizing flame, and on platinum foil, forms an opaque green glass.

COBALT.—This metal is of no avail in its metallic state for use in the arts; is in use mainly by painters and bronzers, as zaffre, smalt, &c. The ore producing them is,

Arsenical Cobalt, composed of cobalt, arsenic, and sulphur, is found combined with silver, bismuth, nickel, arsenic, and copper, in veins traversing primary rocks. The color is silver-white, with a reddish copper tint. Has a metallic lustre; is brittle; difficult to cut; with conchoidal fracture. Occurs massive, reticulated, dendritic, stalactical, and crystallized in cubes and octahedrons. Fused with borax it yields a blue glass. Turns black, with the emission of garlic fumes, in the blaze of a candle. The oxide is unchangeable by itself (before the blow-pipe), but with carbonate of soda, on charcoal, forms a gray magnetic powder; with borax, both in oxidizing and reducing flame, gives a deep blue bead. Specific gravity, 6.30 to 7.30.

For full directions for preparing smalt, see page 283.

NICKEL.—The ore from which this metal is derived is,

Arsenical Nickel (*Kupfer, or Copper Nickel*), composed of nickel, arsenic, sulphur, lead, iron, and cobalt, is found associated with cobalt. It occurs massive, reticulated, and botryoidal. In color is copper red, with metallic lustre; is cut with difficulty; forms a green solution in aqua fortis, and emits garlic fumes when heated. Oxide of nickel (before the blow-pipe) is infusible alone; in the oxidizing flame, with borax, forms an orange-red globule which becomes nearly colorless on cooling; in the reducing flame, on charcoal, the bead becomes gray; in the reducing flame, with soda, on charcoal, reduces to a magnetic powder. Specific gravity, 6.60 to 7.70.

BISMUTH.—This mineral is often found in its pure state fit for immediate use, but more frequently associated with cobalt, iron pyrites, galena, arsenic, silver, &c., in the primary rocks, especially in gneiss, quartz, and mica-slate. In color is silver-white, with a reddish tint. Is softer than copper; tarnishes; has a metallic lustre, lamellar structure, and melts at 476°. Before the blow-pipe, bismuth fuses and gives off inodorous fumes. On charcoal it becomes surrounded with a dark brown oxide, which is pale-yellow on cooling; the flame directed on the coating is not tinged; ultimately the metal is wholly vaporized. The oxide of bismuth, with carbonate of soda, on charcoal, reduces to metal. Specific gravity, 9.

ANTIMONY.—The ore from which commercial antimony is obtained is the

Sulphuret of Antimony, composed of antimony, 74 parts; sulphur, 26 parts; and found chiefly in granite, mica-slate, and gneiss, associated with ores of iron, copper, arsenic, blende and galena. It occurs crystallized and massive, composed of delicate threads or needles. Is brittle; yields to the knife; has fibrous fracture and splendid lustre. Tested in a candle-flame it melts. The ores of antimony afford fumes usually white on charcoal, which are inodorous. The oxides form, with soda on the platinum wire, a clear, colorless bead, which becomes white on cooling; on charcoal they are reduced. In an open tube, antimony gives white fumes, which coat the glass and vaporize easily on a new application of the heat, without fusion to globules. Specific gravity, 4 to 4.80.

GRAPHITE (*Black Lead, Plumbago*), composed of carbon, 9 parts; iron, 1 part; is found in clay-slate, also in the coal formation. The Dixon Crucible Co., of Jersey City, N. J., obtain their graphite from the "Black Lead Mountain," near the village of Ticonderoga, Essex Co., N. Y. The ore is chiefly of the foliated variety, interspersed in gneiss and quartz in veins. Graphite is also found in great abundance near Ottawa, Canada.

ROCK SALT is found in secondary strata; frequently associated with gypsum, marl, clay, &c. Near Goderich, in Canada, at a depth of about 1000 ft., there is a bed of rock-salt 14 to 40 ft. thick. The salt of Salina and Syracuse, N. Y., is obtained from wells of salt water 150 ft. and upwards in depth, which are borings in saliferous rocks, which here are from 700 to 1000 ft. thick. From 35 to 45 gals. of the water yields a bushel of salt, while of sea water it takes 350 gals. for the same quantity.

PRECIOUS STONES.—Diamonds are found in association with sand or alluvium which contain grains of gold. In Brazil the diamond district is called Minas Geraes, 50 miles by 25, near Tejuco. The emerald, garnet, amethyst, tourmaline, chalcedony, topaz, chrysprase, chrysoberyl, sapphire, iolite, spinel, are always found in the primary rocks. The sardonyx, jasper, carnelian, cacholong, are often found in secondary strata, principally in the trap rocks. Cairngorm is a species of quartz. The exudations which form crystals are a very extensive mode of rock formation in all varieties. For hardness of precious stones see page 925.

COAL.—Among the varieties of coal may be noted

Anthracite (*Blind or Glance Coal*), sometimes called stove coal, is found in imbedded masses, veins and beds in primary and secondary rocks, frequently in trap-rocks, graywacke, slate, sandstone, &c.

Black or Bituminous Coal occurs chiefly in the secondary rocks, sometimes in sandstone, limestone, and clay. The various kinds are styled slate, coarse, foliated, and cannel coal. The coal beds vary in thickness from a fraction of an inch to 30 or 40 ft., but seldom exceed 8 ft., and are generally much thinner; 8 to 10 ft. is the thickness of the principal bed at Pittsburg, Pa.; 29½ ft., that of the "Mammoth vein" at Wilkesbarre, Pa., 37½ ft. that of one of the two great veins at Picton, in Nova Scotia. The coal beds, taken together, make up not more than one-fiftieth part of the coal formation; that is, there are 50 feet or more of barren rock to 1 foot of coal. An acre of coals 2 ft. thick yields 3000 tons, 3 ft. thick, 4840 tons, and 5 ft., 8000 tons.

Lignite (*Brown Coal*) occurs in secondary rocks, and occasionally in alluvium. For facts relating to coal, fuel values, &c., see page 627.

GYPSUM occurs in the new red sandstone and other secondary rocks.

LIMESTONE, composing most of the rocks below the drift, is a compact rock of grayish and other dull shades of color to black. Consists essentially of carbonate of lime. When impure, and therefore good for making hydraulic lime (lime that will set under water), it is called *hydraulic limestone.* When composed of carbonate of lime and magnesia it is called *dolomite.* When containing fossils it is called *fossiliferous limestone.* The limestone rocks owe their origin to the organic remains of various species that have lived and died during past time. The best marble is found in the upper part of the primary, and lower parts of the secondary rocks.

Lime (oxide of calcium), before the blow-pipe, is infusible alone; with borax, effervesces; with a comparatively large quantity of borax, forms a clear glass which becomes angular on cooling; in the flame of the oxyhydrogen blow-pipe emits a dazzling white light, and fuses at the edges.

BORAX (*Biborate of Soda*), before the blow-pipe intumeses and fuses to borax-glass; with fluor-spar and bisulphate of potash, colors the flame green; soluble in water; the solution changes vegetable blues to green.

ALUMINA (*Sesquoxide of aluminum*), before the blow-pipe, remains unaltered both alone and with soda; fuses with borax with great difficulty, also with salt of phosphorus; moistened with cobalt solution and brought to a high heat, becomes blue; is not attacked by acids.

SULPHUR, heated in an open glass tube, emits fumes of sulphurous acid; heated with soda, the compound, moistened with water, blackens silver.

TELLURIUM (*Oxide*), before the blow-pipe, colors the flame green, fuses and sublimes; with borax, in the oxidizing flame, forms a colorless glass; in the reducing flame the glass becomes gray; its behavior with carbonate of soda is similar as with borax; on charcoal, readily reduces to metal.

QUARTZ (*Silicic acid*), before the blow-pipe, undergoes no change alone; with soda, readily fuses to a transparent glass.

NITRE, before the blow-pipe, deflagrates vividly; detonates with combustible substances; dissolves readily in water; not altered by exposure.

FLUOR-SPAR (*Fluoride of Calcium*), before the blow-pipe, decrepitates and fuses to an enamel; the flame continued, the specimen assumes a cauliflower; heated with salt of phosphorus in a glass tube, it etches or roughens the inside of the glass.

PHOSPHORUS, moistened with sulphuric acid and heated, gives a green, tinge to the flame.

CHLORINE.—A substance containing chlorine, combined with the salt of phosphorus and oxide of copper, on the platinum wire, colors the flame deep blue.

SODA (*Oxide of Sodium*), colors the flame deep yellow.

ARSENIC (*Oxide*), before the blow-pipe, volatilizes in white fumes of a garlic odor; heated to redness burns with a pale bluish flame.

The following additional tests, &c., for the determination of gold and silver ores, is extracted from Mr. Kustel's incomparable work.

SEC. 10. The use of the following systematic proceeding can be understood easily by an example:

A silver mineral, for instance, approved as such by an examination on silver, must be observed first as to what lustre it shows, or whether it is dull. Suppose, then, the mineral has a metallic lustre. (See I.) The color must be observed next, and compared with those under I. The ore is further found to be "lead gray." We have then to proceed from the indicated letter, B, on the right side, to B on the left, and examine accordingly, whether the mineral gives a sublimate or not. If, for instance, no sublimate has been obtained, we must proceed to c, as indicated. On the described examination under c, the mineral appears tough; it can be cut with a knife.

We go over to Section 16, and see the numbers 2 and 20, Silverglance and Hessite. The description of both will lead to the right determination of the mineral.

I.—*Lustre metallic or Sub-metallic.*

Color, white, greyish-white, yellowish-white, or yellow, see............ *A*
Color, lead-gray, blackish lead-gray, or iron-black,.................... *B*
Color, light steel-gray,.. *C*
Color, reddish lead-gray,... *D*
Color, pinchbeck-brown,... *E*

II.—*Lustre Resinous and Adamantine.*

Color, pearl-gray, yellowish-green, green, olive-green, lemon-yellow, or light yellow, see... *F*

III.—*Dull.*

Color, red, dark red (sometimes externally lead-gray),................. *G*
Color, blackish-blue,.. *H*
Color, greenish-black,... *I*
A It can be cut with a knife, see.................................... *a*
A Cannot be cut ; is brittle,....................................... *b*
B In a closed tube, no sublimate, even under the plow-pipe,........... *c*
B It gives a sublimate, with or without the blow-pipe,................ *d*
C In a closed tube, no sublimate,..................................... *e*
C It gives a sublimate,... *f*
D In a closed tube, dark-red, sublimate. See Sec. 16 (8 or 9).
E In a closed or open tube, no sublimate. See Sec. 6 (4).
F In a closed or open tube, no sublimate,............................. *g*
F Gives, with the aid of the blow-pipe, a slight sublimate,........... *h*
G In a closed tube, red-brown or reddish-yellow sublimate. Sec. 16 (10).
G It gives three sublimates—black, yellow, and gray. Sec. 16 (16).
H In an open or closed tube, no sublimate. Sec. 16 (3 *a'*).
I In an open or closed tube, no sublimate. Sec. 16 (11 *a'*).
a It melts on charcoal to a metallic white globule. Sec. 16 (1).
a It melts on charcoal to a metallic yellow or yellowish globule. Sec. 15 (1).
b It melts on charcoal to a globule of metallic lustre, coating the coal white. Sec. 16 (17).
b It decrepitates somewhat, giving, before fusing, a slight, very volatile whitish coating. Sec. 15 (4), or Sec. 16 (22 or 23).
c It can be cut with a knife. Sec. 16 (2 or 20).
c It cannot be cut ; is brittle. Sec. 16 (3 or 4 *a* or 6), or Sec. 15 (2).
d In a closed tube, it gives a reddish-yellow sublimate. Sec. 16 (6 *a'*).
e On charcoal it fuses, giving a yellow and white coating. Sec. 15 (3).
f In a closed tube, by aid of the blow-pipe, a dark red sublimate. Sec. 16 (11).
g On charcoal it fuses, emits an acrid odor, and leaves globules of silver ; in a closed tube, with bisulphate of potassa, emits no colored vapors. Sec. 16 (12).
g It gives, with bisulphate of potassa, red-brown vapors. Sec. 16 (13 or 14).
h In a closed tube, with bisulphate of potassa, violet vapors. Sec. 16 (15).

DESCRIPTION OF GOLD AND SILVER ORES. *A. Gold Ores.*—SEC. 15. Gold appears mostly in metallic condition, but never free from silver. It is found generally in the form of grains, scales, dust, also in the shape of leaves, threads, or crystals. It is not ascertained but supposed that a part of the gold in iron pyrites does not exist in metallic state, but com.

bined with sulphur, or with arsenic in the arsenical pyrites. The gold is found in combination with the following metals:

1. *Silver.*—In different proportions. The gold of Gold Hill lode, N. T., contains forty-seven to fifty per cent. of silver; that of the Comstock lode, thirty to forty-five; Gila River and Australian gold, three to five per cent. According to the amount of silver, the gold appears more or less whitish. Sixty per cent. of silver renders the alloy white.

On charcoal, treated with the oxidation flame, it gives sometimes a bluish-white coating of antimony. With borax, played upon with reduction flame, a reäction of copper may be observed.

2. *With Tellurium.*—It contains gold, 26; silver, 14; tellurium, 59; with traces of lead, copper, and antimony; hardness, 1.5; gravity, 5.7 to 5.8; lustre, metallic; color, light gray.

In an open tube it emits white fumes, and gives a gray sublimate of tellurium. Directing the flame on the sublimate, it melts into transparent drops. The fumes have a peculiar sour odor. On charcoal, it melts to a dark-gray globule. Played upon with the oxidation flame, it gives a white coating, which disappears with a bluish-green color, under the oxidation flame. Continued blowing yields a yellow, bright gold button.

3. *With Tellurium and Lead.*—Gold, 9; tellurium, 32; lead, 54, with traces of copper, sulphur, and antimony; H. = 1.5; Gr. = 7.72; color, dark lead-gray.

In an open tube it fumes, and yields a gray sublimate, the upper part of which, formed by antimonious acid, can be driven away by the flame. On charcoal it fumes and gives two coatings—a white one, which is volatile, consisting of tellurous and antimonious acids and sulphate of lead; the other coating is yellow, less volatile, and consists principally of oxide of lead. Continued blowing leaves a small metallic button, showing gold color when cupelled.

4. *With Mercury and Silver.*—Gold, 36; silver, 5; mercury, 58. The gold is found also alloyed with molybdenum, platinum, and rhodium.

B.—SILVER ORES. SEC. 16. Silver is found mostly in combination with sulphur, also alloyed with other metals and substances. It appears often in metallic condition.

1. *Native Silver* is found crystallized, in threads or filaments. It often contains a small amount of antimony, arsenic, iron, gold, or copper. The native silver, one variety of the Comstock lode, N. T., contains, silver, 60–85; gold, 1.9; lead, 8–30; copper, 1–5; H. = 2.7–3; Gr. = 10.6–11.3. Heated on charcoal, it becomes covered with lead globules, disappearing again when red hot. It gives a yellow coating of lead, and further off, a bluish-white of antimonious acid. It colors the borax glass green with the oxide of copper.

a. Combination with Sulphur.—2. *Silver glance* (*Sulphuret of Silver*).—Silver, 87; sulphur, 12.9; H. = 2.5; Gr. = 6.9–7.2; lustre, metallic; color and streak, blackish lead-gray; streak, shining. It may be cut like lead. On charcoal, it melts into a dark blue globule, generally emitting metallic silver on the surface on cooling, especially if a small particle of borax glass is added, which dissolves impurities. It yields a silver globule when melted with soda.

3. *Stromeyerite* (*Silver-Copper glance*).—Silver, 50–53; copper, 31; sulphur, 15; H. = 2.5; Gr. = 6.2; lustre, metallic; color, blackish lead-gray. In a closed tube, gives sometimes a little sulphur sublimate; in an open tube, sulphurous acid. On charcoal, it fuses to a steel-blue globule, emitting sometimes metallic silver on cooling. Melted with soda, it gives a copper button, which yields silver when refined. It occurs in the Heintzelman mine, Arizona.

a'. A variety of this ore, containing 40–33 per cent. of silver, with a dull blackish-blue color; streak, shining; can be cut; occurs in Arizona.

4. *Sternbergite* (*Sulphuret of Silver and Iron*).—Silver, 30-33; iron, 36;

sulphur, 30 ; H. = 1 ; Gr. = 4.2 ; metallic lustre ; color, pinchbeck-brown; streak, black. In thin laminæ, flexible, resembling graphite. In an open tube it gives out sulphurous acid. It melts to a globule on charcoal, emitting silver, and follows the magnet.

a'. A variety of this ore is found in the Gold Hill lode, N. T. It consists of silver, 33.25 ; iron, 34.05 ; H. = 2.8 ; Gr. = 5.2 ; color, dull bluish-gray. The fracture has a metallic lustre and dark lead-gray color. The powder is blackish-brown. It is found in small fragments of indistinct cubic shape. On charcoal, it melts, with a spongy appearance, to a dull gray globule, following the magnet. A slight yellow coating indicates a trace of lead. In melting, it gives out a great deal of sulphurous acid. Treated with soda, a silver globule is easily obtained.

b. Combinations with Sulphur and Antimony, or Arsenic.—5. *Brittle Silver Ore.*—Silver, 70 ; antimony, 13.9 ; sulphur, 15.7 ; H. = 2.5 ; Gr. = 6.2 ; lustre, metallic ; color and streak, iron-black, or blackish lead-gray. In a close tube, it decrepitates, melts to a globule, and gives a blackish sublimate, which turns red-brown when cold, consisting of sulphide of antimony. In an open tube it melts, evolving sulphurous acid, and fumes. On charcoal it fuses, and coats the coal white with antimonious acid. By continual blast, the coating assumes a pink color, derived from the oxide of silver. It occurs frequently in the Comstock lode.

6. *Polybasite* (*Eugen Glance*).—Silver, 64–72 ; copper, 3–10 ; sulphur, 17 ; H. = 2.5 ; Gr. = 6.2. It contains also antimony, arsenic, iron, and sometimes zinc. Lustre, metallic ; color, iron-black ; streak, black. In a closed tube it yields nothing volatile. In an open tube it gives antimonial fumes and sulphurous acid. It occurs also in Gold Hill lode, N. T.

a'. The polybasite of the Comstock lode contains 64 per cent. of silver. It gives, in a closed tube, with the aid of the blow-pipe, a reddish-brown sublimate, with a yellow edge. In an open tube, white fumes arise, and some white sublimate deposits. On charcoal, with the reduction flame, it evolves an odor of garlic. Played upon with the oxydation flame, it gives out sulphurous acid and a white coating of antimonious acid. It melts to a globule with a metallic lustre. If the hot blast is changed suddenly to a cold one, and directed on the globule, holding the blow-pipe point close to it, metallic silver is emitted. If the cold blast is stopped too soon, the silver will disappear again.

7. *Miargyrite.*—Silver, 35.8 ; antimony, 42.8 ; sulphur, 21 ; H. = 2.5 ; Gr. = 5.2–5.4 ; lustre, metallic adamantine ; color, iron-black ; streak, dark cherry-red. In a closed tube it decrepitates, melts easily, and gives out a sublimate of sulphide of antimony. In an open tube, sulphurous acid and antimonial fumes are emitted, depositing a white sublimate of antimonious acid. On charcoal it melts quietly, emitting sulphurous acid and antimonial fumes. It covers the coal with a white coating, which becomes pink-colored by continual blast. Melted with soda, a silver button is obtained, which, treated with borax and tin, reäcts on copper.

8. *Dark red Silver Ore* (*Pyrargyrite, Antimonial Blend*).—Silver, 58.9 ; antimony, 23.4 ; sulphur, 17.5 ; H. = 2.5 ; Gr. = 5.7. Lustre, metallic-like admantine ; color, dark-red ; powder, cochineal-red. In a closed tube, by the aid of the blow-pipe, it yields a sublimate of sulphide of antimony, black while hot, but varying from red to reddish-yellow when cold. In an open tube it gives antimonial fumes and sulphurous acid. On charcoal it melts easily, and deposits a white coating of antimonious acid. With soda it gives a silver globule. It occurs also in the Gold Hill lode, N. T.

9. *Light red Silver Ore* (*Proustite, Arsenical Blend*).—Silver, 65.4 ; arsenic, 15.1 ; sulphur, 19.4 ; H. = 2.5 ; Gr. = 5.5–5.6 ; color, similar to dark red silver ore, but lighter. Behaves like the preceding, except the arsenical fumes.

10. *Xanthocone.*—Silver, 64 ; arsenic, 13.4 ; sulphur, 21.3 ; H. = 2 ; Gr. = 5–5.2 ; color, dull red to clove brown ; powder, yellow. When heated in

a closed tube it becomes dark red, melts, and gives some sublimate of sulphide of arsenic. While hot, it is dark, brownish-red, and red to reddish-yellow when cold. In an open tube and on charcoal, it behaves like the preceding.

11. *Silver Fahlerz* (*Argentiferous Gray Copper Ore*).—Silver, 17.71–31.29; antimony, 26.63–24.63; sulphur, 23.52–21.17; copper, 25.23–14.81; iron, 3.72–5.98; zinc, 3.10–0.99; lustre, metallic; color, light steel-gray. In a closed tube it sometimes decrepitates, melts, and gives, by aid of the blow-pipe, a dark red sublimate of tersulphide of antimony, with antimonious acid. In an open tube it fuses, gives antimonial fumes and sulphurous acid. On charcoal it fuses easily, and gives a bluish-white coating of antimonious acid and antimonial fumes. There is also a yellowish coating close to the test, which appears white on cooling. This coating is created by oxide of zinc.

a'. The Reese River ore, from the Comet lode, seems to be a metamorphosed silver fahlerz. The sulphur is represented by carbonic acid, so that almost all copper and silver is a carbonate. It contains silver, 22.35, copper, 17, antimony, and some lead. It has a dull greenish-black or black color; streak, shining; powder, greenish-gray. In a closed tube it yields nothing volatile. In an open tube some sulphurous acid can be observed. On charcoal, fuses slowly, but boils up suddenly in contact with glowing coal, leaving a button of silver and copper. This button, when played upon with the oxidation flame on another spot of the charcoal, gives first a bluish coating of antimonious acid, then a yellow one, nearer to the assay of the oxide of lead. The silver can be separated from copper by cupellation with lead.

b'. The silver fahlerz of Sheba lode (Humboldt) contains, silver, 8.20, goid, 0.008, some antimony and lead, but very little copper. It has a light gray metallic lustre. It is also called gray silver ore.

c. Combination with Chlorine, Bromine and Iodine.

12. *Horn Silver* (*Chloride of Silver*).—Silver, 75.2; chlorine, 24.6; H.=1.5; Gr.=5.5–5.6; lustre, adamantine; color, gray, greenish or blackish; streak, shining. It looks like horn or wax. It is translucent, and may be cut like wax. Occurs frequently in the Comstock and Gold Hill lodes, also in California. It fuses in a candle flame. On charcoal it is easily reduced, and gives an odor of chlorine. If treated under the reduction flame, with an addition of copper, it forms a chloride of copper, and colors the flame azure-blue.

13. *Embolite* (*Chlorobromide of Silver*).—Silver, 66.9 to 75; H.=1–1.5; Gr.=5.3–5.4; lustre, resinous; color, yellowish-green or green. On charcoal it fuses easily, evolves vapors of bromine, and gives metallic silver. Mixed wlth oxide of copper, it colors the flame greenish-blue.

14. *Bromyrite* (*Bromic Silver*).—Silver, 57.56; bromine, 42.44; H.=1–1.5; Gr.=5.8–5.6. In a closed tube, treated with bisulphate of potassa, it emits brown vapors. On charcoal it fuses easily and yields a globule of silver. It is yellow or greenish, and may be cut like chloride of silver.

15. *Iodyrite* (*Iodide of Silver*).—Silver, 46; iodine, 54; H.=1.5; Gr.=5.5; lustre, adamantine; color, yellow, also greenish. It is translucent. In scale shape it is always lemon-yellow. When heated in a closed tube it becomes fire-red, but assumes its former color when cold. It fuses easily, and gives, by the aid of the blow-pipe, a reddish-yellow sublimate, getting lemon-yellow on cooling. With bisulphate of potassa, it emits beautiful violet vapors. In an open tube it gives an orange sublimate, lemon-yellow on cooling. On charcoal it assumes a fire-red color before it fuses, and spreads on the coal and yields many minute silver globules. With an addition of oxide of copper, it makes an intensely green flame with a bluish tinge.

16. *Iodide of Silver and Mercury*.—Silver, 40–42; iodine, quicksilver, and sulphur (chlorine ?), color, dull, dark red; streak, shining; powder,

dark red, but changes soon into lead-gray, if exposed to the light. In a closed tube it gives three sublimates, separated in rings. The nearest to the assay is black (sulphide of mercury), the second, yellow (subchloride of mercury ?), the third is gray (metallic mercury). An addition of bisulphate of potassa causes it to yield violet vapors, which come from the iodine. In an open tube it gives the same sublimate, but the black is very slight ; it gives also yellow fumes. A gold particle in the tube becomes amalgamated. Litmus paper at the upper end is colored red by the sulphur. Heated on charcoal it turns black, fuses easily, and yields silver globules. Melted with soda, it draws partly into the coal. If this crust is broken out and laid on a blank piece of silver, with a drop of water, the sulphur in it will cause a black spot on the silver. Heated with a small piece of pure lead, it gives a beautiful green coating, with a yellow border, nearest the assay. This coating (iodine and lead) is far off from the test. With copper oxide, like the iodyrite.

This mineral occurs, to my knowledge, only in the Heintzelman mine, Arizona.

d. Combination with Antimony.—17. *Antimonial Silver.*—Silver, 77.84; antimony, 23–16 ; H.=3.5 ; Gr.=9.4–9.8 ; lustre, metallic ; color and streak, silver-white. On charcoal it fuses easily to a globule, coating the coal white. A continual blast renders the white coating reddish.

e. Combination with Selenium.—18. *Naumannite* (*Selenid of Silver*).—Silver, 73 ; selenium, 26 ; H.=2.5 ; Gr.=8 ; lustre, metallic ; color, iron-black. It melts easily on charcoal, but with intumescence in the reduction flame. It emits the selenium odor of rotten radish. With soda it yields metallic silver.

19. *Eucairite* (*Selenid of Silver and Copper*).—Silver, 43.1 ; selenium, 31.6 ; copper, 25.3 ; lustre, metallic ; color, lead-gray. On charcoal it melts to a gray metallic globule, fumes, and re-acts on borax with copper. This mineral is soft, and can be cut with a knife.

f. With Tellurium.—20. *Hessite* (*Tellurid of Silver*).—Silver, 62.42 ; tellurium, 36.96 ; iron, 0.24 ; Gr.=8.4–8.6 ; lustre, metallic ; color, lead-gray or steel-gray. It is soft, and can be cut like lead. According to Mr. Blake, this mineral is found in California also. He describes the re-action as follows :

"In an open tube the mineral fuses quietly, coloring the glass a bright yellow under assay. A white or gray sublimate is deposited at a short distance, immediately over it, which, on being heated, fuses into transparent drops resembling oil. On charcoal it fuses to a leaden-colored globule, which, on cooling, becomes covered with dendrites. This globule flattens under the hammer. With the addition of soda, a silver globule is obtained."

f. With Bismuth.—21. *Bismuth Silver.*—Silver, 60 ; bismuth, 10 ; copper, 7.8, and some arsenic ; lustre, metallic ; color, tin-white or grayish. On charcoal it melts easily, covering the coal dark orange. It is yellow while hot, and lemon-yellow when cold. The oxide of copper in it colors the borax green, when melted on charcoal.

g. With Mercury.—22. *Silver Amalgam.*—Silver, 34.8–26.2 ; quicksilver, 65.2–73.7 ; H.=3.5 ; Gr.=13.7–14 ; lustre, metallic ; color, silver-white; brittle. In a closed tube the mercury sublimates.

23. *Arquerite.*—Silver, 86.49 ; quicksilver, 13.51. It behaves like the amalgam

DRY AND HUMID ASSAY OF MINERALS.

Assay of Ores by the Dry and Humid Processes.—In the dry, or fire assay of gold and silver ores, the apparatus required is, 1. A reliable assay balance, as previously noted. 2. A pair of less delicate balances, with the capacity of weighing 3 ozs., the weights to be troy ounces; each ounce to be divided into $\frac{100}{100}$. 3. An iron mortar. 4. A lot of French clay No. 7 crucibles, glass mattresses, and small crucibles of (dry cups) pipe clay. 5. Crucible tongs. 6. A fine wire cloth sieve (50 holes to the inch; 2500 to a sq. in.), extended on a wooden frame. 7. Cupel tongs. 8. Two or 3 muffles, 10 ins. long, 4 ins. wide, and 3 ins. high. 9. A very small, stiff brush. 10. A fine sieve with about 40 holes to the inch. 11. A brass mould, and bone ashes for making cupels.

The formation of the cupels requires bones to be burned perfectly white, then pulverized and sifted through the last-noted sieve. These ashes are mixed with water and worked with the hands to a putty-like consistence, then placed in the mould and beaten with the pestle by a wooden mallet. The pestle is finally withdrawn by a twisting movement and the cupel is forced out of the mould by the ball of the hand.

In addition to the above noted, the following materials will be required. 1. *Wheat flour;* to use as a substitute for charcoal in reducing a portion of the litharge to lead. A compound of 12 parts of wheat flour with 100 parts of soda is an excellent flux for lead assays. 2. *Litharge;* is of great utility in promoting fusion. It should be thoroughly mixed, sifted, and kept from damp. With silver ore, in a crucible, $1\frac{1}{2}$ ozs., with 10 grs. of wheat flour, will produce a button, which is to be cupeled, and the weight of silver product noted. This weight is to be deducted from the assays where this amount of litharge is used. 3. *Iron;* is used to desulphurize the sulphurets. Should be supplied in small pieces of wire $\frac{1}{4}$ or $\frac{3}{16}$ of an inch thick, and from $\frac{1}{4}$ to $\frac{1}{2}$ in. in length. 4. *Carbonate of soda;* for use expose the crystals to the air until it forms a dry white powder. *Soda-ash* or *Bicarbonate of soda* may be substituted for it with good results. 5. *Common table salt;* to use, the water of crystallization must be expelled, by melting the salt on a sheet-iron plate until intumescence ceases. The early fusion of the salt in the assay mixture prevents the injurious contact of air with the latter during the process. 6. *Glass;* serves as an excellent flux; for use it must be well pulverized in the iron mortar, and afterwards sifted.

The sample of ore to be treated being thoroughly pulverized, it is, with the fluxes, weighed out in the following proportion:

a. Ores or Tailings containing but little Sulphurets.—Ore, 250 grs.; glass, 125 grs.; flour, 8 grs.; litharge, $1\frac{1}{2}$ ozs.; soda, 1 oz.

b. Ores containing about 50 per cent. of Sulphurets.—Ore, 250 grs.; glass, 125 grs.; iron, 50 grs.; litharge, $1\frac{1}{2}$ ozs.; soda, 1 oz.

c. Ores being nearly all Sulphurets.—The mixture is like the preceding, but double the amount of iron, 100 grs. must be used. The foregoing proportions are given on the high authority of Mr. Kustel.

The soda and litharge are first placed in the crucible, over a sheet of paper; then the rest of the mixture; all are carefully mixed together (making sure that no portion is lost or spilled), tap the crucible in order to settle the mixture; strew over the whole a layer of salt one-fourth of an inch deep, cover, and place the crucible on the muffle in the middle of the furnace; if there are several assays place them in a row touching each other, but apart from the walls of the furnace, and pile the fuel (charcoal) around them, but not higher than the tops of the crucibles. Ignite the charcoal and maintain the fire as it burns down, by means of fresh fuel, so as to keep the fire nearly level with the tops of the crucibles. The latter should be large enough to prevent the assay seething over into the fire. As the melting proceeds the bone-ash cupels are placed on the muffle and brought to a red heat.

The melting will occupy about one hour; when accomplished, remove first, the crucible covers, and then the crucibles themselves, by grasping them with the long crucible tongs provided for that purpose; remove from the furnace, and pour the contents into the iron moulds, which are formed with small cavities or depressions, about $\frac{3}{4}$ in. deep, for receiving the melted assay. The metallic button in the mould, after being cooled, is freed from adhering slag by being hammered into a square shape, and, by means of the cupel tongs above noted, is transferred into the red-hot, bone-ash cupels, where it fuses in a short time and the lead in the mixture assumes a bright, agitated appearance, fumes, works up to the surface, and draws off to the sides of the cupel, where it is absorbed and disappears in the porous mass. By a proper application of heat this activity continues until a bright dazzling play of rainbow colors announces the final disappearance of all the lead, leaving the button of silver behind.

The silver button is freed from any adherent bone-ash by hammering on the edge; it is then weighed, and the weight noted, then transferred to a glass tube containing about $\frac{1}{2}$ oz. of pure nitric acid, and submitted to the flame of an alcohol lamp, where it soon boils, emitting reddish-brown vapors, and separates from any gold that may be present, leaving the latter as a blackish sediment, undissolved in the tube. The silver being dissolved, the acid solution is carefully poured off, leaving the gold behind, and the tube is then filled with distilled water. When the auriferous sediment has settled, the water is poured off carefully, and it is again filled with all the water it will contain. The tube is then covered with a dry cup, or pipe-clay crucible, and suddenly turned upside down so as to deposit the sediment on the bottom of the cup. The tube is very carefully withdrawn from the water so as to leave every particle of the gold in the fluid, and after the gold has completely subsided the water is slowly drained off, and the sediment dried in the cup over an alcohol flame until the gold assumes a yellow color. This gold is weighed and the weight noted.

The utility of this manipulation will be manifest from the important results obtained, as shown by the following calculations, transcribed from Kustel:

"The gold was found to weigh, for instance, $\frac{35}{1000}$, and the silver button before dissolving $\frac{356}{1000}$. If the gold is subtracted from the silver which contained this gold, we find thus the pure silver—

$$356-35 = 321 \text{ silver} \times 1{\cdot}16 = 372{\cdot}3 \text{ ounces per ton.}$$
$$\text{and } 35 \text{ gold } \times 1{\cdot}16 = 40{\cdot}6 \quad \text{"} \quad \text{"}$$

To find the value, the ounces of gold must be multiplied with 20.67 and those of silver with 1.30. These numbers in their fractions are not perfectly correct, but will serve our purpose. Continuing the calculation we find

Silver = 372·3 ounces × 1·30 = \$483.99
Gold = 40·6 " × 20·67 = \$839.20

Total value............\$1,323.19 per ton.

In case the ore for the assay has been weighed out by half an ounce, equal to 240 grains, the calculation is made the same way as before, with the exception that the number 1.215 must be substituted for 1.16. The procedure of the preceding example would be as follows:

The weight of the button was 321. This multiplied with 1.215 will give the amount of ounces per ton of ore of 2000 lbs.

32 (321) × 1·215 = 390 ounces. The quantity of fluxes used for 250 grains of ore will also serve for half ounce assays.

In gold assays, the resulting button being insoluble in nitric acid, it must be weighed, melted on charcoal before the blowpipe with three times its weight of pure silver, then dissolved and treated as above noted."

The assay of gold or silver ores may also be effected by fusing in a crucible the following mixture:

Ore finely pulverized........	4 parts.
Litharge.........	4 "
Black Flux.................	3 "

If much oxide of lead be present in the ore use the black flux only. If pyrites are abundant in the sample under treatment use saltpetre and nitre. If the resultant button be an alloy of gold, silver, copper and lead, add to it silver and lead, so that the sample will approximately consist of gold, 1 part; silver, 3 parts; and lead, from 12 to 16 parts. Place the lead within a bone-ash cupel within a muffle, melt, then add the gold and silver wrapped in paper, maintain the heat until the play of colors comes over the button as it brightens and becomes tranquil; then cool, and weigh it. To "part" the gold from the silver, anneal the button, hammer it thin, and twist it into a roll (called a "cornet") and submit to heat in dilute nitric acid as long as action continues, then in concentrated nitric acid until the silver is wholly dissolved. Next, well wash, dry, and ignite the "cornet"; the weight of silver is equivalent to the weight of the button before parting, less that of the refined cornet.

Note.—Chloride of silver (Horn silver), composed of silver, 75.2 parts; chlorine, 24.6 parts, cannot be decomposed by heat alone. It melts at 500° Fahr. At a temperature of 212° Fahr., it is decomposed by caustic potassa and soda, and may be reduced to the metallic state by the addition of a little cane sugar. It may also be reduced to the metallic state by fusing 1 part of the chloride with 2 parts carbonate of soda, or 1 part of the chloride with 2 parts of chalk and 2 parts of charcoal.

Assay of Copper Ores, containing Sulphur, but otherwise same as the last.—Pulverize well, and melt in an earthen crucible, at a dull red heat, equal parts of ore and vitrified borax, remove from the slag the matte (crude copper) button. Pulverize it well and slowly, roast in an earthen crucible, stirring meanwhile with a steel rod to promote the emission of sulphurous acid fumes. When no more vapors are evolved raise and maintain the temperature at a white heat for several minutes; then introduce into the same crucible.

Roasted matte................	1 part.
Black flux....................	3 to 4 parts.

Cover the compound with a layer of vitrified borax and submit it to a cherry-red heat for 20 minutes in a wind furnace; then remove and weigh the resultant copper button.

Assay of Copper Ores containing Arsenic and various other Metals.—Treat the pulverized matte as in the previous case, then roast it with pulverized charcoal until the emission of arsenical fumes ceases. Melt the resultant matte with black flux and borax as above noted, and cupel the button in a bone-ash cupel with pure lead. After the metallic globule becomes tranquil, and the brightening takes place, cool, extract, and weigh the metallic button.

Assay of Silver Ores by the Humid Process.—Digest the pulverized ore in nitric acid, then add a solution of common salt or muriatic acid to the silver solution as long as any precipitate is thrown down. Next, filter and dry the residuum, then melt the dry residuum with carbonate of soda in an earthen crucible; when cool, extract and weigh the metallic button. *Chloride of silver* (Horn silver) is not adapted for this treatment, being insoluble in nitric acid, but it can be dissolved in ammonia, or in boiling solutions of the chloride of potassium, barium, sodium, strontium and calcium. Cyanide of potassium, in solution, will also dissolve chloride of silver; strong sulphuric acid gradually decomposes it; iron and zinc will likewise effect its decomposition, especially in presence of free muriatic acid. The behavior of *Bromide of silver* is nearly identical with the chloride.

Assay of Gold Ores by the Humid Process.—Digest the ore (well pulverized) in 1 part of nitric and 4 parts of hydrochloric acid, then dilute, filter and evaporate nearly to dryness to expel excess of acid. Next, dilute the dried filtrate in pure water, and boil the solution with a solution of sulphate of iron, which precipitates the gold as a dark purple powder. Next, filter and heat the residuum with hydrochloric acid, then filter, wash, and dry the gold powder. Oxalic acid, substituted for the sulphate of iron, precipitates the gold in large flakes.—*Quartz Operator's Hand-Book.*

Assay of Iron.—Melt in a covered crucible a well-pulverized mixture of:

Powdered and roasted ore	4 parts.
Fluor-spar	2 "
Charcoal	2 "
Common salt strewed over the whole	8 "

After fusion remove and weigh the resultant button of cast iron. A variety of fluxes, as clay, lime, &c., may be employed, according as the nature of the ore may require.

Assay of Galena, or Ores of Lead containing Sulphur.—Place the following in an earthen crucible in the order of mention:

Well pulverized ore	10 parts.
Iron in strips or plates	1 to 3 "
Black flux	30 "

Common salt, a thick layer over all, with a piece of charcoal on top. Cover the crucible, melt the assay, gradually increasing the temperature from a low heat to a bright red, continuing the latter about 30 minutes. Next, tap the crucible to consolidate the contents, cool, and remove the metallic button.

Assay of Oxidized Ores of Lead.—Place the following in an earthen crucible in the order of mention:

Well pulverized ore	10 parts.
Carbonate of soda	30 to 40 "
Granulated charcoal	3 "
Iron, in strips or plates, if sulphur be present.	1 "

Common salt, a thick layer over all.

Treat as in preceding manipulation.

Assay of Copper Ores where no other Metals are present but Iron and Copper.—Place in a crucible the following:

Well pulverized ore	2 parts.
Black flux	6 "

Begin with a gradual heat, increasing to a bright red, continuing 15 minutes, then extract the button from the slag, and note the weight.

To recover Gold and Silver Residues in Photographic Wastes.—A large list of fluxes for reducing these wastes will be found on page 981. To precipitate the precious metal from rejected solutions of nitrate of silver, add the following as long as it causes a precipitate; carbonate of soda, 4 ozs.; water, 6 ozs.

Add water, and then thoroughly wash the precipitate in plenty of *warm water;* lastly, dry, and put up the precipitate in well-stoppered bottles, if not to be reduced forthwith. Lime water is also a first-class precipitating solution for silver. To obtain it place some pieces of lime in a wide-mouthed bottle or covered vessel; fill up with water, shake well and allow the mixture to subside for several days, then pour off the clear for use.

Among other precipitating solutions for photographer's use the following may be noted: 1. *For Developer Washings.* Common salt, 4 ozs., water, 10 ozs. 2. *For Toning Bath.* Sulphate of iron, 4 ozs., water, 16 ozs. 3. *For Hyposulphite Fixing Baths.* Sulphide of potash, 4 ozs., water, 16 ozs. 4. *The Nitric Acid Plate-Solution.* Hydrochloric acid, 4 ozs., water, 8 ozs. 5. *For Nitrate of Silver Solution, old Baths, etc.* Hydrochloric acid, 4 ozs., water, 4 ozs. The above are used for promoting the separation of valuable ingredients in a solid state from chemical solutions. The process is assisted by previously heating the solution; then add the reagent gradually, and stir well to effect a thorough intermixture. The solution is then allowed to rest until the precipitate subsides. Then add a few drops more of the reagent to the liquid, and if no additional precipitation is effected the process is complete.

VALUABLE PROCESSES, ETC., IN VARIOUS TRADES.

The following items, selected from the *Watchmaker*, having been crowded out of the appropriate department, are inserted here, being deemed too valuable to omit.

MAIN SPRINGS.—When a main spring is cleaned, most inexperienced workmen will take hold of one end and pull the spring about half its length straight out, to save time. This practice will break springs when nothing else will; and springs treated thus generally break after the watch has been delivered to the customer only a few days. Breaking into many pieces is owing to the acid in the oil which is used. We will suppose the main spring is a fine one, and has been evenly tempered and properly cleaned; if, now, old oil is used, or that of an inferior quality if fresh, the acid it contains will eat into the spring, and will finally destroy its texture. The coil nearest the centre breaks first, and as it recoils it breaks every coil in the barrel, and sometimes each coil is broken twice. The spring has become so impregnated with acid that it has no life left.

TO PURIFY OIL.—To make the oil pure, take a good sized bullet or other piece of lead which has a thick coating of lead rust, cut it up fine, put it into the oil, and let it stand for two weeks. This causes the acid to settle, and it then resembles milk at the bottom. Now pour off the top, and your oil is pure. Common clock oil can be treated in this manner and made better than some watch oil.

TO RESTORE LUSTRE.—If not too much darkened it may be restored by dipping the wheel in pure muriatic acid. Test your acid by dipping a piece of polished steel in it; if it destroys the polish, reduce the acid with rain water until it will not. Rinse the wheels well in water. This will also restore the polish to steel that has been blued by heat.

GRINDING GLASSES.—Provide two pieces of cork, one concave and one convex (which may be cut to shape after fitting to lathe). Take a copper cent, or other suitable article, and soft solder a screw to fit the lathe and then wax it to the cork; then get a twenty-five cent emery wheel, such as is used on sewing machines, and you have a complete outfit for cutting your watch glasses. Polish the edge on the zinc collar of the emery wheel, or use a piece of zinc to do it. The other cork should be waxed to a penny and centred. The spectacle lenses may be cut on the same emery wheel, if the wheel is attached to the lathe so as to revolve.

Another method is to take a common piece of window glass (green glass is the best) and make a grindstone of that, using the flat surface to grind on. Cement it on a large chuck, the glass being from 2 to 2.5 inches in diameter.

Any one not familiar with this method would be surprised to see how fast the glass is cut away, for either spectacles or watches. In grinding watch glasses put them flat on the chuck glass—not on the edge.

Some watchmakers are excusable for not keeping a full supply of watch glasses on hand all the time, when it is remembered that there are over four thousand different sizes.

COMPOSITION OF BRONZE FOR MACHINERY.—Below will be found the composition of alloys approved of and used by prominent French mechanics in government and railway work.

FRENCH MARINE.	*Copper.*	*Tin.*	*Zinc.*
Tough bronze for rods, valves, cocks, etc.	88	12	2
Very tough bronze for eccentric straps, etc.	90	10	2
Bronze for plummer blocks	86	14	2
Hard bronze	84	16	2
Very hard bronze for steam brass-cocks	82	18	2
Bell bronze	78	22	0
Anti-friction bronze, with 8 parts antimony	4	96	0
FRENCH RAILROADS.			
Car pillows	82	18	2
Locomotive and tender oil boxes	84	16	2
" slide valves	82	18	2
Cocks	88	12	2

The bronze composed of 86 copper, 14 tin, and 2 zinc, is least porous, and therefore is most suitable when pressure is to be resisted.

PARAFFINE AS A LUBRICANT.—According to a correspondent of the *Railroad Gazette*, the Erie Railway has reduced its oiling expenses from $5,000 to $1,000 a year, by using paraffine on passenger car journals, and has reduced the number of hot journals from 535 to 332. During the winter months it is used without the addition of any other oil, but during the summer it is mixed with some other lubricant to give it body, as owing to its limpidity it is difficult to retain in the axle boxes. A lubricant of notable power for cooling *hot* journal boxes is composed of a mixture of sulphur with oil or grease. Used on the hot bearings of steamships, etc., it is unequalled.

WOODS HEAVIER THAN WATER.—These are French box, Irish bog oak, pomegranate, vine lignumvitæ, Indian cedar, ebony, mahogany, and heart of oak. Lignumvitæ is one-third heavier than water, pomegranate rather more. Cork and poplar are the lightest woody products.

A COMSTOCK LODE MINING PUMP.—The new Chollar Potosi mining pump consists of double columns of 15 in. plungers. The rods with which these are worked are 14 × 14, each stick being of Oregon pine and 100 ft. in length. They are locked together and held by iron plates 10 ins. wide and 1 in. thick. The motive power is a compound, condensing, direct acting engine, of 700 H. P., the initial cylinder being 10 ft. 10 ins. long, by 32 ins. diam.; the expansion cylinder being 8 ft. long and 65 ins. diam.

THE DEEP MINES OF THE WORLD.—The Yellow Jacket is the deepest mine on the Comstock Lode, being now (March, 1879) 2,500 ft. below the mouth of the main shaft, and 2,933 ft. below the Gould & Curry croppings, the datum line of the Comstock Mines. The highest heat known in these mines is, for air 154°, in a closed drift in the Crown Point Mine, and for water 154°, in the Savage, Hale & Norcross Mines. The Adalbert, a lead-silver mine, in Austria, is probably the deepest mine in the world, the perpendicular shaft being 3,280 ft. deep. The next deepest on the Continent of Europe is the Viviers coal mine in Belgium, 2,847 ft. deep This mine penetrated to a depth of 3,586 ft., but no coal being found, all below the 2,847 ft. level has been abandoned. In England the Dunkirk Colliery, Lancashire, has been opened to a depth of 2,824 ft., and the Rosebridge Colliery, same locality, to a depth of 2,458 ft., these being the deepest mines in Great Britain.

INSIDE SURFACE COATING TO PREVENT SCALE IN STEAM BOILERS—*Beuttgenback's Process.*—Gradually dissolve 5 lbs. of a mixture of 25 parts of colophonium, 2½ parts graphite, and 2½ parts of lampblack, in 40 lbs. of boiling gas-tar, adding about 1 lb. of tallow. The solution, with about 50 per cent. of petroleum, is applied in a warm state. It has a pungent smell, and should be put on rapidly, taking the precaution of using closed lanterns. Its effect is to cause the scale to come off in large flakes when picked.

PLUMBAGO AS A LUBRICANT FOR STEAM CYLINDERS.—A practical engineer, in a communication to the *American Machinist*, gives the result of his remarkable experience with dry plumbago as a lubricant for steam cylinders, which fully establishes its vast superiority over the oil, tallow, etc., generally used for that purpose. The engine upon which the experiments were carried on was an 11 × 30 horizontal engine, with a piston speed of 300 ft. per minute, and was worked to its full capacity. To obtain the best results, the common oil-cup was exchanged for a goblet-shaped tallow-cup with a lid, after which the piston-follower and springs were taken out and cleaned. Before starting the engine, one-third of an ounce of finely pulverized plumbago was placed in the cup. When fairly under way the valve of the tallow-cup was opened half way, and a little later it was opened to its utmost extent. The piston-rod became coated with the plumbago soon after starting, and by noon the whole had passed from the tallow-cup into the cylinder. On starting up in the afternoon, one-third ounce more was placed in the cup, and the engine ran till six o'clock with a like result. There was no noise in the cylinder, either in the starting, running, or stopping of the engine, and after eighteen months' use, with the above-named quantity applied twice a day, no noise had been heard in the cylinder, except when the steam was shut off for the purpose of stopping the engine, when it would be heard during one or two strokes of the piston just before the engine stopped. This occurred not more frequently than would have taken place if tallow or oil had been used. Soon after beginning to use it, a portion of the plumbago would be found remaining in the cup. To obviate this, about one ounce of water was poured into the cup, after the plumbago had been put in, when a decided improvement was observed, in that it could be fed into the cylinder as readily as oil or tallow. After four weeks' use, the cylinder-head was taken off, and the working part of the cylinder was found coated with plumbago, which could not be easily rubbed off with the fingers. The interior of the piston was found as clean as when it left the lathe, so far as dirt of any kind was concerned, and such was the condition at the time of writing.

There was an absolute freedom from all choking in the steam passages. The gum joints, six in number, had been renewed a few days before the new lubricant was applied, and at the latest advices all were in perfect condition, showing no signs of leakage, whereas, if oils or tallow had been used, they would have required two renewals during that time.

SILVER POLISH STARCH ENAMEL.—Melt 2½ lbs. of the very best A 1 paraffine wax over a slow fire. When liquified, remove from the fire and stir in 100 drops oil of citronella. Have a lot of round new pie-tins, clean and nice; place them on a level table and coat them slightly with sweet-oil, and pour about 6 tablespoonfuls of the enamel into each tin. The pan may be floated in water to cool the contents sufficiently to permit the mixture to be cut or stamped out with a tin cutter into small cakes about the size of a peppermint lozenge. Two of these cakes added to each pint of starch will cause the smoothing-iron to impart the finest possible finish to muslin or linen, besides perfuming the clothes in first-class style. Thousands of dollars have been made by manufacturers and dealers out of this one article, for, when well made and attractively put up in boxes, etc., the sale is great and the profits immense.

SUPERIOR BAKING POWDER.—Take 2 lbs. best tartaric acid in crystals, 3 lbs. bi-carbonate of soda, and 3 lbs. potato starch. Each article must be pulverized separately and slowly dried by a gradual heat, and afterwards thoroughly mixed by being passed through a fine sieve. In quality this article has no superior, and, when attractively packed in tins, lead foil, or paper glazed on the outside (it must be kept free from damp), it commands a most profitable sale.

VIOLET WRITING INK.—For 2 gals., heat 2 gills of alcohol in a water bath; add to the alcohol 2 ozs. of violet aniline, and stir till dissolved, then add the mixture to two gals. of boiling water; mix well, and it is ready for use. Smaller quantities in proportion. This is the secret, from the sale of which, together with the products of manufacture, so many fortunes are said to have been made. Some parties assert that it is worth to an active man more than $1,000, on account of the large profits obtainable from possible sales.

MANIFOLD PAPER, sometimes called copying-paper, is produced by mixing finely pulverized plumbago or lampblack into a putty-like paste. Pass the substance over tissue paper with flannel, and remove the surplus matter with a soft rag. In use, these sheets are alternated with black carbon paper, and when written on with a hard graphite pencil the product will be several copies of a letter with one writing.

DUNCAN, FLOCKHART & CO.'S BLUE-BLACK AND COPYING INKS.—Blue Aleppo galls (free from insect perforations), 4½ ozs.; bruised cloves, 1 dr., cold water, 40 ozs., purified sulphate of iron, 1½ ozs., pure sulphuric acid (by measure), 35 minims, sulphate of indigo (in the form of a paste) and which should be neutral, or nearly so, 1 oz. The weights used are avoirdupois, and the measures apothecaries' measures. Place the galls, when bruised, with the cloves, in a 50 oz. bottle, pour upon them the water, and digest, often daily shaking for a fortnight. Then filter through paper in another 50 oz. bottle. Get out also the refuse of the galls, and wring out of it the remaining liquid through a strong clean linen or cotton cloth, into the filter, in order that as little as possible may be lost. Next put in the iron, dissolve completely, and filter through paper. Then the acid, and agitate briskly. Lastly the indigo, and thoroughly mix by shaking. Pass the whole through paper; just filter out of one bottle into another until the operation is finished. *Note.*—No gum or sugar is proper and on no account must the acid be omitted. When intended for copying, 5½ ozs. of galls is the quantity. On the large scale this fine ink is made by percolation.

GLAZE FOR ROAST COFFEE.—In one patented process the roasted coffee is coated with a preparation composed of Irish moss, ½ oz., gelatin, ½ oz., isinglass, ½ oz., white sugar, 1 oz., eggs, 24. The first three are boiled in water and the moss strained clear. Another recipe is 1 oz. French isinglass and 4 ozs. water, the moss mixed and molded to form.—*American Grocer.*

VALUE OF FOREIGN COINS.—By a recent official statement of the Secretary of the U. S. Treasury, the value of foreign coins in U. S. money is rated as here shown, and the values of all foreign merchandise made out in any of these currencies, imported on or after Jan. 1, 1879, will be estimated on the following basis:

Belgium, franc, gold and silver, 19.5 cents.
Bolivia, dollar, gold and silver, 96.5 cents.
Brazil, milreis of 1000 reis, gold, 54.5 cents.
British Possessions in N. A., dollar, gold, $1.
Bogota, peso, gold, 96.5 cents.
Central America, dollar, silver, 96.5 cents.
Chili, peso, gold, 91.2 cents.
Denmark, crown, gold, 26.8 cents.
Ecuador, dollar, silver, 93.5 cents.
Egypt, pound of 100 piasters, gold, $4,97.4.
France, franc, gold and silver, 19.3 cents.
Great Britain, pound sterling, gold, $4 86 6½.
Greece, drachma, gold and silver, 19.3 cents.
German Empire, mark, gold, 23.8 cents.
India, rupee of 16 annas, silver, 44.4 cents.
Italy, lira, gold and silver, 19.3 cents.
Japan, yen, gold, 99.7 cents.
Liberia, dollar, gold, $1.
Mexico, dollar, silver, $1.015.
Netherlands, florin, gold & silver, 38.5 cents.
Norway, crown, gold, 26.8 cents.
Peru, dollar, silver, 93.5 cents.
Portugal, milreis of 1000 reis, gold, $1.08.
Russia, ruble of 100 copecks, silver, 74.8 cents.
Sandwich Islands, dollar, gold, $1.
Spain, peseta of 100 centimes, silver, 19.3 cents.
Sweden, crown, gold, 26.8 cents.
Switzerland, franc, gold and silver, 19.3 cents.
Tripoli, mahub of 25 piasters, silver, 84.4 cents.
Turkey, piaster, gold, 4.3 cents.
U. S. of Columbia, peso, silver, 93.5 cents.

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