SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLVIII.—No. 2. [NEW SERIES.] NEW YORK, JANUARY 13, 1883. [$3.20 per Annum. [POSTAGE PREPAID.]

THE GREAT DRY DOCKS AT THE ERIE BASIN.

The largest dry docks in the country, and probably the largest in the world, are located at the Erie Basin, South Brooklyn, N. Y. These docks were built by J. E. Simpson & Co., of New York, and are now under the control of the William Cramp's Sons Dry Dock Co., of this city, lessees. Our engraving shows the docks and their appurtenances in perspective and in detail: Fig. 1 being a view in the engine room; Fig. 2, the general view of the docks; Fig. 3 showing one of the docks while being filled; Fig. 4, the caisson floating away. Fig. 5 is a transverse section of the caisson. Fig. 6 shows the discharge of the pumps, and Fig. 7 shows the dock and the pump connections in section.

The illustration represents the City of Worcester in the smaller dock, and one of the largest ocean steamships in the larger dock. We extract the greater portion of our description from the report of the Board of Inspectors ordered by the Secretary of the Navy. The dry docks are two in number, and of the following dimensions:

DOCK No. 1.

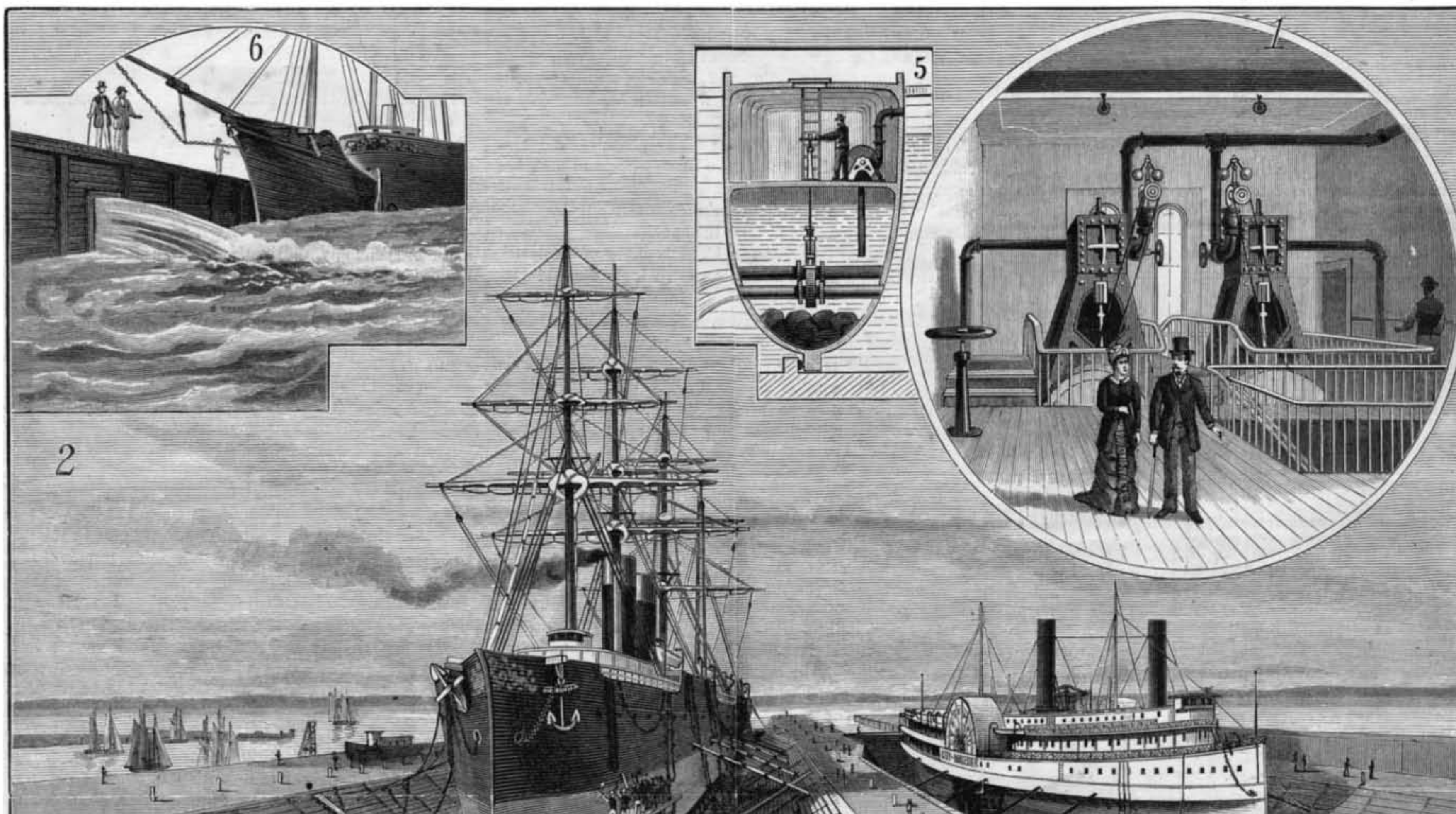
Length over all on coping	540 feet.
" inside of caisson when at outer abutment	510 "
" inside of caisson when at inner abutment	490 "
Width on top in body	124 "
" " floor " "	52 "
" " " at entrance	46 "
" " top " "	100 "
Depth of gate sill below coping	27 "
" " " " " high water	22 "

DOCK No. 2.

Length over all on coping	630 feet.
" inside of caisson when at outer abutment	600 "
" inside of caisson when at inner abutment	580 "
Width on top in body	111 "
" " floor " "	46 "
" " " at entrance	45 "
" " top " "	85 "
Depth of gate sill below coping	30 "
" " " " " high water	25 "

The docks are built upon spruce pile foundations throughout, the floor foundation piles being driven in rows spaced three feet from centers transversely, and about four feet eight inches longitudinally, upon which are fitted

(*Continued on page* 20.)



THE GREAT DRY DOCKS AT THE ERIE BASIN, BROOKLYN, N. Y.

© 1883 SCIENTIFIC AMERICAN, INC

THE GREAT DRY DOCKS AT THE ERIE BASIN.

(*Continued from first page.*)

and secured heavy transverse floor timbers of yellow pine, covered with spruce planking to form the floor, and carrying the keel blocks, the latter being additionally supported by four rows of piles firmly driven under the floor timbers and capped with heavy yellow pine timbers along the axis of the dock.

The heads of these piles along the keelway are also inclosed in a continuous bed of Portland cement concrete.

Open box drains are provided on each side of keelway beneath the floor timbers, leading to the drainage culverts at the head of each dock.

The sides and heads of the docks are built with a slope of about 45°; the alters to high water level are of yellow pine timber, nine inches rise and ten inches tread, and bolted to side brace timbers, which are supported by piles and abut upon the ends of the floor timbers.

The alters are carefully filled in behind with clay puddle, as the sides are built up, and from the level of high water to top of coping the sides are built of concrete *en masse*, faced with Hoope's artificial stone, the alters being continued of the same material to coping level.

The keel blocks are placed upon every floor timber, and bilge blocks of the usual form, sliding upon oak bearers, upon every other floor timber.

Lines of close sheet piling of tongued plank inclose the floor of the dock and also extend entirely around the dock outside of coping, and across the entrance of outer end of apron and at each abutment, forming cut-offs to exclude the tide water, etc.

An iron caisson or floating gate is used to close the dock, made with sloping ends corresponding substantially with the slope of side walls in the body of the dock, which bears against the sill and solid timber abutments the whole length of its keel and stem, "no grooves" being used.

Each dock has two gate sills and abutments, the outer one being provided chiefly to facilitate examination of and repairs to the inner or main one generally used.

The joint is made water-tight by means of a rubber gasket secured to face of sills and abutments.

The principal advantages which these docks possess over stone docks, as usually constructed, are greater accessibility, better facilities for shoring vessels, better distribution of light, and dryness.

The narrow alters and gently sloping sides afford safer and easier means of ingress and egress at every point, furnish a better supply of light and air, and the shoring is more easily adjusted, all of which materially aid in the dispatch and economy with which work of repairs can be prosecuted.

From facts gathered by the inspectors it appears that the life of timber docks is as yet unknown, though the substructure, which is kept constantly wet, can be said to be practically imperishable. Judging from all the information obtainable, the inspectors are of the opinion that the repairs of a timber dock of good quality, of good materials, and well built, would be insignificant for a period of say twenty years, when it would probably be found necessary to renew all woodwork above high water level, and the face timber above half tide level.

The relative average yearly cost of repairs of these docks as now constructed and the ordinary stone docks would, it is thought, be in favor of the timber docks, especially in latitudes much above the frost line.

The manner and cost of operating does not appear to differ materially from other kinds of well constructed excavated docks.

The dock is emptied by two Andrews centrifugal cataract pumps, each driven by a vertical engine, having twenty-four inches diameter of piston and twenty-four inches stroke.

These engines are ordinarily run at fifty revolutions per minute, and by spur gearing between the engines and the pumps the revolutions of the latter are double those of the former.

The dimensions of the pumps were given to us as seven feet in diameter and three feet in width, and the effective capacity of each as twenty-three thousand five hundred gallons per minute. The dock No. 1, at present in use, has, it is said, been emptied, while holding a ship of four thousand tons measurement, in one hour and eight minutes.

The Board is impressed with the efficiency of the caisson of the peculiar shape employed by Mr. Simpson; the sloping ends of the caisson and absence of grooves in the abutments permit the removal of the caisson and the opening and closing of the dock in the shortest time without difficulty and with the least handling of water ballast.

An underground steam pipe from the pumping engine boiler leads to the entrance, whence steam is conveyed to the pumps on board the caisson by flexible hose, and the expense and care of a boiler on the caisson thereby avoided.

Coke and its Products.

The great rise in the value of the products given off in the distillation of coal has, for a considerable time past, directed increased attention to the waste that attends the process of coke burning, and several attempts have been made to utilize the volatile hydrocarbons of the coal without deterioration to the quality of the coke. Recently Mr. John Jameson, of the firm of Jameson & Schaeffer, consulting engineers, Newcastle, has invented a new method of distillation, which is attracting great attention in the North. The process consists in the application of a very slight exhaustion in the floor of a coke oven, while the coking is going on in the usual way. The volatile products thus withdrawn are cooled in a range of pipes, so as to allow the condensable hydrocarbons and ammonia water to be deposited, while the incondensable gas is either used as a by product, or is passed into the lower part of an entirely ignited oven, where the carbon of its hydrocarbon is deposited in the pores of the coke, in the same way that carbon is deposited from a gaseous atmosphere on to the red-hot filament of an incandescent lamp. In the ordinary process of coke burning the ignition of the coal begins at the top of the oven and proceeds downward. Under the heat the coal softens and agglomeration of the particles takes place, accompanied by the evolution of gases and vapors, which find their way toward the surface, where the former are, for the most part, burned, and the latter decomposed and lost. As the process proceeds the stratum of agglomerated particles thickens, and as the heat increases the products separate, the more volatile forcing their way to the surface, and the less volatile becoming set in the charge and coked. Under the new process these conditions do not obtain. The vapors formed at the lowest possible heat pass at once into a colder stratum of coal, the raw coal being gradually warmed and its most volatile products caught away, while the least volatile may be left to enrich the coke. The yield of oil and ammonia varies with the quality of the coal, the quantity obtained from Sherburn coal being 6·8 gallons of oil per ton of coal, and a quantity of ammonia equal to 4 pounds to 6 pounds of ammonia sulphate. An analysis of the oil showed solid paraffin to the extent of 17 to 23 per cent. It is stated that the cost of application of the invention to a row of coke ovens need not exceed £20 per oven.

A Good Varnish.

Shellac in one of its many shapes forms in this case, as in most others, the foundation upon which the varnish is built; and, indeed, we may say at the outset that a plain solution of shellac makes one most excellent in quality. Shellac, under its various names indicative of its color, is really only another form of the so-called "seed lac," and also of stick lac, some recipes giving most absurd instructions as to the proportion of the various forms of resin to be used. Stick lac is simply the twig encrusted by the lac insect with the peculiar substance it produces. Seed lac is the incrustation removed, in which state it presents the appearance of small seed; and shellac is the purified seed lac, melted, strained, and placed on large cylinders or slabs to harden, from which the resin is chipped or shelled off as "shell-lac."

Shellac is found in commerce of an infinite variety of shades of brown from the pale "orange," as it is termed, to the deep garnet or ruby color, which is useless for our present purpose. Such shellac dissolved in spirit would give a solution that could not be decolorized in any practical manner—at any rate by the working photographer. For our purpose the very finest "pale orange" shellac procurable should be purchased; and when varnish is likely to be made in quantity, the samples must be first obtained so as to enable the stock to be purchased where the palest sample came from. Those who have not before paid any attention to the matter will be surprised to discover how varied in color even high priced shellac will be found. Another consideration, which will scarcely need to be pointed out in the selection of shellac, is to see that the pieces are as clean looking as possible. In this respect also great differences will be found.

A solution of such a shellac in methylated spirit forms the basis of our varnish, and a simple varnish so made will answer for all rough work; but where delicate results are wanted it must be paler in color, and for this purpose we use "bleached shellac."

Bleached shellac dissolved in spirit also makes an excellent varnish; but it is not nearly so hard and tenacious as that from the orange shellac. A good strong coating of it is readily scratched by the finger nail—a *contretemps* so likely to occur in printing that such a varnish cannot be recommended. White shellac is made by dissolving ordinary shellac in caustic alkali, and then treating the solution with chlorine, which at one and the same time decolorizes and precipitates it. This process, though it produces a pale resin, of great value for many economical purposes, causes the resin to lose many of those properties that specially fit orange lac for use in photographic varnish. One of the peculiarities of white lac varnish is the frequency with which it dries into a multitude of fine ridges, which no rocking of the plate to and fro during draining or drying will prevent. But for paleness of color in the coating obtained from it nothing can be better; and in a mixture of the two resins—that is, the bleached and the unbleached—the objectionable qualities of either seem either covered or greatly minimized. This mixture, in suitable proportions, constitutes the chief part of the varnish we recommend.

Experimenters with "bleached," or, as it is often called, "white lac," must know that unless it be properly stored it practically loses its solubility in spirit of wine; and we know of many cases of failure in varnish making caused through the purchaser being supplied with a sample that had become insoluble. Of course, this would not be likely to occur in a place where the lac was in great demand; but many of our readers live in places where photographic—indeed, any rare—chemicals are most difficult to get, and when obtainable are not always in good condition. However, in the case of white lac, where the experimenter is ignorant of the appearance it should present, he can easily test a small quantity if he have any doubt in the matter. It should be crushed or pounded into small pieces before adding to the spirit, as even in the best samples a large proportion entirely insoluble always exists, and a clear solution must not be expected. Its solubility or the reverse is soon discovered by noticing whether the small particles begin to disintegrate, as it were, or retain their sharp outlines.

A good indication of insolubility is the outer layer of the round pieces or sticks turning semi-transparent. The plan usually adopted to prevent this change taking place is to keep the bleached lac in the dark and covered with water, when, if it remained so covered, it will retain its solubility in spirit for a lengthened period.

The third and last ingredient in this varnish is "sandarac gum." It is well known by varnish makers that when gums and resins are mixed and "blended" in solution, the character of this solution or varnish is not by any means of necessity an average of the characters of the gums taken separately, and such is the case with sandarac. This gum, taken by itself, gives a varnish that is quite useless from its brittleness, but when added to a shellac varnish it confers a portion of its own quality of brightness of surface, which it possesses in a high degree, but does not, in moderate quantity, tend to make it "rotten."

The formula for a varnish devised on the principles above enunciated is as follows:

Palest orange shellac	2¾	ounces.
Bleached lac	5½	"
Gum sandarac	½	ounce.
Methylated spirit	1	quart.

Bruise the bleached lac till reduced to small pieces. Powder the sandarac, and then add the whole to the spirit, putting in a few small pieces of glass to prevent the shellac caking at the bottom of the jar; stir or well shake the whole from time to time, till it is evident that solution is complete. All that is then necessary is to set aside to clear, pour off the clear, supernatant fluid, and filter the rest. It is best to allow a month or two for subsidence, for the insoluble part occupies so large a space that much waste through evaporation, etc., is caused if an unnecessarily large quantity be passed through the filter.

We may say we have seen many thousands of negatives covered with a varnish prepared by this formula—both collodion and gelatine—and have not seen a single one that has given way in the slightest degree; hence we feel that the above may be recommended as a standard and reliable formula.—*British Journal of Photography.*

A Remarkable Sand Dune.

The Reno, Nev., *Gazette* describes a remarkable hill of moving sand in the eastern part of Churchill County, Nevada, about sixty miles from Land Springs Station. It is about four miles long and about a mile wide.

In the whole dune, which is from 100 to 400 feet in height, and contains millions of tons of sand, it is impossible to find a particle larger than a pin head. It is so fine that if an ordinary barley sack be filled and placed in a moving wagon, the jolting of the vehicle would empty the sack, and yet it has no form of dust in it, and is as clean as any sea beach sand. The mountain is so solid as to give it a musical sound when trod upon, and oftentimes a bird lighting on it, or a large lizard running across the bottom, will start a large quantity of the sand to sliding, which makes a noise resembling the vibration of telegraph wires with a hard wind blowing, but so much louder that it is often heard at a distance of six or seven miles, and it is deafening to a person standing within a short distance of the sliding sand.

A peculiar feature of the dune is that it is not stationary, but rolls slowly eastward, the wind gathering it up on the west end and carrying it along the ridge until it is again deposited at the eastern end. Mr. Monroe, the well-known surveyor, having heard of the rambling habits of this mammoth sand heap, quite a number of years ago took a careful bearing of it while sectioning Government lands in that vicinity. Several years later he visited the place, and found that the dune had moved something over a mile.

Fast Work in a Carriage Shop.

At the annual dinner of the Carriage Builders' National Association, in Philadelphia, Hon. Phineas Jones told of fast work he had lately witnessed in a carriage factory that turns out from 15,000 to 20,000 carriages a year. He said:

"I saw them setting tires. I noticed how fast they put the tires on the wheels. They put on 53 sets of tires in 50 minutes. That is work, and it is a fact. One man put the tires into the oven and took them out after they were heated. There were about 16 tires heated all the time in the oven, and then there were two rollers driven by a belt revolving all the time, with a strong fire at the rear of it, and when the tires were taken out, two other men stood there and put them on. I timed them, and they put on a set a minute. And the man told me that one day, when the tire setter wanted to be away the next day, and it was then five o'clock in the afternoon—he told him those wheels had got to be tired the next day, and he said: 'I will tire them to-night.' There were 53 sets of them, and he put them on in 50 minutes. Those are facts. I noticed one man setting tires, and I timed him with my watch. He lit the forge and put on a tire a minute. I said that is lively work."

THERE are in the United States about 28 establishments devoted to the manufacture of matches.

© 1883 SCIENTIFIC AMERICAN, INC

Tea and Coffee from Guano Synthesis of Coffeine (Caffeine).

Theobromine, the crystalline body present in cacao beans, and first recognized by Woskresensky, in 1841, and caffeine, first met with by Runge, in 1820, and afterward found in tea and termed theine, but which has since been shown to be identical with caffeine, are the two bodies which the chemist has now succeeded in producing artificially. The *Engineer* says that Mr. Emil Fischer has for a long time busied himself with the investigation of the constitution of the caffeine contained in coffee and tea, and a short time since he arrived at a structural formula for this base, which he found to be:

$$\begin{array}{lcl} & N\,(CH_3) - C = CH - N - CH_3 & \\ CO < & \quad\quad\;\; | & > CO \\ & N = \!=\!= C \underline{\quad\quad} N - CH_3 & \end{array}$$

He it is who has now succeeded in preparing the base artificially. He has not, it is true, succeeded as yet in preparing it from the elements composing it, but from a body of quite other origin, a substance present in urine, in meat, in the muscular part, that is to say; and in guano, to wit, xanthine. The three bodies, xanthine $C_5H_4N_4O_2$, theobromine $C_7H_8N_4O_2$ (the alkaloid present in cacao), and caffeine $C_8H_{10}N_4O_2$, are closely related to each other in point of constitution. The last two differ in formula by CH_2, and the first and second by C_2H_4 or $2 \times CH_2$; and it has been shown by Strecker that theobromine and caffeine can be converted the one into the other by taking an atom of hydrogen out of theobromine and inserting in its place the methyl group CH_3. He brought about this change by treating argentic theobromine with methyl iodide in accordance with the equation:

$$\underset{\text{Argentic theobromine.}}{C_7H_7AgN_4O_2} + \underset{\text{Methyl iodide.}}{CH_3I} \quad \underset{\text{Argentic iodide.}}{AgI} + \underset{\text{Caffeine.}}{C_8H_{10}N_4O_2}$$

In a similar way, Strecker tried in vain to obtain theobromine from argentic xanthine. It was reserved for Fischer to be more lucky, by treating the lead salt of xanthine in place of the silver salt with methyl iodide, to produce theobromine, as shown below:

$$\underset{\text{Plumbic xanthine.}}{C_5H_2N_4O_2Pb} + 2CH_3I = \underset{\text{Plumbic iodide.}}{PbI_2} + \underset{\text{Theobromine.}}{C_7H_8N_4O_2}$$

The theobromine thus artificially obtained is in every respect identical with that of the natural alkaloid of the cacao bean. When converted into its silver salt and treated with methyl iodide, it is changed into caffeine, and thus the characteristic alkaloids of cacao, of coffee, and of tea had now been artificially prepared out of guano.

Substitute for Albumen for Fixing Dyes, etc.

J. Hofmeier, Prague, converts the albuminoids of all kinds into soluble proteines and pepton-like substances, and mixes these products with substances that will precipitate or coagulate them at an elevated temperature.

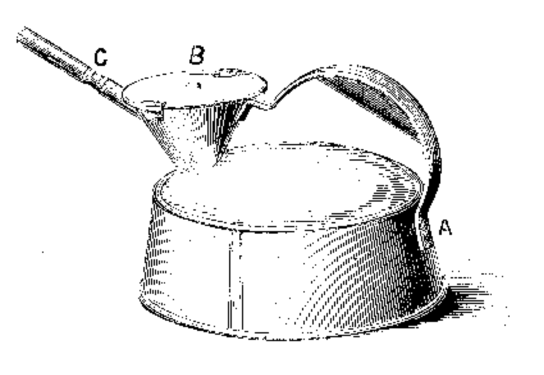
The raw albuminous substance employed is the waste product in making extract of meat, such as insoluble crude albumen meat meal, and other kinds of waste meat, as well as fresh meat itself, the fibrine of blood, dry or fresh, caseine, moist or dried, and finally vegetable substances that contain albuminoids, such as the germs of malt, pressed oil cakes of various oil seeds, and the albumen of legumes and pod bearing plants.

The different kinds of albumen are dissolved either by heating with dilute acids, such as hydrochloric or lactic, or by prolonged boiling in weak solutions of alkali, especially caustic soda. The solution thus obtained, if made with an acid, must be neutralized as far as possible without precipitation. It can then be dried carefully at 35° C. (95° Fah.), forming a solid mass which will dissolve again in fresh water like ordinary albumen, and its solution can be employed with other substances for dyeing and printing, just like other albumen, by mixing it with the color. After printing it is coagulated by steaming, and fixes the dye on the fiber. The substances employed to mix with it are the various soluble salts of lime and magnesia, with the addition of common salt and sulphate of potash. Instead of these salts the same end may be attained by the use of the salts of alumina, zinc, or baryta, which possess the property of forming basic salts by the action of water at higher temperatures. The following are recommended as most suitable, namely, to each 100 parts of albumen in the solution, calculated to substance dried at 100° C. (212 Fah.), from one to two parts of lime or magnesia salts are used, the most suitable being chloride of calcium, chloride of magnesium, sulphate of magnesia, or citrate of lime. The amount of common salt added is five to six parts to 100 of dry albumen in the solution; the quantity of sulphate of potash is 0·25 to 0·40.

The mixtures prepared in this way become insoluble when dry, and hence can only be used in a liquid form. Yet other mixtures can be made that will bear being dried at 35° to 40° C. (95° to 104° Fah.) without producing an insoluble residue, and it can then be redissolved in lukewarm water, and by steaming or heating to 100° C. (212° Fah.) it will coagulate like other albumen. The proper substances to be added for this purpose are salts which decompose under the influence of heat and in the presence of feeble alkaline substances, like protein alkali, liberating an acid or increasing the basicity of its own acid. Certain organic acids are of this nature, especially the sulpho acids, the acid esters of sulphuric, succinic, and phosphoric acids; likewise the salts of meta and pyrophosphoric acid, as well as the biborates, all of which possess the property that when their solutions are heated, even with substances that are but slightly alkaline, they split up and liberate an acid hydrate which neutralizes the soda that kept the albumen in solution, hence causing its precipitation in insoluble form. Glycol-sulphuric and glycol-phosphoric acids and their potash or lime salts are especially useful, but glycol-succinic and glycero-succinic acids can be employed, as well as the analogous citrates, tartrates, and lactates, the alumina zinc and baryta salts being preferred. The pyrophosphates and metaphosphates of lime and of soda are also employed.

The quantity of these salts employed only amounts to 1 or 2 per cent of the dry albumen, and in the case of the glycero-sulphates of lime and potash it can be reduced to a half per cent, if the amount of alkali in the albumen solution is correspondingly decreased. Such mixtures, with the addition of 6 or 7 per cent of the dry weight of albumen of common salt, can be completely dried, yielding a mass that looks just like blood albumen and dissolves readily, forming solutions that coagulate completely when steamed on the fibers. By the use of albuminoids that are nearly colorless, like caseine and vegetable albumen, preparations are obtained lighter in color than egg albumen itself, and not inferior in fixative power.—*Ind. Zeitung.*

In the treatment of bronchial and other throat affections, it is usual to inhale steam impregnated with medicated substances, for soothing the irritation or curing the disease. The accompanying cut of a kettle we find illustrated in



one of our foreign exchanges, which seems to be quite a simple and convenient utensil. The cut explains it. A contains the boiling water; B, the receptacle for the herbs; and C, the inhaling tube.

How to Kill Cabbage Worms.

The ravages of the caterpillars of the cabbage butterfly caused a good deal of trouble last summer at the State Agricultural Experiment Station, Geneva, N. Y., particularly those of the second or August brood. In order to test the efficacy of various reputed remedies for the cabbage worm, the director applied them to special collections of worms, and noted the effects. One specimen confined for three hours in a bottle partly filled with black pepper crawled away discolored by the powder, but apparently unharmed. The second, repeatedly immersed in a solution of saltpeter, and a third in one of boracic acid, exhibited little indications of inconvenience. Bisulphide of carbon produced instant death when applied to the worm, though its fumes were not effectual. The fumes of benzine as well as the liquid caused almost instant death, but when applied to the cabbages small whitish excrescences appeared on the leaves. Hot water applied to the cabbage destroyed a portion of the worms, causing also the leaves to turn yellow. One ounce of saltpeter and two pounds common salt dissolved in three gallons of water formed an application which was partly efficient. The most satisfactory remedy tested, however, consisted of a mixture of ½ lb. each of hard soap and kerosene oil in three gallons of water. This was applied August 26; an examination the following day showed many, if not all, the worms destroyed.

The growing cabbage presents such a mass of leaves in which the caterpillars may be concealed that it is hardly possible to reach all the worms at one application. It is of importance, therefore, to repeat the use of any remedy at frequent intervals.

Japanese Sugar.

The sugar of Japan, says Consul-General Van Buren, is made from that species of the sorghum plant known as the Chinese sorghum. It grows luxuriantly in all the southern portions of the empire south of the 36th degree of north latitude. The whole product of the empire in 1878 was 64,297,580 pounds. Importation in 1878 was 67,434,805 pounds. For three or four hundred years the processes of granulating and refining sugars have been known and practiced. Sorghum is not grown, as with us, from the seed, but from cuttings. In September selected stalks are cut and buried in trenches a foot deep. Through the winter, from each joint of the stalks sprouts grow. In the spring these points are cut off and set out in rows 15 to 18 inches apart, and about the same distance from each other in the rows. The ground has previously been thoroughly dug up, and pulverized by a long-bladed mattock. The fertilizers used are ashes, fish, decomposed hay, straw, and sea-weed, or night soil. The plants are thoroughly hoed, hilled, and irrigated. In October and November the leaves are stripped off and the stalks are then cut and the hard outer covering is removed, and the remaining portion is then ground between rollers of stone or hard wood. The cane juice is then boiled in iron kettles till the granulation takes place, when it is placed in bags and pressed dry. The expressed sirup is used as molasses. Dry upland soils are required for the successful growth of the cane, and the expenditure of labor and fertilizers is as great if not greater than for any other crop. Great exertions are being made to promote the increased production of sugar, which will probably be in some degree successful. In fact, I am informed that large orders for the apparatus for sugar-making have been received from districts which heretofore have not grown sugar-cane.

Crystallization Experiments.

When two different salts are dissolved in the same liquid, such an exchange of bases and acids takes place as will form, if possible, an insoluble salt. Thus barium nitrate and sodium sulphate will form barium sulphate (precipitated) and sodium nitrate. When, however, the given acids and bases are unable to form an insoluble compound, as when barium nitrate and sodium chloride are brought together, it is not easy to see what does really occur. Berthollet says that in such cases four salts are formed and exist in solution. Thus, in the case last mentioned, we should have both of the original salts as well as barium chloride and sodium nitrate. The following experiments of Brugelmann are designed to prove this:

1. Equal volumes of cold saturated solutions of cobaltous chloride, $CoCl_2 + 6H_2O$, and nickel sulphate, $NiSO_4 + 7H_2O$, are mixed and left to evaporate spontaneously. The crystals contain both metals in the form of sulphates, hence the mother liquid must contain chlorides of both metals, making four salts in all.

2. Similar experiments made with cobaltous chloride and copper sulphate yield at first a crop of large wine-red crystals, consisting chiefly of sulphates of both metals, but mixed with these were also crystals of the chlorides.

3. Mixtures of copper sulphate and potassium bichromate ($K_2Cr_2O_7$) gave at first light green crystals, consisting chiefly of sulphates of the two metals. There were also yellowish-green, green, and bluish-green objects formed. Finally, there was left a dark brown, deliquescent mass, which became crystalline when dried in a desiccator, and contained both metals, mostly united with chromic acid. The details are given in the Berlin *Berichte*, xv., p. 1,840.

Potash in Greenhouses.

An experienced gardener, among other insecticides, recommends the use of potash in the greenhouse as providing a remedy against most insects, but also fertilizes the plants. He says: "I use it for cleaning the glass, swilling all wood and brick work everywhere inside, and find it useful both for cleansing and as an insecticide; and I think it is a good dressing for the soil. I have used it as strong as one ounce to the gallon of water for syringing glass over plants, and it has not injured the leaves; on the contrary, improved them. However, I would not advise its use in this way carelessly; but used as I have described, it gets into every crack and crevice, dealing certain death to the insect tribe. I would strongly advise all who have not had a thorough experience of the different kinds recommended to be very cautious in their use of insecticides and note carefully their results, as many are more dangerous than useful. Paraffine, for instance, when applied to plants in any form whatever, kills the insects; but how often does it close the pores of the leaves and makes the plants unhealthy, and, as a consequence, more liable to future attack from insect pests."

The Chief Cities of Europe.

Recently there have been compiled from official and late sources, statistics of population for some of the principal cities of Europe, from which it appears that there are 92 towns in Europe to which the term city can properly be applied, that have a total population of more than 100,000; but there are only four cities that possess more than 1,000,000 inhabitants. These four are London, with 3,832,440; Paris, with 2,225,910; Berlin, with 1,222,500, and Vienna, with 1,103,110. Of the other capitals, St. Petersburg possesses 876,570; Constantinople, 600,000; Madrid, 367,280; Buda-Pesth, 360,580; Warsaw, 339,340; Amsterdam, 317,010; Rome, 300,470; Lisbon, 246,340; Palermo, 244,990; Copenhagen, 234,850; Munich, 230,020; Bucharest, 221,800; Dresden, 220,820; Stockholm, 168,770; Brussels, 161,820; Venice, 132,830; Stutgardt, 117,300. In addition to these, Moscow contains 611,970; Naples, 493,110; Hamburg, 410,120; Lyons, 372,890; Marseilles, 357,530; Milan, 321,840; Florence, 169,000; Antwerp, 150,650; Cologne, 144,770; Frankfort, 136,820; and Rouen, 104,010.

Street Railways in the United States.

A meeting of street railway officials was held in Boston, Dec. 12, for the purpose of forming a National Street Railway Association. The temporary chairman, Mr. Moody Merrill, of Boston, in outlining the scope of the proposed organization, said that there are now organized and doing business in this country and Canada 415 street railway companies. These companies employ about 35,000 men, and run 18,000 cars. More than 100,000 horses are in daily use, to feed which it requires annually 150,000 tons of hay and 11,000,000 bushels of grain. These companies own and operate over 3,000 miles of track. The whole number of passengers carried annually is over 1,212,400,000. The amount of capital invested in these railways exceeds $150,000,000. Messrs. C. B. Clegg, of Ohio, and C. C. Woodruff, of New York, were chosen secretaries.

© 1883 SCIENTIFIC AMERICAN, INC

New Car Signal.

The Providence & Worcester Railroad has been supplying its cars with an apparatus enabling the conductor to signal to the engineer by blowing the whistle from any portion of the train. The appliance is described as being somewhat similar to the automatic air-brake, and consists of a pipe running underneath the cars, with couplings at either end. Attached to the pipe at one end of each car is a smaller pipe running to the top and across to the center, where a valve is fixed. Over this valve is the hole for the signal rope, which is attached to the valve. When the conductor wishes to signal he pulls the rope, which runs through the car, the same as he formerly pulled the bell rope. This opens the valve, the air escapes, and the whistle is sounded by the release of the air from the pipes. The advantage of the new arrangement is readily apparent. With a long train the conductor was formerly obliged to give a long pull at the bell rope, ofttimes bringing it half way to the floor of the car, and even then was not sure that the bell rang, or that it responded to his signal as he wished it to do, while, as a matter of fact, it often did not respond. Now he has only to pull a rope the length of the car at most, and can readily tell whether or not the valve responds, knowing that if it does the whistle is giving the desired signal to the engineer. In case one of the cars in the train is not provided with this new arrangement, the bell-rope is hitched as usual, and if the conductor wishes to signal from that car it is simply necessary to pull the rope, thus opening the valve in the next car. A number of the cars of the above road are said to have been fitted with the new arrangement, which, it is understood, will be applied to all.

NEW POTATO DIGGER.

We give an engraving of an improved potato digger recently patented by Mr. Charles W. Dutcher, of St. Andrews, New Brunswick, Canada. This machine is provided with a share attached by hinged connection to the main frame, and capable of being elevated or depressed by means of a lever near the driver's seat. The share is ribbed longitudinally in the middle to thoroughly break up the hills of potatoes, and is provided with a slotted rear extension, over which the potatoes are crowded on their way to a shaker pivoted at the rear of the share and capable of lateral motion.

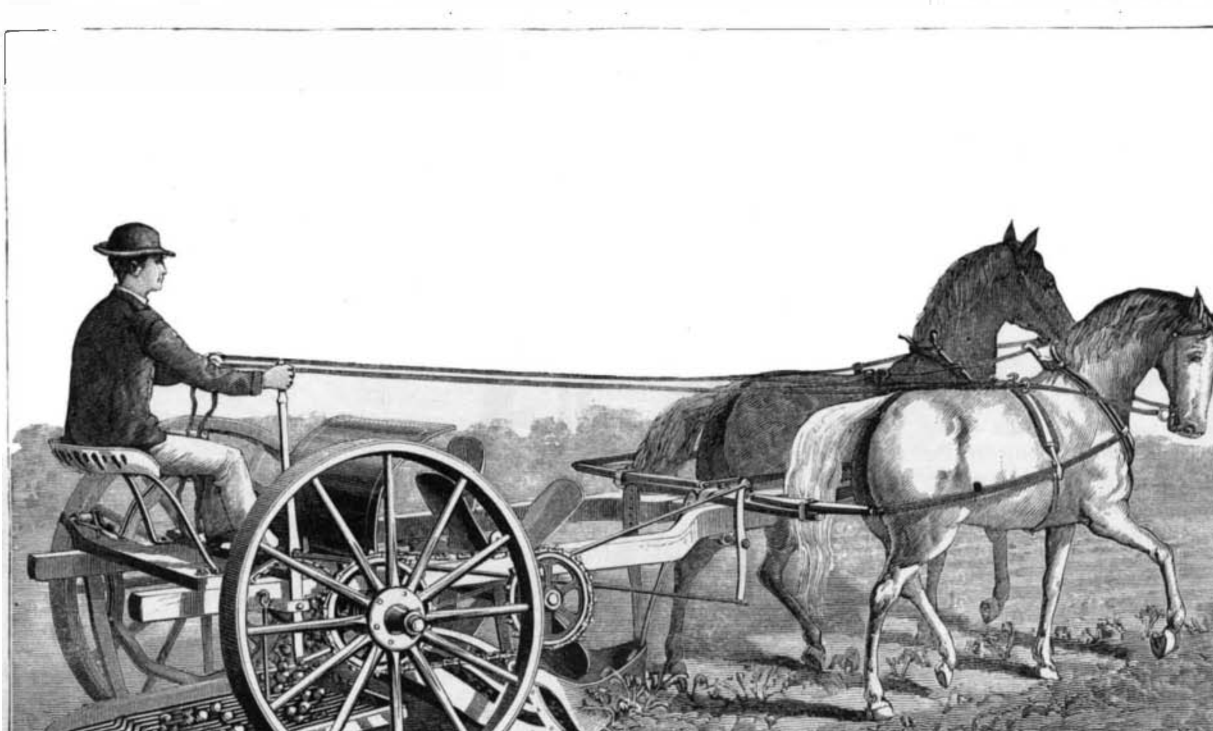
Above the share there is a scraper for clearing the ground of weeds, potato tops, stones, etc., to prevent them from entering the separating devices and becoming mixed with the potatoes; above the share there is a paddle wheel driven by a chain from a sprocket wheel on one of the drive wheels. This paddle wheel pushes the earth and potatoes backward to the separating bars. The separator shaker consists of a number of bars bent at their rear ends toward the right hand side of the machine, and having a downward offset to facilitate the discharge of potatoes. The left hand side of the shaker is provided with a rim that prevents the potatoes from being discharged on that side, and so insures a clear track for the horses and machine on the next round.

The shaker receives its motion from a zigzag cam carried by one of the drive wheels, and its motion is more rapid toward the discharge side of the machine than it is toward the opposite side, the object being to insure a uniform and proper deposit of the potatoes after they are raised from the ground and cleaned.

The raising and lowering of the main frame together with the share is effected by turning the tongue in its socket by means of the hand lever before described, and by the same means the share is raised sufficiently high to clear the ground when it is desired to transport the machine from one field to another.

Another lever is provided for throwing the sprocket wheel that operates the paddle wheel in and out of gear.

A guard consisting of a curved plate of iron is placed at the rear of the paddle wheel to protect the face of the driver from earth that might otherwise be thrown in his face. This machine is simple in its construction, rapid in its operation, and deposits the potatoes in a clean row on the surface of the ground, so that they may be readily picked up and placed in the baskets.



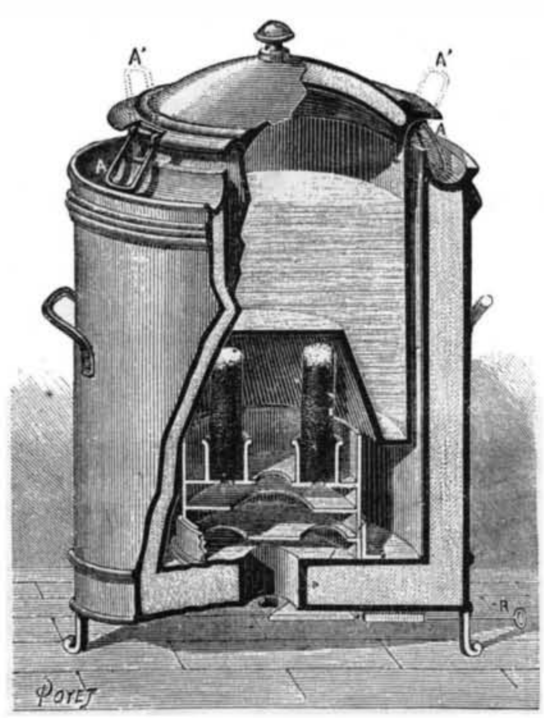
DUTCHER'S POTATO DIGGER.

THE Hudson River Power and Paper Company have completed a new dam across the Hudson River at Mechanicsville, N.Y. It is 1,000 feet long, 16 feet high, 18 feet wide at base and 8 feet at top, with its canal it has cost $300,000. It will furnish 4,000 horse power.

LABORATORY APPARATUS FOR HEATING WATER.

The accompanying cut represents a very useful little apparatus for laboratories that are unprovided with gas, and in which the heating of water by alcohol would cost too much. It is called the "American" kettle, and is heated very cheaply with an asbestos carbon. The laws of thermics are applied in this apparatus very intelligently.

The furnace consists of a double jacket, filled in with materials that are poor conductors of heat. Above the aperture in the bottom for admitting air there is a small sheet iron fire-pan, having a double bottom pierced with alternating holes, so as to prevent the ashes from falling outside, and to heat the air of combustion better. In this fire-pan there



APPARATUS FOR HEATING WATER.

are fixed one, two, or several asbestos carbons, according to the number of holders. The boiler, the bottom of which is concave, descends on the fire-pan in such a way as to allow the escape of none of the heat that acts within the hollow part. A very thin annular space suffices for the draught. With two carbons, of 100 x 70 x 25 millimeters, three liters of water may be caused to boil in thirty minutes at an expense of ten centimes; and the heat may be kept up seven or eight hours on lowering the kettle and closing the lower register, *r*. The handles, A, of the kettle are calculated to give just the draught necessary when, on being turned down (as in the cut), they raise the apparatus on its furnace.—*La Nature.*

GLASS SHINGLES.—The *Brick, Tile, and Metal Review* reports a new use of glass for shingles. It is claimed that glass roofing is at once better, more durable and cheaper than slate. The glass is usually opaque, but may be translucent or clear as desired. The exposed parts of the shingles are corrugated. The shingles lap at the sides, are closely interlocked, and one rivet suffices for a pair of shingles. It takes but 150 of these shingles 8 by 12 inches to cover a square of 100 square feet, the waste is so small; whereas of slates of the same size 300 are required.

New Journal Bearing.

A recent improvement in linings for journal boxes, for car axles, and other purposes, of which Mr. Ferdinand E. Canda, of 52 William street, New York, is the author, consists in taking advantage of the well-known unguentous or anti-friction qualities of mercury. He makes an amalgam of tin in which any of the well-known metals or alloys used for bearings are employed as constituents with mercury.

While the mass is in a plastic state it is subjected to pressure to expel the superfluous quicksilver, and then allowed to harden; the journal box is then ready for use. Plumbago or other suitable anti-friction substances may also be introduced into the amalgam if desired. It has been found by experiment that this new journal box metal has superior qualities as an anti-friction substance, and it promises to form an economical, durable, and most useful material for railway axles, and bearings of every description.

Meteors.

In a letter to a friend in Boston, an officer of the United States steamer Alaska gives an account of a meteor which was seen from the ship on the evening of December 12, 1882, a few minutes after sunset in latitude 38° 21', longitude 134° 7'. All at once a loud, rushing noise was heard, like that of a large rocket descending from the heavens with immense force and velocity. It proved to be a meteor, and when within ten degrees of the horizon, it exploded with much noise and flame, the fragments streaming down into the ocean like great sparks and sprays of fire. The most wonderful part of the phenomenon then followed, for at the point in the heavens where the meteor burst there appeared a figure shaped like an immense distaff, all aglow with a bluish light of intense brilliancy. It kept that form for perhaps two minutes, when it began to lengthen upward, and growing wavy and zigzag in outline, diminished in breadth until it became a fine, faint spiral line, at its upper end dissolving into gathering clouds. It remained for about ten minutes, when it began to fade, and finally disappeared.

The captain of the Bark Gemsbok, arrived at this port from Auckland, December 27, reported that on October 9, during a southwest gale and thick snow squall, a ball of fire passed across the ship, injuring three seamen and breaking both gunwales, and ripping the planks from the stern of the starboard boat, and exploded about twenty yards from the ship with a loud report, sparks flying from it like rockets. There was no lightning or thunder at the time.

A large and brilliant meteor was seen at Concord, N. H., on the afternoon of December 20, between four and five o'clock. It passed across the northern sky from west to east, and was as plainly visible as meteors usually are after dark.

Improvements in Letter Copying.

The process utilizes the well-known glue plate, consisting of glue, water, and glycerine, but with rather more glue than in the hektograph. For writing, a strong alum solution is used, colored slightly with an aniline color to render it visible. The glue plate is moistened with a sponge, and after a few minutes the written paper to be copied is laid down upon it; in taking it off after a minute or two, the characters are seen to be etched or engraved in the glue. By means of a caoutchouc roller a little printer's ink is spread over the plate. Impressions may then be taken off on slightly damp paper. The ink roller requires to be passed over previous to each impression being taken. Herm O. Lehn, of Charlottenburg, has also recently patented an improved copying apparatus, in which a specially prepared moistened paper is stretched in a frame, the original writing is placed upon it, and left for one to two minutes; after removing it again, the negative or prepared paper is spread over with ink, and the copies are taken. The following process is patented by Komaromy in Buda-Pesth: The following mixture is painted over paper impervious to water—1 part gelatine, 5 glycerine, 0·2 Chinese gelatine, and 1 water. The manuscript is written with the following solution—100 parts water, 10 chrome alum, $5H_2SO_4$, 10 gum arabic, and then laid on the first paper. An aniline color solution is now poured over it, and the excess removed with silk paper. Those parts which have been touched by the prepared ink become hard and incapable of taking up the aniline color solution, and the remainder becomes deeply colored. By placing clean paper over it, negative impressions are obtained.

© 1883 SCIENTIFIC AMERICAN, INC