5. *The Stock* connects the different parts of the apparatus with each other. The trigger actuates a lever that passes under the cylinder, G, and that terminates, as before stated, in two teeth, K. The small turn button, L, beneath the trigger serves as a catch.

The manipulation of the apparatus is simple, and may be sufficiently understood from the foregoing description without further dwelling upon it.

This photo revolver offers but one drawback, and that is that in certain cases it may frighten those at whom it is directed. But it is easy to remedy this by covering it with a handkerchief so as to hide its terrifying aspect.—*La Nature.*

AMERICAN INDUSTRIES.—No. 89.

[SEE FIRST PAGE.]

THE MANUFACTURE OF PAINTS, VARNISHES, BRUSHES, AND ARTISTS' MATERIALS.

Only those directly connected with the business can fully realize how enormous has been the increase of American production in this line during the present generation. The growth has been far more than proportionate to the increase of the population, for two reasons—first, the manufacture here has been so improved that we now import very little except raw materials; and second, the condition of the great body of the people has been steadily improving, so that we have more comfortably and tastily fitted up homes, workshops, and business houses, to say nothing of the great demands which modern railway and steamboat traffic have given rise to. And all these causes contribute to making the business in paints and varnishes of much more importance, proportionately, in our industries, than it was a generation ago.

In our first page illustrations we give representations of some of the most important details of the manufacture, as conductedat the extensive paint works of Messrs. F. W. Devoe & Co., in New York city, and at their varnish factory in Newark, N. J. Their manufacture includes colors of all kinds, either dry, ground in oil or water, or in pulp, ready-mixed paints, colors in japan for coach and carriage and railway car painting, and fine varnishes and japans, with every variety of brushes, artists' materials generally, and mathematical and surveyors' instruments.

Although in many pigments the manufacture has been greatly changed within a recent period—more especially since the introduction of the aniline colors—the making of dry white lead and of zinc white, which constitute a large portion of all the paint used, and form the basis of many of the colors, has remained substantially unchanged through a long period. Formerly white lead was largely imported, but there are now some forty corroding establishments in the United States, and imported white lead is almost unknown. In zinc white, however, we still import our best qualities, Messrs. Devoe & Co. using the Vieille Montagne product, made in the largest establishments of the kind in the world, at Paris and Liege. This is a purer article than that made here, from the fact that the American zinc white is made direct from the ore, while that which they import is made from the metal, and, although the house makes all grades of colors which have a popular demand, they sell none carrying the label of their own name and trademark which is not strictly what it is stated to be. White lead and zinc white are much adulterated, for the cheaper paints, with chalk, barytes, and other adulterants.

In making and preparing for use the various pigments which go to make up the great variety of colored paints, an extended knowledge of chemistry is indispensable. Chemically manufactured colors, such as chrome yellow and green, Prussian blue, and vermilion, are not durable when in exposed conditions, but either of these may be mixed with vehicles which will add greatly to their permanence. Ultramarine blue, as now made—for that made from lapis lazuli has been entirely superseded by the cheaper artificial blue—is a durable color, but care is required in mixing it with white lead to be sure that the lead is pure, for that adulterated with barytes is very injurious, causing the blue to fade quickly. Carmine, also, if mixed with varnish instead of oil, is a durable color, although much of the durability of any color is largely dependent upon the ground on which it is spread and the exposure it receives, as well as the vehicles used in mixing. There has long been a good deal of difference of opinion among painters as to the use of white lead and zinc—some strongly advocating one and some another—but these differences are now resolving themselves into pretty general unanimity of opinion that zinc white has many advantages for interior work, and that for exposed situations the most durable white is a mixture of white lead and zinc white in nearly equal parts. But however the painters or the public may differ in opinion on this point, the doctors all strenuously oppose the use of white lead as eminently injurious to those who make it and the painters who use it.

In the manufacture of all their goods the firm start with the raw material, and carry it forward through all the successive stages. Mr. Isaac Wyman Drummond, E.M., Ph.D., has direct charge of the chemical examinations and experiments necessary, and the importance of the most careful attention in this department for the making of durable colors cannot be overestimated. The permanence of colors in secondary or mixed paints depends primarily on the chemical relations of the colors and pigments employed. These secondary colors are produced by various combinations, and the rule is to use the least number of colors possible to secure the desired tint. It is thus that, with the best of skill in the chemical manipulations, and experts to attend to the mixing and all the details of the manufacture, a variety of colors and an excellence in quality is attained which it would be impossible for any single workman to hope to reach.

In our illustrations are given thirteen views of as many different departments of the business, besides one showing the interior of the large and handsome store at the corner of Fulton and William Streets, New York.

In the left hand corner at the top of the page is shown the mixing and grinding of the pigments for standard colors, while adjoining it in the center is a view of the process of making the finer artists' colors furnished in tubes. The engravings are necessarily small, from the desire of the artist to bring into the group as many departments as possible. There is nothing, perhaps, that would be entirely new to the well informed mechanic in the manner of mixing and grinding the colors, but the advantages possessed by a large establishment for doing this work, with ample power and the most perfect mills, make it an easy matter to secure great fineness and uniformity in the product. The constituents required for the different colors and shades are accurately weighed and measured out before they are put into the mills, and the work is afterward done with mechanical precision. The grinding of the artists' tube colors is done on a circular glass table on which, in a regularly changing ellipsis, revolves a heavy granite block.

On sanitary grounds alone, the extent to which ready ground and mixed paints have come into use within the last few years is a matter of public good fortune. The grinding and mixing of paints were among the most unhealthful parts of the business, when done in the old way, as the dry powder was to some extent absorbed by the skin or taken in by breathing, while its being directly taken in through a scratch in the skin was not uncommon, and all tended to give a high death rate among painters before the attainment of middle life.

The pulverizing of dry colors, shown at the left, about the middle of the page, is done with powerful mills, the pigments, when large enough to require it, being first passed through a breaker and then ground between heavy stones, and bolted to secure uniform fineness, much in the same way that flour is ground.

The white lead and zinc grinding, shown immediately below, forms a most important part of the business. The lead or zinc, with its requisite quantity of oil, is placed in a mixer, which has a trough or gutter in a circle, on a bed about six feet in diameter, in which rolls around a stone also about six feet in diameter, and eight inches face, until the oil has been thoroughly incorporated to make a paste or pulp. Thence this is drawn by pipes into mills on the floor below, where it passes between powerful grinding stones, and comes out slowly in a thick paste of great fineness and entire uniformity.

In the grinding of colors for house painting, or what should be more properly styled the making of the ready mixed paints for use without change, the firm do an extensive business. A large portion of their goods are simply ground in oil to a paste consistency, leaving the painter to thin and put in such drier as deemed best; but in those goods sold in cans, pails, etc., ready for use, the requisite driers and all necessary ingredients are incorporated, and the buyer only has to select the color or shade required from the sample on the label or specimen sheet.

The making of vermilion, shown in one of the views, requires a large department. This is principally made from carbonate of lead and bichromate of potash, with water, the resulting liquid being left to settle in large tanks, the sediment being laid out in batches to dry, the final moisture being absorbed by chalk blocks on which the rough cakes are placed. This vermilion has been in practical use for several years; it does not turn brown or blacken, but retains its brilliancy under exposure to sun or weather.

In all the varieties of umber and sienna made, of which the manufacture includes everything known to the trade, the raw umber and sienna are imported by the hundred tons, and burnt, ground, and passed through all the requisite processes on the premises, as is also the case with the various grades of Vandyke brown. For their ivory black the firm buy ivory chips from the manufacturers of billiard balls and ivory goods, and burn it themselves, to be entirely sure of having a perfectly pure article, which they sell in the powder or in the form of drop black.

As a substitute for the chrome or Paris green, the firm have for several years been making a very popular shade of green, known as the "Park Lawn Green," which is much used for window blinds, agricultural implements, ornamental iron work, and machinery, and they also make another shade, known as "Clover Leaf Green," which is strong and brilliant, and with great covering properties.

Of coach and car colors, ground in japan, the firm make a specialty, and furnish all the supplies required by several prominent railway lines. It is absolutely necessary that the identical shade adopted shall be preserved in all subsequent orders, and that the materials shall be the same, so that the wear will be uniform, and on this account they usually make up large lots at one time, so as always to have a supply on hand. For these colors the firm received a gold medal at the National Exposition of Railway Appliances in Chicago last year.

Not the least among the departments of the business is the large tinshop, where the pails, cans, and painters' tinware are made. Everything of that kind required is made on the premises, the most improved machinery being employed, and every piece being made by a pattern that cannot fail to secure absolute uniformity.

The brush making department of the business covers the manufacture of every kind and grade of brushes known to the trade, from the fine sable to those made of bristle—brushes for the japanner or varnisher, the painter, or the artist—and for all classes of work. The deftness with which the hands put together this work, the facility with which they even up the tufts of almost silky fineness, or separate bristles which have split points, or which have been laid with the roots where the points should be, is something quite wonderful to one who has never seen the work in progress. Everything in this room is made according to sample, and specimens to work by are hung up near every work table.

The making of artists' canvas boards requires a large department. Only the best English linen is used, made especially for the purpose; this is first stretched tightly on the frames, and workmen go over each inch of the surface to remove all pin heads or imperfections of the flax—then come successive coats of specially prepared lead and filling, to make a smooth, firm surface, such as best adapted to make an even and permanent surface for the artist's work.

The manufacture of surveying and mathematical instruments, to be used in railroad construction and for engineers, architects, and draughtsmen, as well as for technical schools, has naturally grown out of the gradual expansion of the business into the filling of all the wants of artists, and everything required by contractors who use their paints. A view of this department has been necessarily omitted from our illustrations, but here are made squares, triangles, compasses, pantographs, and a large variety of other instruments, while the transits, theodolites, and levels furnished by the firm have been approved by and are in the use of the United States Coast Survey.

For the making of varnish and japan the works are at Newark, N. J., and representations of some of the leading details in this branch of the business are shown in the views on the right of the page. The first operation in order is the chipping, which is in reality little more than the removal of the outside crust or coating, and the separation of any impurities. There are in all some thirty different resins or gums of which varnish is made, included in which are principally amber, copal, gum cowrie, animé, and common resin. There are natural lacquers from India and China, and drying oils which resinify by oxidation in the air, but oil varnishes proper are composed of an intimate combination of a drying oil with a fused resin, which hardens by the oxidation of the air. Besides these there are varnishes which have a volatile liquid holding in solution resins or gums which, on the evaporation of the solvent, leave behind a vitreous coating on the surface varnished.

The oil used is principally linseed, which from its high drying property and its general constancy in quality is the great favorite in nearly all varnishes. It is obtained as new, sweet, and free from rancidity as possible, and then clarified and allowed to settle for weeks, after which it is drawn off for use. By boiling, the fatty constituents of the oil—glycerine, palmitine, etc.—are volatilized. The various methods of mixing the oils and gums or resins, and the manner and extent to which they are heated together or separately, necessarily vary with the particular kind of varnish or japan being made. It is a branch of the business which calls for the greatest knowledge, experience, and care, together with a skill which can only be acquired by long practice and observation. The resin must be so prepared as to be readily soluble in oil, and then so incorporated as to form a compound which shall be perfectly soluble in turpentine, and so that, on the evaporation of the latter, a hard surface will form before dust, under ordinary circumstances, will attach to the varnished surface. The high success of the firm in this branch of their manufacture, through many years of steadily increasing business, affords the best criterion of the quality of their goods.

The works of the firm in New York city have a frontage of 200 feet on Horatio Street and 175 feet on Jane Street, with a floor space of about four acres. This part of the business is under the especial superintendence of Mr. James F. Drummond, a member of the firm who has attended entirely to the manufacturing since 1856. A view of the main salesroom, at the corner of Fulton and William Streets, forms one of our illustrations, the business department being under the direct personal supervision of the two other members of the firm, Messrs. Frederick W. Devoe and J. Seaver Page. The first floor above, of the full size of the store, is devoted to artists' supplies and painters' sundries, including an assortment of almost everything even remotely connected with painting and decorating. The firm have a branch house in Chicago under the style of Coffin, Devoe & Co.

A Suggestion about Color Blindness.

May not some people, who know well the difference between colors, yet fail to characterize by their proper names the colors recognized? This question is asked by a Kentucky correspondent, who suggests that some of the railroad employes discharged because of not being able to recognize a red, a white, or a green light, may still, as many of them undoubtedly are, be able to distinguish a light which means danger from one that does not. It is so simple, in such a matter, to learn to call things by their right names, where there is the capability of distinction, that we should be inclined to think the failure to do so indicated too low an intelligence for its possessor to be in any way intrusted with responsibility for human life.

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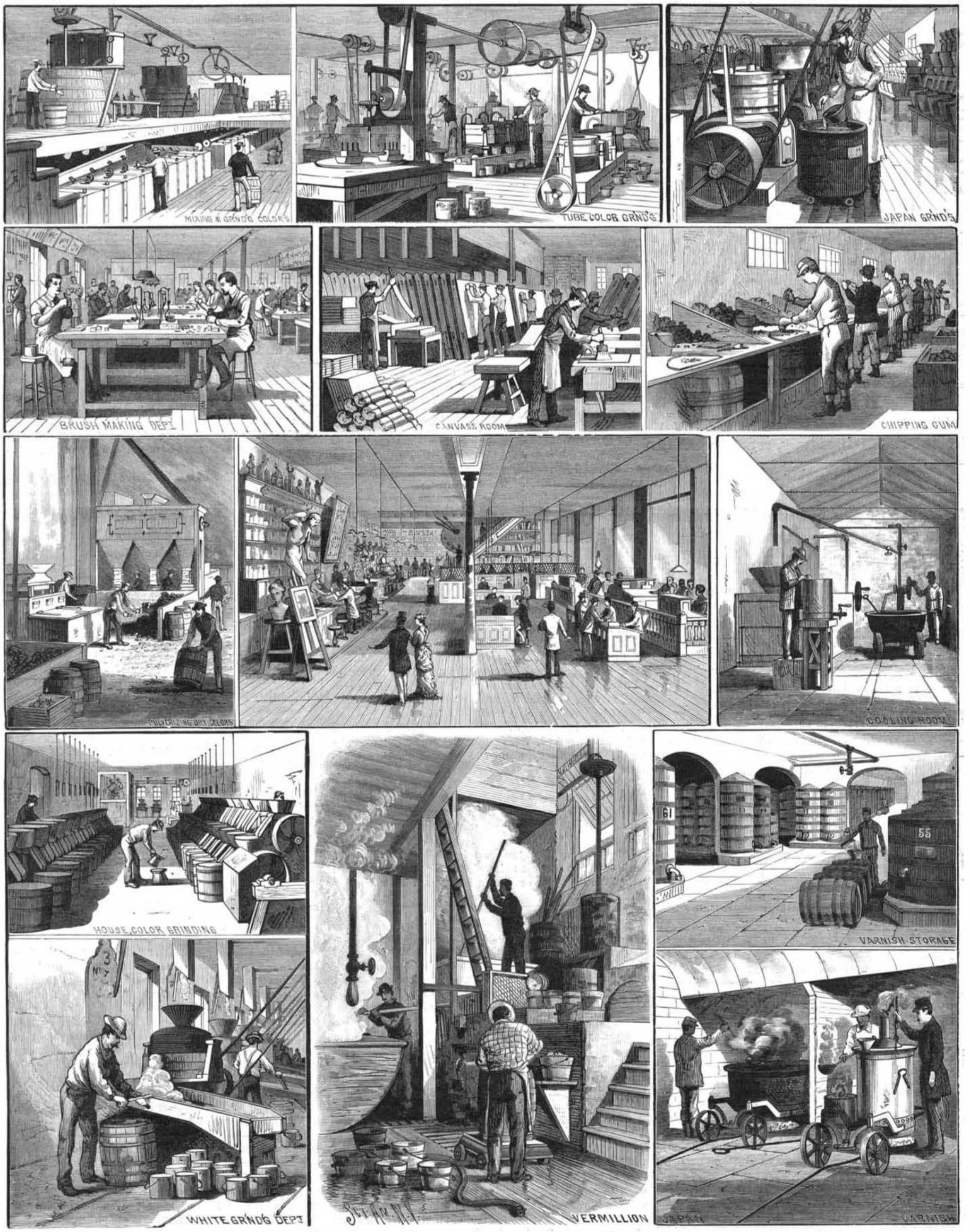

THE PAINT AND VARNISH MANUFACTURE AS CONDUCTED BY F. W. DEVOE & CO. [See page 308.]