AMERICAN INDUSTRIES.—No. 93.

THE MANUFACTURE OF LINEN PAPERS AND PAPER WARES.

CRANE BROTHERS, of Westfield, Mass., whose factory forms the subject of our first page illustrations, make a specialty of producing the finest linen and record papers known to the trade. Their trade-mark of a crane in the water-mark, in different positions for different sizes of paper, is everywhere recognized among buyers of first-class goods as a guarantee of the best material and the most thorough manufacture.

These papers have stood the test of competition at three World's Fairs—Philadelphia, Paris, and Melbourne—and everywhere have received the highest awards.

The variety of materials of which paper is made is almost numberless, and new ones are constantly being introduced, but in the establishment of Crane Brothers only the old-fashioned stock, cotton and linen rags, is used, and these are all new. They are the cuttings of shirt and collar manufacturers, sail makers, etc., which have to undergo comparatively little treatment for the most thorough bleaching, and yield a fiber which is unexcelled for strength and fineness and uniformity of texture. The bales of rags are taken up an elevator to a large sorting room, where they are first passed through a "thrasher" to remove any possible dust or extraneous matter, an operation which, however necessary with old and dirty rags, seems almost superfluous when the rags are all new. But this detail is significant of the thoroughness with which every part of the subsequent work is conducted, in order to make the highest possible quality of stock. This thrasher consists of a closed wooden box, wherein the rags are revolved in drums thickly studded internally with spikes, the box being divided into partitions by coarse wire gauze, through which the dust escapes.

Although rags are largely cut by machine in most paper factories, this work is all done here by hand, and forms the subject of one of our illustrations. The knives are scythe-like, being fixed at a little incline from the perpendicular in the tables at which the sorting and cutting are done, and before which the girls stand, cutting the rags to average about three inches in size by drawing them against the curved blades. This hand-cutting also affords the opportunity of making a most thorough assortment and classification of the stock. After cutting, the rags are passed through a duster in order to complete the removal of any possible remaining dust and dirt, and then again submitted to a final inspection by a separate set of hands.

The next process is the boiling of the rags with alkalies—lime, soda ash, or caustic soda and water being used for this purpose—by which all dirt and grease are removed, as well as coloring and glutinous matters, etc. Sometimes only the lime solution is used, and in other cases only lime and soda ash.

After the boiling, which occupies a longer or shorter time according to the condition of the stock, the rags are ready for treatment in the engine shown in the view of the ledger paper pulp room. This machine is an oblong kind of vat, with rounded ends, divided lengthwise in its center by a midfeather. There is a constant flow of fresh water, only the purest water that can be obtained being used in this as in all other processes of their paper making. On one side of the midfeather is an inclined plane on the bottom of the vat, leading up to the bottom of the dip of a revolving roll, whose circumference carries steel-faced blades; the bottom of the vat so conforms to the space in which the roll revolves that the rags, passing in with the water, are carried partly around the roll against other knives in the bottom, and dropped on the other side of the roll, to be then carried around the end and through the other side of the vat until they come again to the roll, which washes, rubs, and disintegrates the fiber. After the rags have been submitted to this process for a time, the roll is so lowered that its blades reduce the stock to finer fibers than would be effected in its first position, different kinds of stock requiring different treatment, but it being indispensable, in their papers, that the pulp should be fine and even. The bleaching agent, usually a solution of the ordinary bleaching powder of commerce, is applied when the stock is in the condition of half stuff in the washing engine, and very soon gives the contents of the vat the appearance of snowy whiteness.

The beating engine, which succeeds the washer, operates on the same principle, but runs faster and has knives which are not so blunt. The treatment of pulp in the engine differs according to the kind of paper to be made, fine writing paper requiring from fifteen to twenty-four hours' work, while the engine is run two and sometimes three days and nights when the fibers must be fine and long, as on strong bond, ledger, and bank-note papers.

The stock once prepared is drawn into an enormous stuff chest, which occupies a separate building adjoining the room in which is the large Fourdrinier machine shown in one of our views, where the operator is seen holding a sheet to the light to make sure of the proper adjustment of the water-mark. It is a special feature of the Crane Brothers' paper that care is always taken to have the water-mark come in the same place on each sheet.

The Fourdrinier machine has been so often described that it is hardly necessary to more than refer to it here, though it always occupies the most conspicuous place in the machinery of a paper manufactory. The pulp is fed into a regulating box, where any excess over what is required is taken by an overflow and reconveyed to the stuff chest. Special appliances are attached to the machine in this factory to guard against any lumps in the pulp being fed to the machine. The pulp after passing over sand tables and strainers is led to an endless cloth of very fine wire, which, besides the forward motion, is moved from side to side to interweave the fibers; thence it passes to an endless felt and between press rolls to take out the water and knit the fiber, guide bands or deckles at the side controlling the width. The water-mark is fixed by what is called the dandy roll, very near the end of the machine, where letters or figures of any desired design are fixed upon the paper in the soft web by a wire cylinder. When the dandy roll is covered with plain woven wire-cloth, what is called "wove" paper is made; and when the roll is covered or laid over with wires running parallel and at some little distance apart, the paper is called "laid;" but all of Crane Brothers' papers have as a water-mark a representation of the long-legged, long-billed bird known as the crane, which they have adopted as their trade-mark.

The calendering of linen record paper, shown in one of the figures, is effected by passing the sheets between a paper and an iron roll, the latter revolving at a much greater speed than the former. These rollers are so true and are held so closely together that the passing of sheets through them causes the rollers to make a continuous noise of vigorous hammering, as the rolls come together after the passage of each sheet. By passing the sheets through several times, a high calender or glaze is effected.

The plating of "Warranted All Linen" paper, forming the subject of one of our views, is effected by applying heavy pressure to sheets placed between polished plates of copper or zinc. The metallic plates and the sheets of paper are made into bundles, and the whole passed between two strong rollers, heavy pressure being communicated to them by means of screws or levers and weights applied to the ends of the top roller. This makes a dead, hard finish, without the polish of calendered paper.

The main mill, shown in one of the pictures, is 100 by 54 feet in size, and has six engines. The machine room forms an addition, 88 feet long. The rag room and stock house are in an entirely separate building, 80 by 34 feet. Although the mill has a most excellent water power, this sometimes fails, and an engine of 185 horse power is also used. The necessity of a large supply of pure water is always to be considered in any choice of site for a paper mill, and this is especially the case where goods of so superior a quality are to be made. A six inch pipe conducts water to the mill from a remarkably clear spring about a mile away, and the firm have recently put down an artesian well which promises to yield a never-failing supply of equally good quality. All the water going into their pulp is also passed through an admirable system of filters.

Although Crane Brothers do not themselves furnish papers for stationers in ordinary letter and note form, they have an arrangement with the Birnie Paper Co., of Springfield, Mass., whereby the latter, taking their Warranted All Linen paper in the large sheet, made for the sizes required, with special water marks, prepare the goods and make the envelopes for the stationery trade. The favorite mark on these papers is the crane, without any words or other sign, the different positions of the crane showing the different sizes.

The linen fiber mill shown is a distinct building, in which is conducted an entirely separate and very different business from the paper manufacture. Here are made articles in appearance very much like Japan lacquer work, but of great strength, as they are all of the best linen fiber. It is an industry unique in itself, embracing the production of articles to take the place of almost everything used in the way of basket work for the house, the office, or the factory. The list includes a great variety of trays, knife and fork receptacles, and substitutes for all kinds of basket work for house and office use; some of these substitutes for baskets being made of a size to equal large dry goods boxes. The latter are mainly to be used in factories or warehouses where they can be rolled around on wheels, as they are about as light as ordinary baskets of such size, but of far greater strength and endurance. Fire buckets which have lasted for years have been turned out of this department.

The putting of the fiber into shape for the manufacture of these paper wares requires a machine of very different character from that used in the paper factory. It is what is known as a cylinder machine, in which the linen pulp, after it passes the strainer, enters a vat, in the center of which revolves a large drum or cylinder, covered with fine wire cloth. As this revolves, the fibers attach themselves to the wire and the water passes through the meshes, the latter being assisted by means of a pump, the sheet being allowed to wind around a press roll until it has acquired the right thickness, according as a larger or smaller article is to be made therewith. In making the large baskets the sides are fitted around a pattern or former, when the bottom is put on and the whole subjected to a powerful pressure, which drives out most of the water and firmly unites the parts. After they are partially dried they are soaked in linseed oil, receive a coat of japan, then go into drying ovens, steam-heated; this is sometimes repeated two or three times, when they go to the painter's, the process being not dissimilar to many other kinds of japanning, although the degree of heat is not so high, and there are many technical details of importance which the firm have only learned by long experience.

A noticeable feature in the New Orleans Exhibition will be a circular structure, twenty-two feet in diameter, surmounted by the figure of a crane, in which the firm will exhibit a full line of their goods, including a pyramid of Ledger papers, a small pyramid of Warranted All Linen papers, Linen Fiber wares, their boxed goods put up by the Birnie Paper Co., etc., transported there, with the structure itself, in a special car, without breaking bulk. This paper house, shown in one of our views, is built in sections, and was made in their paper ware department, being especially designed and appropriately decorated therefor by the artist who has charge of this branch of the firm's business.

A Visitors' Register made of Crane Bros.' Imperial size Linen Ledger paper by the famous blank book makers, Wm. F. Murphy's Sons, of Philadelphia, will be open for the autographs of sight-seers at the exposition. This huge book contains nearly 2,000 pages and space for over 30,000 names.

The Wine Industry of California.

Notwithstanding the vast increase in vineyards and their products, the price of grapes does not materially decline, nor does the supply exceed the demand. It is estimated that a vineyard in its fourth year will produce two tons to the acre, and in seven years four tons. In the tenth year it is very profitable, reckoning the cost of vineyard at sixty dollars per acre, exclusive of the first cost of the land. The annual expense of cultivation, picking, and handling is about twenty-five dollars per acre. The rapid increase of this branch of industry is something marvelous. In 1848, there were only 200,000 vines in all California. In 1862, there were 9,500,000; in 1881, 64,000,000; and in 1882-83-84, vast numbers of new vines were planted and new vineyards laid out.

The annual yield of wine in California is estimated at about 15,000,000 gallons, nearly one-third of which is made in Los Angeles County. It is interesting to visit the vineyards in the picking season; throngs of Mexicans and Indians are employed in denuding the vines of their luscious burden, and the scene presented would form an excellent subject for the pencil of the artist. The vast wine cellars and great crushing vats give evidence of the extent and importance of this industry. One vat will hold upward of one thousand gallons; piled full of grapes, huge wire wheels are driven round and round in the spurting mass, the juice flying off into troughs on each side, leading into many great vats prepared to receive it. Below, men toil hard working the wheels; loads of grapes, coming up every moment, are emptied into the swirling vat, and the whole atmosphere is redolent of the aroma of richly scented grapes. The cellars where the juice of the grape is stored are quiet, dark, and fragrant; full of great, oval-shaped butts, ten feet in diameter, each containing over two thousand gallons.—*Resources of Cal.*

An International Milling and Baking Exhibition.

A remarkable Milling and Baking Exhibition is proposed to be held next year in Paris. The scheme comprehends every detail of the fitting and organization of the flour mill and bake house, while to round off the whole plan and to provide stalls covered with appetizing and glittering wares, the work of the confectioner and pastry cook has been thrown into the bargain. No pains will be spared to make the exhibition one of the sights of next year's Paris season. The galleries and halls, with their rows of machinery and models, will be largely supplemented by gardens and walks, where the visitor will be able to inspect water and wind mills in full operation, or, as the showman said of his wax-works, "as large as life and more natural." When the idler is tired watching the gyrations of an overshot water wheel, he will be able to saunter through halls full of the bustling life of a great modern factory, to inspect a gradual reduction mill of the most recent type, and to watch the busy movements of bakers hurrying amid all sorts of mysterious machines. This exhibition will be international, that is to say, open to the exhibitors of every country.

To Find the Weight of Silk, Cotton, and Wool in Mixed Fabrics.

Take four samples of the piece of goods to be tested, each weighing 30 grains. Retain one of them for purposes of comparison, and boil the three others for a quarter of an hour in water containing 3 per cent of hydrochloric acid. If the liquid, after this treatment, is strongly colored, renew it, and recommence the operation.

When finished, remove the samples, wash them, and dry them by wringing them in a linen towel. The thickening and sizing are thus removed; so, generally, is the dye of the cotton; that of the wool is less affected; that of the silk is scarcely attacked at all. Dark colored silks are most heavily weighted. If the weight of the salts of iron contained in the tissue is not more than a quarter that of the fiber, they will have been entirely dissolved by the acid solution, and the silk will assume a clear maroon tint. If the stuff was more heavily weighted, it will have been but partially discolored. In this case remove some of the fibers, dry them at 105° C., weigh, transfer to a piece of platinum foil, and calcine. If the weight of the ash exceeds 5 per cent of that of the fiber, note it, and put one of the samples aside. Put the two others for two minutes in a solution of basic chloride of zinc at 60° B.

This chloride is prepared by mixing:

Fused chloride zinc	1000 parts.
Distilled water	850 "
Oxide zinc	40 "

Heat the mixture until the oxide of zinc is dissolved.

Upon lifting the samples from the above solution, let them drain; then wash them in acidulated water, and afterward in pure water. Hasten the operation after each immersion by wringing the samples in linen cloth. The silk will be found to have been entirely dissolved.

One of the two samples, now containing no more silk, is set aside. The other is submitted for a quarter of an hour to a gentle ebullition in from 9 to 10 cubic inches of a 5 per cent solution of caustic soda. If the boiling is too rapid, or the solution too concentrated, the vegetable fiber will be attacked. The sample is washed as before, avoiding all rubbing, the fibers having lost their solidity through the treatment to which they have been subjected.

The four samples are then heated for a quarter of an hour in distilled water, wrung, and dried in the air; on the following day they are weighed. The first piece should weigh 30 grains.

The excess of the weight of the first sample over that of the second gives the thickening and sizing. The excess of the second over the third is the weight of the silk. The weight of the fourth will be the total of the vegetable fibers contained in the tissue, but the number found will always be a little too light, the solution of soda having slightly attacked the fiber. For cotton the loss sometimes equals 5 per cent.

We have only to multiply the numbers obtained by 50 to get the percentage of thickening and sizing, of silk, and of vegetable fiber contained in the fabric; the remaining per cent represents the proportion of wool.

Aquamarine.

Aquamarine, says Mr. Edwin W. Streeter, partakes of the nature of the emerald and the beryl, both of which are varieties of the same species, but the aquamarine contains oxide of iron in the place of the oxide of chromium. Its hardness being less than that of first class stones—7·5 to 8—detracts from its value in the jeweler's estimation.

Most of the aquamarine comes to us from Brazil, already cut; but the stones are found elsewhere, viz., in the granite regions in Siberia, in the Ural Mountains, and in the Altai Mountains. Formerly they were obtained from the frontiers of China.

The varieties known as beryl are discovered in Siberia, in the granite district of Nertschuisk. They occur at times as prismatic crystals of twelve inches in length. But at Dauria, in the mountains of Odon Tchelon, there exist at different elevations, in a mass of decomposed granite, crystals of beryl of a green tint, varying toward a warm yellow, rarely exceeding an inch in length. At a higher range there is a vein of micaceous clay of purer green and of greater size. At the summit the gem is of a different hue, remarkably transparent, and presenting the blue tint of some valuable sapphires. In the United States, France, Bavaria, Saxony, and Bohemia this stone is found.

Its chemical composition is more varied than that of the majority of this class of gems:

Silica	66·45
Alumina	16·75
Glucina	15·50
Oxide of iron	0·60
Loss	0·70
	100·00

This gem is a great favorite with the English, chiefly because it possesses the advantage of retaining its luster in artificial light. Jewelers distinguish the varieties of this stone in a manner peculiar to themselves, viz., the green and blue varieties they call aquamarine, while the yellow variety receives the name of beryl. But the former is again subdivided into (1) aquamarine, pure, light sky blue; (2) Siberian aquamarine, light greenish blue, bright luster, and faintly colored; (3) aquamarine chrysolite, greenish yellow, sometimes yellowish green, with bright luster.

One of the finest specimens of aquamarine is the remarkable sword hilt from the collection of the late Mr. Hope. It is beautiful in color, and perfectly pure. It is covered with facets, and is unique both as a mineral and as an example of the lapidary's art. It is said to have belonged to Prince Murat.

In the same collection is an aquamarine engraved to represent a female holding a bagpipe; a light drapery floats around the upper part of the body.

Aquamarine is made into a variety of ornaments. It is said that the Emperor Commodus possessed a Hercules engraved on aquamarine by Hyllus; and that in the treasures of Odeocalchi there was a stone engraved by Quintilius, representing Neptune drawn by sea horses. In the National Library in Paris there is a beautiful engraving of the head of Julia, the daughter of Titus, by Evodus, on aquamarine. An aquamarine $2\frac{1}{16}$ inches long and $2\frac{3}{8}$ in thickness adorned the tiara of Pope Julius II.

Pasteur's System of Brewing.

In the course of an interesting paper on "The International Health Exhibition," lately read before the Society of Arts, Mr. Ernest Hart drew special attention to Pasteur's researches on beer, and gave the following concise *resume* of this great investigator's suggestions for brewing sound beer. After having demonstrated that brewers employ, generally, a ferment containing, among others, injurious germs, M. Pasteur indicates the following means for obtaining a pure ferment. A small quantity of pure yeast is prepared according to the exact rules of the laboratory. This is introduced into a large copper pan, three-quarters filled with the wort of beer, which has been first carried to the boiling point, and then cooled before the introduction of the yeast. This vessel only communicates with the external air by a long tube of copper, many times bent in such a way as to permit the gases to escape without external germs being able to enter. When the wort has been developed, it is drawn off by a tap placed in the lower part of the apparatus, and which is previously purified with the flame of a spirit lamp. The wort of the beer is put to ferment in a large white metal vat, resting on a plank, and closed by a movable cover, this movable lid dropping into a groove which is kept full of water. As the wort arrives in a boiling state in this vessel, it destroys any germs which may exist there. When it is cooled, and the cooling may be rapidly aided by the use of external cooling water, the yeast is introduced through an opening in the lid. The aeration of the fluid is obtained by two tubes curved downward, by one of which carbonic acid escapes, and by the other the air enters, after being previously filtered through a layer of cotton wool rolled round a cylindrical cage on metal wires which cap the extremity by which the air enters. This apparatus, like the foregoing one, reproduces exactly the conditions which are found to be necessary in the laboratory to prevent the introduction of external germs. The aeration by these two tubes is sufficient, for the carbonic oxide being heavier than air, they are placed in such a way as to form a siphon; moreover, during the fermentation, the wort is certainly kept in movement by the ebullition of the gas which escapes, so that the aeration, although less active than in some of the technical apparatus previously in use by brewers, is more than sufficient. By employing this procedure, secondary fermentations are no longer to be feared, and the spoiling of beer by secondary fermentation is almost entirely put an end to.

Krupp Essen Works.

The following statistics of Krupp's establishment at Essen are of interest. In 1860 Herr Krupp's factory at Essen employed 1,764 hands; in 1870 the number of workmen had risen to 7,084, and the present number is about 20,000. Including the wives and children of the employed, we have 65,381 souls depending for their subsistence on Krupp's works, 20,000 of these inhabiting houses belonging to Herr Krupp. The whole establishment comprises altogether eight sections: 1. The factories at Essen. 2. Three coal mines at Essen and Bochum. 3. Five hundred and forty-seven iron mines in Germany. 4. Several iron mines in the north of Spain, in the environs of Bilbao. 5. The blast furnaces. 6. A range at Meppen, 17 kilometers in length, for gunnery experiments. 7. Other smaller ranges. 8. Four steamers for marine transport. The number of blast furnaces in use is 11, of other furnaces 1,542. There are 439 steam boilers, 82 steam hammers, and 450 steam engines, 185,000 horse power altogether. At Essen alone the works are fitted with 59 kilometers of rails, 28 locomotives, 883 wagons, 69 horses, 191 carts, 65 kilometers of telegraph lines, 35 stations, and 55 Morse apparatus. At present the Krupp works are engaged in manufacturing for the Italian Government a monster gun, which will weigh 130,000 kilogrammes (say 130 tons), and for the transport of which two wagons have been constructed each able to bear a weight of 75,000 kilogrammes.

Expensive Metals.

Following are the names of those metals valued at over $1,000 an avoirdupois pound, the figures given representing the value per pound:

Vanadium.—A white metal discovered in 1830, $10,000.

Rubidium.—An alkaline metal, so called for exhibiting dark red lines in the spectrum analysis, $9,070.

Zirconium.—A metal obtained from the minerals zircon and hyacinth, in the form of a black powder, $7,200.

Lithium.—An alkaline metal; the lightest metal known, $7,000.

Glucinum.—A metal in the form of a grayish black powder, $5,400.

Calcium.—The metallic base of lime, $4,500.

Strontium.—A malleable metal of a yellowish color, $4,200.

Terbium.—Obtained from the mineral gadolinite, found in Sweden, $4,080.

Yttrium.—Discovered in 1828, is of a grayish black color, and its luster perfectly metallic, $4,080.

Erbium.—A metal found associated with yttrium, $3,400.

Cerium.—A metal of high specific gravity, a grayish white color, and a lamellar texture, $3,400.

Didymium.—A metal found associated with cerium, $3,200.

Ruthenium.—Of a gray color, very hard and brittle, extracted from the ores of platinum, $2,400.

Rhodium.—Of a white color and metallic luster, and extremely hard and brittle. It requires the strongest heat that can be produced by a wind furnace for its fusion, $2,300.

Niobium.—Previously named columbium, first discovered in an ore found at New London, Conn., $2,300.

Barium.—The metallic base of baryta, $1,800.

Palladium.—A metal discovered in 1802, and found in very small grains, of a steel gray color, and fibrous structure, $1,400.

Osmium.—A brittle, gray colored metal, found with platinum, $1,300.

Iridium.—Found native as an alloy with osmium in lead gray scales, and is the heaviest of known substances, $1,090.

Fulminate of Mercury.

At Bridgeport, Conn., December 19, a terrific explosion occurred at the works of the Union Metallic Cartridge Company, by which a workman, Peter Burns, aged 40, was instantly killed. The company has three buildings which are used for no other purpose than the manufacture of fulminate of mercury. Each of these buildings has a department sunk below the surface of the ground, and to prevent the demolition of the adjacent buildings in case of an explosion a high embankment of earth surrounds each structure, leaving only the roof visible.

There is no substance so explosive as the fulminate, the slightest jar being sufficient at some stages of its manufacture to cause an explosion; and as a very small quantity will produce great havoc, it is made and conveyed from one building to another in fractions of a pound. Alcohol, mercury, and nitric acid are the ingredients.

The general process is to dissolve the mercury in nitric acid by heat. Alcohol is then poured in, and crystals form. Water is added, and when the fulminate has settled, the acid water is poured off, the residue filtered and washed with water, and dried. This is the compound used in percussion caps and cartridges. It is deposited in the cartridge, and secured in place and rendered waterproof by means of shellac varnish.

There can be only a theory as to how the compound was exploded. It is believed to be due to the carelessness of Burns in dropping a dish. A moment before the explosion William Mackintosh had left the apartment, and when about fifteen feet away, the whole building he had just left was in atoms and in mid air. The embankment prevented disaster from spreading sideways, and the force of the explosion was consequently upward. The shock was severe, glass in adjoining buildings being shattered, and operatives thrown into confusion.

The company, of which Mr. M. Hartley, of New York, is president, is now engaged in filling large foreign orders for cartridges, and every department is filled with busy operatives, hundreds of whom are girls.

Deflection of the Mississippi.

Capt. Eads, who has lately made an inspection of the situation, now declares that within two years the Mississippi is likely to be deflected from its present course past New Orleans down the Atchafalaya directly to the Gulf. Only a tough clay bar across Old River intervenes, and that is being rapidly swept out by the current. The *Times-Democrat* calls earnestly upon Congress to do something immediately to avert the disaster to that metropolis, planting interests of southern Louisiana, as well as the commerce of the great river. The paper asserts that an expenditure of only $1/$15,000 is necessary to obviate the more imminent danger.

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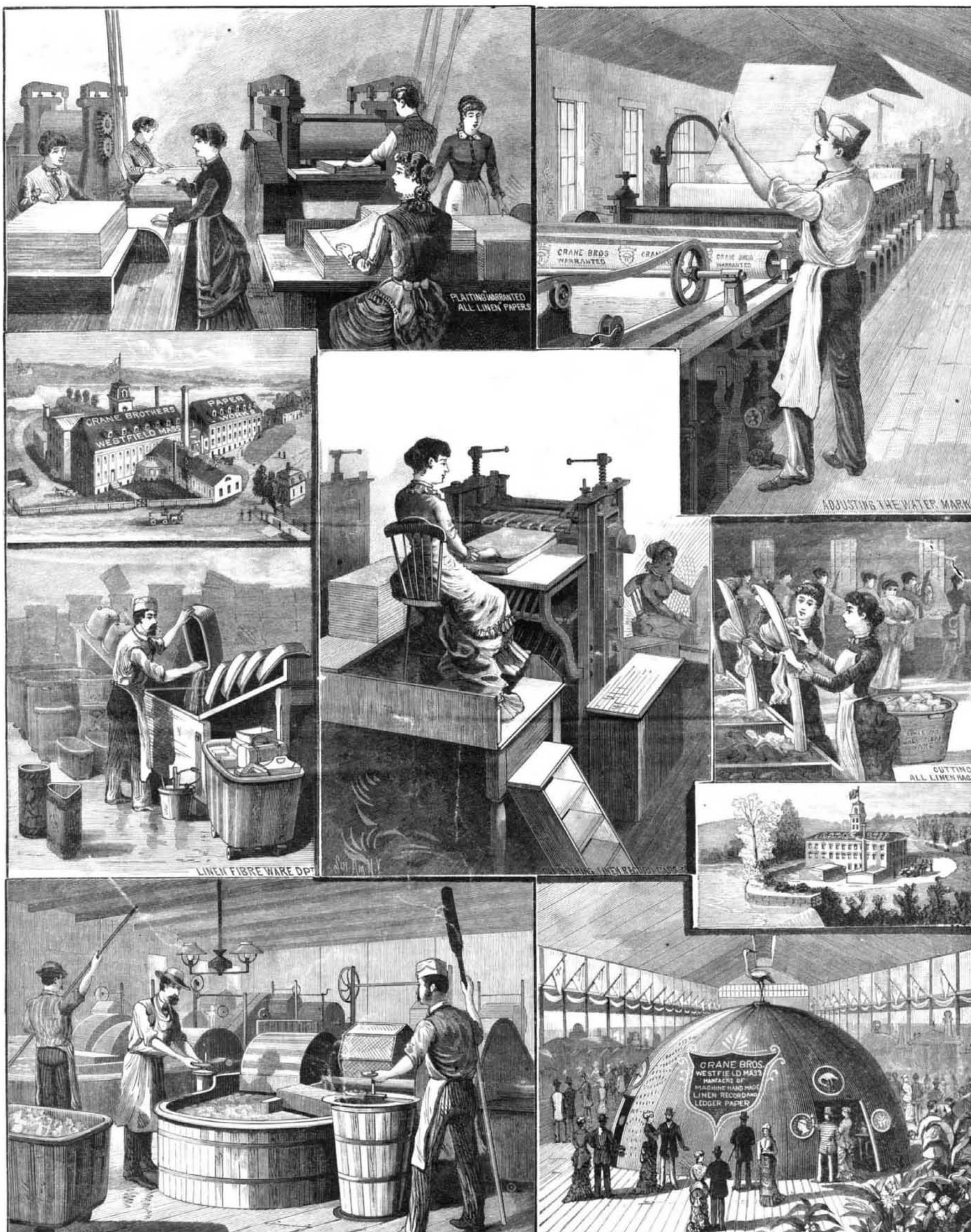

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