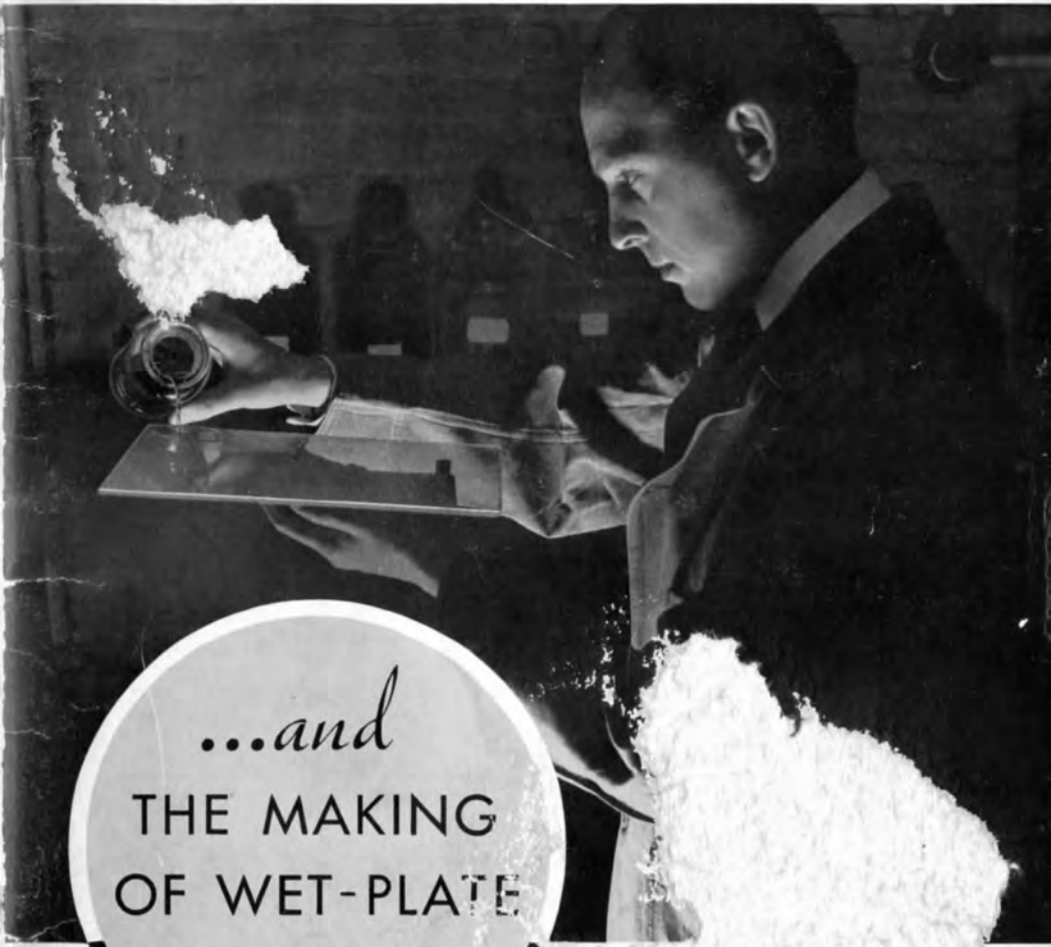
COLLODION



...and

THE MAKING OF WET-PLATE NEGATIVES

EASTMAN KODAK COMPANY, ROCHESTER, N. Y.

The Hugh Ashley Rayner Collection.
www.indiaphotographs.co.uk

Introduction.

Collodion & The making of Wet-plate negatives.
Originally published by Kodak in the USA, in 1934, this is a really useful 34 page illustrated booklet; which give a good practical introduction to making wet-plate collodion negatives, and will be invaluable, both for anyone contemplating experimenting with this fascinating, and once again, increasingly popular, early process; also for any historian wanting a deeper understanding of the primary photographic process of the 19th century. This edition is possibly one of the last practical Collodion manuals ever produced, as by the 1930s' the process was no longer in general use, except for reprographic work in the publishing and mapmaking industries. I have re-scanned an original copy in my own collection, which has a slightly damaged front cover, but apart from the omission of a couple of blank pages, it comprises the complete text, illustrations and advertisements. (2mb. file size)

Hugh Rayner,
Photographic Historian, Collector, & Dealer
in Early Photography from India & South Asia.
Bath, England. October 2015.

COLLODION

AND THE MAKING OF WET-PLATE NEGATIVES

A HANDBOOK ON THE PRODUCTION OF WET-PLATE NEGATIVES ... AND A LIST OF EASTMAN MATERIALS FOR THE WET-PLATE PROCESS

Eastman Kodak Company • Rochester, N. Y.

1934

THE WET PLATE PROCESS

To prepare a sensitized wet plate, three things are required: *clean "subbed" glass*, *iodized collodion*, and a *silver bath*.

CLEANING THE GLASS

Negative glass, whether old or new, should be soaked in a lye bath prepared as follows:

	Avoirdupois	*Metric*
Crude Caustic Soda	2 pounds	960 grams
Water	1 U. S. gallon	4 liters

New glass should remain in the lye for half an hour. Glass carrying old negatives should be allowed to soak until the old film is loosened. The film is then scrubbed off. The glass should not be left in the lye longer than necessary; otherwise it will become etched. The lye bath can be dispensed with, but not the acid bath (see below).

The glass is next placed in this solution:

	Avoirdupois	*Metric*
Nitric Acid C.P. (pure concentrated)	64 ounces (fluid)	2 liters
Water	64 ounces	2 liters

Let the glass soak in the acid for a day, or for several days if possible. It should then be scrubbed in running water, with a soft

SCRUBBING THE GLASS

"SUBBING" THE PLATE

scrubbing brush or pad of carpet, and well rinsed. If the glass is not properly cleaned, fog and streaks will inevitably result.

"SUBBING" THE GLASS

WHILE still wet, the glass is flowed with the following albumen solution:

	Avoirdupois	*Metric*
Dried Egg Albumen, Fresh	70 grains	4.8 grams
Ammonia, Concentrated (28%)	10 minims (1/6 dram)	0.7 cc.
Distilled Water	32 ounces	1 liter

The solution should be filtered before being used. The wet plate is flowed once with it and drained, then flowed and drained again, and put to dry in a dust-free cabinet.

If dried albumen is not at hand, the white of a fresh egg may be used in place of the 70 grains of albumen in the above solution. Some albumen substitutes or dried albumens are not suitable for substratum, causing fog spots or streaks. The albumen solution must be fresh when used. It should not be kept longer than 24 hours unless it can be stored in a refrigerator. Stale albumen can cause serious photographic trouble. If it has decomposed at all, it will

IODIZING THE COLLODION

cause fog. It has even been claimed that a too heavy coating of albumen will cause fog, but a too thin coating has been known to give trouble through imperfect protection. The albumen coating must be perfectly even, free from specks and flowing streaks.

THE COLLODION SOLUTION

EASTMAN Complete Collodion is supplied in two containers, one holding the plain collodion and the other the iodizer.

Add the contents of the two-ounce bottle of iodizer to half a gallon of plain collodion. The collodion is then complete and ready for use. *Do not add anything else.*

Eastman Collodion is always made up in very large quantities, under the most rigid tests at every stage, and is dependably uniform. In the course of its manufacture it is filtered under pressure through the most efficient clarifying equipment, and there is no need to refilter it. If it is found necessary to filter it again at any time after iodizing, use a small filter loosely fitted with Eastman Filter Cotton. This speeds up the operation and minimizes evaporation.

Mix at one time only enough for a two- or three-weeks' supply. After mixing the iodizer with it, let the collodion stand, to ripen, in diffused light or darkness—not in direct sunlight or near an arc lamp.

The freshly iodized collodion may be used at once, but ripening improves it. How long it should be ripened depends upon conditions. In warm weather it gives best results two to six days after ripening,

and in cool weather after one to two weeks.

Ripening can be imitated by adding an alcoholic solution of iodine to the collodion until it is a light orange-brown color. It is not certain, however, that this gives as good results as natural ripening.

A compromise method is to ripen the collodion for four hours, and then to add 15 minims (1 cc.) of a ½% (0.5%) solution of iodine in alcohol to each eight fluid ounces or 240 cc.

The collodion solution will not work well if it is too warm. The best temperature is between 65° and 70° Fahrenheit (18° to 21°C.). If you are compelled to work in very warm weather, it is advisable to place the solution on ice.

THINNING COLLODION

EASTMAN Complete Collodion will never be found too thin, but if a *thinner* collodion is required, add a mixture of equal parts of pure grain alcohol and ether to the plain collodion. Then add two ounces of iodizer to every half gallon of the thinned plain collodion. If a thinner and also *softer-working* collodion is required, use Eastman Special Iodizer, which contains more solvents as well as iodizer of a different formula. Take one part of this to two parts of Eastman Plain Collodion. This gives a 50 per cent thinner collodion.

Ether may be used to thin out regularly iodized collodion that has become too thick from evaporation. Small amounts of methyl (wood) alcohol or acetone prevent the ripening of the collodion. Since common denatured alcohols contain one or both of these, denatured alcohol should not be mixed with negative collodion, and all traces of these liquids should be dried out of any bottles or vessels used for collodion.

LINE AND HALFTONE COLLODION

EASTMAN Collodion is equally good for line and halftone work. A halftone-screen negative is exactly the same as a line negative, inasmuch as the black halftone dots must be as dense as possible and the clear spaces quite transparent. If the collodion is good for line work, it is also good for screen negative making, and vice versa. However, if you have both old and new collodion, use the old for line work and the new for halftone, because the new collodion is faster.

If you are using a freshly iodized collodion for line work, be careful not to overexpose. To get the best results with fine line work, use the collodion after it has been iodized for some time.

COATING THE PLATE WITH COLLODION

COATING THE PLATE

BEFORE coating a plate, it should first be carefully dusted with a camel's hair brush kept especially for the purpose. If the brush is not clean it may leave more dust on the plate than it takes off. Brush gently, to avoid the formation of "static." Never leave this brush lying on the bench, but keep it hanging up.

Hold the plate horizontally, either on a holder or with one corner resting on the first two fingers of the left hand and held down by the thumb.

The collodion bottle is taken in the right hand and the collodion is poured in a pool on the upper part of the plate, the right top corner being covered during the pouring. Then the plate is gently tilted so that the left top corner is next covered, then the left bottom corner, and finally the excess of collodion is drained off at the right bottom corner.

During these operations, the bulk of the collodion should be kept well in the middle of the plate, which is only tilted sufficiently for the collodion to flow to the edge, but not over it and off the plate. Be sure at all times that the edge of the collodion is kept flowing *forward*, and that no flow-back occurs; otherwise the collodion will thicken and cause a mark on the negative.

The draining of the excess collodion should be done very gradually into a bottle, the plate being tilted only slightly at first and then gradually brought up to a vertical position. While this tilting is going on, the plate must also be rocked laterally by free movement of the arm, so that the collodion flows down toward the edges of the plate, and then to the corner, rather than *immediately* toward the corner. Ribbed markings are nearly always caused by hasty and improper draining of the collodion. As the draining nears completion and the position of the plate becomes more nearly vertical, the bottle should be moved with the plate, not scraped against it.

Care should be taken in the first place to pour out a quantity of collodion that is just sufficient for the size of the plate being used. Any excess over the correct amount will make it necessary to tilt the plate too quickly in draining and will produce streaks, besides wasting the collodion that drips over the sides of the plate.

DRAINING THE COLLODION

Care in the methods of coating applies just as much to rubber solution and stripping collodion (see page 22) as to coating the collodion for the negative. Streaks visible in the negative after stripping are usually caused by careless coating. Sometimes this also leads to the splitting of the image, especially in halftone negatives.

When the film of collodion has set to a jelly-like consistency—but before it has fully dried—the plate is at once immersed in the silver sensitizing bath. The proper time to do this can be ascertained by touching one of the thickened edges with a finger, which should leave an impression on the film but should not stick to it. In hot weather it is especially important to immerse the plate very promptly, because if this is delayed the end first flowed will dry and fail to sensitize.

THE SILVER BATH

A FRESH silver bath consists of silver nitrate and water. Distilled water should be used, unless experience shows the local water supply to be satisfactory.

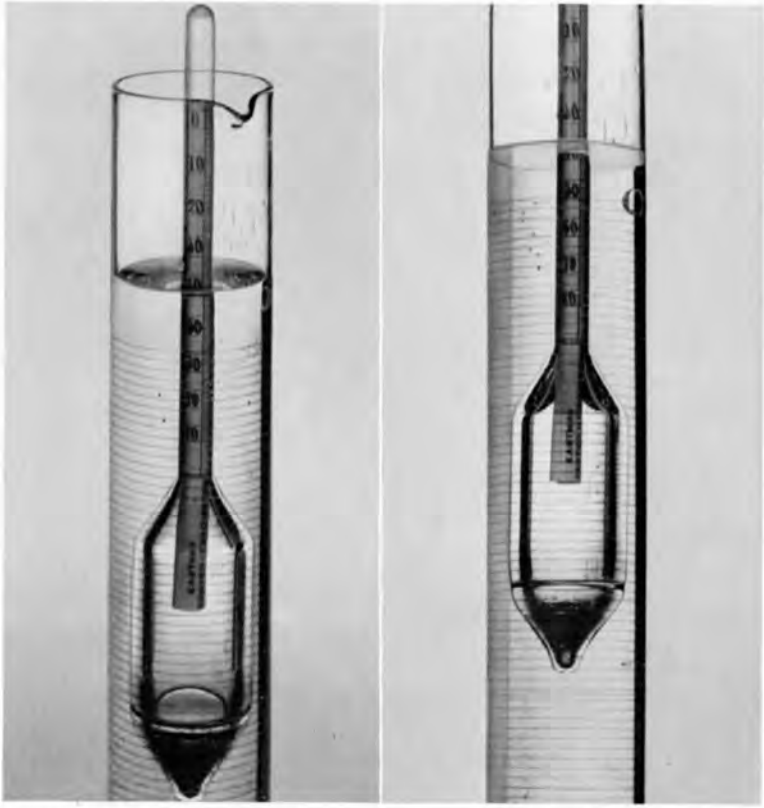
In a clean white glass bottle, dissolve:

	Avoirdupois	*Metric*
Water (at 65°F.), (18°C.)	1 U. S. gallon	4 liters
Silver Nitrate (E. K. Co.)	10½ ounces	315 grams

If tap water is used, set the bottle in sunlight until the precipitate is settled and the bath is perfectly clear.

The strength of the bath may be checked with an Eastman Hydrometer. Pour some solution into the glass cylinder supplied with the hydrometer. *Bring the temperature to 60°F. (15°C.)*, with the aid of a glass thermometer. Now float the hydrometer in it, reading the scale where it is cut by the lower surface of the liquid. (See cut.)

The scale should read "35 grains of silver per fluid ounce," meaning that every fluid ounce of solution contains 35 grains of silver nitrate. In percentage, this is approximately 7.3% silver nitrate by weight. If the hydrometer reading checks the weights used in making up the solution, you can be sure that the hydrometer is accurate. Future baths can then be made simply from a concentrated silver solution, being brought to correct strength with the hydrometer. This removes the need of weighing and measuring. All hydrometers should be checked occasionally, however, as they have been known to change through accident.



WRONG (*reading from above*) RIGHT (*reading from below*)

THE WRONG AND THE RIGHT WAY TO READ A HYDROMETER

There is no definite evidence that a bath of any other strength than that given on page 10 offers any advantages. Nevertheless, a 40-grain bath is commonly employed, to allow for the using-up, or exhaustion, of the silver nitrate. It is made up as follows:

	Avoirdupois	*Metric*
Water (at 65°F.), (18°C.)	1 U. S. gallon	4 liters
Silver Nitrate (E. K. Co.)	12 ounces	360 grams

A 40-grain bath contains approximately 8.25% by weight of silver nitrate.

As to the reaction of the bath, up to a certain point the more nearly neutral it is, the better the negative obtained, *provided* the temperature of both room and solution is below 70°F. (21°C.). This, of

course, does not generally occur, and it therefore becomes necessary to slightly acidify the bath, to reduce fog.

It has been customary to test the reaction of the bath with litmus papers. If it turns red litmus blue, it is alkaline; if it turns blue litmus red, it is acid; while if both litmus papers are unchanged, it is neutral to litmus. It is common in the trade to add nitric acid, one drop at a time, until the bath turns blue litmus paper pink in 5 to 15 seconds. This old-fashioned test is, however, too unreliable to meet modern conditions. Litmus is one of the most variable of indicators. When it is used, there is no certainty that the bath is at the right acidity, or even that it is acid at all. A bath might give fog through being too alkaline, and still test distinctly acid to certain samples of litmus.

There is no longer any reason for relying upon litmus paper, since indicator sets are available at relatively low cost, by which the actual *pH* values of the bath can be measured closely enough for wet-plate purposes.* One need not be a chemist to use these measurements. "*pH*" is a number giving the reaction of the bath. It is not enough to know that a bath is acid; it is important to know *how* acid it is. In the *pH* scale, lower numbers are more acid, higher numbers are more alkaline, or less acid. The *pH* of a fresh silver nitrate solution is about 5.4. This has been known as a neutral bath. At this *pH*, collodions will be variable and generally show fog—sometimes very high fog. As acid is added, the *pH* becomes lower, and 4.7 to 4.4 appears to be an excellent range for the silver bath. At $pH = 4.8$, the indicator Bromcresol Green is a blue-green color, and at $pH = 4.4$ it is greenish yellow. The easiest way for the photographer to measure *pH* is to compare the indicator color produced by the silver bath with the color of indicator papers or solutions whose *pH* is known.** Since the *pH* of a silver bath may change even when standing idle, especially under the action of light, it should be checked every few days.

Before making negatives with a new bath, leave a collodionized

*Sheppard and Rich, of the Kodak Research Laboratories, have pointed out that colorimetric *pH* tests on silver baths are subject to some error due to the "salt effect," but the error is not great. By applying a special technique they have been able to check the *pH* determinations by electrolytic methods.

***pH* testers are available from the LaMotte Chemical Products Company, McCormick Building, Baltimore, Maryland (who also publish a manual, "The A B C of *pH* Control"), and Pfaltz and Bauer, Incorporated, 300 Pearl Street, New York City.

plate in it over night—as large a plate as the bath will hold. Some of the silver halides will be dissolved and establish a balance. If this is not done, a fresh bath will spoil the first few negatives, by dissolving silver iodide out of the emulsion.

The section on *Maintaining the Silver Bath*, pages 14 to 17, is important, and deserves careful study.

THE DIPPING VESSEL

THE collodionized plates are bathed in the silver bath in a vessel kept for that purpose only. It should be made of hard rubber, glazed stoneware, glass, or porcelain. Substitutes for these materials give photographic trouble.

The vessel takes the form of a deep, narrow tank, known as a "dipping bath," in which the plate is dipped vertically, or a developing tray in which the plate is laid flat. In either case the bath is provided with a loose cover of the same material as the vessel.

These two types of baths are discussed further under the heading, *Maintaining the Silver Bath* (see pages 14 to 17).

SENSITIZING THE PLATE

As soon as the collodion has set, as described on page 10, the plate is immersed in the silver bath. A silver or hard-rubber holder is used to lower the plate into the dipping bath, or a silver hook to lower it into the tray bath. From now until it is fixed, the plate must be handled in orange light.

DIPPING THE COLLODIONIZED PLATE INTO THE SILVER BATH

The plate must be immersed in the bath solution in one even movement, so that the solution covers the plate without a stop; otherwise a "bath-mark" line will show in the negative. If a dipping bath is used, the plate is moved gently as soon as it is placed in the solution. If a tray is used, the tray is rocked. This movement is repeated occasionally during sensitizing, which should be completed in about 3 minutes. If the bath is alcoholic, leave the plate in for about one minute after all greasiness has disappeared.

Before withdrawing the plate from the solution, be sure that your hands are clean, so that no dirt will adhere to the plate or get into the bath. Then take out the plate, allowing as much solution to drain back into the bath as possible. Set the plate on a clean piece of Eastman Blotting Paper, and wipe the back with blotting paper or a lintless rag.

Provide the dark slide of the plate holder with a strip of blotting paper on which the plate may be set, to absorb the silver drainings. The latter are corrosive and soon ruin any woodwork with which they come into contact. Plate holders should be wiped carefully with a damp rag at the end of the day's work, and all parts which silver drainings are liable to touch should be coated with shellac once a week.

When a collodionized plate is put into the silver bath, the silver nitrate combines with the iodides in the collodion and forms silver iodide. This gives a creamy film, and it is sometimes thought that the whiter the appearance of the plate in the bath, the better the negatives will be. This is not so.

There is one certain proportion of iodides which, if it is present in the collodion, will give the densest image. This amount is contained in the Eastman Iodizer. More iodides will not yield a better negative, and therefore the extra iodides, although they make the plate look whiter in the bath, have no good effect whatever.

The sensitized plate should be placed in the camera immediately, and exposure started; otherwise some of its sensitivity will be lost.

MAINTAINING THE SILVER BATH

The silver bath is the most important solution used in the wet plate process, and great care should be exercised in its preparation and use. Cleanliness is essential. Keep all dust and contaminating substances away from the bath. Have the darkroom clean, thoroughly

ventilated, and free from dust, so that the bath may be left uncovered without any danger. This has the advantage of allowing the collodion solvents in a used bath to evaporate to some extent. Use Eastman Silver Nitrate, because it is made especially for photographic work.

An ideal silver bath would consist only of water, silver nitrate, and a small quantity of silver iodide, but from the moment it is put into use impurities in the form of by-products begin to form. Silver must not be wasted, on account of the cost, and the bath must therefore be kept in continuous use as long as possible. Maintaining the bath in good working condition is an essential part of wet-plate work.

When the plate is dipped into the bath, the soluble halides (chiefly iodides) carried in the collodion react with the silver nitrate to form insoluble silver halide. This appears as a milky suspension in the collodion film, and gives it its sensitivity. For each molecule of silver iodide formed, there is formed an equivalent quantity of the nitrates of the ions that were originally combined with the iodine; e.g., cadmium, lithium, ammonium, etc. These new nitrates are very soluble, and accumulate in the bath as by-products.

Every grain of silver nitrate which decomposes to form silver iodide is replaced by more than half as much cadmium and other nitrates. Silver and cadmium nitrate solutions of equal strength have nearly the same specific gravities. The natural evaporation of the solution might just make up for the difference in weights of the salts, so that the bath, if measured with the hydrometer, would apparently stay at the same strength, while the actual silver content would be getting less and less. Therefore the consumption of silver nitrate cannot be checked by the hydrometer test. An old bath might test 40 grains per fluid ounce, yet contain only 30 grains of silver nitrate. Sometimes the bath tests heavier the longer it is used, due to evaporation of water, which is more rapid in the presence of alcohol and ether. With some chemical training, it is easy to find out how much silver the bath contains at any time, by titration methods described in any elementary textbook of inorganic quantitative analysis. If a silver bath falls to 30 grains per fluid ounce in actual silver-nitrate content, the negatives will lose speed, density and sharpness of dots. In order to keep the strength up, some shops make up the bath every evening to its original volume by adding a

FILTERING THE SILVER BATH

little 10% silver-nitrate solution, and occasionally titrate a sample of the bath to definitely determine its silver content.

Most of the alcohol and ether remaining in the collodion when plates are dipped into the bath diffuses out into the bath solution. In a dipping bath that is being worked continuously, both alcohol and ether accumulate. In a tray bath the solvents evaporate out faster than they are brought in, and such a bath never contains more than a trace of ether, and very little alcohol.

The bath also dissolves a small quantity of silver iodide but, after the first few plates, it is of course saturated with this salt. After the bath has been in use for some time, the dissolved silver iodide begins to precipitate on the negatives as a fine granular deposit, which produces pinholes. The bath is then said to be "*over-iodized.*" This is unavoidable, presumably because the silver nitrate, which keeps the silver iodide in solution, is gradually being used up, and the other nitrates that take its place have a weaker solvent action on the iodide. The solution then becomes super-saturated in respect to silver iodide, which crystallizes out on the surface of the iodized plates. The substance that crystallizes out may, instead of the simple iodide, be a double salt.

If a tray bath is used, it is possible to so maintain the solution that the only trouble to be corrected is over-iodization. When the bath becomes over-iodized, pour it into a clean, clear glass bottle containing about one-third water. This will precipitate the excess of iodides. Then test it with the hydrometer, adding silver nitrate until

the hydrometer reads 35 (or 40, if that is the strength to be used). Neutralize the acidity by putting in sufficient sodium carbonate. Then set the bath in the light until all the precipitate has settled, filter, re-acidify with pure nitric acid, and it is ready for use.

A dipping bath, besides becoming over-iodized, becomes overloaded with alcohol from the collodion plates sensitized in it. An alcoholic condition can be detected by slow sensitization, the emulsion appearing uneven or streaked. It presents a generally "greasy" appearance, especially when the plate is being flowed with developer. The bath solution will smell strongly of alcohol. When this occurs pour the solution into a porcelain evaporating dish and boil it down. When nothing else is wrong with the bath, only about one-third need be boiled away, but if the bath is giving fog because of the presence of other organic impurities, it should be boiled down until it has formed a pasty mass and has become liquid again. It is then allowed to cool. The resulting fused silver nitrate is dissolved in distilled water, and this is poured into the quantity required to bring the bath to its original volume. It is then tested with the hydrometer, brought up to strength with silver nitrate, and set in the sun for a few days. After being filtered and acidified, the bath is again ready for use.

By setting a silver bath in the sun, all organic matter which it contains will be oxidized, and a dark precipitate will settle out. It is therefore advisable to make enough solution for two baths, so that one may be out in the light while the other is in use. The baths must be filtered at least once a day through absorbent cotton.

THE EXPOSURE

EXPOSE correctly and get good negatives. It is impossible to make good negatives by underexposing, forcing development, and overintensifying. Overexposure can apparently be corrected by reduction, but actually the photographic quality of the negative suffers. The best negatives are obtained only by correct exposure, and there is practically no latitude in process work. In warm, dry weather a wet plate will begin to dry in from six to eight minutes. The exposure must be completed before this drying begins. Glycerine has been used in the silver bath to permit very long exposures, but is not generally used in commercial work.

THE DEVELOPER

FERROUS sulphate, sometimes called copperas, consists of light green

crystals of the formula $FeSO_4.7H_2O$. The dry crystals as used contain 55% ferrous sulphate and 45% water. The developer must be mixed freshly every day because it does not keep. For this purpose it is convenient to have a concentrated stock solution of ferrous sulphate sufficient to last several weeks. This should be kept in a large bottle or carboy, and should be drawn off as required by means of a siphon tube passing through a rubber stopper. The stopper should have a $\frac{1}{16}''$ air hole. Use a white glass bottle, and keep it in as light a place as possible. Light reduces ferric salts to ferrous salts, and tends to delay the formation of the ferric compounds which spoil the developer.

STOCK FERROUS SULPHATE SOLUTION

	Avoirdupois	*Metric*
Ferrous Sulphate, Technical	2 pounds	960 grams
Water to make	1 U. S. gallon	4 liters

This will contain 21% by weight of ferrous sulphate crystals, and is not a saturated solution. It may be filtered as used. Its specific gravity is 1.142 at 60°F., which can be checked on the Eastman Hydrometer. The graduations on the scale end at 1.142.

The composition of the developer is one of the things which a skilled operator varies to meet different conditions, and individuals have their own preferences as to the best formula. The common limits for both ferrous sulphate crystals and glacial acetic acid lie between 4% and 7% by weight.

The following formula contains 5.7% ferrous sulphate crystals and 6.3% glacial acetic acid by weight:

	Avoirdupois		*Metric*
Ferrous Sulphate, 21% stock solution	8 fluid ounces	1 quart	1000 cc.
Glacial Acetic Acid (E. K. Co.)	2 fluid ounces	8 fluid ounces	250 cc.
Water, at 65°F.,(18°c.) to make	1 U. S. quart	1 U. S. gallon	4 liters

Measure the glacial acetic acid by itself in a graduate. Then dilute it with about four times as much water, mix it with the iron solution, make up to the required volume with water, and filter.

This can also be made up from the dry salt, by taking:

	Avoirdupois		*Metric*
Ferrous Sulphate Crystals	2 ounces	8 ounces	240 grams
Glacial Acetic Acid (E. K. Co.)	2 fluid ounces	8 fluid ounces	250 cc.
Water, at 65°F.,(18°c.) to make	1 U. S. quart	1 U. S. gallon	4 liters

The finished developer has a specific gravity of 1.046 at 60°F., or 24 grains per fluid ounce on the silver hydrometer at 60°F.

In hot weather the acid may be increased to 9% to combat fog, but 50% to 100% longer exposures may be required. In the long run, there seems to be little advantage in departures from the formula.

DEVELOPING

HOLD the plate over the sink in one hand, just as it is held for coating with collodion. Keep it level. Take the graduate of developer and place the lip against the edge of the plate next to the hand that is holding it. Tip the graduate up, and as the developer flows out over the plate, slide the graduate along the edge over the whole width of the plate. This is done in a smooth, rapid movement. When done properly no bubbles are formed, and the whole plate is covered in a fraction of a second. As much as possible of the developer is kept on the plate, and no great excess is allowed to run off. This avoids washing off the silver nitrate remaining on the surface, and needed to build up the density of the image. The plate is tilted this way and that, to keep the developer constantly in motion during development.

Development takes from 15 to 30 seconds, and exposure must be adjusted so that correct development falls within those limits. Twenty seconds' development seems to give the best negatives for photographic quality, stripping properties, etc.

There is no advantage in looking at negatives with a magnifying glass during development, because if the exposure is incorrect you cannot make it right in development.

After the plate has been developed, the developer must be thoroughly washed out of the collodion; otherwise it will cause a stain on the negative. Wash at least 20 seconds under a good stream of water, and longer if any tendency to stain appears.

FIXING

THE following solution of potassium cyanide or sodium cyanide is flowed over the plate to fix the image:

	Avoirdupois	*Metric*
*Potassium or Sodium Cyanide	2 ounces	60 grams
Water	1 U. S. quart	1 liter

**Both potassium cyanide and sodium cyanide are deadly poisons, and bottles containing solutions of either should be conspicuously labelled "poison." Use rubber gloves, and do not expose yourself to the fumes. Cyanide reacts with acid to form poisonous hydrogen cyanide gas. When discarding a solution containing cyanide, always flush it out of the sink quickly with water.*

If a tray is used, the plate should be immersed in the solution for an interval twice as long as it takes for the white silver iodide to disappear. If a plate is left too long in the cyanide, the fine detail will tend to be dissolved away.

After fixing the image, wash the plate thoroughly.

INTENSIFYING

THE commonest intensifier is copper bromide and silver. First, make these two solutions:

		Avoirdupois	*Metric*
No. 1	Copper Sulphate	12 ounces	360 grams
	Water to make	64 ounces	2 liters
No. 2	Potassium Bromide	6 ounces	180 grams
	Water to make	64 ounces	2 liters

When dissolved, mix the two solutions and the bath is ready. The plate is placed in the solution until it is bleached white through to the back. It is then washed in running water for about one minute. While under the tap, the plate should be moved to and fro, so that the stream of water will not continually strike the same spot.

The washing must not be too prolonged or the plate will not blacken. On the other hand, if it is not washed long enough, silver bromide will be precipitated by the silver-nitrate solution.

The plate is now drained well, and then blackened by pouring over it the following solution:

	Avoirdupois		*Metric*
Silver Nitrate (E. K. Co.)	1 ounce	2¾ ounces	80 grams
Water to make	12 ounces	32 ounces	1 liter

A weaker silver solution may result in sudden and uneven reduction of the negative at a later stage in the process.

Freshly made silver solution for intensification will often give streaks. However, the addition of a few drops of nitric acid will insure its working smoothly.

Singly intensified negatives work best in the stripping operations, but the density can be further increased if desired, by simply repeating the above steps.

For lead and mercury intensifiers, see page 25.

REDUCING

REDUCTION clears the negative by removing all silver grains between the dots or in the lines, leaving all dense parts with a hard edge. It also reduces the size of the dots on a halftone negative, cutting the

shadow dots faster than the highlights and middle tones. It widens the lines on a line negative.

The usual method of reduction is to bleach the plate, after intensification, in the following solution:

	Avoirdupois	*Metric*
Potassium Iodide	2 ounces	60 grams
Iodine resublimed	1 ounce	30 grams
Water to make	64 ounces	2 liters

After bleaching, it is flowed with a weak solution of cyanide:

*Potassium or Sodium Cyanide	1 ounce	30 grams
Water to make	64 ounces	2 liters

*See warning on poisonous nature of cyanide, page 19.

The cutting action is stopped with running water, the plate examined with a magnifying glass, and the treatment repeated, in careful steps, until it has gone just far enough. When reducing fine-screen halftones, and in the later stages of any reduction, the above cyanide solution should be diluted with a great excess of water, say 20 to 1, in order to maintain control over the process.

After the reduction is complete the plate is rinsed, and then blackened by flowing it with the following:

	Avoirdupois	*Metric*
Sodium Sulphide (E. K. Co.)	4 ounces	120 grams
Water to make	64 ounces	2 liters

If there is any sign of yellow stain, it is removed by flowing with weak nitric acid solution (about 2%). It should be washed for three minutes to remove all trace of soluble sulphide.

Never use the sulphide in the same room in which the silver sensitizing bath is located.

VARNISHING

THE wet plate negative is now complete. If it is not to be reversed, it should be coated, when dry, with Eastman Engravers' Hard Varnish, to protect the delicate surface.

In varnishing a negative, be sure to have both varnish and negative fairly warm, and of even temperature. (about 100° F.) (38°c.).

STRIPPING

To reverse a wet plate negative, or to transfer a number of negatives to a large piece of glass in order to make one print instead of a number of prints, take the following steps:

After thorough drying, and when cool, the negative is flowed with

CUTTING FILM TO SIZE FOR STRIPPING

rubber solution. Eastman Rubber Solution is prepared ready for use and is just right for this purpose. It is intentionally made thin.

When the rubber is dry, the plate is coated with Eastman Stripping Collodion, which is collodion containing a small quantity of castor oil. Eastman Stripping Collodion is very efficient, forming a very tough and very flexible coating or film.

Read again the instructions on pages 8, 9, and 10 for coating collodion. They apply just as much to the coating of rubber solution and stripping collodion.

Blisters are sometimes caused in stripping by pouring the stripping collodion on when the plate is too warm, by heating the plate too much before the collodion has set, or by air bells in the collodion. Try to avoid these faults. Be sure, also, that the negative is completely dry before you apply stripping collodion.

When the film of stripping collodion is dry, it is cut around with a knife, and the plate is put into the following solution:

	Avoirdupois	*Metric*
Water	32 ounces	1 liter
Glacial Acetic Acid (E. K. Co.)	2 fluid ounces	64 cc.

When the film begins to lift, remove the plate from the bath, lift

up the film by one corner with a pocket knife, and transfer it to the position required, turning it over if reversal is desired.

STRIPPING WITH PAPER

To be quite sure that the film is not damaged or stretched in stripping, it may be handled on paper. Thoroughly wet a piece of thin paper so that all stretch is taken out, and bring it into perfect contact with the negative by means of a rubber roller or other squeegee. Lift one corner of the paper and with it a corner of the film, which may be started with the point of a pocket knife. Draw the paper and film off together. For reversing, the film is now transferred to another piece of paper, the second paper and the film being trimmed with scissors and then laid on glass, preferably moistened with a little gum water. If the negative is not to be reversed, the transfer to the second piece of paper is of course omitted.

When the film has been placed in position on the glass, it can be squeegeed down evenly by stroking with a few pieces of 3″ x 3″ Eastman Blotting Paper, or with a piece of velvet rubber. If the latter is used, keep it in water when not in use, so that it will remain soft and pliable.

Negatives that curl at the edges after stripping, due to being

STRIPPING THE FILM FROM THE PLATE WITHOUT THE USE OF PAPER

STRIPPING THE FILM FROM THE PLATE WITH THE AID OF PAPER

underexposed, and forced in development and intensification, can be made to stick down with a few drops of gum arabic solution.

PROTECTING AND STORING NEGATIVES

NEGATIVES from which many prints are to be made should be protected. A good plan is to cover them with .003-inch Kodaloid, a thin, transparent sheet that can be fastened to the corners of the negative with Eastman Film Cement. The Kodaloid can be replaced easily and inexpensively in case it is damaged.

ASSEMBLING FILM ON GLASS FOR PRINTING

Negatives which are to be preserved for future use should be stripped on to .0075-inch Kodaloid. This is light, unbreakable, and requires little space for storage. Negatives transferred to it are instantly available at any time, and can be reprinted just as easily as though they were on the original glass.

LEAD INTENSIFIER

To get the highest possible intensification, the following intensifier may be used:

	Avoirdupois	*Metric*
Lead Nitrate	3 ounces	90 grams
Potassium Ferricyanide	3 ounces	90 grams
Glacial Acetic Acid (E. K. Co.)	3 fluid ounces	96 cc.
Water to make	64 ounces	2 liters

The plate is placed in this bath and allowed to remain until the color is evenly yellow through to the back. It is then washed thoroughly and flowed with a weak nitric acid solution (1 part concentrated nitric acid to 30 parts water), rinsed again, and blackened with the following solution:

	Avoirdupois	*Metric*
Sodium Sulphide (E. K. Co.)	4 ounces	120 grams
Water to make	64 ounces	2 liters

Ammonium sulphide may be used instead of sodium sulphide if there is no objection to the unpleasant odor. The plate is rinsed once more and flowed again with weak acid. Thereafter it is flowed with gum arabic or weak glue solution, to protect the film. Never use a sulphide in the same room in which the silver sensitizing bath is located.

Any reduction necessary in a negative that is to be intensified by the lead ferricyanide method just described must be done prior to intensification. It cannot be done afterward. This method is used for line work in which there is no very fine detail.

MERCURY INTENSIFIER

Sometimes, for fine line work, the following mercury intensifier is used:

	Avoirdupois	*Metric*
Mercuric Chloride	5 ounces	150 grams
Ammonium Chloride	3 ounces	90 grams
Water to make	64 ounces	2 liters

The bleaching of a wet-plate negative in this solution is slow, but

it may be hastened by warming the solution. After thorough washing, the blackening is done with the following:

	Avoirdupois	*Metric*
Concentrated Ammonia (28%)	3 ounces	90 cc.
Water to make	32 ounces	1 liter

In this case also, any reduction necessary should be done before intensifying.

VARIATION IN RESULTS

No wet-plate manual or textbook has been considered complete without a long list of "defects and their causes." Wet-plate "defects" are so numerous that no complete list has ever been made of them. The more common ones have been given names, such as "oyster shells," "sunbursts," "bullets," "comets," "dry effect," "groundglass effect," "scum," etc.

It is not generally admitted, although it is common experience, that *variation from normal goes with the process.* "Trouble," so-called, is a part of wet-plate work.

In nearly all cases troubles are external and not inherent in the collodion. They are due to the lack of uniformity of hand operations, to contamination, and to improper manipulation.

To appreciate the problem, each operator must be pictured as a one-man factory, manufacturing photographic plates one at a time, by hand. Every time a plate is dipped, he produces a micro-batch of silver halide emulsion. Even in a photographic factory, where emulsions are made in large batches, in purified air maintained at an even temperature, and with laboratory-controlled materials—that is, under the most favorable conditions—the highest scientific skill is required to get sufficient uniformity.

The wet-plate man generally works under conditions unfavorable to the manufacture of photographic emulsions. Few people have any conception of the cleanliness necessary. In most shops such cleanliness is impossible without new construction. It is common to see trade darkrooms so dirty or otherwise unsuitable that it is a wonder how a single usable negative could ever be made in them. Consequently the making of commercial wet-plate negatives often depends upon the dexterity, resourcefulness, and experience of the operator, under any conditions prevailing in the trade.

"THE BEST" CONDITIONS

THE following are typical questions: "What, exactly, is the correct acidity of the bath?" "What exact silver nitrate strength gives the best negatives?" "Is the formula in this booklet the best developer?" "Exactly how long should a collodion be ripened?" "What is the correct development time?"

The answer to all these questions is that so far as known at present, the ideal conditions can not be stated and adhered to unless the darkroom and gallery are maintained at exactly the same temperature and humidity the year round. It is believed that the best room temperature is close to 65°F. (18°C.), and the best humidity about 60%. *Under these conditions only*, the best negatives are obtained with Eastman Collodion, when the following supplementary conditions are maintained. The Collodion is ripened for about five days, in the dark. The plate is flowed in 45 seconds. It is dipped in a 35-grain silver bath, in a tray, for three minutes. The acidity of the silver bath has an actual pH of 4.7; that is, nearly neutral. The developer is made up fresh, and its strength is 5.7% ferrous sulphate crystals and 6% to 7% glacial acetic acid by weight. All plates are developed for twenty seconds. A screen distance of 90 times the screen opening is used, with a detail stop of 1/90 the camera extension. Exposure is exactly right. The inside of the darkroom is washed out every day. The room is continuously supplied with pure, filtered air.

If these conditions were attained, with a trained man operating, it is believed most of the uncertainty would be removed.

VARIABLE I: TEMPERATURE

THE wet-plate process is highly sensitive to temperature. It is probable that, in practice, the greatest variations from normal quality are caused by the ordinary variations in temperature. When the room temperature is above 70°F. (21°C.), an increase of 2° has a definite effect. Therefore, if it is remembered that weekly variations of 20°F. (about 10°C.) are common, it will not seem surprising that the quality of the negatives sometimes gets out of control. If operators would accustom themselves to working in a room temperature of not over 68°F. (20° c.) during the winter—actually a healthy condition—the trouble caused by varying temperature could be avoided for several months of the year, except in warm climates. Wet plates

that are being worked at a room temperature of 75°F. (24°C.), a common mean in trade darkrooms, are a constant source of trouble. They are subject to sudden and untimely attacks of fog and other imperfections, which may be very baffling and may cause serious commercial loss.

Generally the trouble will vanish as suddenly as it appeared. On the other hand, measures can be adopted that will minimize it at the outset. In warm rooms, the collodion and developer can be kept at 65°F. (18°C.) by means of a refrigerator, and the silver bath can be reduced to the temperature of the water supply (which, for instance, is about 75°F. (24°C.) in New York in summer), by the use of a water jacket. The temperature of the water used for washing does not matter, but in the whole process the real remedy for high temperatures is, in general, a lower temperature.

VARIABLE II: HUMIDITY

The effect of humidity is not known exactly. The humidity in work rooms varies from 30% to full saturation. It affects the rate at which the plate dries in the camera. The best humidity is at present believed to lie between 55% and 60%. Humidity may have an important effect on fog and speed.

VARIABLE III: VENTILATION

In the wet-plate process, the silver bath is especially sensitive to ventilation. It readily absorbs gases or vapors that cause fog. Consequently, if such gases are allowed to remain in the air of the darkroom, a fogged bath will invariably result. It is a common experience for an operator to leave a perfectly working bath at night, only to come in the next morning and find a fogged bath. If the darkroom is closed up tight at night, the bath will usually fog in the morning. This fogging is independent of temperature. It is believed to be due to absorption of hydrogen cyanide, hydrogen sulfide, ammonia, and other gases. If, as is frequently the case, the darkroom is left open, but is ventilated only with stale air from the interior of the shop, which is closed at night, the bath may still fog because of the absorption of gaseous impurities.

It is a problem, in closely built-up industrial sections of a city, to obtain proper ventilation of wet-plate darkrooms. The silver bath is more sensitive to gases than the workmen, and sometimes fogs

from this cause even when the air seems to be good. Common sources of trouble are gas stoves, garages, chemical plants, drying paint, and possibly stale air from human respiration.

It is not definitely known which gases are most harmful. The proper air to use for photographic manufacture is air from which all smoke, gases, and dust have been removed, and which is supplied at a uniform temperature and humidity.

VARIABLE IV: CLEANLINESS

THE wet-plate operator who wants to make good negatives must acquire the cleanliness of an analytical chemist or a surgeon. It must not be possible to find dust anywhere in his darkroom. There must be no dried chemical deposits in the plate-holder. It should be someone's job to wipe everything with a damp cloth every morning —including walls, moldings, lamp reflectors, tops of cabinets, and all stock bottles, benches, and shelves. The attitude should not be "Is the dust on that shelf causing any trouble?"—but rather, "That shelf must be cleaned to prevent any *possibility* of trouble." There must be no corners of the darkroom that cannot be reached with a wash cloth. Clothing should be kept free from dust. All rustable or corrodable pipes and fittings should be kept painted or varnished, and in a washable condition.* No chemicals should be kept in the wet-plate room except solutions actually used in the process.

As stated before, the negative glass must be chemically clean, coated with fresh albumen as it comes from the final rinse water, and kept in dust-tight cabinets, which are not used for storing chemicals. The operator's hands should be well rinsed after finishing a negative and before flowing a new one. Glassware, such as graduates, must be kept clean, and should be replaced when cracked or damaged. See page 4, "Cleaning Glass." This can be applied to bottles, glass trays, and other glassware. The floor should be oiled with mineral oil. No bottles should be allowed to stand with solutions in them when not in use, unless they are sealed with corks that actually fit them. Scales and weights should be kept clean and checked occasionally.

The walls and ceiling should be painted with a semi-gloss, washable material, such as Kodak Panchromatic Green Paint. The ceiling should be low enough to permit its being kept clean with a mop.

*A good protection for pipes and fittings is provided by Kodacoat Paint.

The air coming into the darkroom should be clean, as described under *Ventilation.*

Collodion that dries on the pouring bottle should be peeled off. Finally, care must be taken that dust, especially chemical dust, such as hypo, is not carried into the darkroom on the clothing.

VARIABLE V: MANIPULATION

MAN is not a machine, and therefore cannot do any voluntary act exactly the same way twice in succession. When the same manual acts making up a skilled craft are repeated day after day, and when the operator works by himself without close supervision, the series of acts sometimes tends to vary progressively from the normal, a little more every day, until finally the results are not acceptable and the operator is in "trouble." For instance, men with years of experience have been known to forget completely the rocking of the plate in the dipping bath to keep it agitated. Apart from such slips, it is impossible for any man to carry out the wet-plate operations in identically the same manner every time, so that variations in photographic quality could not be avoided even if all other conditions were ideal.

In such a skilled art, it takes time, of course, to train men who can make a plate free from streaks, because those may be encountered in almost any step that is not perfectly performed. Thus, there are dirty-glass streaks, substratum streaks, coating streaks, bath marks, alcohol streaks, developer streaks, intensifier streaks, rubber streaks, and stripping-collodion streaks. The remedies for all of these are practice and care. The operator or apprentice who takes a laboratory course in analytical chemistry as a training in manipulation and cleanliness will find his time well spent.

Manipulation includes the proper care of camera and screens. Always be sure that the lens is clean and *clear.* If a Cooke lens gets scratched, or develops a hazy film inside, it may be sent to Eastman Kodak Stores Company, 133 North Wabash Avenue, Chicago, Illinois, for reconditioning. Lenses of other makes should be returned to their respective manufacturers. Keep the screens clean, dusting them frequently when in use, and watch for condensation of moisture on them in the morning if the room is cold at night. Be sure at all times that your darkroom lights are safe, that there are no light leaks or internal reflections in the camera, and that no stray light strikes the lens.

The camera can be tested for light leaks by placing an Eastman Process Plate—half-covered with black paper held on by a rubber band—in the plate holder, and leaving it in the camera for five minutes. The copy-board lights should be on, with a sheet of white paper on the board, and the plate-holder slide should be open. Everything about the camera should be the same as during an exposure, except that the lens cap is left on. The process plate is then developed in Eastman D-11 developer for five minutes at 65°F. (18°C.), or in D-9 for two minutes. If any difference can be seen between the covered and uncovered halves of the plate, there are leaks which must be located. Cracks can be located by looking into the back of the camera and covering the space between the camera and the head with a focusing cloth, thus excluding all light. When the eyes have become accustomed to the darkness, any cracks present will become apparent.

CONCLUSION

In making wet-plate negatives, it is well to remember that prevention is better than cure. The foregoing list of specifications may seem formidable, but there would seldom, if ever, be any defects if the methods described in this booklet were followed. Use Eastman Complete Collodion, Eastman Silver Nitrate, and other Eastman supplies. They have the benefit of large-scale, rigidly controlled production and are, without exception, tested thoroughly in the Kodak Research Laboratories and in our own engraving plant before being offered to the trade.

Consider yourself free to write us whenever any question arises in connection with the processes described in this booklet. Our Graphic Arts Department is the clearing-house for a great deal of information valuable to all makers of wet plates, and our staff of experts will be glad to lend their aid in the solution of any problem that may confront you. Address your correspondence to:

EASTMAN KODAK COMPANY
Graphic Arts Department
Rochester, N. Y.

EASTMAN MATERIALS FOR THE WET-PLATE PROCESS

EASTMAN COMPLETE COLLODION

PLAIN collodion with the proper quantity of iodizer in a separate bottle. Requires only the addition of the iodizer to be ready for use.

From the selection of the cotton for this product, through the mixture, settling, filtering, and bottling, one purpose is held constantly in view: to provide a material of the finest photographic characteristics. Eastman Complete Collodion is fast. It holds its iodides uniformly, flows evenly, and forms a tough film. Because of the care exercised in its manufacture, and the large quantities in which it is made, it will always be found reliably uniform. It is equally good for line or halftone work.

1-quart bottle	$1.20	1-gallon bottle	$ 4.00
½-gallon bottle	2.20	5-gallon can	18.00

EASTMAN PLAIN COLLODION

NITRATED Eastman cotton dissolved in pure alcohol and ether, under conditions that assure cleanliness and uniformity. (Without iodizer.)

1-quart bottle	$1.00	1-gallon bottle	$ 3.50
½-gallon bottle	1.80	5-gallon can	16.00

EASTMAN STRIPPING COLLODION

A FLEXIBLE collodion of exceptional toughness, which gives body to negatives that are to be removed from their original support, for reversing, or for assembling and printing with other negatives. This stripping collodion is manufactured under the same carefully controlled conditions that obtain in the case of other Eastman collodions—in a plant where even the air is kept clean to prevent contamination.

1-quart bottle or can	$1.00	1-gallon bottle or can	$ 3.50
½-gallon bottle or can	1.80	5-gallon bottle or can	16.00

EASTMAN IODIZER

USED with Eastman Plain Collodion, this iodizer gives a collodion that yields brilliant line and halftone negatives. Eastman Iodizer may be purchased to advantage as a part of Eastman Complete Collodion. (See preceding page for description and prices.) This iodizer is made to a carefully balanced scientific standard, and packed in amber bottles to prevent premature ripening.

1-ounce bottle (sufficient for 1 quart of collodion) ..... $ .30
2-ounce bottle (sufficient for ½ gallon of collodion) ..... .50
2-ounce bottles, per dozen 5.50

EASTMAN SPECIAL IODIZER

FOR making thin, soft-working collodion, or for thinning collodion that has become too thick. One part of Eastman Special Iodizer added to two parts of Eastman Plain Collodion will be found to give an ideal soft-working collodion.

1-pint bottle ..... $1.25 ½-gallon bottle $4.00
1-quart bottle $2.25

EASTMAN COTTON FOR MAKING COLLODION

A HIGH-GRADE, clean, uniform cotton for making collodion. Packed in bottles and moistened with solvent. This material is taken without discrimination from the cotton used in Eastman collodions and Eastman films. Because of the exacting requirements of these products, it is selected and tested with the utmost care. As a result it is a completely dependable material for workers who prefer to make their own collodion.

1-ounce bottle ..... $ .30 8-ounce bottle $1.50
4-ounce bottle $1.00

EASTMAN ENGRAVERS' HARD VARNISH

A CLEAN, quick-drying varnish that forms a tough film for the protection of wet-plate and dry-plate negatives.

1-quart bottle ..... $1.90 1-gallon can $7.00

EASTMAN SILVER NITRATE

THIS silver nitrate is produced in great quantities from carefully selected silver bullion. It is processed under the most exacting conditions, because a large percentage of it is used in Eastman high-

speed photographic emulsions that demand ingredients of highest purity, dependability, and uniformity.

The maker of wet plates benefits by this requirement when he uses Eastman Silver Nitrate. He eliminates costly difficulties at their source with a material of unquestioned quality.

Packed in bottles of 1-, 4-, 8-, 16-, 100-, and 200-ounce capacity. A full weight of silver is assured by careful drying. The price is always strictly in accord with the market price of silver bullion. An advantage in price is offered to purchasers of 100, 500 and 1,000 ounces, or larger quantities. Current quotations will be forwarded immediately on request.

EASTMAN RUBBER SOLUTION

PURE crepe rubber, dissolved in water-free benzol. Ready to use. A sure protection for wet-plate negatives that are to be stripped.

1-quart bottle or can	$ .80
½-gallon bottle or can	1.20
1-gallon bottle or can	2.25
5-gallon bottle or can	10.00

EASTMAN TESTED HYDROMETER

Where formulas are checked with a hydrometer, only a *tested* instrument is of real value. The Eastman Tested Hydrometer is graduated with extreme accuracy. The scale, which is graduated in grains per fluid ounce, can be read even in poor light.

This hydrometer enables the careful operator to check not only his silver bath, but other light solutions, such as wet-plate developer.

Hydrometer with jar	$1.50
Hydrometer only	1.00

EASTMAN FILTER COTTON

First-quality cotton, prepared especially for laboratory use.

4 ounces	$ .40
1 pound	1.30

BLOTTING PAPER

Highly absorbent, chemically pure stock. "Regular" weighs 100 pounds to the ream; "Extra Heavy," 120 pounds.

	Regular	*Extra Heavy*
1 dozen sheets (19 x 24 inches)	$ .80	$ .90
¼ ream (125 sheets)	8.00	9.00
½ ream (250 sheets)	15.00	17.00
1 ream (500 sheets)	27.00	33.00
75-pound roll, 24 inches wide	21.00	21.00
10-foot roll, 24 inches wide	.40	.60

SEND FOR THIS BOOK

NOT ONLY the complete list of Eastman materials for the Graphic Arts but many specific Graphic Arts processes are described in this booklet. It is both a valuable manual of information and a splendid example of modern letter-press printing. If you have not received a copy, send for one now. There is no charge, and no obligation.

EASTMAN KODAK COMPANY

GRAPHIC ARTS DEPARTMENT • ROCHESTER, NEW YORK

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EASTMAN TESTED CHEMICALS

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