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No.	Dimensions of Plate.	Equivalent Focus.	Price.
1	5 x 4	4·9 in.	£5 15 0
2	6 x 5	6·9 ,,	7 0 0
3	8 x 5	7·6 ,,	8 0 0
4	8½ x 6½	8·4 ,,	9 0 0
5	9 x 7	9·1 ,,	11 0 0
6	10 x 8	9·8 ,,	13 0 0
7	12 x 10	11·2 ,,	15 0 0

W.-A. RECTILINEAR (Patent). *f*/16.

No.	Dimensions of Plate.	Equivalent Focus.	Price.
1aa	7½ x 4½	4 in.	£4 5 0
1a	8½ x 6½	5½ ,,	5 5 0
1b	10 x 8	6½ ,,	6 5 0
1	12 x 10	7 ,,	7 5 0
2	15 x 12	8½ ,,	10 0 0
3	18 x 16	13 ,,	13 5 0
4	22 x 20	15½ ,,	19 0 0
5	25 x 21	19 ,,	28 10 0

W.-A. LANDSCAPE LENS (Patent). *f*/15.

No.	Size of Plate.	Equivalent Focus.	Price.
1A	5 x 4	5¼ in.	£3 0 0
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2	8½ x 6½	8½ ,,	4 5 0
3	10 x 8	10 ,,	5 5 0
4	12 x 10	12 ,,	6 15 0
5	15 x 12	15 ,,	8 0 0
5A	15 x 12	18 ,,	9 0 0
6	18 x 16	18 ,,	10 0 0
7	22 x 20	22 ,,	13 5 0
8	25 x 21	25 ,,	18 0 0

RAPID LANDSCAPE LENS. *f*/12.

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2	8½ x 6½ ,,	12 ,,	5 10 0
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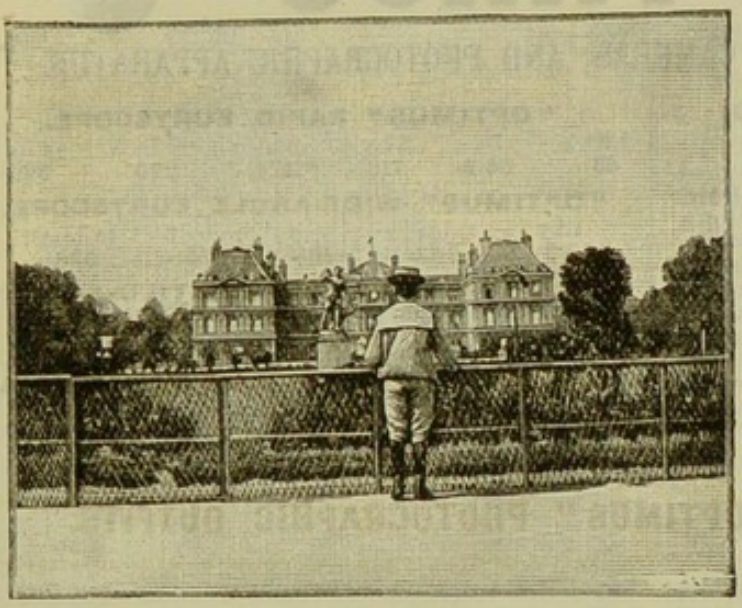
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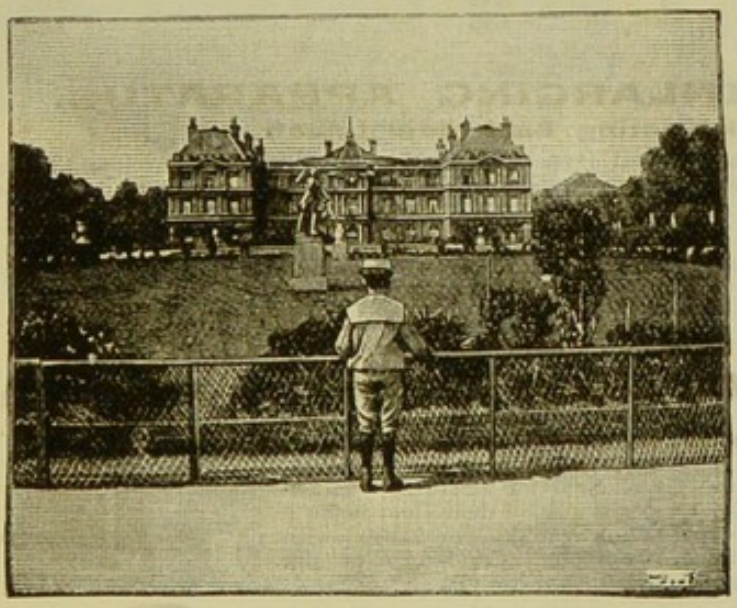
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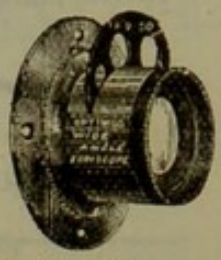
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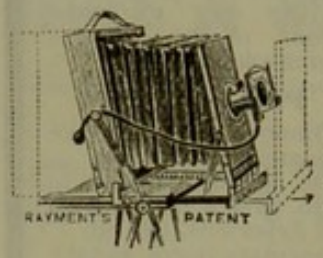
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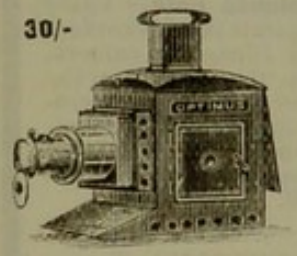
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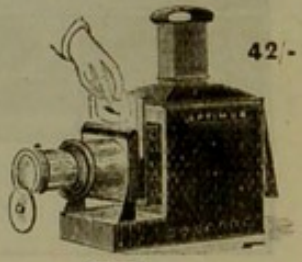
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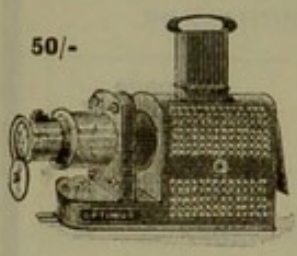
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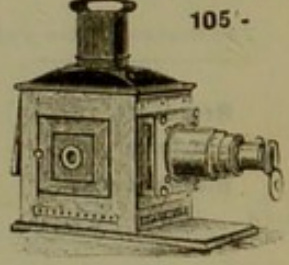
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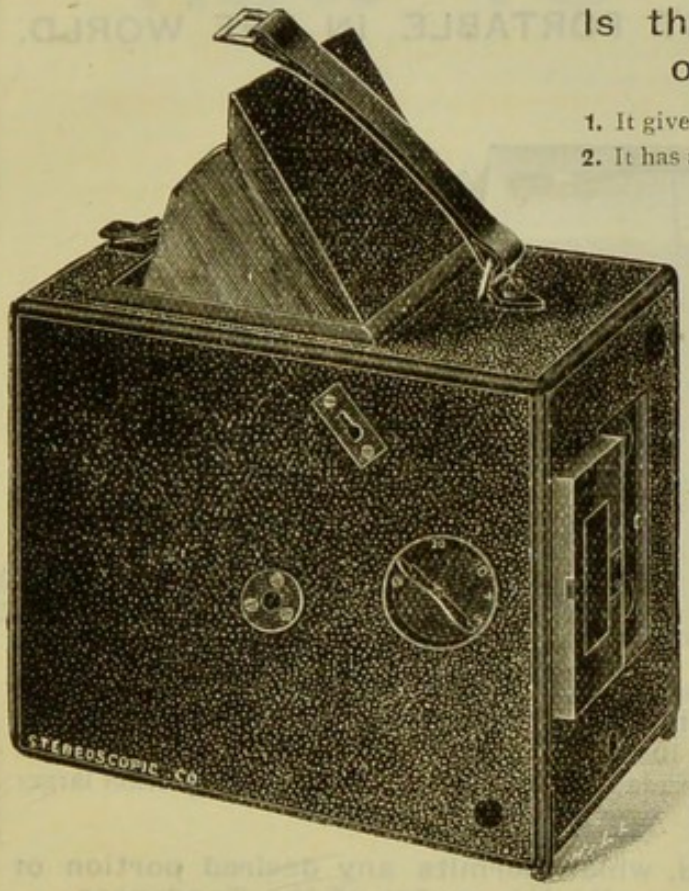
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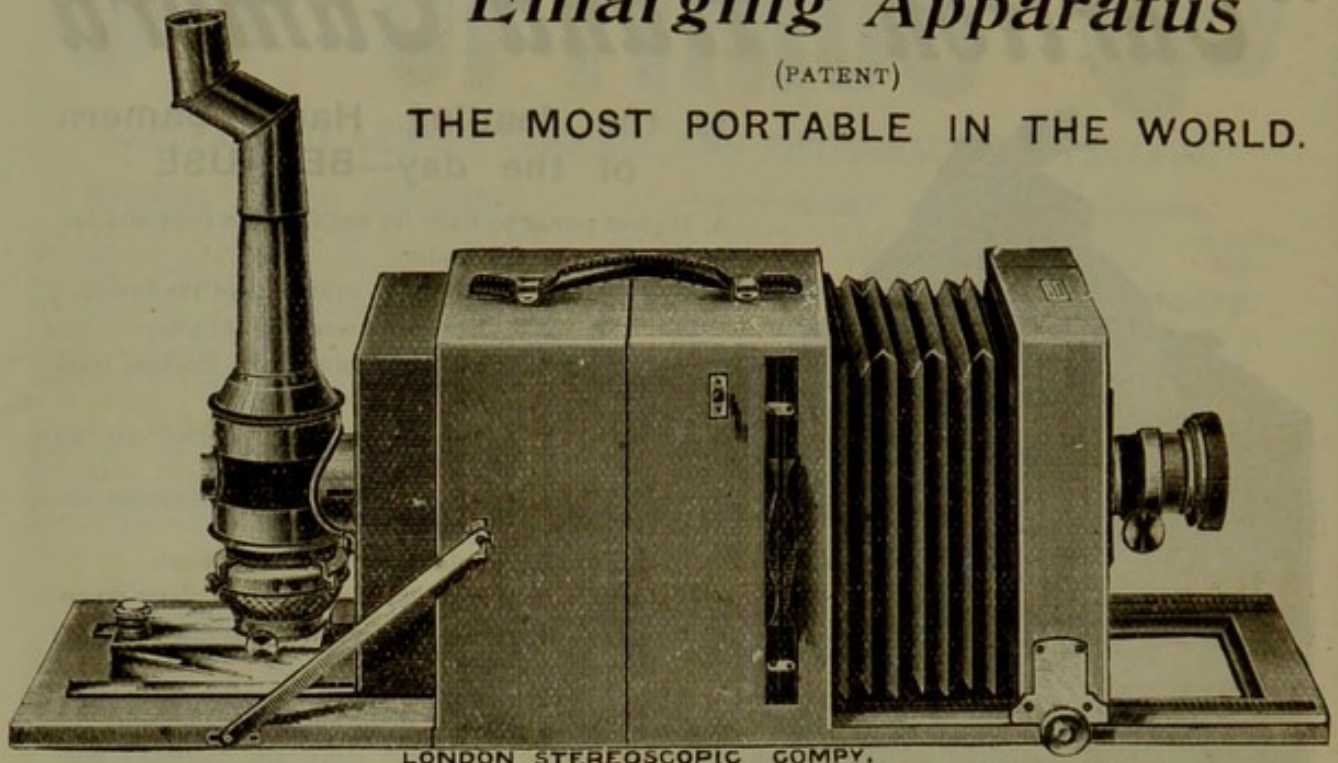
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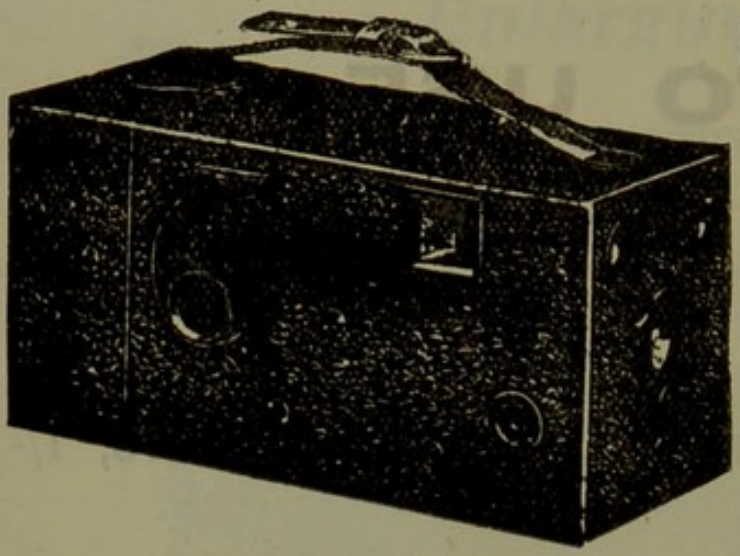
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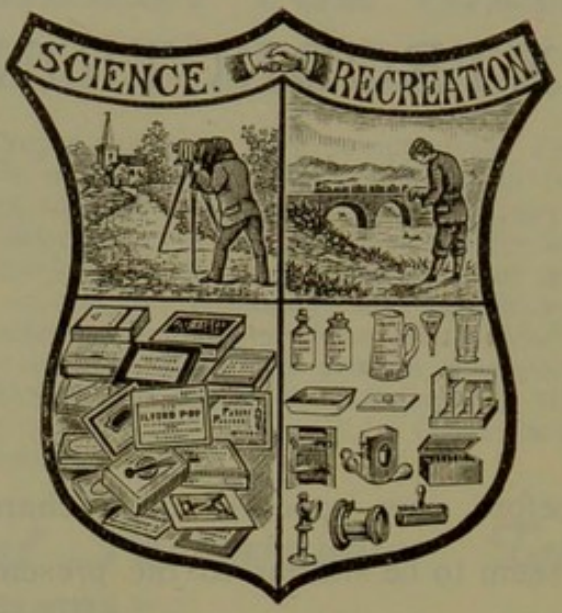
BOOKS have before now appeared of a character which at first sight might seem to be similar to the present volume, but when looked into they will be found to be entirely different. "The Photographic Reference Book" is neither an encyclopædia nor a dictionary, but is essentially a worker's handbook, the keynote of the volume being how to *do* everything in connection with photography. The volume is largely the outcome of a preconceived idea which originated with the earliest numbers of *Photography*, and the columns in that journal headed "The Question Box" have been to a large extent a means to an end, that end being the present book, in the compilation of which, however, we have by no means confined ourselves to that source of information, but have drawn from every available authoritative supply, and we trust that the result of our endeavours will be appreciated by the class for whom the book is intended.

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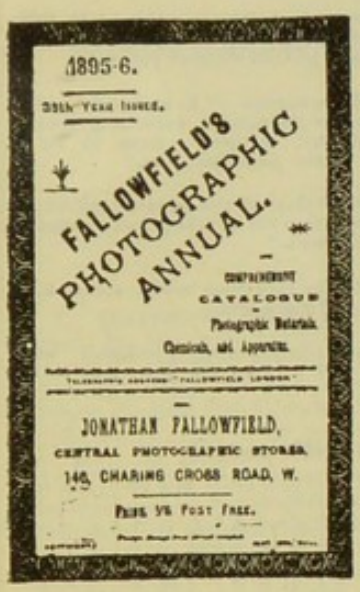
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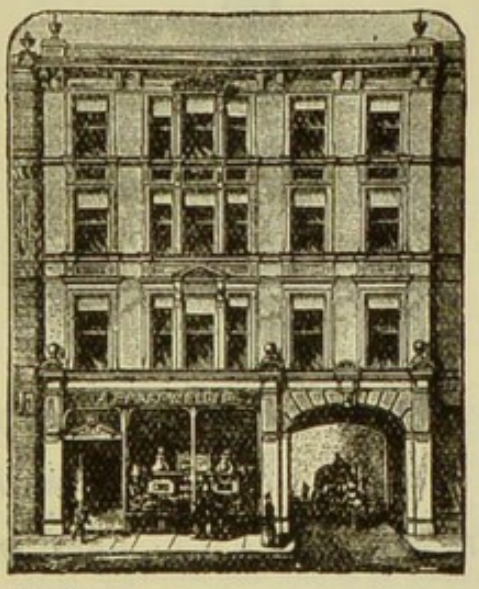
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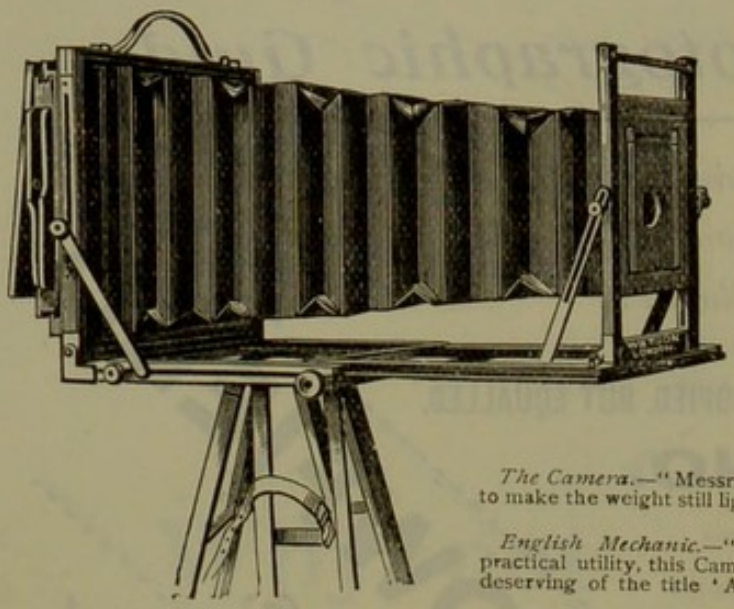
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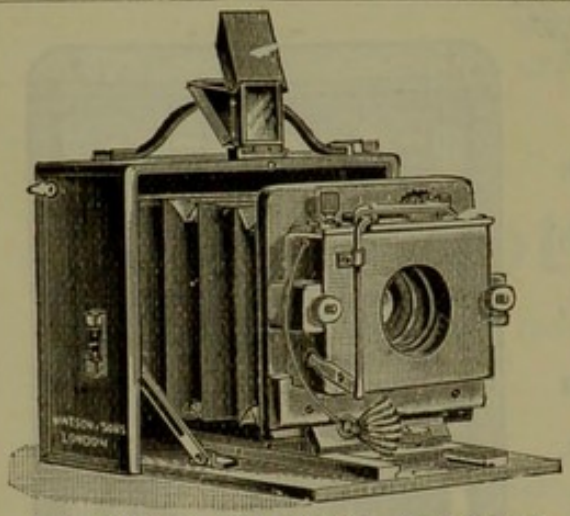
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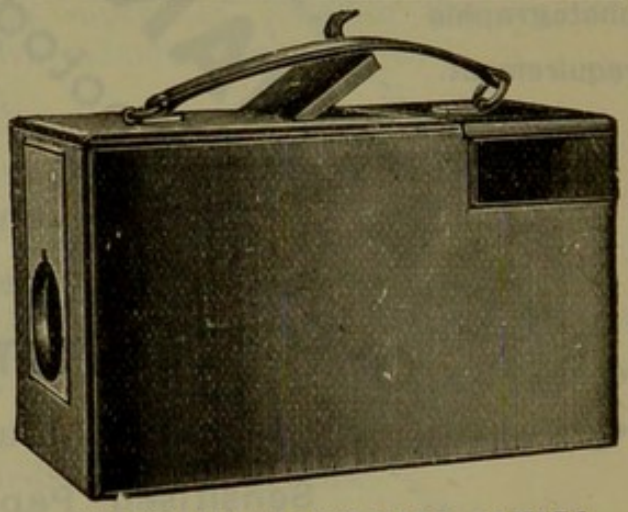
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CHAPTER I.

CAMERAS, AND APPARATUS CONNECTED THEREWITH.

(DARK SLIDES, SHUTTERS, TRIPODS).

1. Camera Bellows—To Make Support for.- In the best methods of making bellows no frame is necessary, as the paper is *creased*, then glued flat, and folded up into the creases after it is dry. When the first few folds are formed, the structure is sufficiently rigid to be easily dealt with. There is no denying, however, that the making of these first folds presents considerable difficulty, which might be lessened by some such contrivance described as follows: In making cloth bellows with cartridge paper strips between to form the folds, first make a box about an eighth of an inch smaller than the size of camera, cover the box with black calico, then paste the strips upon the calico with good flour paste, afterwards cover all with another covering of calico; when dry, draw off the box, one strip at a time, and the bellows will form themselves very neatly. If making bellows of leather, parallel or taper, make a box to suit the dimensions required, cover with black calico and the usual strips of cartridge paper, and when dry, cover with leather; cement with isinglass dissolved in acetic acid; when the cement has got well dried, draw off the box and fold with the calico and strips inside, press well when folded up, then draw the whole out to full stretch, and pull the lining out. The leather bellows will fold up in small compass.

2. Camera Bellows—To Make—Make a box of $\frac{3}{8}$in deal or pine, open at each end, 18$\frac{1}{2}$in. long × 7$\frac{1}{4}$in. square at one end, and 3$\frac{1}{4}$in. square at the other, screwed together from the *inside* with angle-pieces made to the proper bevel; $\frac{1}{4}$in. from each end draw with a marking awl on each side of the box a line parallel to the *arris* at each end, calling one C D and the other E F: bisect each of these lines on one side in A and B and join A B. Determine the depth of the folds, which must be an *integral* measure of 18, *i.e.*, a number which is contained in 18 an integral number of times—$\frac{3}{4}$in. will suit—this will give 24 folds. With a pair of dividers, open $\frac{3}{4}$in., step the line A B, marking the points of division clearly but lightly; set a joiner's bevel at C D or E F to one side of the box, and against it, through each point made with the dividers, draw with a marking awl a straight line parallel to C D or E F, continuing these lines round the box: they must be accurately drawn and hit one another at last. In each of the lines thus drawn make accurately with a tenon saw a cut about $\frac{1}{16}$th deep. This contrivance serves as a templet. For the leather buy a roan *skiver*, morocco or Russia if preferred. Wrap a piece of brown paper of manageable thickness round the templet and fold and cut it to fit accurately, so that the edges meet an inch or so to the right or left of A B. To this pattern cut out another piece of paper of whatever thickness is desirable; that is to give the folds the necessary stiffness; cover one side with paste and lay over this side a piece of black calico, leaving uncovered on one side an inch of the paper, and on the other side an overlap of calico an inch wide; trim the ends of the calico by the paper, and then cover the templet with this sheet, calico inwards, pasting the overlap of the paper to that of the calico, and taking great care that the calico and paper adhere everywhere, and fit the templet accurately. When this is dry, with a paper-knife or other instrument with not too sharp an edge, feel for the saw cuts, and mark each all the way round lightly but distinctly. The next operation is difficult to describe. The best plan is as soon as the templet is finished to model on it a piece of paper, or paper-lined calico, six or nine inches long, marking on it the saw cuts as before described; when dry, remove it from the templet, and you will have a section of the bellows for experimenting with. Make the folds, and arrange the corners properly tucked in; pull it out again and fold it flat, and cut off one side of the bellows, and from it—on each side—the corners as marked, and through each remaining fold; this gives a series of trapeziums, each being a model of the fold it belongs to without the corners. For each side of the bellows there will have to be cut out 24 trapeziums of increasing or decreasing dimensions: 96 in all, in sets of four alike. The thickness of the paper should be equal to that of calico paper and leather twice repeated, for the object of cutting off the corners is to form a recess for the folded corners of the bellows, so that the bellows when folded shall lie perfectly flat. Each trapezium, which should be a little smaller than its model, to allow for expansion, must then be pasted in its proper position on what is now the templet. If preferred, a full-sized plan of one side of the bellows may be drawn on paper with all the folding lines marked; place this on three other sheets of paper, and cut out each set of four with the same cut; be careful there is no shifting of the paper. Now for the *skiver*. Lay down on it the brown paper shape, and cut the leather to it, but let the line of junction for the leather be in the middle, so that the junction of the calico, that of the paper pasted on it, and that of the leather, may each fall in a different position, and the weak junctions not all fall together, but rather be strengthened. There should be a slight overlap—about $\frac{1}{4}$in.—of one edge of the leather, and each edge should be thinned, the upper on the lower side, and the lower on the upper. Spread some paste over the top of what is now on the templet, and adjust the leather carefully to it; treat similarly the two sides in succession, and lastly the bottom

taking care that all is well and smoothly pasted, and that the overlap of the leather lies well and evenly on the other surface. When all is dry mark as before the saw-cuts evenly, carefully, and more deeply than before, so as to leave a decided impression, unscrew the angle-pieces, and remove the templet. The marks made on the leather form an accurate guide for folding, and the unjoined trapeziums help the process, and also afford an excellent guide for tucking in the corners This makes the folding a fairly easy process, but still one requiring care, patience, and control of temper. When the folding is finished, place the bellows under a press, using light pressure at first, and at intervals increasing it, not excessively, for that would crush the leather and spoil the work. Before being removed from the templet the leather should be carefully cleaned and renovated.

Another somewhat simpler description is as follows: First as to material with which to make the bellows. It is that for indoor work two thicknesses of good thin silesia lining, pasted together with plenty of good flour paste, answer admirably. The lining must not be too thick, or else there is a danger of the join becoming so clumsy as to prevent the bellows from closing easily. For outdoor work one thickness of morocco leather, lined with a thin black silesia lining, answers admirably. In pasting together, lay one piece on the flat table, and place one edge of the one coincident with corresponding edge of the other, the surface of both having been previously well pasted. Now get a friend to gradually lower the upper piece on to the lower, while you at the same time rub the two in contact with the palm of the hand. By this plan it is easy to obtain the double cloth without any air bubbles of importance. Hang the cloth up to dry where it will be well exposed to the air, and next day proceed to mark out the surface ready for creasing. Now supposing that the bellows are to be half-inch fold, which is a convenient size for a quarter-plate. The bellows is to be 9in. in length, so that we must make the cloth about 12in. or 13in. in length, allowing 3in. for attaching it to camera, and also for its not stretching out completely. The piece must be 15in. broad, which length will allow ½in. for overlapping, in order to secure the ends. The piece, measuring 15 x 12, has now to be ruled. The ruling can be done with a blacklead pencil, the marks of which are clearly visible on the silesia lining. At distances ½in. apart draw lines parallel to the longer side. These lines represent where each fold is to be made. Along one of these lines mark off accurately the following lengths from the edge: ½in., 2½, 3, 5⅝, 6¾, 9¾, 10½, 12⅞, 13⅜, a length of 1⅝in. being left over. Through each of the points thus obtained draw a line parallel to the shorter side, and at right angles to the line, ½in. apart. The second lines represent where the corner folds are to come, it will then be noticed that these lines form with the cross lines four series of ½in. squares. Now start to draw the diagonals of these squares by the following rule: Starting from the edge of the sheet, the diagonals of the two centre series of squares point to the edges of the sheet, the diagonals of the two outside series of squares point to the centre of the sheet. In the next row this order is reversed, whilst in the third row the arrangement of the first row is preserved, and so on alternately. The sheet has now to be creased, the lines being followed with a rather blunt tool (an old toothbrush handle does very well), and then creased with the hand. The two ends of the sheet are now glued together, the join well pressed, and the bellows put aside to set. It only remains to press the creases in and out in order to develop the bellows. If the creases have been properly made this is soon done, but it is best to first draw the lines on a piece of stiff brown paper, and to make a model of the complete bellows. To render the bellows waterproof it is varnished outside with a couple of coats of shellac varnish.

3. Camera Enlarging—How to Improvise.—An ordinary bellows camera can be used for enlarging, either by attaching it to an optical lantern, or by the following arrangement: A square box is made of 1in. deal, the same height and width as the camera. This box is open at both ends. A portion of the under side of the box is cut away to allow the baseboard of the camera to fit in, so that when camera and box are placed on a level surface, the box fits up close to the focussing screen The front of the box is made small enough to fit inside the walls of the same, and should be pushed in for about an inch from the end and secured there. In the centre of the front a circular hole is cut 5in. diameter, and 5in. mounted condenser fixed in it. In the top of the box a lantern chimney is easily fixed by cutting a suitably sized hole and fixing a collar of tin in it on which to slip the chimney. The back of the box is closed by means of a door hinged at the top, consequently opening from the bottom. An ordinary paraffin lamp with a circular wick completes the apparatus. A convenient length for the box is nine inches. To use this apparatus, the glass is removed from the focussing screen and replaced by a carrier holding the negative; the lamp placed in the box, with the glass passing up the metal chimney. The door at the back partly closed to allow for ventilation, and a fold of some light material of a dark colour thrown over back and sides, to prevent the light escaping. A piece of white paper is fastened on to a board, and the board hung up on the wall perfectly horizontal by means of a ring at each end. The picture having been carefully focussed on to this paper, the lens capped, the other side of the board (on which a piece of bromide paper has been attached) is turned to the camera, suspended by the same rings as before. The exposure is then made, and the board removed to the dark room. A long table, on which two strips of wood are fastened, forms a useful stand, the camera and lantern travelling between the strips. If the camera is to be attached to an optical lantern, the lens with which negative was taken would be substituted for the optical lantern lens, and pointed towards the camera front, the space between such lens and camera front being rendered impervious to external light by the focussing cloth, etc. Then a sheet of bromide paper, cut to size of plate usually used in camera dark slide, would be laid in the slide, and a waste plate placed at the back of the paper to keep it flat. But this latter way of enlarging within the camera would prove more easy, and produce better results, with *da light*; a *smaller* camera taking place of lantern, negative being contained in *smaller* camera slide (with front and shutter thereof opened), and lens put in *smaller* camera front.

4. Camera Extension—To Improvise.—There are several ways of so doing. Perhaps the best is to make a small square box, just the size of the front of camera (where the piece of wood that carries the lens is), so that you can place it in front, instead of front the lens is on; you only have then to put the lens in front of this box, and you get what you require. It is necessary to find out the focal length required first, or it may easily be done by making an arrangement out of an American corned-beef tin. Fix the broad end on to front of camera, and to the other end fix a piece of wood with an opening to place lens in. This hole should be lined with cloth glued round the edges, or strips of cork from the neck of an Eno's Fruit Salt bottle, to make it light tight. The inside of tin must be painted black. A cone made of cardboard, and fixed on front, would do either

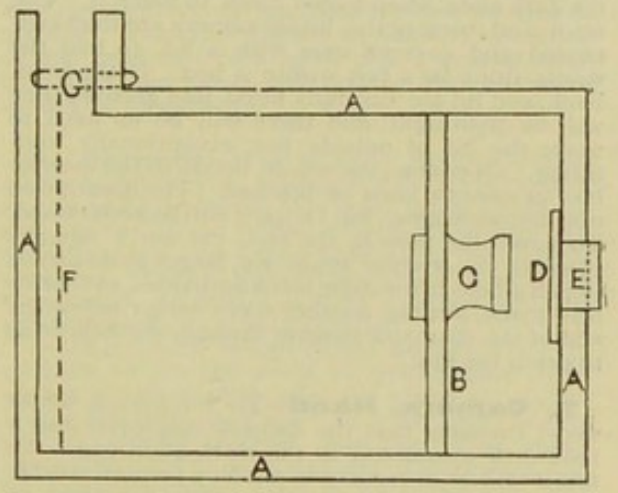
or one of black velvet or twill, with an arrangement to keep it extended.

5. Camera (Hand) — How to Adapt "Instantograph."- Place "Instantograph" in a cigar box as long as the longest distance the bellows will rack out to. Knock out one end and put it upon hinges, so as to put a hand inside to focus. Make a round hole in the other end for the lens to "see" through. It must now be well wrapped in brown paper, and, presumably, fastened with twine; it will look an innocent parcel. A hole must be now cut in the side for the shutter to be introduced; this must be hidden with a flap of brown paper. There is now a cheap, simple, and effective "detective" camera.

The "Instantograph" can be converted to a hand camera by enclosing in a box, covered by any material thought proper, so as to avoid detection. The box should have lid and falling end, with hole cut in it, and a hole at other end for lens. These holes can be closed by sliding shutters. The focussing screw for "Instantograph" should come through the side. Fix a twin camera, coinciding with the "Instantograph" in angle of view, and working with focussing arrangement of it, so as to be in focus at the same time; you can then have plate ready and shutter set for a shot yet unseen. By turning screw of "Instantograph," which comes through side, and looking through hole at back, the view reduced in size on the ground glass of small camera may be seen. This does away with focussing cloth. Or, better still, attach an index finger to the camera front, showing through a slit in the side of the box. Along this slit a scale must be made showing the correct focus at various distances. This enables the ground glass to be removed. By fastening tripod head to the bottom of box, the camera can be used for ordinary work, the falling end allowing focussing to be done on the large camera. A roller slide and a few backs, carried in separate bag, complete the arrangement.

6. Camera, Hand—To Make.—The following descripton of a camera is given by one who made it: "I became the possessor of a small wooden box, about 10×7×7, with a sliding lid. In one end of this I fixed a false end 2½in inside the real end; to this was fastened the lens flange, so that when in position the hood of the lens just came to the real end, in which a round hole was cut and stopped with a plug (similar to a Kodak) when not in use or for time work. In the space between the two ends was my shutter, working between the lenses, and adjustable from the outside. Next I procured a quarter-plate bellows from H. Park for 2s. 9d., and focussing screen with roller slide, to which I fixed one end of the bellows, and the other to the false front. I now had a quarter-plate camera enclosed in a very innocent-looking box, with nothing to be seen but the top screws of the roller slide and the screw of the shutter, which, being painted black like the box, was not noticeable. With this camera I have done some good work, and I think altogether it cost me about £2. A single lens, however, is not quick enough for this work. The best lens is a doublet of rather long focus. With this everything beyond about 20ft. will be comparatively sharp The focussing part of my camera is movable, and clamps with a screw like the old box cameras, and the end of box lifts up on hinges, so I can use it for groups, etc."

Another description is given of a camera adapted to a half-plate W.A. Optimus lens which practically worked at a fixed focus from about 10ft. to any reasonable distance. A camera was therefore constructed for it of the detective or hand kind, of which the following are the details: Outside measurement, 8in. long, 7¼in. broad, 5½in. deep in front, and 6½in. deep at the back; material used, ¼in. mahogany. Fig. 1. is a sectional sketch of the camera, A A A A being the outline along which the measurements are taken. B is a division-board to hold the lens C, and must be fixed at the correct distance for focus on a plate at F—in my case 5in. from back of lens to plate. The dotted line F shows a groove within which slides the sensitive plate, and the dotted line across at G is a plate of sheet steel, which slides across the opening after the sensitive plate is in position. D is the shutter working inside the aperture E in outer board of camera, which aperture is further protected by a plug-cap E. The shutter was fully illustrated in the "Bazaar" of October 21st, and consists of C, a disc of wood or metal revolving on a central pivot or screw, and in this disc an aperture corresponding in size with the aperture in the front board. The disc is revolved in either direction by threads of silk which pass either over a groove or over small studs fixed on the disc, and led through a loop or eye screwed on the inside of camera front. These cords may pass through the same opening in the camera side. There is another contrivance for exposure, which consists of a flap shutter opening downwards behind the lens, and actuated by a large watch key working on a projecting stud at the camera side. The

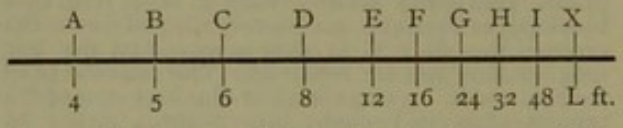


advantage of this is that no one can make an exposure unless he has a key to fit the square head of the stud. The plates are either carried in bags or transferred from a small plate-box by means of a changing bag; in either case the action is much the same, and is as follows: The mouth of the bag, whether merely a sheath to hold two plates, or large enough to hold a box with six or a dozen, must fit over the raised part of the camera at G, and be held in position by either elastic or tape, or both. The plates, previously secured back to back, with thin black paper between, are merely slipped down the groove, the slide G is shot across, and the bag may or may not be removed. The removal is, of course, made by a reversal of the action, and the second plate is brought into position either by reversing the sheath or turning it by hand if a changing bag is used. The plates need only be fastened together at the four corners, and gummed lantern slide paper is the easiest to apply.

Another writer says: "First procure your lens. A comparatively wide-angle single lens would do, but I should advise you to have a symmetrical—for instance, an Optimus 5×4. You will find a marked difference in street scenes, or any shot with buildings in it. However, suppose you have your lens, and have ascertained its focal length for an object, say five yards distant. First make a box of length

sufficient to take in the lens and shutter, the ascertained focal length, and at least three double dark slides, of breadth 4¾in., and of height 6½in. I am supposing the camera is to take quarter-plate slides. I should advise a Kershaw shutter, as it can be used from outside by lengthening the brass rod at the top so as to go through a little hole in the box, while a small trigger can be easily arranged to release it. Inside the box a groove should be cut to admit what will be the front of the camera, at a distance from one end equal to depth of shutter and lens mount; on this front (which, if neatly fitted, can remain movable) the flange and lens are fitted, and a hole made in the end of the box concentric with the lens. From this point carefully measure the distance of focus above ascertained. Of course, in the case of a symmetrical lens, the distance is measured from the diaphragm slot, making allowance for the register of the dark slide; in fact, you must get the plate inside the slide into its proper place, and this can be done by inserting into a dark slide a piece of ground glass to occupy the exact position of the plate, pull up both shutters and shift the dark slide bodily until an object at the given distance is in focus. Now mark where the dark slide is, and fit in a back—like the reversing back of a camera—to take the dark slide. The lid of the outside box should be just deep enough to allow the shutter of the dark slide, when folded down, to touch it. The front and back of the inside camera are then connected and covered over with a lid, so that the whole thing is a box within a box. If the front, back, and lid are carefully fitted into grooves they will be light-tight, and there will be no need to make the lid of outside box exceptionally well-fitting. Of course, the whole inside of the interior box or camera must be blacked. The description may not seem clear, but I hope it will be understood. To cover the hole in the end, cut out a circular piece of tin or sheet brass, ½in. larger in diameter, punch a hole in the edge, black both sides, and screw into place, putting another screw rather below the end of the diameter passing through the hole so as to catch the disc."

7. Camera, Hand—To Focus.—A writer says: Presume that the camera employed has a rackwork movement to the dark slide end. To this it will be necessary to attach a pointer, visible on the outside and traversing over a flat piece on which the scale can be constructed. The length of the index scale depends upon the focus of the lens, as well as the nearest distance at which an object is to be focussed. Herewith is a small scale taking the distances with an Optimus R.R. 7×5, and the distances given are as nearly correct practically as possible. The method pursued was as follows: A half-plate camera was erected with the above lens on tripod, and from the diaphragm slot a bullet suspended to just touch the ground,



Ax = 2⅞ inches. and from this the distance of the
Bx = 2 ,, object was measured, which
Cx = 1⅝ ,, was a piece of white cardboard
Dx = 1 ,, with a black cross in the centre
Ex = ⅝ ,, and held in a cleft stick, which
Fx = ⅓Dx latter when stuck into the grass
Gx = ⅓Ex was of such height as to bring
Hx = ⅓Fx the centre of the cross approxi-
Ix = ⅓Gx mately on the axial line of the lens. With a tape measure the object was focussed at 4, 5, 6, 8, and 12 feet. The camera was then tilted, and a small cloud as near the horizon as possible was focussed, and this gave the equivalent focus mark. It was then found that when the object was focussed again at 16 feet this point was nearly exactly one-half the distance between the equivalent focus mark and the eight feet mark, so that practically there was no more to do than to keep bisecting these distances to obtain marks for objects twice the distance off. Thus, X is the equivalent focus mark, A the 4 feet mark, B 5 feet, C 6 feet, and so on. Now, although A D is not equal to D X, yet, when the distance of the object is much increased it will be found that the length of the mark from X for one distance is twice the length of the mark from X for twice that distance. Thus, the 48 feet mark I is midway between X and the 24 feet mark G, and practically all is in focus with this lens beyond about 128 feet, or, say, 43 yards. These distances from X as given below the scale are as nearly accurate as can be measured, so that if an object is four feet away when taken the scale on the camera must be at least 2¾ inches long. If it is wished to find the focus by calculation, we proceed thus: The first thing is to know the focal length or principal focus of the lens, which is readily ascertained. Place the camera and lens on a large smooth sheet of paper resting on any flat surface, say a table top. Having marked in pencil two vertical lines on the ground glass at equal distances from its edges, select an object, say a telegraph post, situated as far off as possible, and focus it so that its image falls on one of the lines on the ground glass. Using the side of the camera as a straight edge, draw in pencil a line on the sheet of white paper. Next turn the camera until the image of the same object falls on the other pencil mark on the ground glass, and again using the side of the camera as a straight edge, draw another line on the paper. Lastly, remove the camera, and produce these lines until they meet. Bisect the angle so formed, and at right angles to the line of bisection draw another line equal to the distance between the vertical lines on the ground glass and meeting the lines forming the angle. The distance between the apex of the triangle and the point bisecting its base is the focal length of the lens. Having got so far, construct a wooden box in two parts, one sliding tightly within the other, and capable of in and out motion to the extent of, say, two inches. This box is to hold the camera, the back and front of which are rigidly fixed to the two halves of it, so that when the box is pulled out, the distance between lens and ground glass will be increased. As a rule, it will be found necessary to remove the rack and pinion of the camera to enable it to follow easily the motion of the box. The length of the box is so adjusted that when racked in it holds the camera focussed for a distant object. The minor conjugate focus for nearer objects is readily determined from the equation $\frac{1}{F} = \frac{1}{f} + \frac{1}{f^1}$ in which F = principal focus, f = major conjugate focus or distance of object focussed for, and f^1 = minor conjugate focus. Having got the minor conjugate focus, it is merely necessary to deduct the principal focus from it, and we have at once the distance the box must be pulled out. The necessary calculations may be put in words thus: "Multipy the focal length in inches by the distance of the object in inches, divide the product by the difference between the distance of the object in inches and the focal length in inches, and deduct from the quotient the focal length in inches." Suppose, for example, the focal length of the lens was found to be seven inches, and the object focussed for was thirty feet away. Then $\frac{7 + 30 + 12}{30 + 12 - 7} = 7{\cdot}14$ inches nearly, so that the box would have to be drawn out ·14 inches. Again, if the distance of the

object focussed for was five feet, the calculation is $\frac{7 + 5 + 12}{5 + 12 - 7} = 7{\cdot}93$ nearly, in which case the box would have to be drawn out ·93 inches. Having in this way calculated the amount to which the box must be racked out for distances of, say, 50, 40, 30, 10, and 5 feet, these distances are marked on the sides of the box, placing opposite each mark the number of feet of distance it corresponds to. With a box so marked, focussing is, of course, merely a question of being able to estimate accurately the distance between the lens and the object it is required to photograph. Once this is done the box is pulled out to the requisite extent, and the lens will then be in focus if the estimate of distance is right.

Another method is by using the lens to throw an image by means of a mirror at an angle of 45° within the camera on to a ground glass admitted into the top of the same. This plan is advantageous, as it necessitates less space in the construction of the camera, and obviates the expense of an extra lens. In the absence of knowing what focal length is to be used, suppose that 5½ inches has been selected for the quarter-plate. Having made a box in ¼in. mahogany of 9½ × 5¾ in. (both inside measurement), and of height so as to allow the winding key of roll-holder to protrude, a second front is contructed within the camera, to which the lens is received by its flange. This front is given a play of about one inch by means of rack and pinion, the pinion just protruding through the side of the box. A mirror is next fitted at an angle with the bottom of camera between the roll holder and lens, capable of being turned up out of the way after focussing. This is done by means of a spindle passing through the box, and provided with a milled head. In order to find the position of the ground glass, measure exactly the distance between the film and the centre of mirror. The ground glass will have to be exactly the same distance above the mirror, the centre of mirror and ground glass being in the same vertical line. A blind shutter, as a No. 2 Kershaw, adjustable from outside of camera, is fixed from behind the mirror, as near as possible to it, so as to intercept as small a cone of rays as possible. The lens of camera must be provided with a cap or slide, in order to allow of shutter being reset.

8. Camera, Hand—To Prevent Dust in.—The following method will prevent the nuisance. Clean off all the black from the sheaths down to the metal, now heat them till you cannot bear your hand on them. The sheaths should, however, be made of what is known in the trade as "black" iron, which is simply untinned iron, instead of the tin, and then they will not require blacking at all, and will be more perfectly free from dust. The black will adhere to the tin much better if you roughen the surface all over with sandpaper or emery cloth, and apply the following varnish, which dries a dull black:

Alcohol	...	8 ounces
Lampblack	...	2 ,,
Shellac	...	1 ,,

Dissolve the shellac in seven ounces of the alcohol, and mix the lampblack with the remaining ounce, then add the two together and apply to the metal. Try varnishing with ordinary varnish, and when it is nearly dry cover the sheaths with thin dull black paper, easily obtained at the stationer's. It is always wise to smear glycerine over the inside of a hand camera, to fasten any loose particles of dust.

9. Camera—To Adjust the Working Height of.—The best height for three-quarter standing figure is about level with the chest of the victim, as there is less marginal distortion, due to equality of plane, but if your subject is very long-faced, you would please him better by foreshortening the features. This can be done by raising the camera and depressing the lens. *Never* elevate the lens, or you will obtain a view of the interior of the nostrils, and the photograph will make the subject appear to have a snub nose, and a very projecting chin. The height for a sitter, however, is greatly a matter of taste, and depends much upon the characteristics of the sitter. Theoretically the lens should be placed at the height of an average person's eyes, say 5ft. 2in. Practically the lens is placed between that height for a tall sitter and about 4ft. 6in. for a short one. If the camera is low, the apparent height of the sitter is increased in the resulting photo.

10. Camera—To Level.—An ordinary stout steel knitting needle is softened at one end in the fire or gas flame, and with a pair of nippers turned, while still red hot, into a loop, and cooled by plunging into cold water. A couple of stout pins, with their heads cut off, are bent into a ⌐¬ shape, one of which, placed vertically at the side of the swing back, suspends the knitting needle to swing freely. The other, placed horizontal near the lower end of the swinging needle, limits the play of swing. The swing-back is carefully set vertical, and the position of the needle when at rest is marked. A suitable marker is obtained by cutting off the head end of a small pin, a quarter of an inch from the head, and driving into the wood flush with its surface.

11. Camera—How to Keep Steady.—Have a hole bored through the head of the tripod screw, and suspend therefrom by a stout string a cabbage net. In the net put stones, or any other heavy and suitable object which may be handy at the time of exposure. The net should hang about a foot above the ground. In default of a net, a pocket-handkerchief may take its place at a pinch.

Another useful thing—either instead of or in addition to the above—is an india-rubber door-spring, a rather weak one, say about six inches long, and with an "eye" at each end, and to suspend this by one end from the tripod screw. Tie a thin cord to the lower end of the spring, and let the cord have a loop at its lower end, into which the foot may be inserted. This loop should be about three inches above the ground when the tripod is set up. By inserting the foot into the loop and pressing the foot upon the ground the spring is stretched, and a great downward pull is exerted upon the camera, which holds it as firm as a rock.

12. Camera when worn—To Renovate.—If the leather is very dry it will be better to detach the bellows from the camera, and, after removing the mildew, carefully rub in as much oil, say castor oil, as possible, if it can be done with heat so much the better; if it is done cold several applications will have to be made, say, at intervals of several hours between each treatment. When the leather has become softened, the superfluous moisture should be rubbed off, though it will probably take some time to become dry. Instead of castor oil other softening oil or fluid may be used; melted wax or glycerine could be used, or dubbin; this can be obtained from any bootmaker or leather seller. Warm the dubbin slightly, and rub on the leather in front of the fire. To clean the brasswork, after removing the lenses from the lens tube apply petroleum, and allow to soak for some time, rub off, and then polish with ordinary brass paste—the petroleum quickly softens and reduces the dirt and oxidisation; or the brass-

work may be cleaned with the following: One ounce oxalic acid, six ounces rottenstone, half-ounce gum-arabic (all in powder), one ounce sweet oil, and sufficient water to make a paste; apply a small portion, and rub dry with a flannel or wash-leather. To clean and polish the woodwork, use furniture paste and plenty of elbow-grease.

13. Camera Fittings—To Blacken.—It is essential that all parts of the interior of a camera should be of a uniform dead black. The brass diaphragms, inside of lens tubes and other fittings have a knack, however, of wearing bright, and when this has been the case they can be re-blacked by the application of a paint made of a mixture of lamp-black and gold size, with just sufficient oil of turpentine to make it thin enough to use with a camel-hair brush. If however the parts can be—like the diaphragm, for example—easily removed, the following is a better plan: Prepare 40 % solutions of silver nitrate and copper nitrate; mix these, clean the brass and dip it into the solution. Let it remain five minutes, then remove and allow to dry. When dry, heat on a sand bath until a deep dead black colour is assumed.

14. Changing Arrangement — To Make.—A piece of thick brass sheet is riveted tightly to each end of a length of wire, the length depending on the size of the camera. This is fixed under the bottom of the camera at one side, the one brass piece in a recess underneath the exposed plate. When the brass piece outside is turned, the one inside does so as well, raising the plate at the same time. The brass slip is then turned back, the plate raised is caught hold of by the top corners and placed at the back, when the next plate comes into position. Another method is to cut a hole in the bottom of the camera, underneath the sheath containing the plate it is desired to raise, and cover this with flexible indiarubber, which must be firmly fixed round the edge, and carefully made light-tight. The plate may then be raised with the forefinger, but it is better to make a push of wood and fix to the camera with a spring, so that the rubber will be flat, then by pressing the spring the rubber will be raised, and consequently the sheath with the plate; or the compartment for the sheaths may have a plate with spring at back to push them forward when front one is removed. Under the front sheath fix near sides of camera two iron pegs, about 1½in. long, with strong spiral springs; upon them a strip of brass, with holes in, fitting on pegs. This carries front sheath. The top of compartment for sheaths is closed by a lid, under which is a bag of Suède leather, into which front sheath is pushed up by the spiral springs when the lid is opened, and it may then be removed to back. Arrange a lever to pull down the strip, so that the second sheath may be pushed up into position for exposure. Another simple way is to have but one groove in the bottom space for the plates in the reserve or top, to be simply held *en bloc* by a spiral spring, have a door underneath, to which is attached a piece of black twill lined with a close turkey red, and also attach it to the inside. Make this a little larger every way than the plate, stitch it well and "whip" a piece of braid over the seam, to prevent any chance of light coming through the needle-holes. This will form a square tube or sleeve. When the plate is exposed, turn the snaps or buttons that hold the door, and the cloth tube draws out with it; the plate will fall into the tube, and one from above will instantly take its place in the groove. You must prevent this falling too far by placing one of the fingers of the left hand immediately under the plate, and turn the camera on its side; it will then, of course, remain in position. The exposed plate can then be readily "handled" and placed through a slot cut through the partition and at the end of the part that contains the reserve. If a piece of wood just a *little* thicker than will fall into the exposing groove be placed at the back of the last unexposed plate it will form a safety arrangement, for the exposed plates put against it press it forward, and when all are exposed it blocks the groove, and no more plates can then be brought into position. Have an ample cloth tube, for it can be packed away in the "well" that is formed under the reserve for plates. The door must, of course, be recessed into the base, and can be fastened flush with four turn buttons.

15. Changing Bag—To Make.—A very useful changing bag may be made thus: Procure two picture frames made of thin moulding of the size most convenient according to plates used; fit one with ruby glass, and cover this with canary paper. Connect the two frames together by hinges. This forms the base or bottom of the apparatus. Then make a bag of black twill lined with yellow, of the shape of a Kinnear camera bellows, without the creases. The bottom of this bag should be fastened on to the top picture frame, which is without glass. In the top of the bag is fixed a wooden board fitted with two watchmakers' eyeglasses from which the lenses have been removed, and a broad elastic band nailed to the sides of the board large enough to go round the head of the operator. In the bag near to the bottom two short sleeves are inserted with elastic bands round the wrists. The apparatus has the appearance of a long stereoscope, and is thus used; the upper frame is opened to admit the dark slide, then closed on the lower one, and fastened by a hook and pin at each side. The band at the top passed over the head, keeping the eyepieces in their position over the eyes; the hands are then placed through the sleeves, and the head being raised the bag is expanded; a good supply of light comes through the bottom, and the plates are easily changed. A very convenient changing bag is an oblong shape, about 24 inches long, 12 inches wide, and 12 inches deep. The bottom is formed of thin, strong slats of wood, jointed like a wooden roller blind; this is also continued along the back, and thin brass rods along the sides and top keep it in shape. These rods are removable. The light is admitted by a sheet of ruby fabric let in at the top, and a window in one side allows the operator to see the plates, etc. The hands are inserted through sleeves on each side of the window. The whole is covered with black indiarubber cloth, lined with ruby fabric as an extra protection. When not in use the brass rods are withdrawn and laid in the middle, and the whole then rolls up into a compact little parcel. A stout cord attached to the four top corners, joined in a stout ring affixed to the bottom of the camera screw, for outdoor work, or the whole may be placed on a table or anything else flat. If somewhat of the same arrangement were attached to the camera case, by allowing the front of it to fall down, and drawing an absolutely opaque curtain over it, a window might be made in one end, which could be protected when not in use by removable screens inside and out.

16. Changing Bag—To Make Folding.—Changing bags may be made on two plans, either to go over the head and shoulders and fasten tight round the body, or with sleeves, enabling the hands to be inserted in the bag. In either case the bag should be made of two thicknesses of light-tight material; waterproof cloth is good for the outside, and velvet or black twill for the inside. The bag, on the first principle, should be cut in two portions, the inner and outer, each being made up separately; the inner bag should then be put in with the uncu

side next the joined side of the outer one. This will obviate any chance of light leaking in through the seams. They are then sewn together round the neck, and a stout cord run round the neck inside, to enable it to be tied closely to the body. Don't use a tape for this, or it will be difficult to get out again. This form of changing bag is good in design, but it offers a terrible incitement to practical jokes at the user's expense; it also puzzles dogs, and it is most unpleasant to be tied up with a strange dog growling about your heels, though possibly amusing to onlookers. The second form of bag should be made in the form of a soda-water bottle, with two sleeves inserted into the bottle portion; in use the slides, plates, etc., are put in at the neck, which is then tied in a knot, and the arms put through the sleeves into the bag, an indiarubber band on each sleeve keeping the light out. Either of these bags fold into a small space. The latter is not convenient for anything larger than whole-plates. Another form can be easily made by anyone who can manage the ordinary bellows for cameras. The bag consists of a light cardboard bottom and top, connected by means of a bellows of two thicknesses of orange medium. In opposite sides of the bellows are orifices with velvet sleeves (closed by elastic bands) for the plates, hands, slides, etc., to be inserted. The bottom and top should be rather more than twice the area of the plates used, and the length of bellows twice the length of the dark slide. The top is perforated with two holes, glazed with orange or ruby glass, by which the operator can see how to manipulate the plates and dark slide inside. The whole packs up into very small compass.

A very good bag is made as follows: Procure two yards of thin waterproof sheeting one yard wide. Double this lengthways upon itself, and cement edges together. To do this the cement (procurable from the rubber warehouses) is well rubbed into both surfaces with a bit of smooth stick, permitted to get tacky, and the surfaces then brought together and well pressed in contact, so as to get rid of the excess of cement. Take care in any case not to apply *too thick* a coat of it. It is as well for the sake of security to add an extra band over the seam. This will give a bag a yard long and about twenty-four inches in diameter—quite large enough for anything up to 12 x 10. If required smaller take less material, but do not make the bag *less* than a yard long. The most convenient slides to use are those of book form. Before starting on the trip procure a number of pieces of black cardboard same size as plates, and just thick enough when put between two of them to prevent the plates wobbling in the slides. There will be wanted some pieces of thin sheet copper or brass, about a quarter of an inch wide, and as long as the short side of the plates used. At home, in the dark room, put a piece of black cardboard between each pair of plates, turning film sides out, of course, and bind them top and bottom with the thin metal. Return the plates so "prepared" to their boxes, filling also the dark slides with them, leaving out the usual tin partition, the place of which is now taken by the cardboard. Carry for exposed plates a different *kind* of box to that in which the unexposed plates are stored, say in a tin box for the former and cardboard for the latter. To empty and refill slides, insert left hand into one end of the bag and slip a rubber band over the arm. Now put in the slides and plate boxes, and having slipped another rubber band over the second opening, push in right hand and arm. Open slides and the plates at once fall out in pairs, and can be put away into their box without any trouble, similar pairs of plates taking their place. Grooved boxes are most convenient to use, but, of course, the grooves must be extra wid and the bag itself can be made of thick black silesia or other material, and stitched, but there is never the same security when using the latter, as the holes made by the needle are almost sure to let in light. Of course, by making the bag double, and having the seams at opposite sides, the entrance of light can be avoided, but then the arrangement becomes heavy and cumbersome. For lightness and efficiency the thin rubber bears the palm.

17. Changing Box — To Make. — The simplest plan would be to purchase three metal-grooved plate boxes. Only two should contain plates. Then No. 3 could be used to receive the exposed plates till full, when, of course, No. 2 becoming empty, could receive the plates as they are removed to No. 1 box. The changing must be done either under the focussing cloth or with the help of a changing bag. The latter is preferable to fumbling under the former, which may scratch the plates. There is in Photography Annual a cloth with a piece of ruby glass let into it so that you can see every plate you handle. The cloth will serve for focussing purposes at the same time. If reference is made to pp. 451 and 452, an opinion can be formed. Another, and perhaps more convenient, being slightly less bulky, method would be to obtain a box with very closely-fitting sliding lid which should be made to withdraw sideways in order to economise space in the bag by exposing the whole box at one time, and a false side should be fixed in it so that the lid may be withdrawn to the width of a half-plate, and yet remain in its groove and become blocked to avoid the generally troublesome process of replacing it in its groove. The small empty partition could be used for some camera necessary. This could be made by a good carpenter, and cost about five shillings or less. In order to prevent the plates from rubbing against each other while in the box, it would be advisable to put them in sheaths, as used in the Talmer hand-camera, and the box should be divided into two compartments to hold fourteen, so that a dozen would fit loosely into them and yet keep the plates in a vertical position. If this method is adopted be very careful to re-fill from sheaths on the left hand, placing the empties on the right ready to receive the plates after exposure, and, to avoid any risk of double exposure, the last piece should be fastened to a thick piece of wood.

18. Cloth—The Best to Use for Changing Bag.—It is best to have Turkey twill inside, then yellow lining outside a black, or it may be made of one thickness of light black waterproof cloth outside and one of black silesia inside. If the bag is to be used for a focussing cloth, the following is an excellent one: Take a piece of black silesia (obtainable at any draper's), double thickness, and double it in half and stitch the sides together; on one side insert a piece of canary medium, and also a piece of ruby fabric. To change the plates put the bag over your head and draw the tape tight round your waist.

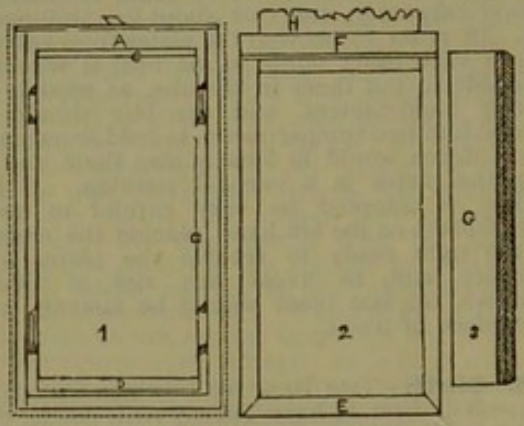
Another handy changing bag can be made in the following manner: Take two thicknesses of red Turkey twill and one thickness of black silesia. Make a bag with the red cloth inside, about 3½ft. or 4ft. square. In the black cloth make a window 12in. square of yellow sateen. Hem the mouth, run a string through, and the bag is finished. To use the bag, envelop the head and body, and tie the strings tightly round the waist. There will be ample light to change the plates, and it may be done in open sunlight, without fear of fog.

Another authority says: The best cloth for a changing bag would be thick velvet, so that it could be used also as a focussing cloth, which is usually

of velvet. It can be bought at any draper's for about 3s. per yard. There are many forms of bags, but the simplest is just a bag with two holes which draw tight for the arms, and which, when used as a focussing screen, do to slip over the lens and so cover the camera entirely.

And still another: The best kind of cloth is waterproof cloth, such as is made up into ladies' cloaks, and one thickness of red calico. It is both light and light-tight, and can be procured from the dealers in waterproofed goods. The price varies according to the quality.

19. Dark Slides—To Make.—The following are the measurements of a slide for 7 × 5 plates; of course, it can be worked out for any sized plates. First, make a frame (see drawing) (A) 7¾ × 6⅜ outside measurement, 7⅛ × 5⅛ inside, and half-an-inch thick. Either mitre or make it "slate-frame" fashion. Cut two small recesses on either side of the frame, and in these screw small brass buttons. The top and bottom of the frame must be rabbeted down to one-eighth of an inch to form a couple of ledges (C and D) for the plates to rest upon. Now plane up some stuff five-eighths of an inch wide and one-eighth of an inch thick, and put together the frame E. The top bar F, 6½in. long and ½in. wide, is glued and screwed on the outside to allow the lifting shutter to work in the groove. To form the groove for the lifting shutter H, the frame E is rebated on one side only, as in G, fig. 3. The frame E being glued on to A, and another frame a little wider on the other side, tends to give it strength. The size of the frame E is 8 × 6⅛, and the position it should occupy when screwed on to the frame A is shown by the dotted lines. One lifting shutter is 7¾ × 5⅜;



the other is 5¼ × 7⅛. The reason why one is larger than the other is to allow room for the turn-buttons on the upper side. Now, the two frames E being fastened on either side of A, and the lifting shutters fitted, the dark slide is complete. The slight projection shown by the dotted lines forms a tongue that slides in the groove of the camera. The weight of this slide is ten ounces. To put in the plates, draw up the lifting shutter on what may be called the front side of the slide; put in one plate, film downwards, and then put in a piece of cardboard with black paper pasted each sfde, and then put in another plate, film upwards; turn the brass buttons over the edge of the plates, put down the shutter, and the two plates are ready for exposure. The following description is given for a solid dark slide (15in. × 12in.) Plane up perfectly square a piece of mahogany ½in. × ¾in. × 19in., and in the ¾in. side cut out a rebate ½in. wide and ⅜in. deep from the centre, and along a line ⅛in. from each edge cut a groove to take the two shutters Now, with the mitre-cut cut into two pieces 5½in. from end to end, and two pieces 4⅝in from end to end. Now, from the two 5½in. pieces remove one side of the rebate (be careful that when the four pieces are fitted together the pieces removed will be on the same side, *i.e.*, in front) and make the grooves on these sides again for the shutter. Now take one of the 4⅝in. pieces for the top of the slide, and cut the rebate rather more than ⅜in. deeper, so as to be rather more than ½in. deep altogether, and in the centre screw a piece of blackened brass 3in. long and ½in. wide, bent so as to form a spring, so that when the plates are put in they are pressed up against the spring so as to allow them to fall into the rebate at the bottom, and are kept in their place by the spring. Through the middle of the other piece fit a screw and bush, which, when screwed in, will push the plates up against the spring, and allow them to be removed from the slide. Now the four sides can be secured together by glue, and a piece of wood spliced across and into each corner. With the measurements given, the cell ought to just take a plate 4½ by 3½in., if not a little "juggling" will soon effect this. Now for the shutters. These are made of ⅛in. stuff, which, of course, is rebated to prevent warping, and the best way to make them is to *fit* them to the framework. They will require to be in breadth equal to the breadth from inside of groove on one side to inside on other. The top piece of the frame must have had the groove continued into it on each side, after ⅛in. taken off on each side, before being fastened up. This sounds obscure, but the figure will explain. Make rebates ⅛in. deep and wide to fit the shutters in the grooves on three sides, and so as to leave about ½in. above the frame. Now shape these pieces so as to have something to pull them out, one on one side and one on the other, and glue a piece of ⅛in. stuff to inside each shutter-top so as to exclude light, and a small piece to the bottom of each shutter, after the shutter is in, to form the stop. Then black all the inside with lamp-black, rubbed up with a little gold size and thinned with turpentine. Two stops - bent brass wire with a screw end—must be screwed into the framework so as to catch the shoulder of the shutter. A piece of black cardboard to separate the plates, or some such contrivance, will also be necessary. One more point. One shutter will obviously be larger than the other, in order that the plates may be introduced; in fact, it will be 3½in. (excluding rebate) in width.

20. Dark Slide—To Make Draw-out Shutter for.—A worker says: The method of cutting off light which I employ is that shown in accompanying drawings. Fig. 1 is a section of slide grooving, A A being the grooves for covers. In the end piece I continue these grooves through, thus making it into three pieces, the shaded parts being those cut away, the central piece is then cut through other way at the line B, making two pieces of it, the C and D, the latter about double the width of the former. D is then cut through the middle width-ways on line E, and a rabbet made on each piece, so that when laid together the space F is left open. These two pieces, when put together, will be about a sixteenth of an inch thinner than C, and this must be rabbeted along on each side, so as to bring it to the same thickness. A piece of velvet is now stuck in these rabbets in C and all over the sides of D, as shown by thick lines G, and when the glue is dry, each piece can be opened back as far as it will go, and a small spiral spring fixed in the space F, by means of a small staple inserted in C, and passing through the coils of spring. One end of spring will impinge on each of the pieces of D, and force them outwards, so that when the covers are drawn, these pieces spring out and stop the opening before the cover is quite out of slide, and the velvet makes a light-tight joint, while the action of pushing the covers in forces the spring back into its place again.

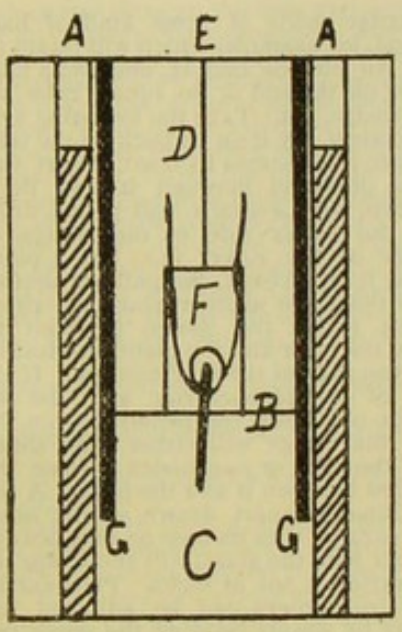


FIG. 1.

Fig. 2 shows a longitudinal section of spring as inserted. The best material you can use for your covers is vulcanised fibre. This can be had in any thickness, and will neither swell nor shrink, neither will it warp in any way.

There are several other materials which may be employed as shutters for dark slides, and they vary in price, durability, and weight. The cheapest is millboard, and this answers very well if a good elastic sample be chosen, but there is millboard *and* millboard, and some of the latter would crack in two on receiving a very slight bend, and this sort should be rigorously let alone, and a close-grained flexible sort chosen. Then ebonite or vulcanite makes a very nice slide or shutter, but it is rather expensive, and comparatively heavy, but on the other hand they are very durable and thin. A third substance which can be used is veneer, in two or three layers, according to the area of the shutter being made. The veneer should be glued

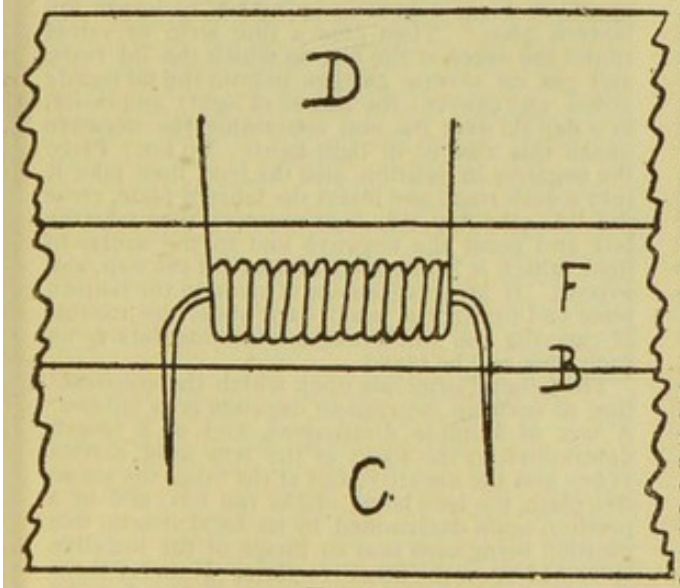


FIG. 2.

together with the grain of the first piece running in the opposite direction to the grain of the net. A good way to join the pieces is to coat the two pieces of veneer to be joined with good glue (a (thinnish coating), and let them dry, then sponge over with a damp cloth or flannel, and bring the surfaces together, applying a hot iron for a minute or so, then put under heavy pressure until dry (a copying press will answer very well if the bed-plate is true). A third sheet may be then applied in a similar manner. Iron is sometimes used—it is cheap, but heavy. As regards the cut-off, an effective, and probably as simple a way as any is as follows, presuming the slide is of the solid type: Two circular holes are made through the top of the solid frame, about an inch and a half from either end—also one in the middle if desired. In these circular holes spirally coiled wire springs are placed, and on either side a velvet-covered strip to act as a cut-off is fixed. The springs always having a tendency to open out, press the cut-off strip outwards from the centre frame toward or against the outside strip which keeps the shutter in place.

21. Dark Slides—TO REMEDY CRACKS IN.—These can be easily obviated by making a cement of a mixture of liquid glue, *fine* sawdust, and whitening. Make the glue in the ordinary way, and not too thick, and when ready add two parts of *fine* sawdust to *one* of whitening. Mix all well together to make a paste (thick), then apply to the cracks with a putty knife (or ordinary blunt knife) and press well in; then wipe off with a clean rag any cement remaining outside cracks, and allow to dry. When dry, rub smooth with sandpaper and re-varnish; or if a piece of thin black silesia or indiarubber cloth is pasted inside over the cracks, they may be filled up either with blackened plaster of Paris or blackened putty, or some other black pigment. Another method is to repair the cracks in slide by making a thick solution of shellac in alcohol (the dregs of negative varnish will do), which must be well rubbed into them with a brush; this does not in any way disfigure the slide. A very useful temporary substitute is a stick of Prout's elastic glue, to be obtained at any grindery establishment; this can be warmed and applied on the inner black portion of slide, and will make it light-tight, but of course the shellac would be the best method for outward appearance. Some other recipes which will be found useful for the purpose are: (1.) Red lead and white lead in equal parts, and squeezed into the crack with a putty knife or palette knife. (2.) Resin 2½ ozs., beeswax ½ ounce, Canada balsam 1 dram. Dissolve with heat and mix, use with heat and press in with knife-blade moistened with methylated spirit. (3.) Litharge mixed with glycerine to consistency of dough. (4.) Litharge 1 oz., plaster of Paris 1 oz., powdered resin 1 oz., and treacle 1 oz.; mix with gold size to the consistency of putty and use. This is a most useful mixture for mending all sorts of cracks or breakages, and will last a long time. (5.) Caoutchouc cement, to be obtained at any optician's will also effect the purpose.

22. Focussing Screen—TO GRIND.—First obtain a small packet of Wellington knife polish. Next, take two jugs—glass preferably—into one of which drop a spoonful of the polishing powder, fill with water, and stir well. Leave it for a few seconds, then pour off the somewhat turbid water carefully into jug No. 2, and let remain till quite clear; pour back the water into No. 1, and repeat the process till a sufficiency is procured. The contents of No. 1 may now be thrown away, and if the deposit of No. 2 be again washed in the same way, there will then remain a very fine powder, which may be safely used without risk of scratches. This can be dried and kept till required. Now for the grinding. On a flat table lay an old newspaper; on this place the glass to be ground, in the centre of

which drop a small pile of the washed emery, and moisten with a dilute solution of sulphuric acid, say one dram to the ounce of water; then, in the right hand, take a small piece of plate glass, and with a circular motion work over the surface to be ground, continuing till a satisfactory result is attained. Add acid, water, and emery as required. The powder which works over the edges can be scraped and used over again till the process is finished. An occasional rinse under the tap will show progress.

23. Ground Glass Screen — How to Obtain Very Fine.— The finest glass used in cameras is not ground at all, but worked with fluoric acid, which gives it a fine mat surface without the deep grain that is found in ordinary glazier's glass. It is impossible to get ground glass so fine as not to show through the focussing glass. It is best to use a clear centre, made by cementing a piece of thin microscopic covering glass on to the ground glass with Canada balsam.

If fine lines are drawn on the mat surface of the glass, either with pencil or ink, and then a thin microscopic covering glass be cemented over them with Canada balsam, it will be found perfectly clear, and if the focussing glass is focussed for the pencil lines, the image will also be seen when sharp. If a larger surface is required, a thin lantern-slide covering glass might be used in the same way, or the following gives a very much finer grain than any ground glass—

Gelatine, or glue	60 grains.
Distilled water...	½ ounce.

Soak for half-an-hour and add

Boiled milk	½ ounce.

Melt by the aid of a water bath, and flow over the glass like collodion, or procure from "Wellington" knife polish the finest particles of emery by decantation, and grind the plain *plate* glass with it moistened with dilute sulphuric acid. With care a beautifully smooth surface is produced.

24. Ground Glass Screen — To Find Substitute for. — Should the ground glass screen unfortunately be broken, and another piece of ground glass not be at hand, as it ought to be, the following dodges will give fair results. (1.) Expose a dry plate of the required size to gaslight for a second or two, then develop until a slight grey deposit is obtained, wash and fix; wash, and when dry the surface will be found admirable for a screen. (2.) If the developing kit is also absent, and there is no glazier near, put a dry plate into boiling water and melt off the film; clean and dry, and then get some putty—if there is no shop whereat to get this, take some tooth-powder and mix it with a few drops of, preferably, boiled linseed oil, or if not this then salad oil, until of the consistency of putty—stick the ends of the fingers in this, and then lightly go over the glass, just dabbing the tips of the fingers on the glass, each time making five marks; go all over like this with the same sort of stippling motion until the glass is lightly but evenly coated. Allow the putty marks to dry somewhat, and then fix in the reversing back. Or if possible get some varnish—hard crystal is the best, but oak varnish thinned with spirit will do—and give the cleaned and warmed glass a thin coat; when dry, rub all over gently with the tip of the finger, previously rubbed on a piece of resin, chalk, whitening, etc. The surface of the varnish will become just abraded, and furnish a screen which, when carefully made, is superior to fifty per cent. of the ground glass to be bought at a glazier's.

25. Ground Glass Screen — To Test Register of.—(1.) Get a straight edge any suitable length and three-quarters of an inch square, and a short wedge made of some kind of hard wood (boxwood, for example) which will retain its angles sharp. An oblique cutting, one and a half inches long, cut off the end of the square ruler, will serve for the wedge. (2.) Take the focussing screen out of the camera, lay it on its back on the table, place the square ruler across its front, insert the wedge (without pressure) between it and the ground glass, then, with a sharp lead pencil, draw a line across the upper side of the wedge, close to the edge of the ruler. (3.) Put a plate in the slide, lay it on its back, and pull the shutter open; then, in the same manner, place the ruler across its front, insert the wedge (without pressure) between the ruler and the plate, and test it first on the centre, then at the four corners. If the registration of the plate-carrier and the focussing screen do not agree, the pencil line on the upper side of the wedge will either stop short of the edge of the ruler or pass under it when the wedge is inserted between it and the plate. A few lines, one millimeter apart, drawn on the sides of the wedge, parallel with its base or side, always placed in contact with the glass, will show how much the plate carrier is out of focus. Plate-carriers with silver wire corners can be adjusted in a few moments by simply bending the wires in or out, according as the pencil line on the upper side of the wedge indicates.

26. Lantern Slide Camera.—To Make.— Assuming that it is required to reduce from half-plate, the best plan will be to proceed as follows: Using a half-plate R.R. lens of 7in. focus (of course, if lens is of a different focal length the exact distances must be determined by experiment between the negative and lens and from lens to lantern plate); but at any rate it may be arranged to make the camera as follows: Make a box 3ft. 2in. long × 7in. × 6in.; one of the 3ft. 2in. × 7in. pieces is hinged on and forms a lid, in one end a hole is cut 6¼in. × 4½in., and a rabbet is cut in the inside ½in. all round; in this the half-plate negative fits, and is held in its place by a small catch. Then measure 25in. from the negative, and here fix two grooves, one on each side, a piece of board is then made to slide into these grooves, a hole is bored in the exact centre and the lens fitted therein. At the opposite end of the box, on the centre of the end piece, place two small pieces of wood 3½in. apart, to form a groove in which to insert the lantern plate. Then glue a thin strip of velvet round the edges of the box on which the lid rests, and put on several catches to hold the lid tightly down, and prevent the access of light; and lastly, fit a flap lid over the end containing the negative (make this also to fit light-tight). To use: Place the negative in position, also the lens, then take it into a dark room and insert the lantern plate, close the lid, also flap lid, over negative, then take the box and point the negative end to the source of light which it is intended to use; lift the flap, and expose. If an arrangement is made in the lantern plate end to carry a small dark slide, the trouble of carrying the whole concern into the dark room each time will be saved.

The general principle upon which the construction of such an instrument depends is as follows: A box of suitable dimensions, and of a length determined by the focus of the lens used, carries at one end the negative, and at the other the sensitive plate, the lens being inside the box, and in a position again determined by its focal length, this position being such that an image of the negative is formed upon the sensitive plate. If under these circumstances the negative end of the box be pointed to any source of light for a sufficient time, a positive image, rendered visible by development, will become impressed on the transparency plate. This latter is, of course, shielded from all light but

that which passes through the lens, and means are provided for varying the exposures. Presuming, then, that the theory has been mastered, the following are practical details. Assuming the lens to be of symmetrical type—*i.e.*, both combinations exactly the same, and of 6in. focus, the correct position in which to place it can be arrived at from the following considerations. Since the negatives are half-plate ones, and it is required to make lantern slides, they must be reduced from 6½ to 3¼, *i.e.*, exactly half lineally. Now, since the lineal dimensions of any two conjugate images formed by a lens are proportional to the conjugate foci themselves, it follows that calling the lesser conjugate focus f, the greater will be 2f. Making use of the well-known equation, $\frac{1}{F} = \frac{1}{f} + \frac{1}{f'}$, and substituting for F, f, and f' the particular values 6, f, and 2f, in this case $\frac{1}{6} = \frac{1}{1f} + \frac{1}{2f}$, and from this f = 9 and 2f = 18. The box must then be of such a length that the distance from negative to transparency plate shall be 18 + 9 = 27in. To make the box, two pieces of deal 27in. × 9in. × ½in. and two others 27in. × 6in. × ½in. are taken and nailed together to form a box open at both ends, brown paper being pasted over the outside to make the whole light-tight. Another piece of deal 8in. × ½in. × 8in. is next planed up, and a hole having been made in the centre of it, the flange is screwed over the hole and the lens placed in position exactly as it was in the camera front. The board carrying the lens is then fixed inside the box in such a position that the diaphragm slit is exactly 18½in. from one end of the box. To save the trouble of having to unscrew the flange each time, it would be well to procure an extra one from the lens maker, and leave this permanently attached to the lantern slide camera. Another piece of deal, 9in. square, is next planed up until exactly half an inch thick: an oblong aperture, one eighth of an inch less all round than a half-plate negative, is made symmetrically in it, and this piece of wood is fixed over that end of the box 9in. from the diaphragm slit of the lens. Another piece of deal, 8in. square, is next planed up until, when one of the transparency plates is placed over it, this piece of wood, *plus* the transparency plate, equals the thickness of the other piece, *i.e.*, half an inch. This piece, which should fit inside the box, is then glued over another piece, 9in. square, so that when the two are placed on one end of the box, the larger piece prevents the smaller from falling through. Four small hooks attached to each of the sides of the box fit into four eyes attached to this movable piece of wood and enable it to be permanently fixed in position. A square 3¼in. in the side, drawn in pencil on the 8in. piece of wood, shows where the sensitive plate is to be fixed. Nothing now remains but to blacken the inside and outside of the box with lampblack, mixed with shellac varnish, and to make two square cardboard caps about 3in. deep, one to fit over the transparency end to keep out stray light, the other to fit over the negative end to expose. To use the instrument, the lens is screwed into position with a suitable stop, and without its cap, and the negative is fixed with four drawing pins over the outside of the 9in. board, the film side facing the lens. The box is then brought into the dark room, and the transparency plate attached, also with four drawing pins, in its proper place, and the board carrying it placed inside the box. Both caps having been put on, the box is brought into daylight, the negative end pointed to the sky, and the exposure made by removing the cap, or, instead of daylight, the negative end may be pointed at a sheet of ground glass, placed a couple of inches in front of a paraffin lamp or gas-burner Instead of using clumsy drawing pins to attach the negative and transparency plate to their boards, spring clips, similar to those used with the microscope, might with advantage be employed.

27. Leak in Camera—To Discover.—Plates are often unaccountably fogged owing to light going through some minute hole in the bellows or fittings of the camera. It is not always easy to discover if this be the case. To do so, erect the camera in the open when a strong sun is shining, put the lens in with the cap on, and the diaphragm slot covered up. Then remove the ground glass, put the focussing cloth tightly round the back frame of the camera, and completely envelop the head in it, tucking it well under the chin. Wait a few minutes until the eyes are accustomed to the darkness, then gradually turn round, so that all parts of the camera are exposed to the direct rays of the sun. If there is any leakage the light will in this way make itself apparent, and the weak spot found out, can be stopped by gluing a strip of leather over it.

28. Camera (Pinhole)—To Make.—Any rectangular box which is perfectly light-tight will do. Make a hole in one end with a needle, and at the other place the sensitised plate. The image is always in focus. The greater the distance the plate is from the hole the larger is the image; and the larger the plate the wider the angle. Expose about thirty times longer than with a lens.

Fuller directions are given as follows: Take an empty cigar box—say 10in. long, 3⅞in. wide, and 3⅜in. deep (inside measurements), cut a hole an inch square in one end of the box, on which to fix the pinhole. The inner sides of the box at the other end are then grooved, to allow the plates to slip in. It is best to have several grooves, so that the distance between the plate and the pinhole can be easily adjusted. Then paste strips of non-actinic coloured paper around the joints of box, and give the inside a coat of dead black paint. On the inside of lid, just where it shuts on to the box, stick three strips of black velvet to exclude light, and along the hinge glue a strip of black calico. The lid is kept fastened by an elastic band over the box. A block of wood, 3½ x 6½in. thick, with a hole for the camera screw, is then glued on to the bottom of the box. Now comes the most important part, viz., the pinhole. Pieces of cardboard and paper, with a minute hole pricked with a needle, thin metal plates, with the hole drilled and countersunk, etc., have been tried, but not one of these methods give a hole the edges of which are free from burr on being examined through a magnifying glass. After these discouraging results, for the burr is fatal to sharpness, the plan was hit upon of making the puncture into a piece of tinfoil with a *red-hot* needle point. This produces a perfect hole. This is fixed over the hole in the front of the box. As regards exposure, a fair *portrait* was obtained in the studio in November with an exposure of three minutes, while equally satisfactory photos were taken with the cigar-box, one in the stndio ten minutes, and the other five minutes (over-exposed) out of doors, both on dull days in November, on Ilford ordinary plates.

29. Camera—To Adapt to Print Stereo Transparencies.—If the negatives taken by the camera are 7½ × 4½ there should be no difficulty, or even with the smaller size, 6½ × 3¼, if the lenses can be brought nearer or further by a right and left-handed screw. But an extra sliding body will be needed, with partition to lengthen the focus, and at the back of the camera a carrier to hold the negative

that will allow it to be moved horizontally or vertically. If these are arranged point the negative to the northern sky if daylight, and to a lamp with condenser if at night, and with a little adjustment there should be no difficulty. If there is any difficulty in focussing or reducing the medial line, place a cheap stereoscope without ground glass base over the ground glass of camera to focus by.

There is also an arrangement for making stereo transparencies, with which the ordinary camera can be used. It consists of wooden baseboard with a box attached, and an adjustable frame for the negatives. The camera is placed upon the board and fixed with the ordinary tripod screw. An additional front board is applied to the camera, provided with an arrangement for opening and closing the centres of the lenses, to reduce the centres of the transparencies (the centres of the negatives being greater).

30. Camera, Stereoscopic—To Construct the Front for.—The best mechanical method of obtaining equal and opposite motion in the two fronts would be a pair of right and left-handed screws on the same axis, working in corresponding nuts affixed to the two fronts, and turned by a milled head from the side. The same object might be attained by a wedge-shaped piece of wood having a rising and falling motion between inclined planes obtained by cutting off the inner and opposite ends of the fronts at a suitable angle. The further introduction of the wedge would separate the fronts, and their automatic approach on its withdrawal might be provided for by means of an elastic band stretched across the wedge from one side to the other.

Take off the usual sliding front, which must slide horizontally, or a similarly constructed camera front must be made with horizontal slide, and make in the camera front two oval-shaped holes for the lenses to work through—oval to allow play both ways—then make sliding front in two halves, each, of course, pierced with round hole for its own lens, so that when both are moved as near together as may be necessary, say lenses 2½in. apart (though this will depend upon the diameter of the lenses), the lenses will just touch the two inner edges of the oval-shaped holes, but will both slide outwards, say ½in. each, so as to bring the lenses to outside edges of the holes, which should be so proportioned as to stop the sliding before the pieces have gone far enough to uncover the inner edges.

31. Camera—How to Adapt for Stereoscopic Work.—If there is no motion this can be managed with the camera as it is, or by a modification of its front to accommodate the use of either one or two lenses. In the first case, it is absolutely necessary to have on the stand an oblong table of wood, about 12in. long, and wide enough to act as a solid basis on which the camera may be shifted through a side distance of from three to four inches. In fact, a base line of the parallactic angle must be secured. A small spirit-level should be mounted on the baseboard or table, so as to keep the camera level in the direction of the shifting. Rule a series of small squares on the ground glass, and select a view in which some objects "stand out." Push the camera to one end of the slide, and focus so as to get some point on a particular part of the pencilled lines. Take the negative, shift the camera to the other end of the slide, and focus so as to get the same point in the view in the same spot on the ground glass (by twisting the camera on its axis, and this, in amount, depends on the distance of the view, being less for greater distance and *vice versâ*). Take the second negative, being careful to use plates of the same batch, maker, etc.; timed as nearly alike as possible and developed together. Trimming the prints from the negatives and mounting them are somewhat troublesome occupations, and are outside the scope of this article. The same object is effected by altering the sliding front of the camera so as to shift or rotate the lens from one side to the other, but in this case a partition is necessary. For views in which there is motion or anything demanding simultaneity of exposure, two lenses must be used, also a partition which, however, need not extend all the way to the front of the camera, but sufficiently far as to prevent light from one lens having access to the opposite compartment. The easiest method of doing this is to attach to the inside of the front of the camera a partition of black opaque cloth, folded like the side of the bellows; this should reach close up to the back of the camera, and, if carefully made, will in no way prevent the camera from being closed up, even when in position; and it may also be made detachable so as to allow of the camera being used for half-plate. If two lenses are to be used, a new front to camera, with apertures for the lenses, should be fitted, the distance between the centre of the apertures being of course 3½in., or the sliding front may be modified by having each lens mounted on a separate sliding portion, so as to vary the convergence if necessary. Obviously the camera front itself must be cut into to accord with the different positions of the lenses.

32. Camera Stereoscopic—To Make Partition for.—Take a piece of cloth as wide as the height of the camera inside, and as long as the longest focus at which lens will be used, fold in a similar manner to one side of the bellows of a camera, only in rather small folds. Attach a strong strip of wood firmly at each end. Make some arrangement for fixing these strips of wood one at the front of the camera and one at the back, just in front of the dark slide. The one at the back is generally made to fit into sockets, cut in the wood; but so much depends on the form of camera that it is impossible to give precise directions. On each side of the cloth partition put two pieces of elastic attached to the tops and the bottoms of the two strips of wood. The object of the elastic is to keep the partition from bulging into either side when a short focus is required. The following description is given of another form made for a special camera. A piece of light tin (zinc, sheet-iron, or even cardboard would also do) was cut to size and shape, having two projections *a* and *b*. Of course, the height will depend upon the size of camera it is to be used in, and the breadth upon the focus of the lenses. This was for a square half-plate camera, and the lenses were of 5½in. focus. The reversing back B was then taken, and two slits *a b* were cut with a fret saw in the exact middle of the longest way, about a ½in. deep. The distance between *a* and *b* in A is just enough to allow it to go into the slits, the notch preventing it going in too far and catching the dark slide. It is then dead blacked. If the camera is not fitted with a reversing back the slits could be cut the same way in the camera back, or else the partition could be cut in height the distance between the folds of the bellows, and two strips 1½in. wide soldered on to prevent it cutting them or tumbling over.

33. Sheaths for Plates—To Make.—Supposing it to be for quarter-plate take a piece of thin sheet tin or iron, and cut it square to size 4¾ x 3¼. Make a mark ½in. from edge down the two short sides and along the bottom, and cut out the two ½in. squares thus made at the bottom corners. Now turn up at right angles the sheet at the mark all round the three sides, then get a piece of band iron a little thicker than the plate, place it inside the tin against the edge sticking up, and knock down

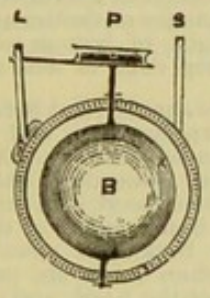
over it the part of the edge sticking up above the iron.

To make sheaths of brass obtain some No. 26 gauge annealed sheet brass, cut this three-eighths of an inch wider than plate, and the same length (an ordinary pair of domestic scissors will do this); next make a template of sheet iron, about as thick as the average plate (that will number on the gauge 13 to 14) and the same size; now with a light hammer beat the edges of the sheet brass over the iron. This is very easy, and this will form a ledge about ⅛in. to clip the plate; slide the sheet iron out, and make as many as required. With the brass being annealed and soft, give it a pinch with the fingers to grip a very thin plate, and a thick plate will open it again with very little pressure. The sheaths must next be cleaned and blacked. Clean them by dipping in nitric acid, and black them by a mixture of hyposulphite of soda 6 drams, copper sulphate 4 drams, and water 20 ounces. Place the pieces in this, and boil until black enough. This black is very durable, and requires no varnish to protect it.

34. Shutter (Blind)—To Make.—A wooden frame is made sufficiently large to admit a blind a shade wider than the plate used, and a little longer than the plate from roller to roller. The blind is of flexible rubber cloth, strengthened at the edges with strips of the same material. The aperture in blind may be from ¼in. to 2in. wide, the narrow one being necessary only for extremely rapid exposures. The edges of the aperture are stiffened by thin strips of cane. With reference to the spring, very fine watch springs, such as are used in very small watches, may be obtained from the watch material shops, or a small screw may be arranged to act as a brake upon the top roller, and so reduce the speed. The speed is regulated also by increasing or decreasing the tension on the spring. The cord-winding arrangement will be found to be the best; it forms an indicator which will show if the shutter is working satisfactorily.

The following also is a modified description of a roller blind shutter, such as may be made by an amateur of a mechanical turn of mind. The dimensions will, of course, vary with the size of camera used, as it is to be used directly in front of the plate. It consists of a wooden roller loose on the spindle, to which is attached the brass barrel containing a small watch spring (this can be obtained second-hand at a watchmaker's for a small sum) attached at its outer end to the case, and its inner end fastened to a hook on a small metal disc fastened on the spindle. The metal spring-case is connected to the roller by two brass plates. The ratchet wheel is affixed to the spindle outside the woodwork of the shutter, and the catch and spring retain it in position. The bottom roller is fixed to its spindle, and on the outside of the case the spindle carries a wheel with two notches for holding the shutter open for focussing and "full closed." The shutter is kept in position and released by means of a catch and spring; there is a winged nut for winding similar to Lancaster tripod nuts. The shutter proper is made from a piece of macintosh cloth, tacked and glued to the rollers with the edges turned over and cemented, and strengthening pieces cemented across the top and bottom of opening to prevent puckering. Instead of using the winged nut for setting the shutter, a cord may be used, attaching it to the lower roller which will have a groove for it to run in. The release also can easily be effected by a pneumatic ball.

35. Shutter (Diaphragm)—To Make.—Most shutters working in the diaphragm slot are patents, some are excellent, and others of no use—in fact, some makers have ceased to supply them owing to their so readily getting out of order There is also a very great amount of skill required in their manufacture, and only very skilled mechanicians, such as watchmakers, etc., would attempt the work. The following is, however, an original idea of a shutter working *within* the lens tube that is not difficult of manufacture. First, turn a ball of sound, hard wood that will just revolve in the lens tube. Place it in the tube, and advance it until it is just, and only just, clear of the smallest diaphragm it is desired to use. Then measure and score off on the outside of the tube the exact centre of the ball. Drill two holes (top and bottom) and mark through on the ball. Then bore a clean hole (equal to f/8) through the ball, and drill and tap the marks scored on the top and bottom, and insert a piece of suitably thick brass wire, tapped to fit about No. 6 B.W.G. is right. Unscrew these, and place the ball in the lens tube, and the wires again screwed into place. A small hole will then have to be drilled through each pivot, just outside the mount (keeping the ball central), and a fine needle inserted and broken off long enough to prevent the ball from rising or falling out of place. The



sketch is a section, B is the ball (the orifice is, of course, not shown, being at the side), the outer circle is the lens tube, S is a piece of wire screwed into the mount to stop the extension piece of P, which is liberated by pulling the lever L; a piece of fine cord is put through a small hole at the top of L (which is a piece or strip of brass, loosely screwed to a block shown attached to tube, so as to form a hinged lever); P is a pulley fastened to the brass pivot with a hole drilled in it. Thread a piece of rubber through this and fasten; then pull the rubber taut, and wrap it round P two or three times, and fasten the other end to a suitably placed hook on the front of the camera; the action then is—pull the cord attached to L (the pressure of the extension of P, due to the strain of the rubber, is quite sufficient to keep L upright when the shutter is set). This liberates P extension, and it flies round and is stopped by S, which can be covered with a bit of rubber. This carries the ball round, and, of course, allows the f/8 orifice to admit the light to the plate during its excursion. If desired, a pneumatic release can be attached to L, and the speed can be regulated by strength of rubber, and also by a slot in P, and fitting a piece of cardboard in—the larger the piece the greater the resistance and the longer the exposure, and *vice versâ*—the final finish being a piece of velvet stretched on holder and inserted in *front* of the ball shutter in lens tube, and a f/8 opening cut in the velvet, the pile of which can *touch* the ball, and will make it perfectly light-tight.

36. Shutter (Simple)—To Make.—The simplest shutter to make is a drop-shutter, which is made as follows: Get two square pieces of mahogany, ⅛in. larger each way than the diameter of hood of lens. In both of them cut a hole large enough to fit tightly on the hood of lens. Another

piece of wood is now required about three and a half to four times the length of the other two × ½ larger than hood of lens × ⅜in., and two strips the length of the first two × ½ × a little thicker than ⅜in. The first two pieces are now placed one over the other, with the last two strips between at the edges, and some ½in. fine screws put through, holding the whole together. The dropping-piece should now slide easily up and down the hole between the two first pieces. A screw should be put through the top of the dropping-piece to prevent it from coming clean out when used. The aperture should then be cut in it, a little less in width than the diameter of hood, taking care to leave enough on each end to well cover the lens when set for use or after use—a simple release can easily be attached. If required to work quicker, almost any speed can be got by slipping a rubber band or bands over the screw at top of dropping-piece, and a pin on body of shutter. The duration of the exposure can be calculated from the formula:

$$\text{Time in secs.} = \cdot 072 \left\{ \sqrt{h + d + a} - \sqrt{h} \right\}$$

in which a = diameter of lens aperture
d = diameter of shutter aperture
h = height of bottom edge of shutter aperture above top edge of lens aperture.

The following is another, and is capable of giving long or short exposures at will. It is on the window blind shutter principle. A shallow box is made slightly over three times the length of the diameter of the lens hood, and 1in. broader, and having apertures in the middle of the two opposite faces (front and back). A piece of thin india-rubber cloth is then taken six times the length of the diameter of the hood, and sewn, or better cemented, at the ends, so as to make a band, the width being ⅞in. broader than diameter of hood. Lay the band flat, and at the bottom and the other top corner attach strings. Then again laying the band flat so that the strings are in the middle of its length, cut out two circular holes the size required, so that the holes coincide when the strings are level in the middle. Drive two stout knitting needles at top and bottom of the box to take the band somewhat tightly stretched, and attach to hood of lens; by pulling one string the band is pulled round, and the holes pass each other in the line of the centre of axis of lens; by pulling the other they again pass, but in the opposite direction. Of course, the top and bottom of the box must be covered, and holes made in the bottom for the strings to pass through.

A simple rebound shutter may be made thus: Taking the measurement of the hood of the lens outside as 1in. in diameter, the following pieces of wood will be required: (1) One piece $\frac{3}{16}$in. thick, 3½in. long, 1½in. wide; (2) one piece $\frac{3}{16}$in. × 1½in. × 1½in.; (3) two pieces 3½in. × ½in. × $\frac{3}{16}$in.; (4) one piece 1½in. square, ½in. thick; (5) one piece 1½in. × ⅞in. × ½in. Cut a piece of each of the two pieces (3) $\frac{3}{16}$in. in depth and ⅞in. in width out of the broad side, leaving the pieces the shape of an **L**. Cut a circle 1in. in diameter in the centre of piece 1 and ⅞in. from one end. Cut a circle 1in. in diameter from the centre of piece 4. Screw the two pieces (3) and piece 5 to the edges of piece 1 in such a way that the longer pieces form grooves down each side, and piece 5 forms a stop at the end nearest to the opening for the lens. Screw 4 on to the opposite side to that on which the grooves are to fix the hood of the lens into. ½in. from the top of the grooves screw a small brass ring on each side. At one edge of piece 2 screw another brass ring, also a small catch for a release at the opposite end. Put piece 2 (the shutter) in the grooves with the ring uppermost. Round the two first rings stretch an indiarubber band, draw the *top* side of this down over the ring on shutter, release the catch, and the shutter will fly up as far as the band and be immediately shot back again.

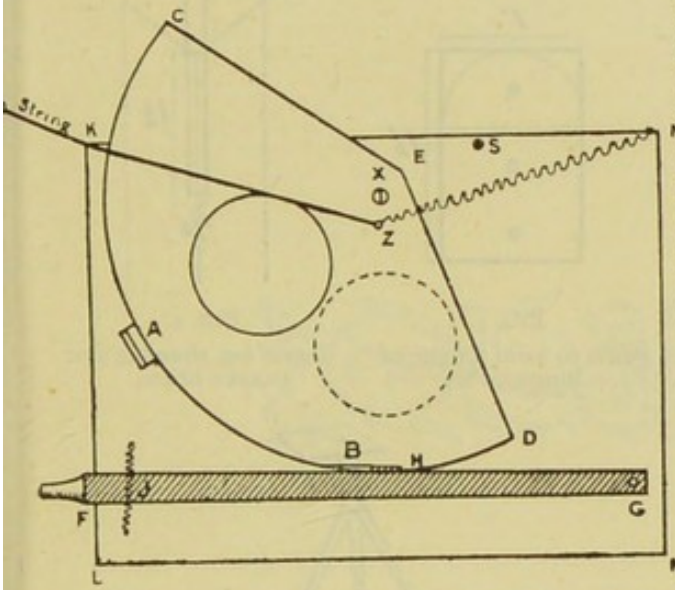
37. Shutter—To Adapt to Stereoscopic Work.—Any good shutters with pneumatic release can be adapted to stereoscopic work. Take a Y-shaped piece of brass tubing which will fit inside the rubber tubing of the release. Join the two top arms of the Y with the two tubes from the shutters (these tubes must be of the same length and cut off from the bulb), and join the other arm with a tube connected with the bulb. By squeezing the bulb now, the shutters will work synchronously.

38. Shutter (Studio)—To Make.—First, make what may be best described as a wooden box 3in. square and 1in. deep with a hinged lid attached to it. This is to form the shutter and the lid will be the flap. Make it out of $\frac{3}{16}$in. mahogany, and in the bottom of the box cut a circular aperture 2$\frac{3}{16}$in. in diameter, and around the edges of this aperture glue a strip of velvet so as to make it fit well on the lens. Now on one side of the flap fix a small metal plate about an inch long, and let it project about half an inch over the edge of the lid. On the same side of the box as the metal plate is fixed, fasten a steel spring in such a manner that it exerts its pressure on this metal plate, and with sufficient strength in it to drive the flap in an upward direction. If the spring is only made just long enough to reach the metal plate, it will not interfere with the flap when falling downwards. Now fasten a stout piece of string to the opposite side of the shutter, and secure its other end to the edge of the flap. The string should be just long enough to allow the shutter, when released, to fully open itself, but no more. On the bottom of the shutter fix a small lever catch, in order to hold the flap in position before exposing. The pneumatic release may now be fixed to the bottom of the shutter in such a position that, when the ball is pressed, the pin of the release will press the catch and release the shutter. A screw should be put in the top of the shutter, so that it may be quite firm when on the lens. Now paint the inside of the shutter dead black, and it is complete. The shutter should be placed on the lens with the hinged side upwards. It may be placed either in front of the lens or inside the camera. When the rubber ball is pressed, the catch is withdrawn from the flap, and the spring then drives the flap upwards to the full extent of the string, when it is checked and falls by its own weight. Very quick exposures can be given with this shutter, and its speed can, of course, be regulated by the strength of the spring.

Another somewhat more complicated may be made by anyone of mechanical tastes. First cut a piece of hard wood 3in. square and ½in. thick. In centre of this bore a hole to fit the hood of lens. Then make strips of brass, one 3in. long and ⅞in. wide for bottom, and two for sides, each 3½in. long and ⅞in. wide. Screw these on wood, leaving ⅛in. projecting on one side. Then get a round or square rod of brass 3¾in. long and $\frac{3}{16}$in. thick. File or turn down a shoulder one end for ¼in. and other end for ⅛in.; drill hole in ends of side strips to fit these shoulders. Cut a flap of thin brass or zinc 3in. × 3$\frac{3}{16}$in. and solder this on the rod, filing up one side of rod flat if necessary. Turn up a piece of brass in which are cut two notches, and solder this on projecting end of rod. In lower part of side of shutter fix one or two thin screws projecting ⅜in. The release is made of thin hard brass 3½ × ⅝in. wide. Cut two slits in this ⅛in. deep and ⅛in. apart, and turn up the bit of brass between

at right angles. Screw the stop at one end of lower part of shutter, the other end projecting ¼in., the bit of brass turned up will keep the shutter flap down. The pneumatic release consists of the usual ball and tube. This is fitted to a bit of brass tube, the end of which is covered with thin sheet rubber. This forms the valve. A small brass bracket is screwed at side of shutter and carries this valve, the indiarubber end of which touches end of spring release. To set the shutter, an india-rubber band is put over outer pulley through lower notch, round back pulley, then through upper notch and down to projecting screws. On squeezing the ball the flap flies up and then down again, giving an exposure with one band of from one-fifth to one-tenth of a second. With two or more bands a much shorter exposure is obtained. This shutter can easily be fixed inside the camera if preferred. This shutter has stood the test of experience, and given satisfactory results.

39. Shutter (Time and Instantaneous)—To Make.—First procure an oblong piece of wood K L M N, preferably of mahogany, for the base of the shutter, measuring, say, 4in. × 3in. × ½in., plane it smooth, and cut in its centre a hole, as shown by the dotted line in the figure, with a diameter slightly larger than the stop, if for a view lens, or than the front combination in the case of an R.R. being used. In this case, for simplicity, let it be 1in. in diameter. Now, cut out



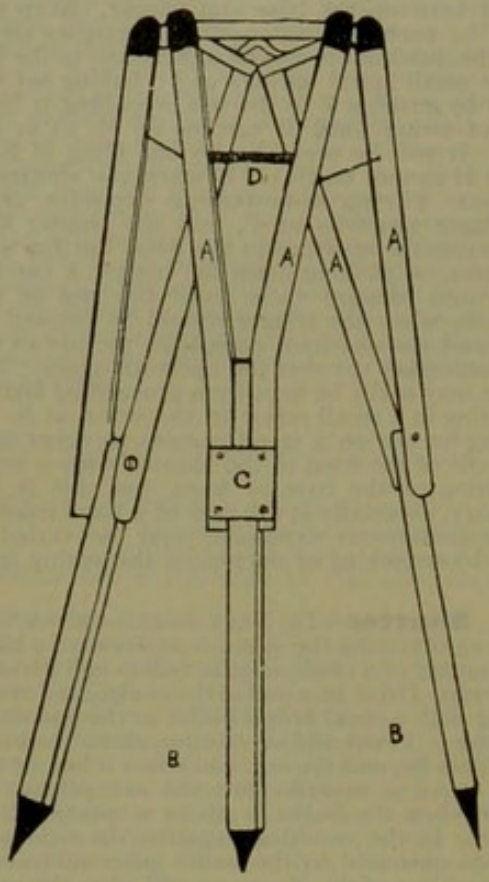
of thin brass plate a quadrant, as C E A D in the figure, with a radius of 2½in., and the arc C A B D being from five to six times the length of the 1in. aperture. Drill a hole X about ¼in. lower down than E, and half-way between A and X and C and D cut out a circle with a diameter of 1in. to correspond with that in the base. In cutting out the brass quadrant leave two small tongues A and B, A being ⅜in. and B ¼in. long, so that A is directly below the centre of the aperture in the quadrant, and B is 1in. from D. Turn up these two tongues at right angles, taking care that the bottom edge of A is at least ¼in. lower down than B, and pivot the brass quadrant to the base by a screw through X, taking care that it can swing easily. Now screw a small pin *Z* into the brass, and another into the wooden base at N, and fasten one of the two ends of a small brass spring or loop of an elastic band to each pin, taking care that the spring is always under tension in whatever position the quadrant may be. The only remaining part now to be made is the trigger. Cut this 4in. long out of thin brass, leaving a projecting tongue H half-way along, and turn it down at right angles as A was made before. Pivot the trigger at G to the base-board, keeping G about ⅜in. away from the base by a spiral spring along the screw by which it is pivoted between the base and trigger. Keep the trigger in such a position that H catches on B when the quadrant is moved sufficiently to the left by two small spiral springs at J; having set the shutter by pushing *Z* to the left or pulling it by a piece of string until B catches on H, as in the figure. It will be seen that by the filing of B to the left H cannot catch on B when the shutter is being set. For an instantaneous exposure, press the trigger upwards at F, and the shutter flies right across the aperture in the base, but for time exposures, on pushing *down* the trigger A catches on H, and remains there until the end of the exposure, when the trigger should be pressed up again, and the quadrant completes the arc of the circle necessary to cover the aperture again. The shutter may easily be kept from proceeding farther by putting in a small screw in the wood at S. It is better for use on a stand camera to cover over the whole of the front of the shutter with a small box fitting on the base in front, but this is not necessary, especially in the case of a hand camera. The instantaneous exposures may be varied in length by stretching or slackening the spring from *Z* to N.

40. Shutter—To Test Speed of.—A very easy way of testing the speed is to draw on a black board an arc of a circle of 39in. radius and divide it into 100ths. Drive in a nail at the centre, and attach a string with a small *bright* bullet at the end (in all 39in. long). Focus and set shutter, cause the bullet to oscillate beyond the arc, and when it has slowed down so as to describe just the arc, release the shutter when the bullet is about a quarter down the arc. In the resulting negative, the number of divisions obscured by the bullet (after subtracting the equivalent of the diameter) will give the speed in $\frac{1}{100}$ths of a second. The bullet will be at nearly its average speed when it is between a quarter and one-sixth of the arc, as it is stationary at the end and quickest at the half of the arc. Of course the board must be placed in a vertical plane when the bullet is set oscillating.

41. Tripod—To Make.—An excellent tripod can be made as follows: For each leg take three pieces of ash ⅝in. × ½in., planed up smooth, two pieces of which should measure 32in. long (AA), and one piece (B) 29in. long. Lay all three pieces ½in. way upwards, placing five inches of the bottom between the top ones (AA). Now four inches from the bottom of AA bore a hole right through the three pieces of wood, and fasten all three together with a small bolt, and let a two inch brass plate in (C) flush with the wood. Near the top (D) a small brass strut is fixed on the inner side of tripod, which slips into a hole on the opposite side. Holes must be made in the top of A for the tripod head to fit on. A brass head, brass plates, and protectors for the bottoms of the legs may be obtained of apparatus dealers at a small cost. If well fitted together and varnished, this makes a rigid and nice-looking stand, which can easily be folded up and strapped together for travelling.

A cheap and serviceable stand may also be made thus: Having procured three broom handles, as free from knots as possible, saw them about three parts of their length down the centre. Insert a screw just below where the cut is made to prevent splitting, then procure six small brass plates, shape of a dome, with three small holes. Two bottom ones are screwed inside leg, top one to take pin of triangle. Then taper ends of each leg with spoke-shave or plane to give them a little shape, insert

screw at bottom of each, file off heads to prevent slipping. Then cut out triangle from a hard piece of wood; when done, insert a screw each side of triangle, filing off heads of screws, then give all a



rub up with glass-paper, stain, and varnish. When done, a strong and serviceable tripod, fit for any reasonable sized camera, has been produced at the bare outlay of one shilling.

42. Tripod, Walking Stick—To Make.—Take three pieces of wood, 3ft. 6in. long and 1in. square, mark the ends as in fig. 1 (which is half size), and plane off the pieces occupied by the angles of 30°, so that the three pieces when put together will fit. Now take off the sharp corners, and taper down until the ends form a circle when put together. Now take another piece of wood, about 18in. long and 1½in. square, turn or plane off the corners, so as to make it round, and drive on to one end a brass ferrule, 1in. deep. Round this and through brass and wood cut three slots at equal distances from each other, and meeting in the centre (fig. 2), the slots to be ½in. deep and ⅜in. wide. Through brass and wood drill holes at right angles to each slot, to take pins to form hinges for the legs. Take three pieces of sheet brass (fig. 3), ⅛in. thick, and each 1½in. long by 1in. wide. In the thicker ends of the legs cut a slot, as in fig. 4, 1in. deep, insert the piece of brass, and drill two holes through wood and brass, and rivet. Now round off the end of projecting tongue of ½in., and insert in one of the slots in the ferrule; mark position of hole, and drill to just fit the pin without shake. Do the same with the other legs and fit on to the handle—so to speak—of the stick, and plane down to size. For the top of the stand employ either a small square piece of wood, say 3in. square, with a hole for the camera screw 1in. from one side on the meridian line, and itself screwed to the handle of the tripod at 1in. from the opposite side, or make a wooden hunting cross handle, of size equal to wood used, *i.e.*, 1½in. in diameter, and flattened at the top. This, however, will not be anywhere near as steady as the square piece. At the end of the legs either put on iron ferrules or screw in screws, and file the heads to a point.



Fig. 1.
End of leg.

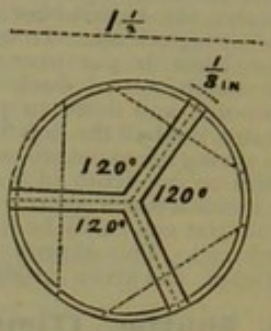


Fig. 2.
End of ferrule, showing how slots are to be cut and holes drilled to take pins.

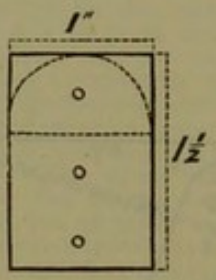


Fig. 3.
Brass to form tongue of hinge for leg.

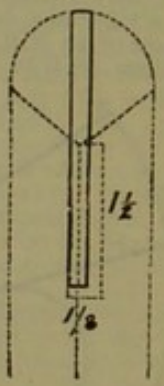


Fig. 4.
Top of leg, showing slot to take brass.



Fig. 5.
Sketch of tripod complete.

Another one is made of three equal lengths of light brass tubing, the largest ⅞in. to 1in. in diameter, the next a size smaller, and the next a size smaller than that, so that they will all slide one inside the other, as section at A, the length depending upon the length most suitable for the user. A ferrule cap will have to be fixed upon the bottom of the largest to prevent the others from dropping out when used as a walking-stick. Now for fixing to tripod top, take each tube and make two saw cuts 1½in. long down the tube. The two pieces of metal are then sawn out, leaving the top with two tongues. A hole is then drilled in the two tongues of metal 1½in. from the top. The top may be the ordinary hard wood top, the three projections being made to slip inside the places cut out

of the tubes; a hole is also drilled through each, so that a small bolt and nut can be put through the lot, making it secure; or three pieces of wood can be screwed to the bottom of the camera in the proper positions, and a bolt and nut put through the whole as before. To finish off the walking-stick the outer tube should be japanned bright black, add a knob of ornamental wood. The bottom part should be turned to fit inside the inner tube, a small hole drilled through it, and a slightly taper peg put through the holes in the tube, and this holding all together, and yet being quickly removed for setting up.

The following is given as the specification of a simple walking-stick tripod: Material, ash; height, 36in.; diameter at top, 2½in.; diameter at bottom, 1½in. Description: Stick made in three pieces, fitting each other accurately, and capable of opening or closing by means of a ball and socket joint at the top. The top of each piece carries a segment of a screwed ferrule, and the bottom of each carries a similar segment, and is provided with a spike. Two caps screw over these segments when the stick is closed. Top of ball and socket joint provided with a ⅜in. projecting screw, fitting into brass piece sunk into baseboard of camera. Into the top of each of the legs slides a ¼in. × 6in. hinged steel bar. These bars pull out when stand is opened, and serve to support baseboard of camera, acting like the usual triangle.

CHAPTER II.

CHEMICAL (WASTES, STAINS, ETC.)

43. Acid Solutions — To PRESERVE.—Fungoid growths may best be prevented by the addition of a minute quantity of salicylic acid, say one or two grains to the pint of solution.

44. Alabaster Solution—To MAKE.—Any of the following will serve to give a white backing to a glass negative: (1.) Sulphate of barium ground fine, and incorporated with a thin solution of gelatine to consistency of cream, and the glass coated with it. (2.) Sulphate of baryta ground fine, and shaken up with plain collodion. (3.) Chinese white or flake white used with either gelatine or collodion. Just a touch of Vandyke brown will produce a creamy white with the above. In order to produce a positive suitable for backing, the negative must be very thin, not veiled in the high lights; in fact, as near a thin lantern slide as possible, and then coat it with the white *on* the film. To prepare the sulphate of barium in a fine state of division add to a weak solution of barium chloride a weak solution of some sulphate, say zinc, a few drops at a time, with shaking. Collect and wash thoroughly the precipitate. If to be used with collodion it had better be dried.

A saturated solution of mercuric chloride will whiten a negative, but the following *modus operandi* is better: Give a short exposure (about one-fifth of that requisite for a good negative), develop with well-restrained ferrous oxalate, stopping development when detail is all out and shadows unclouded, wash off developer, soak in alum, fix, well wash and bleach in iodine 2 grains, potassium iodide 2 grains, water 1 ounce. A short immersion in dilute ammonia serves to remove the last traces of iodine.

45. Alkalies—Relative Proportions of—HOW TO CALCULATE.—In the *Bulletin de la Société Francaise de Photographie* the results of some scientific experiments on hydroquinone and the alkalies employed in development are published, and the proportions of the various alkalies are given as follows: Caustic soda ·2353 part, caustic potash ·33 part, potassium carbonate ·4064 part, crystallised sodium carbonite ·8411 part. For practical purposes the proportions may be set down as follows: 3, 4, 5, 10½ respectively. So that in the developing formulæ 100 parts of caustic soda may be replaced by 133 of caustic potash, 167 of carbonate of potash, or 352 of crystallised carbonate of soda. According to O. G. Mason, the proportions are—Caustic soda 80 parts = carbonate of soda (crystallised) 286 parts = caustic potash 112 parts = carbonate of potash 165.

So far as the acetates, carbonates, and phosphates of these metals are concerned, there is but little or no difference in their action in the toning bath. One reason, however, why sodium salts are usually preferred to potassium salts is that the former possess greater chemical activity, *i.e.*, sodium will do more work than an equal weight of potassium. Their chemical energies are in the ratio of Na : K : : 23 : 39. Another reason is that the sodium salts are usually cheaper than those of potassium. Compare the following prices of the principal toning agents:

Na.	K.	
6d.	3s. 6d.	Borate per lb.
4d. or 8d.	1s. 6d.	Acetate ,,
6d.	4s.	Phosphate ,,
8d.	4s.	Carbonate ,,

This may be traced to the fact that the natural sources of sodium compounds are much greater than those of potassium.

46. Allyl-thio-carbamide for Reversal—To PREPARE.—Col. Waterhouse has published instructions as to the preparation of Allyl-thio-carbamide which are quite simple. He says, add four parts of the strongest liquid ammonia to one part of essential oil of black mustard. As soon as the ammonia has taken up as much of the oil as it will, the solution may be decanted off and the ammonia allowed to evaporate. Of the solution thus obtained about one part in one hundred parts of the mixed developer recommended (Dr. Nichol's eikonogen developer formula) is sufficient to produce reversal in development. A little bromide may be added. As the solution has a most unpleasant smell it is advisable to evaporate it, and obtain the thio-sinnamine in a crystallised and odourless form. Of the saturated solution of the crystals from half to one part to one hundred of the developer is enough.

Col. Waterhouse states, in a further communication, that tetra-thio-carbamide ammonium bromide compound salt gives better results than the plain thio-carbamide. The following directions are given for preparing this latter salt: Heat ammonium sulphocyanide to 140° C. It alters in constitution, and the NH_4CNS becomes $CS(NH_2)_2$, mixed, however, with some impurities, chiefly guanidin compounds and unaltered ammonium salt. To remove these, pulp up the mass with its own volume of water, and dry it on blotting paper or on a porous slab. To purify, further dissolve and crystallise out from hot water. To make the double salt with ammonium bromide $(CSN_2H_4)_4$ NH_4Br, dissolve in boiling alcohol three parts of sulpho-urea, and one part of ammonium bromide. Keep boiling for half-an-hour, when on cooling the double salt will crystallise out. See *Journal of the Chemical Society* (2), 7, 1.

47. Argentometer—How to Use.—The argentometer or hydrometer is divided up the stem from 0° to 80°, and shows the number of grains of silver to the ounce of water by the degree at which it floats. Thus in plain water the surface of the liquid cuts the scale at 0, but when there are thirty grains of silver to the ounce of water the scale floats at thirty, and so in proportion for other points. To use the argentometer, take a glass test tube about eight inches long and an inch in diameter. These are made for use with argentometers, and one should be got. Fill to within a couple of inches of the top with the silver solution, and float the argentometer in it. It will sink lower the weaker the solution is, and the strength can be read off from the scale at the edge of the solution. It should be remembered that the argentometer only gives the approximate strength, as the silver bath after use contains alkaline nitrates, and frequently organic matters, which, of course, alter the specific gravity. It should, however, be pointed out that the indications of the argentometer are in many cases unreliable, owing to the fact that the albumen, ether, alcohol, alkaline nitrates, etc., taken up by the bath during use, alter its specific gravity independently of the alteration due to the removal of the silver nitrate by each plate or sheet of paper. On this account it is recommended to exchange it for a small *burette* graduated into minims, which can be used to estimate *accurately* the quantity of silver nitrate in a solution in the following way: Begin by drying some good white table salt in the kitchen oven, and when quite dry, weigh out 345 grains of it into a ten-ounce measure, and fill this up to the mark with distilled water. Now, with the burette, measure out one hundred minims of the bath into a small wineglass, and having rinsed out the burette, fill it up to the mark with the salt solution, and let this fall drop by drop into the silver nitrate. As each drop falls, a precipitate will be seen to collect, and the salt must be added until no further change takes place. Shake the mixture after each drop, and let the liquid settle for a few minutes. When the liquid above the precipitate appears bluish-white, it is a sign that the reaction is nearly complete. Having in this way added just enough common salt to precipitate all the silver, it is only necessary to read off how many minims have been used, which number gives the number of grains of silver nitrate in an ounce of the solution taken for analysis.

48. Blacking Brasswork—Best Means of.—First method: Clean off the old black with fine glass-paper and polish with tripoli; then use the following preparation: Dissolve forty grains of silver nitrate in one hundred minims of distilled water; also dissolve forty grains of copper nitrate in one hundred minims of distilled water; mix the two solutions. Dip the stops in this mixture and let them dry. When dry they should be heated on a sand bath until they assume a fine dead black colour. A simple method is to make lamp-black into a paste with gold size, and add just sufficient oil of turpentine to make it thin enough to use with a camel-hair brush, then paint the stops with it. Also either of the following may be used with the greatest chance of success: (1) Make the diaphragms quite clean, and apply a mixture of solutions of nitrate of silver and nitrate of mercury, and then heat, wash in warm water and dry; or (2) apply, by dipping in or painting, a hot mixed solution of chloride of platinum and chloride of tin (stannic chloride), and heat as before. Success depends on the metal being quite clean and on the temperature of the solution and the metal to be stained. Another method is to dip the diaphragm into a strong solution of ferric chloride (perchloride of iron), or paint it with a camel-hair brush dipped in the solution. Allow it to dry, and then dip into or paint with a strong solution of tannic acid. Repeat if necessary.

49. Blacking for Steel Sheaths—To Make.—A dead black stain for metal can be made as follows:

A	
Nitrate of silver	4 parts.
Distilled water	10 ,,
B	
Nitrate of copper	4 parts.
Distilled water	10 ,,

For use take equal proportions of A and B, mix together, and then dip in the metal, which should have been previously well cleaned. Let the metal remain in the solution for about ten minutes, remove, and allow to dry. When dry heat on a sand bath until a deep dead black colour is obtained. A varnish for the same purpose may be made of a spirit varnish, with lamp-black added. Almost any spirit varnish will answer most purposes, but an ordinary shellac negative varnish is the best, as it gives a hard tough film which dries without tackiness. A sufficient quantity of lamp-black or drop-black is taken, mixed with the shellac varnish, and if too thick, methylated spirit is used for thinning. Too much varnish must not be used, or it will dry glossy, but it is impossible to give exact proportions, as different kinds of varnishes will require different quantities of lamp-black, but the following may be taken as a guide:

Shellac varnish (1 ounce shellac, spirit 6 ounces	7 ounces.
Lamp-black	2 ,,
Alcohol (methylated spirit) ...	1 ,,

Grind up the lamp-black in the ounce of methylated spirit, then mix well the varnish and shake well. If the shellac varnish has been previously filtered, a very fine black varnish will be obtained suitable for blackening lens, mounts, camera interiors, etc. To coat the sheaths, they should be first slightly heated before applying the varnish with a broad brush. If the metal is very smooth, it may be improved, for varnishing purposes, by first heating it thoroughly in the gas or fire, in order to roughen the surface so that the varnish will adhere more firmly.

50. Blotting Paper—To Make Chemically Pure.—Ordinary white and coloured blotting papers contain notable quantities of sulphites which have not been perfectly washed out of the pulp before passing to the machine. These bodies are added to the pulp after bleaching to get rid of the smell of chlorine, hence they are called "anti-chlors," and generally consist of sulphites and bi-sulphites of soda. Their presence in papers which are used to dry photo prints is fatal to permanent results. It therefore behoves us to discard the use of common papers for such purposes, unless specially treated to remove such impurities. The following tests will enable anyone to judge as to the suitability of the various papers offered. *Acidity:* Take a piece of the paper, six inches square, place in a saucer, and pour over it distilled water, and work about with a glass rod for five or ten minutes. Now take a blue litmus paper or a little tincture of litmus and test extract, when if either turn red it shows presence of acid. Divide the extract into two parts; to one add a few drops of nitric acid, then nitrate of silver solution, when, if a white curdy precipitate is formed, it proves the presence of hydrochloric acid or chlorides. To the second

portion add a few drops of hydrochloric acid, heat to boiling in a test tube, and add a solution of barium chloride; a white precipitate indicates the presence of sulphuric acid or sulphates. *Sulphites:* Take another piece of the paper, same size as before, and extract with water, and divide solution into two parts; now prepare a solution of starch, made by boiling four or five grains of starch with an ounce of water; allow it to cool. Get a little tincture of iodine, and dilute it five or six times with water, then mix equal parts of the starch solution and the dilute iodine solution, when an intense blue colour is produced; add a drop of this blue compound to one of the water extracts of the blotting paper, when if sulphites be present the colour will be instantly discharged. Add to the remaining portion of the extract a few drops of silver nitrate solution, when a black precipitate will be formed on heating, if any sulphites or hypo-sulphites be present. To free blotting paper from all impurities likely to injure silver prints, place the paper in a large developing dish, and flood with boiling water three or four times, then with a dilute solution of carbonate of soda, and again with hot water, washing free from soda; hang the paper up to dry. When dry it is ready for use. The best to use is what is called Rhenish filter paper, made by Schliecher & Schüll, in two qualities, Nos. 595 and 597, at 1s. 6d. and 2s. 6d. per quire, it being free from all impurities, and may be obtained from any dealer in chemical apparatus.

51. Bottles—To Label.—Mix pyrogallic acid and sulphate of iron in equal parts. This will form an intense black ink that nothing will bleach, while the application of a little varnish over the whole label will prevent it from being affected by moisture.

Another indestructible and non-corrosive ink may be made as follows:

Oil of lavender	1 ounce.
Powdered copal	1 drachm.
Lamp-black	6 grains.
Indigo	2 ,,

Dissolve the copal in the oil with gentle heat, then add the lamp-black and indigo.

52. Bromides—How to Use.—Bromide of ammonium is slightly more powerful in restraining action than potassium bromide, the proportion is as 98 : 119; that is 98 grains of ammonium bromide have as much restraining power as 119 grains of potassium bromide. Consequently, to find how much potassium bromide to substitute for 120 grains of ammonium bromide in a formula, all that has to be done is to work the following sum:

As 98 : 119 : : 120 grains : 145⅝ grains. Ans.

But for all practical purposes potassium bromide may be assumed to be the same as ammonium bromide, as when we come to two or three grains the difference would be inappreciable. Practically, also, the potassium salt is the best to use, as the ammonium salt is liable to decomposition, which, of course, throws the weight to be used different.

The following is a short *précis* of an article by C. H. Bothamley on "Bromides" in the *B. J. Almanac*, 1890:

(1.) If the alkali used be *ammonia*, the bromides can be used indifferently, taking, however, equivalent proportions—thus:

	Potass. brom.	=	Ammon. brom.
Parts	1	=	0·82
	1·22	=	1

(2.) If, however, the alkali be sodium or potassium carbonate, while potassium bromide is unaltered, ammonium bromide is decomposed into ammonium carbonate and sodium or potassium bromide, and in presence of water the ammonium carbonate becomes ammonium-hydrogen-carbonate, and free ammonia is liberated, and this free ammonia almost entirely neutralises the restraining action of the bromide present. The following equations will represent the respective reactions:

I.

Am. brom. + Sod. carb. = Am. carb. + Sod. brom.

$2\,NH_4Br + Na_2CO_3 = (NH_4)_2CO_3 + 2\,NaBr.$

II.

Am. brom. + Pot. carb. = Am. carb. + Pot. brom.

$2\,NH_4Br + K_2CO_3 = (NH_4)_2CO_3 + 2\,KBr.$

And am. carb. in presence of water gives am. hyd. carb. + ammonia.

III.

$(NH_4)_2CO_3 + Water = NH_4HCO_3 + NH_3 + Water.$

So that the conclusion to be deduced is, if the alkali be ammonia, either of the bromides (in their equivalent proportions) may be used. If the alkali be an alkaline carbonate, potassium bromide should alone be used.

53. Bromide Emulsion (Old)—To Utilise.—Treat the emulsion with a mixture of ether and alcohol in order to remove the collodion. This operation can be carried out in a large stoppered bottle; after the alcohol and ether has been added shake vigorously for a few minutes, then let the bromide settle and again shake. This should be done several times; finally pour off the ether-alcoholic solution of collodion into another bottle. By successive treatments all the collodion will be dissolved out, leaving the silver bromide, which may be mixed with charcoal powder and bi-carbonate of soda, and heated in a crucible in order to reduce it to metallic silver. This is dissolved in nitric acid, giving nitrate of silver. An alternative method for the conversion of the silver bromide into chloride may be used. After the collodion has been separated treat the bromide with *strong* nitric acid, which decomposes the bromide, then dilute with water, and evaporate to near dryness, add more water, and repeat evaporation until all free nitric acid is removed. A solution of nitrate of silver is thus obtained, from which chloride of silver may be precipitated. By evaporating off some of the alcohol from the separated collodion it can be concentrated to the required strength for making a collodio-chloride print-out emulsion, to be used along with the nitrate of silver obtained from the separated bromide. Another method is to get rid of the solvents and of the pyroxyline. Distil off the solvents, either allowing them to escape into the air or collecting them by means of a Liebig condenser, as most convenient. Place the residue in a parcelain crucible, moisten with nitric acid, and heat until the acid has evaporated. If the heat be now increased so as to raise the crucible to redness, the pyroxyline will burn quietly away without any explosiveness, and will leave behind what is practically bromide of silver.

54. Camera Case—To Stain.—The usual brown colour is caused by tanning the canvas, to render it more durable. The method is as follows: Boil eight ounces of tan in one and a half gallons of water down to one and a quarter gallons, and pour the liquor while hot upon the fabric to be tanned, and let it remain forty-eight hours; then take the fabric, rinse in cold water, and dry. The above quantity suffices for about a yard of canvas. It may be dyed as follows: Soak the case first in a solution of picric acid till dyed yellow, and dry. When dry, work about for thirty minutes in a decoction of ½lb. of lima wood and two ounces of logwood, in sufficient water; after which remove to a solution of one ounce alum in one gallon of water, and work for fifteen minutes, then wash and dry. Before dyeing, the canvas

should be washed with soap, to free it from grease, oil, etc., that may have accidentally got on it.

Another method. White canvas may be *dyed* a good buff by leaving it for twelve hours in a solution of ferrous nitrate, and then transferring it to a hot solution of caustic soda. Both solutions should be of the strength of an ounce to the gallon. A more brilliant buff may be obtained by first mordanting the canvas by dipping it in a weak solution of sodium phosphate, then drying it, and re-dipping it in an aqueous solution of four parts naphthol yellow and one part blue shade eosine. A golden brown can be got by using Bismarck brown, a flesh colour with two parts methanyl yellow and one part phloxine, and a straw colour with naphthol yellow.

Or any of the following recipes would answer: (1.) Fast dark brown sufficient for 110lbs. of cotton. Dissolve 22lbs. of catechu and 2lbs. 3 ozs. of blue vitriol (sulphate of copper) in boiling water. Steep for one hour in the boiling liquid, lift, drain, and dye in the boiling solution of 3lbs. 4 ozs. bichromate of potash, rinse and dry. N.B.—No specified quantity of water is given, but for the camera case take about $\frac{1}{100}$ of the above to one quart of water. (2.) Bismarck brown for 100lbs.—Steep the material overnight in a decoction of 20lbs. sumach, wring, and pass into a boiling bath containing the colour previously dissolved in boiling water. Others are to be found in Spon's "Workshop Recipes," second series, p. 225, but a cheap and effective method is to get a 6d. bottle of Stephen's mahogany stain. Make the case thoroughly wet, and let it drain, then mix the stain with one quart of water, and immerse the case. When it has acquired more than the desired colour, take it out and wring, when the colour will be found somewhat lighter. Allow it to dry. This, though not a fast colour, is so cheap and easy a method of staining the case that it will probably be more satisfactory than others, and it can be repeated again and again when the colour wears off.

55. Celluloid—How to Make.—Celluloid is an intimate mixture of pyroxylin (gun cotton) with camphor. It appears to be simply a mixture of these two substances, since, by appropriate solvents, the camphor can be removed, and, on heating the mixture in a tube, the pyroxylin burns away whilst the camphor volatilises. Since, then, from the very essence of the nature of its constituents, celluloid is highly inflammable, it is in vain to hope that any modification in the method of its manufacture should produce a product that is not inflammable. Celluloid softens in boiling water, and may then be rolled or moulded easily into various forms. Its power of resistance of pressure at the temperature of boiling water is far less than that of any of the ordinary metals. The following method, which is the usual one, adopted for its manufacture is taken from Thorpe's "Dictionary of Applied Chemistry." The camphor is dissolved in the least possible quantity of alcohol, and the solution sprinkled over the pyroxylin, which is then covered with a second layer of pyroxylin, and then again treated with the camphor solution, the addition of camphor and pyroxylin being continued alternately until the requisite amount of celluloid mixture is obtained. The mass, which sinks together in transparent lumps, is worked for an hour between cold iron rollers, and then for the same time between rollers slightly heated by steam. The layer of celluloid surrounding the rollers is then cut away and again pressed, the resulting cake, which is now about 10m. thick, being cut into plates about 300m. broad and 700m. long. These are placed one above the other and strongly pressed together by hydraulic pressure at a temperature of about 70°C. for twenty-four hours. The thick cakes are once more cut into pieces of the desired thickness and placed in a chamber heated to 30° or 40° for eight to fourteen days, whereby they are thoroughly dried and are ready to be fashioned into various articles either by being moulded whilst warm or by being turned. This interesting substance, known also as Parkesine and xylonite, was discovered by Mr. Alexander Parkes, of Birmingham, who, more than forty years ago, being impressed with the necessity for the introduction of a substance to take the place of certain natural productions, such as ivory, tortoiseshell, etc., set himself to discover such a substitute, and with this end in view made many thousands of experiments, till at length his ardent search was rewarded by the "epoch-making" discovery, that by combining gun-cotton with various other substances he could produce such an article as he had been so long in quest of. In 1855 Parkes took out his first patent, but being at that time engaged with the firm of Elkington, Mason & Co., he was unable to give his unremitting attention to the subject, and so it was not till the London Exhibition of 1862 that he succeeded in gaining much attention to his product. Though the specimens there exhibited were made in a rough manner by himself without the suitable appliance used in the various trades, he received the silver medal. By the time, however, of the Paris Exhibition, 1867, the matter had made such progress that his exhibit was judged one of the most remarkable specialities shown. Up to this time no name had been given to the new product, and in honour of the inventor one of the French papers called it "Parkesine." On his return the Parkesine Company, Limited, was formed, into which the inventor threw his patents and took common lot with the other shareholders. The speculation was not, however, a financial success, and its collapse left Parkes minus his outlay of money and his patent rights, and with nothing but the medals he had gained in London and Paris, and the satisfaction of knowing that he had been the discoverer of what is admittedly one of the most important substances applicable to the arts and manufactures ever discovered. A second company followed the first, and this latter was succeeded by the British Xylonite Company. Of course, the details of the manufacture vary according to the purpose to which the product is to be applied, and by proper manipulation (mainly by variation of the solvent used, and the amount of pressure applied) any required degree of hardness or flexibility can be secured. It can be made, for instance, as hard as ivory, or in so soft a condition as to be capable of being spread in layers over textile fabrics, much in the same way as paint is used. The product is waterproof, acid-proof, and air-proof, and may be made, if not fireproof, at least non-inflammable.

56. Chemicals—To Keep.—The following is a list of photographic chemicals which are deliquescent, that is, are more or less affected by exposure to the atmosphere, they either taking up or giving off moisture, thus becoming either deliquescent or efflorescent, examples of the latter action being found in Glauber salts, washing soda, borax, etc. The principal deliquescent photographic salts are the following, which should be kept in well-fitting glass stoppered bottles:

Ammonium iodide.
" carbonate.
" nitrate.
" sulphocyanide.
Calcium chloride.
" hypochlorite (bleaching powder).
" iodide.
Cupric bromide.
Chloroplatinic acid.

Ferric chloride (perchloride of iron).
Gold terchloride (sealed tubes).
Magnesium chloride.
,, bromide.
,, iodide.
Potassium carbonate.
,, cyanide.
,, chloroplatinite (sealed tubes).
,, hydrate (caustic potash).
,, nitrite.
,, iodide (to a certain extent).
,, sulphocyanide.
Platinum tetrachloride (commercial).
Sodium nitrate.
,, hyposulphite.
,, hypochorite.
,, hydrate (caustic soda).
,, sulphocyanide.
Zinc chloride.
,, nitrate.

Chemicals which oxidise on exposure to the atmosphere, such as ferrous sulphate, sodium sulphite, etc., should also be kept in stoppered bottles; so also should strong acids, such as sulphuric or sulphurous, nitric, hydrochloric, and acetic acids; and developers, as a rule, when kept in the solid state, are better kept in stoppered bottles. A good cork, which fits the mouth of a bottle well, is better than a badly-fitting glass stopper, of which there are a great many on the market; but, of course, for acids and substances which would attack cork, glass must be used. A little vaseline rubbed round the top of a glass stopper will prevent it from sticking fast in the bottle.

57. Chromate of Potash, Neutral—To Prepare.—There are three chromates of potassium known: (1.) Neutral potassium chromate (K_2CrO_4). (2.) Bichromate or acid chromate of potash (K_2CrO_7). (3.) Terchromate of potash ($K_2CrO_4CrO_3$). Only the first two are of importance. The ordinary method of making the *chromate* is by beating the native chrome iron ore (a compound of chromium sesquioxide, Cr_2O_3, and ferrous oxide, FeO) with nitre or potassium carbonate. The heating has to be carried on for a long time. If any salt of the sesquioxide be fused with an alkaline carbonate a chromate is formed. The neutral chromate consists of anhydrous *yellow* crystals, having a bitter taste, soluble in two parts of water at 15°C. The *bichromate* can be made by adding sulphuric acid in moderate quantity to a solution of the chromate. This salt forms *red* tabular crystals, soluble in ten parts of water, and having an acid reaction. The neutral chromate can be easily prepared by adding to a solution of red chromate (bichromate) of potash sufficient potassium carbonate to change the red colour to a fine yellow, evaporate, and allow to crystallise. The cost of the materials is: Bichromate of potash (commercial), 7d. per lb.; carbonate of potash, 6d. per lb.; while neutral chromate of potash is 1s. 4d. per lb. To make half a pound of neutral chromate add three ounces of carbonate of potash to a solution of six ounces of bichromate. The solution will turn yellow. Place the basin in a warm place, and allow to evaporate for a day or so, when yellow crystals will fall out of solution. These are the neutral chromate, and have the formula K_2CrO_4. They are fished out, allowed to drain, dissolved in as little water as possible, again evaporated, and allowed to crystallise, when a pure salt will be obtained. Hence the cost of making ½lb. comes to about 4½d., plus labour and fuel for evaporating.

58. Chromic Acid Poisoning—To Prevent.—In his excellent handbook, "Materia Photographica," C. J. Leaper gives the following particulars concerning potassium bichromate poisonings and its antidotes. Taken internally, it acts as an irritant poison, the antidote being magnesia carbonate or chalk, followed by an emetic. The poison is also absorbed by the skin, especially if cuts or scratches be present. In its manufacture the septa of the workmen's noses are often destroyed by it, the liberal use of snuff being a good preventive. Its effect on the hands begins with a violent irritation, followed by ulceration. The disease sometimes takes the form of a red rash, which becomes a sort of pityriasis, the skin being destroyed and breaking up into scales. If the skin is broken the disease is chiefly confined to ulceration, the ulcers increasing in size, and often reaching to the bone. It is said that the citrine ointment of the pharmacopœia has proved an effectual remedy, the potassium bichromate being converted into insoluble and harmless mercuric chromate. In photo-mechanical work the fingers sometimes become coloured with spots, which, if scratched, exude a watery fluid. These spots increase in size, spreading to the back of the hand and wrists, and finally die away, the skin cracks and scales off, leaving painful sores. Rubbing the hands with a mixture of ammonia, carbolic acid, and glycerine is recommended as an effectual cure. The following is the formula for the citrine ointment as given in the British Pharmacopœia:

Mercury, by weight	4 ounces.
Nitric acid	12 fluid ounces.
Prepared lard	15 ounces.
Olive oil	32 fluid ounces.

Dissolve the mercury in the nitric acid, with the aid of a little heat, melt the lard in the oil in a water bath, and while the mixture is at about 212°F. add the solution of mercury, also at the same temperature, and mix thoroughly. If the mixture does not froth up, increase the heat till it does, then stir until it is cold.

59. Collodion—To Make a Tough Sample of.—One of the following three formulæ will no doubt be suitable:

No. 1.

Methylated alcohol	·820 ...	4½ ounces.
Sulphuric ether (methylated)	·725 ...	5½ ,,
Celloidin (Schering's patent)		...60 grains.

Put the above into a well-stoppered bottle, and shake until it is all dissolved. The above and the two following will each make ten ounces of plain or normal collodion:

No. 2.

Methylated alcohol	·820 ...	4½ ounces.
,, sulphuric ether	·725 ...	5½ ,,
Dr. Liesegang's papyroxyline		...50 grains.

No. 3.

Methylated alcohol	·820 ...	4½ ounces.
,, sulphuric ether	·725 ...	5½ ,,
Pyroxyline		55 to 65 grains.
Castor oil		... 4 or more drops.

Mix Nos. 2 and 3 in the same manner as directed for No. 1. Care must be taken not to add too much castor oil to No. 3, because if too much is added it will be made too horny, and will repel the silver solution, and will make the collodion opalescent, and difficult to coat the plates with, and will render it unfit for anything. No. 3 should answer well for enamelling photographs if a suitable pyroxyline has been employed, and too much castor oil has not been added. No. 1 when iodised and bromised makes an excellent negative collodion, but is scarcely suitable for either ambrotypes, ferrotypes, transparencies for the lantern, or for enamelling photographs, *because it gives a film slightly opalescent*, which, however, is of no consequence in negative work, but renders it next to useless for the other purposes. No. 2 has similar properties to No. 1. *Celloidin* can be obtained at the Photo

Stores in Charterhouse Square, London, and very likely at several other photo dealers as well. *Papyroxyline* is made by treating white blotting paper or Japanese paper with acids instead of the cotton as in making ordinary pyroxyline. The method of making both the latter, and formula for sensitising collodion and making collodio-bromide emulsion, will be found in the fourth edition (and probably in all the later editions) of Capt. Abney's "Instruction in Photography." It should be understood that the method of preparation of the pyroxyline affects the final qualities of the collodion. If the acids have been too much diluted a collodion is obtained which adheres firmly to the plate, but which furnishes negatives of an abnormal softness. The following formula steers clear of both extremes, whilst the addition of a further quantity of water gives tenacity to the collodion:

Sulphuric acid, 1·845	9 fluid ounces.
Nitric acid	3½ ,,
Water	2½ ,,

Use at a temperature of 150° F.; immerse the well-washed cotton for ten minutes, and then wash in running water until all acidity has disappeared. The formula for the collodion is:

Pyroxyline	5 grains.
Alcohol, ·820	½ ounce.
Ether, ·725	½ ,,

If, in spite of all care, the collodion exhibits a tendency to leave the plate, it must have a preliminary coating of albumen. Take

Albumen	1 part.
Water	50 to 100 parts.

Ammonia sufficient to give it a smell of ammonia. Cover the end of a glass plate (the breadth of the plate to be covered) with a piece of swansdown calico, moisten it with the above fluid, and squeeze out all excess. The brush, known as Blanchard's brush, is then drawn down the plate, and gives the finest coating possible. Instead of the albumen, the following solution may be flowed over the plate like collodion, and allowed to dry spontaneously:

Indiarubber	1 gramme.
Benzine	500 c.cs.

60. Collodion Filter—To Make.—A ball of cotton wool inserted in the bottom of a glass funnel makes the cheapest and best filter that it is possible to get for this purpose. Another way is to take a piece of stiff paper, such as writing paper, fold it into a cone, and fasten the edges together with gum. When dry, cut off the tip, leaving a hole about ¼in. in diameter, and push a tuft of cotton wool through the hole of such a size that it fits tightly. It is then ready for use. It is best to make a fresh one each time of using. A good substitute for the usual glass filter can be made by obtaining a very narrow-mouthed twenty-ounce bottle, pour cold water in to the depth of half an inch, then place the point of a red-hot poker just on the water line and carefully and slowly rotate the bottle. This will cause a clear crack, and the bottom will fall out; lightly plug the neck with clean cotton wool, and place it neck down in a wide-mouth bottle as a receiver. The dome-shaped shoulder of the filter bottle will fit ¼lb. pyro bottle fairly accurately. It is now quite ready for pouring the collodion in, and when that is done, cover the top with a flanged tin lid, say from a coffee tin; this will allow enough air to pass to enable the collodion to filter through, but will prevent all but a very small amount of evaporation.

61. Copper—To Silver-plate.—Instead of throwing away the old, used-up hypo bath, utilise it by immersing articles of copper or brass in it for twenty-four hours, when they will be found to be beautifully silvered. Dry, and polish with chamois leather.

62. Dirty Bottles—To Clean.—Dissolve half an ounce of potassium dichromate in ten ounces of strong sulphuric acid, and let the mixture remain in the bottle for a minute or so. Nordhausen sulphuric acid is also very effective. Another method is to use ordinary shot, with soda and water, shaking well. If this does not clean them use a little very dilute hydrofluoric acid. If used too strong this will eat into the glass, but a very dilute solution, say one dram to five ounces of water, is effective. The method with shot is perfectly effectual in most cases, however, and does not necessitate the use of hydrofluoric acid, which is very troublesome stuff to deal with. It is easier, however, when one knows what solution they have contained. Some dirt can be cleaned off them with an alkali, while an acid is necessary in other cases. For example, if a bottle has contained iron solution, it is easiest and quickest cleaned with sulphuric acid and water, about one part acid to four to six parts water. For bottles that have contained nitrate of silver bath solution, use nitric acid, in the same proportion as above stated. In both these cases the acids mentioned dissolve the dirt. If one kind of acid fails, another kind should be tried. The same with alkalies. Carbonate of soda (washing soda) may not be strong enough for some dirt, and therefore potash, or even caustic potash or soda, might be tried instead. A little rather coarse sand put into the bottles, and shaken up with the acid or alkali they contain, will also assist to shift the dirt. A mop, formed by a piece of rag bound on the end of a piece of stout wire, which can be bent to any curve as may be required, is also a great help in bottle cleaning. After all the dirt has been removed as above, wash the bottles well in warm or cold water. Hot water is best in some cases, but is risky, as it is very liable to crack the glass. Metals which have been deposited from solutions are best removed by the application of nitric acid (aqua regia must be used if the metal is gold, which is frequently deposited on the walls of the vessel containing old toning baths). Organic matter, such as lamp-black, etc., is best removed by the potassium bichromate and sulphuric acid, whilst for insoluble oxides and salts, such as lime, chalk, etc., hydrochloric acid is the best solvent.

63. Gold Chloride—To Make.—In order to make chloride of gold from 18ct. gold, the first thing to do is to obtain metallic gold free from copper. To do this dissolve up the sample of alloy in a mixture of four parts of strong hydrochloric acid, and one of nitric acid. This mixture is called aqua regia, and it is capable of liberating the element chlorine, which attacks both gold and copper, converting them into perchlorides. Heat the gold and aqua regia in a beaker, and as soon as all is dissolved, boil the liquid until the acid is all expelled. Boil up the residue with water, and then add a cold saturated solution of proto-sulphate of iron, previously made slightly acid with sulphuric acid. The addition of this substance precipitates pure gold as a dark powdery precipitate. Filter it off through a filter paper placed on a funnel, and repeatedly wash it with boiling distilled water until, on testing a few drops of the filtrate with chloride of barium solution, there is no turbidity produced. This is a sign that all the ferrous sulphate has been washed away, and that nothing but pure gold remains. Place the paper and filter somewhere to dry, and as soon as it is dried, detach it from the filter paper, and redissolve in aqua regia as before. The solution must be evaporated to complete dryness on a water bath, in order to obtain the solid chloride. No heat must be applied that is any stronger than that of the water-bath, or else the chloride of gold will be split up into gold and

chlorine again. It is best to evaporate the solution twice in order to get a less acid product. In this way the chloride of gold is made. For photographic purposes it is best to dissolve it in water in the proportion of one grain in one dram of water. If kept in the dark this solution will preserve its properties for an indefinitely long time. If it is desired to keep the gold in the dry state it is best to convert it into the sodio-auric chloride. To do this dissolve the gold chloride in water, and add a quantity of pure common salt in the proportion of five parts of common salt to twenty-six parts of anhydrous choride of gold. The relative values of the different forms in which gold is supplied is contained in the following little table, which is abridged from Dr. Eder's "Jahrbuch." One part of metallic gold is equivalent to—

Dry gold chloride.	Cry'd gold chloride.	Chloride of gold and potas.	Chloride of gold and sodium.
1·540	1·814	2·148	2·020
·762	·898	1·062	1·000

18ct. gold contains seventy-five per cent. pure metal, the remainder being copper and silver added to improve its hardness. In above process the following apparatus is necessary: One porcelain evaporating basin 4in. or 5in. diameter, one cover glass, 6in. diameter; one 3in. filtering funnel; one 4 oz. flask; one packet 3in. filter paper; one sand bath with tripod support; one Bunsen burner, with rubber tube, to connect same with gas supply. The chemicals required are nitric acid, specific gravity, 1·4; hydrochloric acid, specific gravity, 1·16, and a saturated solution of ferrous sulphate. For each ounce of metal use four ounces hydrochloric acid, and one ounce nitric acid, with two ounces of water. If, however, the chloride of gold is to be used for a toning bath, the following is the simplest possible method: Place the 18ct. gold in a porcelain dish, and cover with a mixture of three parts of hydrochloric acid and one part of nitric acid. This should now be put on a sand bath, which can be made by half filling an old saucer or the lid of a tin canister with sand, and placed on a hot part of the hob till the gold is dissolved. If this takes a long time, pour off the liquid into a bottle, and add a little more of the acid mixture till the whole is dissolved. Then mix the two liquids together. Use as little acid as possible. This yields a very acid solution of chloride of gold. The solution can now be made up to any strength, remembering that one grain of gold makes about one and a half grains of gold chloride. It may be stored in this condition, and being acid is not so likely to be decomposed; when a quantity is required for use it should be neutralised by adding a little whiting or chalk.

A convenient and economical method of carrying out the above process is to use a coin as follows: Mix two drams of pure nitric acid with eight drams of hydrochloric acid, and place in the mixture a *new* sovereign, or an equivalent weight of pure gold. A half-sovereign will require half a dram of nitric acid mixed with two and a half drams of hydrochloric acid, and three drams of water. Gently heat the mixture in a sand or water bath. Copious volumes of gas will be evolved, and the gold will gradually disappear, a solution of perchloride of gold in excess of acid resulting. The solution may be evaporated in a sand or water bath till the solution crystallises; the crystals must be preserved in hermetically sealed tubes or a tightly-stopped bottle, as the crystals are very deliquescent; but as it is necessary to use the salt in solution, it is preferable to keep the salt in solution and save the trouble of crystallisation. It is absolutely stable in solution if kept in the dark. To the solution, therefore, when the coin has disappeared, add five ounces of distilled water and common chalk or carbonate of soda until nearly all the acid is neutralised; filter and make the solution measure 178 drams by washing the filter with successive portions of distilled water. The resulting solution will contain one grain of perchloride of gold in every dram. A half-sovereign weighs (about) sixty-one grains, of which fifty-six are pure gold, which is equivalent (about) to eighty-six grains of chloride, which will be the quantity obtained. Many prefer an Australian coin, as they are free from copper.

If gold leaf is to be used, dissolve ten sheets of gold leaf in a test-tube containing three drams of hydrochloric acid. Add eleven drams of distilled water. When the deposit is settled, add chalk or whitening till it ceases to effervesce, pour on it twenty ounces of water, and the chloride of gold is made. To tone prints add to the above eighty ounces of water, and three of sodium acetate. This will give rich brown results.

64. Gold—How to Recover from Old Toning Bath.—When a sufficient quantity of waste bath is accumulated precipitate the gold by adding drop by drop of the following filtered solution as long as a brownish precipitate takes place. One ounce of pure sulphate of iron, dissolved in four ounces of distilled water, and half an ounce of hydrochloric acid. When no more precipitate is formed, stir the mixture, and set it aside for several days; then pour off the supernatant liquor, and place the precipitated gold into a clean porcelain evaporating dish, pour upon it hydrochloric acid, and apply a gentle heat; this will remove all the iron. Convert the gold left into chloride by first washing it with distilled water and then adding to it a mixture of one part nitric acid and three parts hydrochloric acid. This may be done in a dish, and preferably in the open air. It requires about four parts by weight of nitric acid to convert one part of metallic gold into the ordinary terchloride. The gold solution may be diluted, neutralised with pure chalk, and kept for ordinary toning purposes. The amount of gold, however, left in toning bath is but small, especially with the new chloride papers, which use up more, so that unless considerable quantities of spent toning baths accumulate it is not worth the trouble to recover the gold. When the quantity of old bath to be operated upon is large the following is the method to adopt: The spent baths should be set aside in some large vessel, such as a barrel, or better, a tank having a V-shaped termination at the bottom, so that the precipitate subsequently produced may sink below the level of the top by which the liquid is drawn off, and thus left undisturbed The solution of ferrous sulphate is added to the contents of the tank in the proportion of thirty grains of the salt to about every gallon of residue. The contents of the vessel are then allowed to stand for twelve hours, in order that the precipitate of metallic gold may settle completely. The supernatant liquid is then drawn off, either by a tap in the vessel some distance above the bottom, or by a syphon (easily made joining two pieces of wide glass tubing with a piece of flexible tubing). Fill the syphon with water from a tap, then placing the finger over one end, immerse that end in the water, and before removing the finger, lower the other piece of tubing outside the vessel until it stands at a lower level than the one inside. The liquid will thus be quietly decanted from the vessel as long as the end outside the vessel is lower than the one inside, whilst the precipitate will not be disturbed. When as much liquid has been removed as is possible without disturbing the precipitated gold, the remainder is stirred up, and, with the gold suspended in it, is rinsed out on to a paper filter,

and washed with hot water. When dry, the gold can be preserved, and is ready for conversion into gold chloride.

65. Hydroquinone—How to Distinguish from other Substances.—Hydroquinone may be tested as follows: (1.) If a solution of quinone ($C_6H_4O_2$) be mixed with one of hydroquinone ($C_6H_6O_2$), beautiful green crystals are deposited of the composition ($C_6H_4O_2$ $C_6H_6O_2$), and are known as green hydroquinone. The one solution developer being alkaline, must, of course, be rendered acid. (2.) The same green crystals are produced when hydroquinone is acted on by oxidising agents (for instance, ferric chloride—iron perchloride), and if the action be carried beyond this point quinone is formed. If this be treated with hydrochloric acid and potassic chlorate, it is converted into a yellow crystalline substance, chloranile ($C_6Cl_4O_2$), which dissolves in potassic hydrate, yielding a purple solution. Of course, if there be pyro in the solution, this green hydroquinone will be entirely obscured by the red colouration. When ferric chloride is added as a test, and if the solution be alkaline, there will be hydrated ferric oxide precipitated. Hydroquinone can also be distinguished from iron with potassium ferrocyanide, which gives a blue precipitate with iron, and none with hydroquinone. To distinguish from pyro, use ferrous sulphate, which gives a dark brown precipitate with pyro, and none with hydroquinone. The best test for hydroquinone itself is to oxidise by carefully adding chlorine water, heat gently, and allow to cool, when crystals of quinhydrone will separate out which are of a deep green colour.

66. Ivory, Artificial—To Make.—The usual method of making artificial ivory is first to prepare a substance similar to pyroxyline, and included under the name "celluloid," and secondly, to treat this compound with certain solvents in order to make it plastic, mixing with it other substances to give grain, etc. A brief outline of the manufacturer's method is as follows: A convenient quantity of cellulose, or woody fibre, is treated with an acid mixture composed of one of nitric acid to four or five of sulphuric, and so converted into pyroxyline. The specific gravities of the acids are: Nitric 1·420 and sulphuric 1·845, and the acids are mixed and cooled in a separate vessel. The pyroxyline is then converted into celluloid by means of solvents. Now, these solvents are employed in various ways, and consist of wood naphtha, nitro-benzol, camphor, alcohol, and glacial acetic acid, and to go through each process would take up too much space. In any case, however, to imitate ivory, the celluloid, when in a dough-like state, is rolled out into sheets $\frac{1}{16}$in. thick. Another celluloid is prepared containing about half per cent. of carbonate of strontia, rendering it opaque. These sheets are placed alternately one over the other, rolled up together, the roll is then twisted and passed through heated rollers down to the required thickness. One point about white celluloid is that porcelain or glass vessels must be used, and the rollers must be coated with platinum, as ordinary metals are acted upon. So far, very briefly, for the manufacture of celluloid ivory. A simple means, however, for making a substance closely resembling ivory is as follows: Make isinglass and brandy into a paste with powdered egg-shell, very finely ground. Give it any desired colour with suitable pigments, and pour it while warm into an oiled flat tin to the required thickness. When dry it will strongly resemble ivory, but whether it will stand the developer and hypo is another question.

67. Litmus Test Papers—To Prepare.—Bruise one ounce of litmus in a mortar and add boiling water; shake well together, and transfer to a flask; then add more boiling water to make up to half-a-pint. When cool, stra n it and keep in a bottle. *Red litmus* is made as above, adding to the strained liquor a few drops of nitric acid or of pure acetic acid. Any chemist will supply litmus wholesale; it costs 2s. per lb. Now take strips of paper of the required size and stain with the blue solution, and allow to dry, which will give *blue* test papers. To obtain *red* papers hold the blue ones at the mouth of the bottle containing hydrochloric acid, and the fumes will produce the required colour. The test papers should always be kept in a stoppered bottle in order to guard against fumes in the air, and the bottle shielded from light as much as possible. For the detection of alkaline reactions turmeric is much more sensitive than red litmus, but fades quickly when exposed to daylight. The most convenient plan, however, is to buy the litmus solution at the chemist's, about twopence an ounce. Divide into two portions, and make one portion red by the addition of a small proportion of very dilute acid. These two solutions, one blue the other red, should be kept at hand in two wide-mouthed bottles. When a batch of papers is wanted, soak the strips of unsized paper in their respective bottles according to the colour required, and dry in air. Blotting paper is unsized, and will be found convenient in absence of more suitable paper.

68. Mercury—To Clean.—Mechanical impurities (such as dust) may easily be got rid of by filtration through a paper cone, at the apex of which a pinhole has been punctured, or, better still, by forcing the liquid through chamois leather. To carry out the first method, take a piece of writing paper, fold it upon itself twice, and open out, so as to have three folds at one side and one at the other, pierce the apex, place paper in funnel, and pour in mercury, when it will issue through the hole in a slender stream. To filter through chamois, get a bag made of the latter, taking care that the stitches are very close, fill it with the mercury, tie neck very tightly, place in ordinary letter copying-press, and screw down, receiving the mercury in a tray in which the copying-press is placed. Commercial samples generally contain tin, lead, zinc, and bismuth, or some of these metals, and such samples are known by leaving a trail when a globule is caused to roll over clean glass. Filtration will not get rid of these, as they dissolve in the liquid metal To get rid of them, the impure metal must be subjected to distillation. To carry this out procure a small iron kettle, place the mercury in it, lute on the lid with plaster of Paris, and to the spout connect six feet of iron tubing with the same material. Place the kettle in a fire, and cause the end of the iron tube to dip beneath the surface of a basin of water, when the pure metal will distil over, leaving the impurities behind. Be very careful at the conclusion of the process to remove the end of the tube from beneath the surface of the water *before* removing the kettle from the fire, and select a kettle of such a size that the liquid metal in it does not reach to the end of the spout inside the kettle. A simpler, though wasteful, p an to remove impurities consists in placing the impure metal beneath the surface of nitric acid diluted with twenty times its volume of water. In this, after some days, the bismuth, etc., will dissolve (together with some of the mercury), and when this occurs, it is only necessary to well wash the metal in running water, and permit it to dry after having removed most of the water with blotting paper. Those who have access to a factory might carry out the purification of the mercury by placing it in an iron bottle, together with its own volume

of finely powdered sugar, and then fastening the bottle very securely (by permission of the proprietor of the factory) to the fly wheel of the engine The vigorous agitation of the contents will result in a couple of hours in the oxidation of every foreign metal present, and it will then merely be necessary to filter off the scum as before described. Pure mercury should run in spherical form on a rough surface leaving no "tail." To test for its various impurities dissolve about ten grammes of the metal in nitric acid, evaporate to complete dryness, and ignite the residue, so as to drive off the mercury compound. Extract the residue with nitric acid, and filter; a white residue on the filter indicates the presence of tin. To the filtrate add hydrochloric acid; a white crystalline precipitate indicates the presence of lead. Filter from this precipitate, taking care that the solution is cold, or much of the lead will be dissolved. To the clear solution add sulphuretted hydrogen solution, or pass a current of the gas; a black precipitate is produced which contains both bismuth and lead. Dissolve in nitric acid, add sulphuric acid and alcohol, filter off the precipitated sulphate, and add ammonia to the filtrate. A white precipitate indicates the presence of bismuth. To the filtrate from the mixed sulphides of bismuth and lead, add ammonia and ammonium sulphide; white precipitate shows that the mercury is contaminated with zinc.

69. Metabisulphite of Potash—To Make.—Metabisulphite of potash is made by passing sulphurous anhydride SO_2, through saturated solution of carbonate of potash. The resulting solution contains some acid sulphite of potassium $KHSO_3$, with some K_2SO_3, SO_2, and usually much sulphate. It acts as a preservative of pyro by absorption of oxygen. After keeping in solution sulphurous acid is freely evolved; sulphuric acid is also formed. It should be used in much weaker strength than the sulphite of sodium, as it acts as a very powerful restrainer or retarder of development.

70. Oxygen—How to Make.—A mixture of four parts chlorate of potash with one part black oxide of manganese requires the application of only a moderate degree of heat to cause it to part with most of its oxygen. The chlorate alone is decomposed, according to the equation

$$KClO_3 = KCl + O_3.$$

This gives theoretically five cubic feet of oxygen for every pound of chlorate, but four cubic feet per pound may be taken as a practical average. If only small quantities are required at a time, the ordinary glass apparatus of the laboratory will be found efficient, but for quantities greater than one cubic foot a properly-constructed retort must be provided. This may take the form of a cast iron bottle, to be thrust into an ordinary fire, or a light vessel of riveted or brazed copper, to stand on a ring, or solid-flame burner. In either case, a screw cap, fitted with delivery tube, should be used to close the retort after the charge is inserted. This delivery tube should be of large bore, and, if bent, the curvature should be gradual, in order to prevent a lodgment of the solid particles driven over with the gas. For the same reason, the wash-bottle and its furniture should be of ample dimensions. If coarsely granulated manganese and chlorate in small crystals are used, the amount of dust carried away is much reduced, and the danger of clogging lessened. The following answers well: An old kettle, a purifier, consisting of two wide-mouth Winchester quart bottles fitted with rubber corks, and two glass tubes bent at right angles, one passing nearly to the bottom of the bottle, the other cut off flush with the inside of the cork; a gas bag to hold the oxygen when made, and a supply of rubber tubing are required. To operate, begin by making a mixture of ten parts by weight of potassium chlorate in crystals with one part by weight of manganese peroxide in powder; introduce the mixture into the kettle, and lute down the lid with red lead, keeping it firmly in position by jamming a piece of wood between it and the handle. Next half fill one of the glass bottles with a strong solution of hypo (old fixing baths answer perfectly), and completely fill the other bottle with wadding or cotton-wool. By means of rubber tubing connect the spout of the kettle with the tube passing to the bottom of the hypo bottle, and connect the other tube to that passing to the bottom of the bottle full of wadding, the other tube of which is lastly joined up to the empty bag. Now place the kettle on the fire and heat it very gradually (one of Fletcher's solid flame burners are, however, preferable), when the gas will be evolved from the mixture, and, having been purified by passing through the hypo, and partially dried by the wadding, will gradually fill the bag. When gas ceases to be evolved, remove kettle from fire *first*, and then disconnect tubes. This is the only *practicable* way to make oxygen on a small scale. The mixture costs about 1s. per pound, and this quantity will yield three cubic feet of gas.

71. Oxalate of Potash Residues—To Utilise.—The crystals, as obtained from the platinotype hot developing bath, are potassium ferric oxalate. They may be used as follows: For view printing, make a ten per cent. solution of the crystals, coat paper with the hot solution, and dry in the dark room; then expose under a line negative in bright sunlight for some hours until an orange print on greenish white ground is obtained; then treat image with a five per cent. solution of potassium ferro-cyanide, and wash. The image is now white on a bluish green ground. The process is useful for making positives direct from lace, leaves, and other botanical specimens. If also they are dissolved in water acidulated with sulphuric acid and three per cent. of ferric chloride added, it forms a reducer and clearer of bromide of silver plates and papers, and these, after the use of the above, require dipping in the fixing bath again. By dissolving them to saturation in antimony chloride, it forms a very good blacking solution for brass lens stops.

72. Paint, Luminous — To Make.—Balmain's luminous paint consists of a phosphorescent substance introduced into a colourless varnish made from mastic and turpentine; drying oils, gums, pastes, sizes, etc., however, may also be used. The particular phosphorescent substance used in this case (for there are numerous such substances) is a sulphide of calcium, and was prepared originally by Canton from calcined oyster shells heated with flower of sulphur. At present, however, it can obtained in the following ways: (1) By simply heating gypsum or plaster of Paris with charcoal; (2) by heating lime and sulphur together; or (3) by heating lime in a vapour containing sulphur. The sulphide is generally of a greyish white colour, though the temperature to which it has been subjected modifies the colour. It is mixed with the vehicle and used as ordinary paint. It may also be easily prepared by cleaning thick oyster shells and then burning them until they are red hot; when cool, roughly pound them and pick out all the black and dark pieces. When fairly clear, pound fine and place a layer of about half-inch thick in a suitably-sized fire-clay crucible, and then a layer of same thickness of flower of sulphur, then another of oyster-shell ash, then sulphur, and so on until the crucible is filled to within one and a half inches

of the top. Fill this space up with well-worked clay, and allow it to dry in a warm place; when dry, place the crucible and contents in the fire, and, when a low blood red, endeavour to keep it at that for at least sixty minutes. Two hours would be better, if the clay luting is done well. Allow it to cool slowly, and then turn out the contents and pound to a powder. This will give a very bright blue luminous paint. If wanted as a water-colour, it can be employed by the addition of gum senegal dissolved in water, or if for outside use, copal gum dissolved in turps and one-fifth the bulk of poppy oil added. The poppy oil is to prevent it cracking. If it is to be applied to iron, the iron *must* be painted first with an oxide of iron paint, or the luminous paint will soon lose its luminosity. The sulphides of barium and strontium and the oxysulphide of calcium have similar properties. This last may be made by intimately mixing and igniting one ounce lime with half an ounce of sulphur. It is also sometimes mixed with twice its weight of a solution of gelatine in water (containing one part of gelatine to fifteen of water), and one or two coats are applied with a brush to the articles to be made luminous. For outdoor use equal parts of boiled linseed oil and turpentine may be substituted for gelatine solution.

73. Platinic Chloride — To Utilise.— An acid solution of platinic chloride, although it can be used for toning purposes, is not to be recommended on account of its greatly reducing the image, and in some cases entirely destroying the half-tones; it is therefore better to obtain the chloroplatinite of potash K_2PtCl_4, to prepare which the following apparatus and chemicals are necessary: One 6in. Berlin porcelain basin, one sand bath with tripod support, one Bunsen burner with gas tubing, one 3in. filtering funnel, one packet filter paper, four ounces hydrochloric acid, two ounces potassium chloride, six ounces alcohol (methylated spirits). Take the acid solution of platinum already prepared, place in the porcelain dish, and add two drams hydrochloric acid, evaporate down on the sand bath (to ensure freedom from any nitric acid) till a thick red syrup is left, now dilute with water, add half dram hydrochloric acid, then potassium chloride solution in excess, evaporate down to small bulk, place on one side to cool, when a crop of red crystals will be formed, filter off excess of liquor, and wash residue with alcohol. To obtain a pure salt, dissolve in water again, evaporate down, crystallise, wash with alcohol, and dry in air, then bottle for use. For toning, make a stock solution of sixty grains to two ounces of water, and of this take one dram, ten ounces of water, half dram nitric or hydrochloric acid. With this bath the toning proceeds slowly, and a pretty sepia colour is obtained on bromide prints.

74. Platinotype Developing Baths— To Utilise.—These can be utilised by adding sheet copper to them, which will gradually dissolve and precipitate metallic platinum as a black powder, partly falling to the bottom of the vessel, and partly collecting on the copper. When the action is at an end each piece of copper is scraped clean, and the black precipitate collected on a filter, well washed, and dissolved in a mixture of three volumes hydrochloric and one nitric acid, and the solution evaporated to dryness. The solid chloroplatinic acid so obtained may then be dissolved in water, and used for toning purposes by mixing some of it (the quantity depending on the number of prints to be toned) with a solution of twenty grains of sodium sulphite in an ounce of water. Another method is to evaporate the bath to about half its bulk and add about one-fourth its volume of a saturated solution of ferrous sulphate, and heat to boiling point in a porcelain basin. Platinum then separates in the metallic state, and can be collected on a filter. Digest the metallic platinum with hot hydrochloric acid to get rid of any remaining trace of iron, and then convert it into platinum chloride by heating on a water bath with aqua regia. The platinum chloride can then be used in a toning bath for silver prints.

75. Platinotype Residues—To Recover. —If silver refuse is worth keeping, the refuse platinum from the platinotype process is certainly so, as platinum and its salts are from four to five times as valuable as silver. In the hot process the paper, the oxalate bath and the acid bath will all contain some platinum. In the cold process there is no platinum in the paper, but the oxalate bath or developer, even after it is no longer effective, will still contain platinum, as will also the acid bath. In the Pizzighelli paper there is platinum in both the paper and the bath (after it has been used). Throw all the refuse into tubs. To recover the platinum: Any soluble platinum chloride is precipitated by the addition of ammonium chloride, and the filtered precipitate is dried and heated to redness in an open porcelain vessel. The residue is then thoroughly washed with hot water, and dissolved by boiling with a mixture of three parts of hydrochloric to one of nitric acid. It is best to pour off the solutions from time to time, and add fresh acids. The solution is then evaporated nearly to dryness. Hydrochloric acid is then added (to expel the nitric), and the liquid evaporated to complete dryness on a water bath. The residue is pure platinic chloride. The best way to deal with the paper cuttings, which contain ferrous and ferric oxalates and potassic platinous chloride, is as follows: They should be fully exposed to light, to convert all the ferric into ferrous oxalate, and the platinum may then be reduced on the paper by using an old oxalate bath. The paper will, of course, be quite black, and after passing it through an acid bath to remove all the iron salts, washing and drying, it should be burnt and thoroughly incinerated, treated with aqua regia, filtered, and the result is platinic chloride. From this the potassic-chloro-platinite may be prepared for the cold development process, or paper ashes disposed of without taking more trouble than to find a purchaser. Another method is by the zinc precipitation. Dissolve the precipitate in aqua regia, and add a solution of ammonium chloride. This precipitates ammonium-platinic-chloride. By heating this, spongy platinum is obtained. The reaction is $2\,(ClH_4N), Cl_4Pt + \text{Heat} = 2ClH_4N + Cl_2 + Pt$. The quantity of metal recoverable is so small that, unless there is a large quantity of cuttings of paper, it is hardly worth the trouble. Other methods are given, *e.g.*: All the solutions should be evaporated down to dryness, and the residue, along with all other solid residues which contain platinum, treated with aqua regia until there is no black residue left. The solution is then diluted slightly and filtered. The filtrate is evaporated down to dryness on a water bath, dissolved up in hydrochloric acid, and again evaporated to dryness in the same way as before. The brown mass thus obtained is then dissolved in water with a little hydrochloric acid in it, and to this is added a hot saturated solution of ammonium chloride. The ammonio-platinum chloride thus precipitated is filtered off and washed with some of the strong ammonium chloride solution. The precipitate should then be gently dried and finally ignited at a red heat in a platinum crucible. Pure platinum is thus obtained in a spongy state. From this tetrachloride of platinum may be prepared by dissolving up in aqua regia, evaporating to dryness

on the water bath, again dissolving in strong hydrochloric acid, and evaporating to dryness to get rid of the nitric acid. The brown residue thus obtained will be the pure salt, and if the spongy platinum is weighted before dissolving it a good idea will be given as to how much of the salt there is by calculation, it being very difficult to weight the salt itself *owing to its deliquescent nature.* In treating developing baths which have been used many times it is advised to expose the bath in a white glass bottle to sunlight for a few days. The addition of ferrous sulphate in small quantities will effect the same purpose, however, and the platinum will be thrown down as a black powder - platinum black. This should be carefully collected on a filter, and the mass on the filter washed thoroughly, first with dilute hydrochloric acid, and then with distilled water. The platinum thus obtained can be disposed of as it is, or converted into chloroplatinic acid (platinum tetrachloride), by dissolving it in a mixture of three parts of concentrated hydrochloric acid to one of nitric acid. *Do not heat* this to try and hasten the solution, as the dissolving power of aqua regia on platinum is weakened by heating above a very gentle heat. When the platinum is all dissolved, evaporate down to a syrup, and allow to crystallise. Pizzighelli paper can be treated in the same way as advised above. The sepia paper, however, and its developing solution, both contain mercury; therefore, although the above treatment for the paper will serve for this also, with the old developing bath, when the platinum is thrown down, it will be mixed with a certa n quantity of mercury, and the washing should be conducted with weak nitric acid to remove the latter. The treatment is then as before.

Captain Abney gives the following directions for paper: "The whole of the paper, linen, etc., containing any salt of platinum or metallic platinum, is collected, and when a considerable quantity has been brought together, it is incinerated. The ashes rema ning after the incineration are stirred up into a thin paste with a mixture of three parts concentrated hydrochloric acid and one part nitric acid. This is then set to digest for a few hours at a temperature of from 50° to 70° C. After this is diluted with an equal quantity of water, then filtered, and the insoluble residue washed in the filter with water. From the filtrate and wash water the platinum is precipitated by adding ammonia (or ammonium chloride) as chloroplatinate of ammonium, and this being heated in a porcelain crucible leaves a black residue, which is spongy metallic platinum." Before converting this into any platinum compound, it is best to digest it with a little dilute hydrochloric acid in order to get rid of traces of iron.

76. Platinum Salts—To Prepare.—What is sold as bichloride (really tetrachloride) of potassium can be used for toning silver prints, and, in fact, up to quite recently it was the principal salt used for that purpose until Mr. Willis and Mr. Clark drew attention to the salt in the form of potassium chloro-platinite. If the tetrachloride is used for toning, it should be acid; this can be ensured by neutralising with bicarbonate of soda, and reacidifying with acetic or citric acid, and allowing to stand for a day before using. It is best, however, to convert the tetrachloride of platinum into potassium chloro-platinite by following the instructions below, as recommended by Messrs. Pizzighelli and Hübl. Take fifty grammes of bichloride of platinum (or chloro-platinic acid as they call it), dissolve in one hundred c.c. distilled water, filter and heat to one hundred degrees in a water bath, and pass through it a strong stream of washed sulphurous acid gas. After a time the yellow liquid will begin to turn red. It must now be tested from time to time by taking a little on the end of a glass rod and mixed with a little chloride of ammonium on a piece of glass; if any unreduced or platinic chloride is present an insoluble yellow precipitate will be formed. When the precipitate is formed but slightly lessen the supply of gas, and altogether stop it when no precipitate occurs on testing. Care must be taken that the gas is stopped at the right time, not too soon, nor yet too late. There is now a mixture of platinous chloride, sulphuric acid, and hydrochloric acid. To convert this into the double salt, when cooled pour it into a porcelain dish, and stir in a hot solution of chloride of potassium (twenty-five grammes to fifty c.c. water). The chloroplatinite then separates in the form of a crystalline powder. Let it settle for twenty-four hours, then collect the deposit on a filter, draining off the mother liquid, wash the deposit in a little water, and then in a little alcohol until the last washing is free from acid. Now spread the powder out on a filter paper, and dry in the dark, as the salt, when moistened with alcohol, is sensitive to light. Salt thus prepared is perfectly pure, and can be used at once. About seventy-five parts, consisting of the double salt, can be obtained from one hundred parts of tetrachloride of platinum in this way. For toning the following bath will give good results:

Potassium chloroplatinite	2 grains
Citric acid	5 ,,
Sodium chloride	8 ,,
Water	10 ,,

If this acts too quickly the platinum salt may be reduced by one half or even more. After toning immerse the prints in water containing a little ammonia, and fix as usual. The toning bath will not keep. If potassium chloroplatinite be purchased the following are tests of its purity: (1.) One part of the salt must be quite soluble in six parts of cold water. (2.) The solution produced must have no acid reaction.

77. Porcelain Trays—To Clean.—It depends whether the stains are those caused by the solution penetrating under the glaze and into the earthenware or only surface stains. In the former case they cannot be entirely removed, though by leaving acid in the dish for some time, say a day or two, they can generally be modified. In the latter case the following method may be tried: Mix together one pound of pearl ash with half-pound of quicklime and a quart of cold water, stir it up, and pour into the stained dishes. Let it remain for two or three hours, then turn it out, and thoroughly wash the dishes. Then fill the dishes with cold water, to which has been added sufficient hydrochloric acid to make it taste very acid. This will remove traces of the lime and pearl ash, and the dishes will be clean. Stains are caused chiefly by the glaze cracking, and the cracks absorbing decomposed organic matter. If granitine dishes be used, cracks will be impossible, consequently no permanent stains.

78. Potassium Bromide—How to keep in Saturated Solution.—To ten ounces of the saturated solution of KBr forty-six ounces of water would have to be added to make it ten per cent.

A saturated solution of potass bromide will be in the proportion of one ounce of the potass bromide made up to two ounces with water, whilst a ten per cent. solution would be equivalent to one ounce of the salt made up to ten ounces with water, so that in the ten per cent. solution there is just five times the quantity of water as in a saturated solution; consequently, if five times the existing quantity of water be added to the solution, it will make it ten per cent.

79. Saturated Solutions—To Make.—Get a glass funnel with fairly long stem, and a bottle provided with ring of cork and glass stopper (such as Rose's lime-juice cordial bottles); pass the funnel through the ring, and fill the bottle with water until it touches the end of the stem of funnel; then run the funnel down tight into the cork ring. Put in the neck of funnel a large crystal of the salt to be dissolved, and pile up crystals over it, then add just sufficient water to reach above the big crystal. The arrangement is then self-acting, only requiring crystals to be placed in the funnel as they are dissolved. For larger bottles, an indiarubber ring from a soda-water bottle round the stem of the funnel answers equally well. Another method: Three-quarters fill a jar with water, and, having placed the crystals in a muslin bag, suspend it so as to be enveloped by the water, but without touching the bottom of the jar. Solution immediately commences, and the water speedily becomes saturated.

80. Sea Water—To Utilise. There is no reason why sea water should not be used for first washings; in fact, it is frequently employed by yachting photographers. But care must be taken to wash out the salt, or the negatives take such a tremendous time to dry, even if this does not "crust" on the film. Do not, however, prolong the sea-water soaking, as chloride of sodium has a considerable solvent effect on silver and its salts; in fact, the sea contains thousands of ounces of silver. The following is a list of the salts occurring in sea water, and the proportions of each:

Sodium chloride	2·50
Magnesium chloride	0·35
Magnesium sulphate	0·58
Magnesium carbonate — calcium carbonate	0·02
Calcium sulphate	0·01
Water	96·54
	100·00

None of the above salts would injure the negatives after a rinse in fresh water. A good plan would be to use no sea water, and soak in fresh water and drain. Then soak the negatives in a bath of methylated spirit for a minute or two, and dry. They will keep for some time treated in this way, and could be well washed for several hours in fresh water upon returning home again. Negatives which were dried with spirit have been developed six weeks before being soaked without showing any sign of stain or fading.

81. Silver and Gold—To Separate.—About the easiest method for cleansing articles from coatings of silver and gold is known as "stripping," and the process for silver articles is thus: Get a porcelain jar large enough to take the article to be stripped, and put some strong sulphuric acid into it, and a few crystals of nitrate of potash (saltpetre). Gradually warm this solution until the crystals have dissolved, and while the solution is still hot immerse the articles, but now and then give them a move about, so that the silver can be thoroughly dissolved from the articles, but be careful to watch the articles, for if the copper gets much dissolved it upsets the process of getting the silver later. If the solution does not seem to move the silver quickly, add a few more saltpetre crystals, and also heat up the solution more. After the articles have all been cleaned, cool the solution, and put in some pieces of zinc, which will precipitate metallic silver, but in a grey powder form. But a preferable method is to add a strong solution of common salt. This will throw down the silver as a chloride, after which the superabundant liquor may be drained off, the white precipitate being washed and finally dried. After this the powder may be put into a crucible, mixed with a little dry powdered potash to form a flux, and heated in a furnace until the metal is finally melted, which will form a button at the bottom of the crucible. From this, of course, it may be dissolved in nitric acid, and so made into nitrate of silver. With reference to gold, this metal may be stripped by placing the articles in a solution of strong nitric acid, to which a little dry common salt has been added; about a teaspoonful to the pint of solution will be enough. After all the gold has been removed the solution must be evaporated to dryness, and fuse the residue the same way as the silver, after which the metal may be made into chloride or other salts. The fumes that arise from stripping the plated articles are unpleasant as well as positively dangerous in a room, therefore the jar had better be placed out of doors or on the stove while any chemical action is going on, that the fumes may go up the chimney. Another way of extracting gold from the surface of a gilded metal is to dissolve away the other metals by means of nitric acid (strong nitric acid and water in equal volumes), leaving the gold behind, unless the deposit of that metal is so thick and close as to protect the baser metal from the action of the acid. If nitric acid alone be used, it is important that it should be free from hydrochloric acid, since, if that substance were present, solution of a portion of the gold might take place. The residue left from the action of the nitric acid is washed with water and dried, or it may be further purified by dissolving it in a mixture of hydrochloric and nitric acids, and reprecipitating it with sulphate of iron as described below. If, however, nitric acid alone does not dissolve the original metal, in consequence of the film of gold, it is necessary to employ a mixture of nitric and hydrochloric acids, in the proportion of one volume of the former to two of the latter. This mixture will effect the solution of all the metals likely to be present, with the exception of silver, which will be left behind as a white precipitate of silver chloride, and should be filtered off. The liquid is then evaporated down to get rid of most of the acid, it is nearly neutralised with chalk, and a clear solution of sulphate of iron added to it. This will precipitate the gold in the form of a purple powder, which has only to be filtered off and dried. Instead of throwing down the gold in this way, a strip of aluminium may be placed in the liquid, on which the gold will deposit itself. In this case the liquid should be strongly acid with hydrochloric acid, and the deposit of gold should be occasionally brushed off the surface of the aluminium so as to expose the latter to the action of the liquid. The gold obtained in either way is converted into chloride.

82. Silver Bath—To Resuscitate.—Presuming that the bath has been used for sensitising plates (collodion), it is recommended to evaporate it to dryness and fuse. Some part of the silver nitrate will be reduced to the metallic state. This must be dissolved by heating with nitric acid and water (one part acid and ten parts water), and again evaporated to dryness. Redissolve in distilled water and evaporate again. This will rid the bath of alcohol and organic matter. If other substances are present in any quantity, it is best to precipitate the silver and reconvert into silver nitrate. Another method to put the bath in thorough working order is to take a clean glass bottle, in which pour twenty ounces of distilled water, and then gently add the silver bath. This should cause a cloudy effect, which is produced by the liberation of the excess of iodide of silver from the old bath. Should the solution not become cloudy, add more distilled water, or, better still,

more water to the bath until this is effected; now carefully filter through two thicknesses of filter paper until clear. If this is not effected by the first filtration, repeat the operation with fresh filter papers, and proceed to boil down to slightly less than its original bulk. Now allow the bath to cool, and test the strength with an argentometer. In summer the bath should be worked at thirty, and in winter at thirty-five grains per ounce. The strength of the bath is managed by the addition of nitrate of silver or water as required. Now neutralise with a ten grain solution of bicarbonate of soda until litmus paper turns blue. If possible place the bath in the white bottle in the sun or strong light for twenty-four hours, which causes any impurity and organic matter to be precipitated. Acidify with nitric acid until the litmus paper shows a slight reddening. A chalky metallic appearance is due to organic matter. The above treatment is never known to fail if the directions are carried out.

83. Silver Bath, when Forming Scum—To Remedy.—The delayed sensitising, and the appearance of scum on ferrotype plates, indicates that the silver bath contains a large quantity of organic matter which has accumulated from various sources. The best way to remedy this is to sun the bath. This is done in the following way: The nitrate of silver solution must be poured into a bottle, and be diluted with half its bulk of water. Add to this five grains of carbonate of soda to each pint of solution, and place in the sun for three or four days. Then either boil down to its original strength, or make it up with fresh nitrate of silver. Filter carefully and test for neutrality. Acidify with nitric acid.

84. Silver Bromide—To Reduce to Metal.—Procure some dried sodium carbonate and mix it with its own weight of potassium carbonate. This will constitute the "flux." Collect the silver bromide on a filter, wash it, dry it thoroughly in an oven, and grind it up in a mortar with its own weight of the above flux. Now take a small clay crucible, holding, say, three ounces, half fill it with the mixture, place it in the centre of a bright coal fire, cover the crucible, and urge the fire for half an hour with the bellows. At the expiration of this time remove the crucible from the fire (an ordinary tongs skilfully used will do this, but a crucible bow tongs is better), let it cool a little and pour away slag, when the silver will be found as a brilliant button at the bottom. The process is not in the least dangerous.

Another method is to boil the emulsion with one-sixth part of hydrochloric or sulphuric acid, which will destroy the gelatine and bring about the precipitation of the silver bromide. The precipitate is then washed with boiling water, dried, and then fired in a Stourbridge clay crucible with two parts of sodium carbonate and a little borax to each part silver haloid. The crucible should be kept at a white heat for a quarter of an hour after all conflagration has ceased. The molten silver should be turned out into an iron pan (previously rubbed over with plumbago to prevent spurting of the metal) and immersed in a pail of water. The washing should be repeated until nothing but pure silver remains. There is another method of reducing silver salts, which, however, is not so convenient as the former, viz., to place them in water slightly acidulated with sulphuric acid, together with granulated zinc. The zinc is attacked, nascent hydrogen is produced, which at once reduces the silver haloid and forms the halogen acid. After well washing, the black spongy metal is dissolved in nitric acid to form silver nitrate. The silver salt may be boiled with sugar of milk, and caustic potash dissolved in water. The silver is rapidly reduced, must be well washed, and ignited to redness to drive off any insoluble organic matter which may have been formed. None of these operations present any danger to an operator who works with anything like care.

85. Silver Citrate—To Prepare.—The simplest plan to make citrate of silver would be to dissolve one ounce of silver nitrate in the smallest possible quantity of water, and, in another vessel, 270 grains of neutral potassium citrate also in the smallest possible quantity of water. Now mix the two solutions together and stir. A white precipitate at once falls. This is the silver citrate. It should be collected on a paper filter, washed with the smallest possible quantity of cold, distilled water, and allowed to dry. Another method. Take a saturated solution of citric acid and one of silver nitrate. Add the citric acid solution to the silver slowly, and until no further precipitation takes place; allow it to settle. Decant and wash, with two or three changes of water.

86. Silver Compounds Sensitive to Light—To Prepare.—There are a very large number of salts that may be added to silver to form a sensitive compound. There is the fluoride of silver, which was suggested by Sir John Herschel, phosphate of silver suggested by Dr. Fyfe. The late Professor Hunt said the fulminate of silver presented a very promising line of inquiry. There is also carbonate, tartrate, acetate, citrate, oxalate, all of which added to silver form salts sensitive to light. Again, the addition of any organic matter to a solution of nitrate of silver at once renders it sensitive to light. Salts also of iron and silver have proved most useful, but others would no doubt give good results if they were as carefully worked up as these have been. Of the silver salts the most used hitherto have been the so-called haloids, that is, the compounds with chlorine, bromine, and iodine, but others give an image which can be printed out or developed. Of these the citrate and the ammonio-carbonate have been most investigated, as in the kallitype process and in some German-made dry plates.

87. Silver Nitrate—To keep in Solution.—In preparing a solution of silver nitrate, first of all be careful to use only distilled water, otherwise a heavy precipitate of silver chloride will be produced. The strength of the solution is immaterial, a saturated solution, perhaps, being more convenient than any. (1.) If carefully shielded from the air, it will keep almost indefinitely. (2.) If kept in a stoppered bottle it is immaterial whether it is kept in the light or in the dark, as it only blackens when in contact with organic matter. It would, however, be preferable to keep it in the dark. However, if used for floating paper, it should be kept in the light (sunlight if possible), and should have sufficient carbonate of soda added to just form a precipitate which should be left in the bottle; this ensures the neutrality of the solution, and the sunlight will precipitate any organic matter from the paper.

88. Silver Nitrate—To Prepare.—In order to make nitrate of silver from a silver coin it is necessary to get rid of the copper, of which there is seven and a half per cent. in sterling silver. Dissolve the coin in nitric acid (the quantity is not very particular so long as there is enough and not a large excess) and add hydrochloric acid or a strong solution of common salt to the boiling solution. The addition of this reagent will cause the silver to be precipitated from the solution in a white, clotty precipitate,

which is silver chloride. Filter it off, and wash it with hot water until on testing a few drops of the washing water with ferrocyanide of potassium no red-brown colouration is obtained. As soon as this is the case the silver chloride is free from copper, and has now to be reduced to the metallic state in order to restore it to the condition in which nitric acid is capable of acting on it. There are two ways of doing this; the first is "fusion with alkalies." Add to the silver twice its weight of dry sodium carbonate, a little potassium carbonate and a little borax. Mix these thoroughly together and expose to a strong heat in a coke fire. After all action of the crucible has ceased it ought to be raised to a white heat for a quarter of an hour and then turned out in an iron pan (previously rubbed over with plumbago to prevent the molten metal from spurting), and finally washed in a stream of water. The second method is "reduction by zinc and sulphuric acid." Place the chloride of silver in a beaker, cover it with some ten per cent. sulphuric acid, and about an equal weight of granulated zinc. In a short time the white silver chloride next to the zinc will become dark grey in colour, a change due to its conversion from silver chloride into metallic silver. Stir the mixture every few minutes in order that the zinc and silver chloride may come in contact with each other as much as possible, and that, therefore, the reduction may be the more complete. It will take two or three hours to completely reduce the silver, and even then a small quantity of chloride escapes reduction. Wash the black spongy mass of silver with three or four changes of water, allowing the silver to settle each time, pouring off the clear supernatant liquid, and finally drain it thoroughly. Having now obtained the pure silver by either of these methods it remains to convert it into silver nitrate. To every ounce of silver add three-quarters of an ounce of nitric acid (of density 1·4), and heat in a beaker until the silver disappears; then transfor the liquid to an evaporating basin, and drive off the excess of acid by placing the basin on a saucepan of water kept boiling by a Bunsen lamp. In order to recrystallise the salt dissolve it in the smallest possible quantity of boiling water, and on cooling the silver nitrate will be deposited in crystals. The salt remaining dissolved in the mother liquor can be recovered by evaporating to dryness and preserving it as a less pure sample. Since, however, ordinary silver coins contain a small percentage of copper, which requires extracting, it considerably minimises trouble, as well as risk of failure, by purchasing, in the first instance, what is known as *fine granulated silver*. This can be obtained from the assayer's or refiner's, and should yield a weight greater than the silver coins invested. Put the silver in a glass beaker, and pour over it one and a half times its weight of strong nitric acid diluted with an equal volume of water. Now apply a gentle heat by means of a sand bath, when the silver should begin to dissolve. When the action ceases, if the silver is not all dissolved (which would indicate that the acid was below strength), pour off the clear liquid into another beaker, and add a little more dilute nitric acid to the residue. When all is dissolved, add the two solutions together, and cool as *slowly* as possible. In a few hours a quantity of crystals should have formed themselves at the bottom of the beaker. Pour the clear solution from these, and evaporate in a porcelain evaporating dish until a drop of the solution taken out on a glass rod solidifies on cooling; then put aside, when more crystals will be formed. Now take all the crystals, and dissolve in the smallest possible quantity of hot water, and recrystallise as before. This will purify the crystals, and the operation might again be performed with benefit. Distilled water only must be used in all the above operations. It does not, however, pay to make the nitrate, as, owing to waste, etc., it will be found in the end that it has cost more than what it could have been bought for, not to speak of the labour involved. Another method of dealing with the silver chloride is as follows: Dissolve silver chloride in clean filtered hypo, and precipitate by adding a solution of ammonia sulphide until no further black silver sulphide is formed, allow to settle, pour away liquid, and wash residue in several changes of clean water. The silver sulphide thus obtained is dissolved up in *pure* nitric acid, an excess of which does no harm. In order to free the silver nitrate solutions obtained in this process from free nitric acid, they are heated upon a water bath to dryness, thus obtaining pure silver nitrate with a trace of nitric acid, which is not harmful, but which may be got rid of by adding water to silver nitrate and re-evaporating to dryness. If a water bath is not at hand an ordinary gas burner (Bunsen preferred) or spirit lamp will do, but towards close of experiment care must be taken not to heat too high, or the silver nitrate will be more or less split up into nitrite of silver.

89. Silver, Old—To Convert into Nitrate.—Probably the old silver is old silver plate, and the alloy copper. Put the silver into a glass or Berlin ware vessel, and add nitric acid to it by degrees. The metal will dissolve. When the operation is nearly complete, warm the compound rather than add fresh acid. This yields a dirty green liquid, dirty from a few impurities which could be filtered out, and green from the presence of nitrate of copper, which must be got rid of in a different manner. Evaporate the green liquid to dryness, and heat the mass over a spirit lamp flame, or even over the chimney of a large paraffin lamp. Do this on the hob, for the fumes which will rise are poisonous. A black-looking cake is obtained, and this, when nearly cold, should be dissolved in distilled water, and filtered through cotton wool or blotting paper. Rub a piece of wax or grease around the edge of the vessel to prevent the creeping of the solution, which would otherwise occur, and put the vessel with its contents in a secure, dry, warm place, until crystals form and grow, and nearly all the mother liquid disappears. Now pour the mother liquid into a bottle to be used for the silver it contains, in some future operation, and rinse the crystals if convenient with a little alcohol. The characteristic crystal plates of nitrate of silver remain, and these are of known strength, for in one "strength" only does nitrate of silver exist. Another way is to add hydrochloric acid or solution of common salt until all the silver is precipitated in the form of silver chloride. Filter this off and wash the precipitate so obtained in hot water several times, until when the wash water is tested with ferrocyanide of potassium no brownish colour is produced, the precipitate then being pure silver chloride. It is now necessary to reconvert this into metallic silver, in order afterwards to obtain nitrate of silver. The silver chloride is, therefore, collected and fused in a crucible with double its weight of "fusion mixture" (a mixture of sodium and potassium carbonates), the metallic silver will collect at the bottom of the crucible, and when the fusing is completed and the mass cooled, a button of silver will be found at the bottom. This is now dissolved by heat in sufficient nitric acid (the exact amount is immaterial), and the solution evaporated to dryness in a water or sand bath. The residue is now to be dissolved in a small quantity of boiling distilled water, and on cooling the silver nitrate will be deposited in crystals. As it is most likely that some silver nitrate will be left in solution in the mother liquid,

this can be evaporated to dryness in another vessel. Should the silver salt have been dissolved in too great an amount of boiling water, it can be reduced by boiling until the water is reduced to the correct amount, or the silver chloride may be thoroughly washed by filling up with water, allowing to settle, and pouring off as much as possible of the clear liquid, filling again, and repeating the process three or four times. Having finally drained off as much water as possible, pour over the chloride sufficient *dilute* sulphuric acid to cover it, and float on the top of the mixture a piece of clean sheet zinc, and allow to remain perfectly quiet in a fairly warm place for twenty-four hours. By this time all the silver chloride will have been decomposed and the pure metallic silver deposited on the bottom of the vessel in the form of a fine black powder, which must be well washed with water to remove all traces of acid. This pure silver must be carefully dissolved in just sufficient pure nitric acid. Three ounces of pure silver require from two to two and a half ounces of strong acid diluted with five ounces of water. (To get approximately the weight of pure silver obtained deduct one-tenth from the weight of silver originally started with, as usually in England that represents the amount of alloy present.) As it is impossible to prevent excess of acid, the solution must be evaporated to dryness, and the residue slightly heated. This is then pure nitrate of silver. To obtain it in the form of crystals it must be dissolved by heating in a very little water, when, on cooling, the nitrate of silver will separate in crystals.

90. Silver Sulphide—To Convert into Nitrate. — Having precipitated the silver as sulphide, take the black, slimy deposit and place in a large mug or basin, and fill it up with hot water, stir well, and allow to stand till completely settled, the clear is then poured or syphoned off, and this operation repeated four or five times to remove all the soda compounds originally present; the washed sulphide is then filtered through grey filter paper, which is folded in four, then one of the cones opened out and placed in the funnel into which the mixture is poured, and allowed to drain. Now place the paper, etc., in the oven on a plate and allow to dry, when dry get an old house shovel or thin baking tin on which cakes are made, and place same on a bright red fire, now put on the crushed dry sulphide along with the paper, when it will burn the sulphur present away; continue the heating till there is no smell of burning sulphur, then allow to cool. Take a large porcelain basin, and into it brush the residue left after ignition, which consists of metallic silver with a little sulphide, cover with a glass square and add nitric acid in excess, and place over the Bunsen and apply heat, when a violent action will take place, the residue being dissolved to nitrate of silver, dilute with water, filter into small dish, and concentrate down to small bulk, dilute again with water and concentrate; repeat this operation three or four times, again filter, wash filter, and evaporate solution down to small volume, cover dish with glass square, and put on one side to cool, when the salt crystallises out in flat shining plates; the mother liquor is drained off; the crystals washed with a little water, redissolved, concentrated, and allowed to crystallise, drained, dried, and bottled for use. The mother liquors are added to the next lot of sulphide before dissolving in acid after roasting. The filter papers are dried and roasted for the silver sulphate they contain.

91. Silver—To Precipitate from Fixing Bath.—To precipitate the silver, zinc alone will do it, but sulphide of potassium or calcium will do better, or use both methods at once; and, further, if the pyro ammonia developer is used don't throw it away, but add it to the old hypo bath, and keep it in the daylight; this will deposit the silver fairly quickly. This is easily proved by fixing a few plates without washing, and direct from the developer, in a used hypo bath, leave it in the light, and in a day or so the silver is left as a muddy substance on the bottom of the dish; collect and dry, and melt on a piece of charcoal with a blow-pipe, and metallic silver is obtained. The colour of the silver precipitate with sulphide of potassium is black, while that of sulphur is white or yellowish white in colour. When, therefore, the addition of sulphide ceases to produce *a black precipitate* the silver is all down. It may also be known when the sulphide is present in excess by the smell becoming apparent after stirring the liquid. When it smells decidedly of the sulphide an excess is present. It is not advisable to add the liver of sulphur to such an excess as this. The sulphur should be *gradually* added, and to test the superfluous water take a small quantity in a glass and add a few drops of the sulphur solution, and if no further turbidity arises it can safely be assumed that all silver has been thrown down. If there is not a large quantity of waste to deal with, it is best to evaporate it by putting it in an old enamel saucepan with some sawdust. Zinc may be used, and it will completely precipitate the silver, but its use is not satisfactory. The precipitate produced by it is bulky, it contains much foreign matter, and the silver is only separated from it with much difficulty.

92. Silver—To Recover from Waste Paper.—The following plan will answer well: Take a quantity of silvered paper, chippings, misprints, filters, saturated paper, etc., and reduce the whole to ashes upon a grate in a fireplace, or in a clean stove. Run through the ashes with a sieve to separate any foreign substances. Then, to one part of ashes by weight, mix one and a half parts of finely dried carbonate of potassium (this can be done by placing the carbonate in an iron pan over a gentle fire), and pack this mixture rather tightly into a sand (Hessian) crucible to nearly the top. It is important here to note that the material must be quite dry or the silver contents of the crucible will boil over. Next place in a clean stove, coal or coke to three inches in depth, and place the layer of coal over the glowing fire. On this layer the crucible must be placed, and then coal is to be packed all round it to the top of the crucible. Raise the heat gradually and keep it at a dull red for thirty minutes, after which raise to full redness, and keep so until all bubbling ceases, and the contents become uniformly liquid and quiescent. When no more gas escapes, and the mass is liquid throughout, remove the crucible from the fire, and allow it to cool. Then break the crucible, and the button of silver will be found at the bottom.

Captain Abney gives the following directions in "Instructions in Photography," p. 323: It is stated that by carefully saving and reducing silver residues, from fifty to seventy-five per cent. of the whole of the silver used can be recovered. Always trim the prints before washing, toning, and fixing. When a good basket of them is collected, this together with the bits of blotting paper attached to the bottom ends of sensitised paper during drying, and that used for draining wet collodion plates upon, should be burnt in a stove (or out of doors in an iron pail), and the ashes collected. In large establishments the films of rejected negatives may be added to the trimming of prints, etc. These ashes will naturally occupy but a small space in comparison with the paper itself. Care should be taken that the draught from the fire is not strong enough to carry up the ashes, or if out of doors the wind does not blow

them away The ashes can be stored in large glass jam-pots until the time arrives for turning them into silver nitrate by the aid of nitric acid, or into metallic silver by the aid of the crucible, etc. To make silver nitrate, boil the ashes in strong nitric acid, using a proper porcelain dish made and kept for this purpose only. It is best placed on the hot plate of a close stove, but so placed that the acid fumes are carried up the chimney and not inhaled, which might be fatal. The contents of the "dish" are stirred with a glass rod, and evaporated to dryness, the dry substance produced being the crystals of silver nitrate. If it is not found desirable to do the silver nitrate or the metallic silver making from the ashes at home, they can be sent to a refiner. For metallic silver, the crystals or silver nitrate are dissolved in water and filtered quite clear. Common salt is now dissolved in it, and the precipitate formed, which is chloride of silver, is well washed in water, caught upon a filtering paper or papers, and thoroughly dried. It may then be reduced to metallic silver in a reducing crucible (the crucible should be of Stourbridge clay) by adding two parts of sodium carbonate and a little borax to one part of the silver chloride. These should be well mixed together, and placed in the crucible in a coke fire and gradually heated. After a time, on lifting off the cover, it will be found that the silver is reduced to the metallic state. After all conflagration has finished, the crucible should be heated to a white heat for a quarter of an hour. The molten silver should be turned out into an iron plate (previously rubbed over with plumbago to prevent the molten metal spurting) and immersed in a pail of water. The washing should be continued until nothing but silver remains.

93. Silver Wastes — To Recover. — (1.) Collect the old fixing bath in some large vessel, and proceed to precipitate the silver by adding thereto sulphide of ammonium, about three per cent. for plate fixings and one per cent. for print fixings, or by suspending strips of zinc in the liquid and adding a small quantity of liver sulphur. When it is all precipitated pour off the liquid, and dry the residues, and send them to the assayer. Or if it is preferred to convert it to metallic silver at home, first roast it in an iron pan over the fire until it reaches a red heat, and is fused into a smooth even mass. Then mix fourteen parts of the sulphide to sixteen parts of a flux composed of carbonate of potassium three parts, and carbonate of soda two parts. Half fill a crucible with the compound finely powdered, and expose to red heat for half an hour; then allow to cool, when it may be broken, and the silver will be found at the bottom in a lump. Another authority says the silver can be reduced by adding pieces of zinc, but the better way is to pass sulphuretted hydrogen through it, until all precipitation ceases, or, which amounts to the same thing, a solution of calcium sulphide added; the exact quantity cannot possibly be given, for it depends upon the amount of silver present. The calcium salt is made as follows, and it is very effective and *cheap:* Slack "quick lime," and make into consistency of thin cream, add about three ounces of flour of sulphur to each quart, and boil in a large old pan or copper for about fifteen to thirty minutes; allow it to settle, and it leaves a strong solution (in *smell* and otherwise) of calcium pentasulphide, which will rapidly precipitate the silver. When the old fixing bath has cleared, after adding the sulphide, take a small glassful and add a little sulphide solution; if it remains clear, draw it *all* off and throw it away. If a muddy precipitate take place, of course more sulphide should be added to the old baths. Another simple way is to put sheets of clean copper in the old baths, conveniently contained in a glass bottle. The hypo will attack and dissolve the copper, and the silver will be thrown down as a black powder. Another method is to precipitate the silver as silver sulphide by adding potassium sulphide (liver of sulphur) to the old baths. The potassium sulphide is made by fusing together in a crucible one part of sulphur with four parts of potassium carbonate. The black silver sulphide can be converted into metallic silver by fusing it with an equal weight of a mixture of two parts sodium carbonate and one part potassium nitrate, or more expeditiously thus: Make a mixture of flour of sulphur two parts, nitre four parts, fine dry sawdust two parts. See that the ingredients are thoroughly dry; reduce the nitre to the finest powder in a mortar, and mix it *on paper, and with the fingers*, with the sulphur and sawdust. To reduce the silver sulphide mix it (also thoroughly dry) with an equal volume of the reducing mixture, and place the whole in an aperture made in a piece of dry wood. Apply a match to the top, when it will ignite, and an ingot of metallic silver will remain at the bottom.

94. Solutions—To Test Strength of in Silver and Citric Acid.—Obtain a burette, that is a long tube graduated so that any quantity of liquid delivered can be accurately measured. The one most generally useful to a photographer would be Binks's, graduated to one hundred decems. This measure is very useful, as each decem. equals ten grains of water. Make a solution of 190 grains of common salt (previously dried on a shovel over the fire) in ten ounces of water. Add to this enough chromate of potash to give the solution a slightly yellow colour, fill the burette to O (the mark at the top), now take a measured quantity, one dram, of the solution from the bath, and place in a glass jar, and add one ounce of water. Place the thumb over the opening through which the solution is introduced into the burette, and very slowly pour the salt solution into the bath solution, stirring with a glass rod all the time. A precipitate of silver chloride will be formed mixed with silver chromate; on stirring, the latter will be destroyed, and the precipitate will become quite white. The operation is finished when the faintest *permanent* red colour is produced. Now read off the number of decems. used, and it gives the number of grains of silver nitrate in each ounce of the bath. It is possible to test the bath without a burette, thus—dissolve twenty and a half grains of salt or forty-two grains of bromide of potassium in one ounce of water, then a minim of this solution will precipitate silver in a dram of bath solution equal to a grain of silver nitrate per ounce. To determine the amount of citric acid dissolve 320 grains of pure caustic soda in sixteen ounces of water. Now, one ounce of this solution, containing twenty grains of soda, will neutralise one hundred grains of citric acid (approximately). Take a measured quantity of the bath solution, and add to it a small quantity of litmus solution; then add soda solution till another drop imparts a blue colour. Solution is now neutral. Note quantity of soda solution used, and citric acid present can be easily calculated from figures above given. To get rid of impurities several methods may be adopted. Here are two—(1.) Add about a teaspoonful of kaolin (white china clay), and well shake, then filter. (2.) Add four to eight grains of sodium carbonate, and place in daylight. Impurities become oxidised at the expense of silver nitrate and fall to the bottom. Action is slow in dull weather.

Captain Abney's directions are as follow: Measure one hundred drops of the solution and drop in a solution of well-dried salt (thirty-five grains to one ounce of water) drop by drop until no more precipitate of silver chloride is seen to form, then the

number of drops added will indicate the number of grains of silver nitrate in the bath. If ammonia is present in the bath to be tested it should be made slightly acid by the addition of a little pure nitric acid. A rather more accurate method is to dissolve eight and a half grains of pure chloride of sodium in six ounces distilled water—each dram will precipitate half grain of silver nitrate. Take one dram of the bath and put it in a phial, and add the test solution dram by dram, shaking briskly until the white curds have perfectly separated and the supernatant liquid is clear. When the last addition causes no milkiness, ascertain number of drams employed (subtracting the last dram or half-dram), and multiply by four; this will give number of grains per ounce. If a little chromate of potash be added, a deep red precipitate (chromate of silver) is formed, which will tinge the silver chloride formed on adding the test solution until the last addition, when all the silver being thrown down, the chloride of sodium finally decomposes the chromate of silver into white chloride, and the completion of the test is evident from the change of colour in the precipitate. Instead of pure chloride of sodium, commercial chloride of ammonium may be used (seven and three-quarter grains to six ounces distilled water). To neutralise the acid present in a bath add gradually a solution of carbonate of soda. This will with the silver form carbonate of silver, and if an appreciable amount of this precipitate be kept at the bottom of the bath it will be known that no free acid is present. It also carries down with it any organic matter in the bath (which should be placed in the sun until cleared), and is probably the most useful purifier of a bath known. When the precipitate becomes black, the solution may be filtered and a little more silver added.

95. Stains, Amidol—To Remove.—Try the following method. It has always been successful in removing stains. Mix up the following solution—

Dry chloride of lime...	2 ounces.
Carbonate of potash...	4 ,,
Water	40 ,,

Mix the chloride of lime with thirty ounces of the water, dissolve the carbonate of potash in the remainder. Mix, boil, and filter. Then thoroughly soak the part with the stain in it in the above solution, and when wet rub it all over with a crystal of citric acid. The stains should then gradually disappear.

96. Stains, Chloride of Gold—To Remove.—Gold stains may be removed from a fabric by immersing in a solution of chlorine water (obtainable from chemist) until the stain gradually disappears. Then wash well. The cause of the stain is the reduction of the gold chloride to metallic gold by organic matter in the cloth, and this gold is completely dissolved by chlorine water with reformation of the chloride. If chlorine water is not obtainable, a strong solution of bleaching powder, to which a little hydrochloric acid has been added, will answer the purpose equally well. From a negative the stain may be removed by the same means as above, at any rate if by no other. There are three other ways of removing the stain from cotton: The first is by soaking the stained portion in a saturated solution of hyposulphite of soda, and when thoroughly wet through pour a few drops of saturated solution of ferricyanide of potassium on to the spot, and then wash with water. This should be continuously applied until the stain is removed, and may require four or five applications. The other method consists in rubbing the stain with metallic mercury, the cotton being quite dry. The mercury combines with the metallic gold to form an amalgam of gold and mercury, and is easily removed. An easy way to do this is to get a glass funnel and place the cotton so that the stained portion is at the apex of the cone, then pour the mercury into the cotton, and it will, with gentle pressure, run through, carrying the amalgam with it. The next method is by boiling with *yellow* sulphide of ammonium; the colourless will not do. As regards a negative, the application of the above solutions of hypo and ferricyanide by means of a brush will probably remove the stain, but greater care is necessary owing to the powerful reducing action of the mixed solutions on silver.

97. Stains, Ferricyanide—To Remove.—These stains are either blue or yellow. To remove the blue stains due to ferricyanide and iron, place the plates, etc., in ten per cent. ammonia until the blue stain is changed to a brown one, then wash thoroughly and remove the brown stain with ten per cent. oxalic acid. To remove the yellow stain produced by ferricyanide and hypo, use the following after getting rid of all the hypo by prolonged washing: Nitric acid ½ dram, alum ½ dram, water 10 ounces. The following plan seems also fairly successful: Wash well—this removes part of the stain—and soak in ammonia as strong as the paper or film will bear. This decomposes the blue colour—Turnbull's blue or Prussian blue—and leaves a brown stain of hydrated oxide of iron. Wash *thoroughly* to remove the soluble ammonia salts; after this soak in an acid—hydrochloric is as good as any—to get rid of the iron oxide, and finally wash with water. Unless the ammonia salts are thoroughly washed out, the acid will bring the blue colour back again. When reducing with ferricyanide and hypo be sure to finish off with a soak in pure hypo. If any yellowness still remains wash out the hypo and soak in a strong solution of alum with twenty minims of hydrochloric acid added to each ounce. The blue stain may also, to a certain extent be removed by the application of a weak solution of potash, then a good wash, and treating with a weak acid (say, hydrochloric one in fifty of water), and again thoroughly washing. But in all cases of stains prevention is better than cure, and circumstances alter cases. Generally in removing one class of stain another stain, equally unsightly, is introduced. Another mode of removing yellow stain from lantern slides is to wash well, and place in

Hydrochloric acid	1 dram.
Alum	½ ounce.
Distilled water	20 ounces.

Wash thoroughly, and immerse in a five per cent. solution of bichloride of mercury until well bleached; again wash well (say half an hour with the tap dripping gently on them), and redevelop with diluted ferrous oxalate or hydroquinone; when dense enough give them a rinse and five minutes in the clearing, wash and dry. They should then be a pure warm black. Or it is possible to make a virtue of necessity and convert the slides to Prussian blue if they are suitable subjects, *i.e.*, seascapes, and do away with the stain at the same time, as follows: Immerse slides in

Ferrous sulphate	10 grains.
Distilled water...	1 ounce.

Wash and place in

Potassium ferridcyanide	15 grains.
Distilled water...	1 ounce.

The slides will then go a splendid blue tint, suitable for "moonlight" effects. The only thing essential to success in the above is *absolute* cleanliness and thorough washing between each operation. Strong solution of sodium sulphite or potassium metabisulphite, acidulated with hydrochloric acid, is sometimes successful in removing them. Alum and citric acid may also be tried, or soaking for an hour or two in a saturated solution of tartaric acid.

98. Stained Fingers—To Clean.—Development with pyro is a fruitful cause of brown stains on the fingers, to which many not unreasonably object. These stains may be removed by washing the hands in a saturated solution of chloride of lime, and then repeating the operation in a dilute solution of citric acid, or, better still, rubbing the stained part with a crystal of the acid. It may be, however, that the stains are due to silver nitrate coming in contact with the hands during the dipping of the plates and being reduced on the hands touching the ferrous sulphate used for developing. The usual remedy prescribed is to wet the hands with a solution of cyanide of potassium. As this salt is extremely poisonous, whether taken internally or absorbed externally, it is probable that every one who has occasion to use the wet-plate process will welcome the following simple method of removing silver stains, published a few years ago in the *Photographic Times*: Make a weak solution of iodine in potassium iodide solution. With a tuft of cotton wool, cover the stains with this solution and allow it to remain in contact for three or four minutes. Then wash off with strong solution of ammonia. This process is quite harmless, and any stinging produced by the ammonia can be stopped at once by flooding the hands with cold water. When the stains are old ones nothing will remove them which does not also remove a portion of the skin. Frequent washing in hot soap and water, with scrubbings, and the use of pumice-stone to the fingers, and penknife to the nails, will make the hands presentable in about a fortnight. But, in the meantime the old stains should not be added to. The use of cyanide of potassium is hardly advisible at this stage, because the skin, being thin with the frequent rubbings, will be susceptible to the poison. A good soaking of the hands in a hypo fixing bath after washing them well will be all that is needful, especially if the hypo be allowed to dry in for a time. It must not be forgotten that the hypo-contaminated hands will need thorough washing before any photographic operations can be undertaken. When the hands are clean, and in no danger of absorbing the poison, the best plan is to use a fragment of wet cyanide of potassium, and to rub with it the parts of the finger most susceptible to stains. If evidences of "silver" appear after this they can be removed without difficulty while fresh by rubbing the spots with a wet crystal of iodide of potassium until they become yellow by formation of iodide of silver. The yellow iodide is then easily removed by cyanide. A useful solution to keep always at hand in the dark room is two drams of sulphuric acid in twelve ounces of water; this will at once remove all fresh stains caused by either pyro or oxalate developers. Once the hands are clean they should be kept so by the very simple process of rubbing them over with a little vaseline ere touching the defiling chemicals. It is a good plan also to invest in rubber gloves or finger-stalls, as nothing is more objectionable, from the sitter's point of view, than a dirty fingered operator, who persists in handling his models in the arranging of the pose.

99. Stained Finger Nails—To Prevent.—A few drops of sulphuric acid in a pint of water is a good thing for cleaning and strengthening the finger nails. The nails should be thoroughly brushed with the above and periodically trimmed; or a frequent rubbing of the nails with lemon juice, with, for a change, a slight oiling now and then, in the way of outward application. Prevention is better than cure. The practice of dipping the fingers into alkaline solutions should be avoided, and to this end finger stalls should be worn. The new covers for bottle stoppers, which some of the rubber dealers are now offering for sale, answer admirably for the purpose, and cost only twopence each.

100. Stains, Hydroquinone—To Remove.—The following has been found serviceable in removing stains of hydroquinone: Pour a saturated solution of chloride of lime on to affected parts of the linen, and work it about thoroughly. Then take a crystal of citric acid, and use it in the same manner as soap, or like a nail brush. The acid liberates chlorine gas, which is very active as a decolouriser. Try also (1) a little alum citric clearing solution, and (2) solution of oxalic acid one to five, followed by very weak hypochlorite of zinc. Another method: Sodium bisulphite, or potassium meta-bisulphite, or a strong solution of sodium sulphite made acid with sulphuric or hydrochloric acid will do this. Of course it is almost needless to say that after either of the above methods have been used, the linen should first be washed for some time in several changes of clean water, and afterwards in the usual manner Pyrogallic acid will not do to follow the bleaching powder, as, apart from its property of staining afresh, it is not a true acid.

101. Stains, Ink—To Remove.—The best method of removing ink stains from photos is to dissolve a dram of oxalic acid in an ounce of warm water, and, having wetted the surface of the print with warm water, apply the solution to the spot, and rub gently till it disappears, keep it warm throughout, wash thoroughly, and dry. Or else try the following. Immerse the print in

Mercury bichloride...	100 grains.
Potassium bromide...	100 ,,
Distilled water	10 ounces.

Soak print in this until thoroughly bleached and the stain has come out. Then immerse the print in a very weak solution of hypo. The stains may be removed by a concentrated solution of chloride of lime, or fresh prepared eau de javelle, made to the following formula:

Dry chloride of lime...	2 ounces.
Carbonate of potash...	4 ,,
Water	40 ,,

Mix lime with thirty ounces of the water, dissolve the carbonate of potash in the remainder, mix, boil, and filter. When the stain is bleached and removed wash well with distilled water at once. Another method is to get some binoxalate of potass, otherwise known as "salt of lemons." It is a powerful poison, therefore be sure not to leave any about after using. Put a dram of this material into two drams of water, and apply carefully with a camel-hair brush, well washing the photograph afterwards.

102. Stains, Oil—To Remove.—Mix pipe-clay or fullers' earth with cold water to a paste, and apply some of it to the soiled spot, without friction, so as not to injure the design. After having remained there for about twelve hours, it is removed and the remains brushed off. The porous material, after the water has evaporated, soaks up at least a portion of the oil. If the stain does not disappear by one application, it is to be repeated.

103. Stain, Platinum—To Remove.—This is usually impossible to do, but it is worth trying the following: (1.) Moisten a tuft of cotton wool with a weak solution of cyanide of potassium, and apply carefully to the negative.

(2.) Sulphocyanide of potassium ...	10 grains.
Nitric acid	5 minims
Distilled water	1 ounce.

Use with great care.

(3.) Chrome alum ... ... 1 ounce.
Citric acid ... ... 1 „
Water ... ... 20 „

This is a good clearing bath, and one that is useful to cleanse negatives from various stains. When the negative is immersed, dip the tip of the finger in and gently work about over the surface of the negatives where the stains are. (4.) Pour a saturated solution of chloride of lime into a dish, and add to it a little citric acid in solution. Treat the negative very carefully with this mixture with the tip of finger or otherwise. If it is impossible to get rid of the stain, dry and varnish the negative, coat the back with mat varnish, and work over the unstained parts with blacklead till it prints with the same speed all over.

104. Stains, Pyro — To Remove.—Mix bleaching lime (so-called chloride of lime) to a paste with water, and add a strong solution of citric acid, or some hydrochloric acid, until a clear yellowish solution is obtained. This, smeared over the pyro stains, will soon cause them to disappear. When they are gone, wash the hands in running water for some time in order to get rid of the chlorine, or use a solution of salts of lemon. Begin with a weak one, and rub the solution on with a bit of rough flannel. Some other things to try are—(*a*) Strong solution of ferrous sulphate, acidified with hydrochloric acid. (*b*) Hot strong solution of sodium sulphite, either acidified or alkaline. (*c*) Acid alum solution. In either of these cases the ivory must be subjected to long soaking, and then to brisk rubbing with a rag, saturated with the respective reagent.

105. Stains on Marble—To Remove.—Many marble-workers say if such a stain has gone deeply into the pores of the marble nothing will remove it. Indeed, some photographic printing processes are based on the fact. If not too deeply embedded, the following will remove it: Make a paste of equal parts whiting, pearlash, and dry soap, cover the article thickly, and allow the paste to remain on for fourteen days, then wash off with a sponge and water. Another method that can be tried is this: Make a strong solution of chloride of lime, and put on the marble, and rub the stain over whilst on with a crystal of citric acid. This will liberate chlorine, which is well known as a decolouriser. The following paste also is very efficacious in removing stains from marble: Some common whiting is made into a stiff paste with hot water, in which some oxalic acid has been dissolved. The paste is smeared over the marble with an old brush, and left for twenty-four hours. It is then washed off with hot soap and water. It might be an advantage to add some sulphite of soda to the water in which the oxalic acid is dissolved, since by the action of the latter upon it sulphurous acid would be liberated, and would assist in destroying the stain.

106. Stains, Silver—To Remove.—(1.) Moisten the stain with alcoholic solution of iodine and refix or gently rub the stain, after treatment with iodine, with solution of cyanide of potassium. This alone, without iodine, will also sometimes remove silver stains. (2.) If varnished, remove with methylated spirit and a clean rag. Then apply—

A

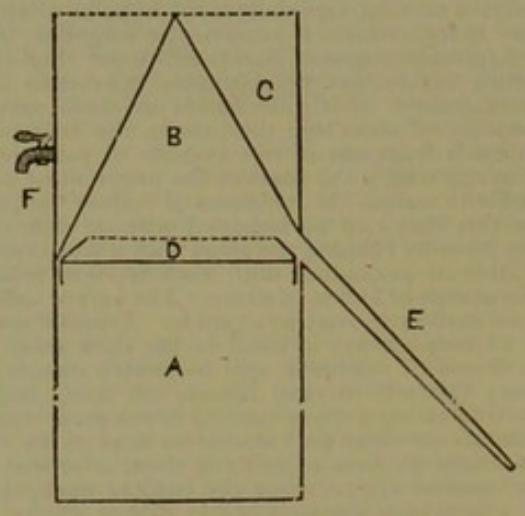
Sulphocyanide of ammonia... ... ½ dram.
Water ... ... 1 ounce.

B

Nitric acid ... ... ½ dram.
Water ... ... ½ ounce.

Thoroughly wash, then apply a saturated solution of chrome alum. (3.) Wet the negative and apply a dilute solution of potassium cyanide, by means of a rag, to the yellow stain. If this does not remove the stain, use a more concentrated solution of the potassium cyanide. If the stain still remains make the cyanide solution still stronger, and so on until the stain disappears. The precaution of using the dilute solution at first is necessary, as permanent injury may happen to the negative if too strong a solution be used. Another method of removing stains is advocated by Mr. Hanson. Rub the stains briskly with a wash-leather (or other suitable material) stretched tightly over the end of the finger and moistened with spirits of turpentine; even green fog can be thus rubbed away. Another and better method, however, is to make a solution of potassium iodide one ounce, water two ounces; immerse the negative in this until the stain disappears, and then wash well. If the stain is of long standing, use a stronger solution and rub with the tip of the finger. Sometimes the stain is very troublesome, and may take an hour or more to remove. If the negative is varnished, remove the varnish by soaking in methylated spirit (two baths of it) and proceed as above.

107. Still—To Make.—Make a worm from three feet of lead gas pipe by filling with sand and bending around a large round bottle. Place this in a good sized flower-pot, letting one end come through the hole in the bottom, and making it water-tight by means of putty or clay. Now connect the other end of the pipe to the spout of a boiling tea-kettle, and keep the flower-pot full of water, the vapour from the kettle, coming in contact with the cold lead pipe, will condense and form *pure* distilled water. Another method is to fit a tall metal vessel of suitable capacity with a hollow inverted cone in place of a lid. When the liquor to be distilled is placed in



the tall vessel and heat applied, the steam condenses upon the lower surface of the cone, which is continually kept full of fresh cold water by means of a syphon. The condensed steam flowing down to the apex of the cone is received in a bowl, like that of a tobacco pipe, connected with a tube carried through the side of the tall vessel, and leading to the store bottle for the distilled water. The following is a description of an efficient and substantial still. It consists of a cylindrical tank (A) for water to be distilled, on which is fitted another cylinder. In this is fixed a cone (B), on the sides of which the steam condenses. Running round the inner side of the base of B is a collar (D), which forms a trough for the distilled water, which is collected, and flows through a tube (E) into any suitable receptacle. The

space (C) surrounding the cone should be filled with cold water. A tap (F) is provided, by means of which the heated water may be run off. A fresh supply of cold water may then be poured in to maintain a low temperature necessary to condensation. The still may be put into operation on a kitchen stove or other heating apparatus. It should be constructed of copper, tinned inside on all parts coming in contact with the water or steam.

108. Stoppers — To Remove.—When a stopper is found to be immovable, it may often be loosened by gripping the neck of the bottle firmly in the left hand, applying the thumb at the same time with a firm upward pressure against one side of the head of the stopper, and smartly tapping the opposite side with the handle of a spatula or other suitable piece of wood. The force should be applied in the direction of the longer axis. The operation may often be expedited by placing a drop of oil or other liquid—according to the nature of the contents of the bottle—on the line at the junction of the stopper and the neck of the bottle; when the stopper is tapped a minute space is momentarily formed, into which the liquid slips, and so gradually gets between the stopper and the neck of the bottle, and allows of the former being easily withdrawn.

109. Sulphite of Soda—How to Test its Goodness.—There are three methods of telling if sulphite of soda is still good—(1.) *By its appearance.* If the crystals are transparent, and have not gone powdery on the surface, the sulphite is probably good. (2.) *By testing with barium nitrate or chloride.* Prepare a solution of the sulphite (say one small crystal to half a test tube of hot distilled water), and to this add a few drops of dilute hydrochloric acid and a solution of barium chloride or nitrate. If a *copious* white precipitate results, the sulphite contains too much sulphate to be of much use. *Theoretically*, there should be *no* precipitate, but there always is a little, even with fresh sulphite. (3.) *By testing with sulphuric acid.* Put about ten grains of the sample into a dry test tube, and add a dram of strong sulphuric acid. If the sample is all sulphate, no effervescence will occur; if sulphite be present, a violent effervescence will be produced, with the escape of a suffocating gas (sulphur dioxide). The violence of the action is a rough test of the purity of the sample, necessarily a rough one, however, as most samples of sulphite contain carbonate as well, and this will effervesce with the acid, although the sulphite itself may have been all converted into sulphate.

110. Sulphurous Acid—To Prepare.—Mix four ounces of strong sulphuric acid with two ounces of water, and pour the mixture into a twenty-ounce flask containing an ounce of wood charcoal, broken up into small pieces. Connect the flask to a wash bottle containing a little water, the delivery tube from which dips beneath the surface of a bottle containing forty ounces of ice-cold water. On gently heating the flask, sulphur dioxide is liberated, and is condensed in the ice-cold water. At the expiration of about an hour the operation will be at an end. The solution so made will contain about twenty per cent. by weight of sulphurous acid. Sulphur dioxide may also be prepared in either of the following ways: (1.) Decompose ordinary sulphuric acid by heating it with copper turnings, but be careful not to heat too strongly, as boiling sulphuric acid gives off most suffocating white fumes. Equation is:

$$Cu + 2H_2SO_4 = CuSO_4 + 2H_2O + SO_2.$$

Copper + sulphuric acid yields copper sulphate + water + sulphur dioxide. The gas is passed through the waste bottle and then into the required distilled water, which should be kept cool and occasionally shaken up until no more gas is absorbed, *i.e.*, there is no indrawing of air after shaking. The specific gravity of the fresh acid solution should be 1·04. (2.) Another way to get the gas is to decompose old hypo solutions, or, better still, hypo crystals with any mineral acid, sulphuric or hydrochloric. (3.) By burning sulphur and drawing the gas thus formed through the water by means of an aspirator, but this involves a lot of apparatus.

111. Vulcanite — To Mend. — There are several cements suitable for the purpose of mending vulcanite dishes. Fish glue twenty parts, raw indiarubber twenty parts, and carbon disulphide sufficient to make thick cream, is a useful cement. Coat the edges of the article, and put on one side for some time to thoroughly set. Amber one part, carbon disulphide two parts; this is an excellent cement for mending articles that are required immediately for use afterwards, as it dries in a few minutes, and should be applied to the edges of the articles to be mended. Another excellent cement, and one of the most useful cements a photographer can have, as it mends nearly everything and resists the action of water and moisture perfectly: soak isinglass or the best gelatine in water till it is quite soft, then dissolve it in the smallest quantity of alcohol, by the aid of gentle heat (great care must be used); in four ounces of this mixture dissolve about twenty grains of ammoniacum or gum ammoniac (this is a concrete juice of the Dorema ammoniacum—a Persian plant); while still liquid add a dram of mastic dissolved in six drams of alcohol, and stir all well together. To liquefy the cement the bottle must be placed in hot water, and it improves by keeping. This cement can be used for vulcanite and glass, and will remain intact for years with constant use of the article that has been repaired. Marine glue is another excellent cement, but its dark colour is somewhat detrimental to its use in many cases. It is used by melting with gentle heat until sufficiently liquid and then applied in the same manner as the other cement, but sets quicker. It is very strong—in fact, it has been called the king of cements. It was used frequently in the days of the old collodion process for cementing strips of glass to the bottoms of dippers, and for mending broken dipping baths, and found to resist the action of nitrate of silver and acid solutions well.

112. Zinc—To Stain.—Zinc may be blackened with a solution of bichloride of platinum. Clean the metal thoroughly, and polish with fine emery powder. Heat, and apply the solution with a brush or tuft of cotton wool. One or two applications will chemically produce a durable black. Brass and other metals may be blackened in the same way. Platinum bichloride 24 grains, water 1 ounce. A good dead black stain is given by the following:

Sulphuric acid	½ ounce.
Hydrochloric acid	½ ,,
Arsenious acid	¼ ,,
Water	1 pint.

Applied to the zinc with a camel-hair brush. It may also be done with a solution of cupric chloride and silver nitrate, or a solution of ferric chloride, or the following dead black could be applied, which will stand any amount of rough usage, and will not chip or rub off: In a smooth dish place sixteen grains of lamp-black and twelve drops of gold size. Mix well together. When thoroughly incorporated, add one hundred drops of turpentine and five of methylated spirit, warm the zinc slightly, and apply with a brush. This is a good black for shutters, stops, etc. Another way:

Dissolve eighty grains of nitrate of silver in half an ounce of pure water. Also make a solution of nitrate of copper of the same strength, mix the solutions, and paint the zinc with it. When dry, heat on a sand bath or before the fire, until it turns a fine dead black colour. Other methods are the following:

Sulphate of copper	2 grains.
French verdigris (acetate of copper)	1 ,,
Sal ammonia (chloride of ammonia)	1 ,,
Water	2½ ounces.
Vinegar	2½ ,,

Or else ten ounces strong vinegar with one grain of bichloride of platinum. If a polished appearance is desired, dust the articles over with blacklead, brush off, and lacquer with the following:

Mastic	1 part.
Shellac	1½ ,,
Dragon's blood	2 ,,
Turpentine	1½ ,,
Alcohol (by weight)	9 ,,

Mix the turpentine and spirits over a slow fire, then break the mastic, shellac, and dragon's blood in fine pieces, and mix them together. Keep the mass over a slow fire, and stir repeatedly until the gum is well dissolved.

CHAPTER III.

DEVELOPMENT.

113. Accelerator—How to Use.—For use either with pyro or ferrous oxalate. Himly recommends a new accelerator compounded as follows:

A.

Water	500 parts.
Zinc filings	100 ,,
Sulphuric acid	50 drops.

This solution is well shaken, and kept for some days in a stoppered bottle, then are added two hundred and fifty parts of sodium sulphite; when this is well dissolved it is allowed to stand a few days.

B.

Water	500 parts.
Sulphite or sulphate of ammonia ...	250 ,,

The solution is filtered, and solution A mixed in equal parts with B. This forms the stock solution. When used with pyro, add one part sulphocyanide of ammonium to each fifty parts accelerator. With ferrous oxalate, four parts of citrate of iron and ammonia should be added to each fifty parts of the accelerator used. Filtered from time to time, and kept in stoppered bottles, this preparation lasts for many years.

114. Acid Pyro Developer—To Neutralise.—It is difficult satisfactorily to neutralise the excess of citric acid, as the only result would be to form citrate of potash, soda, or ammonia, which would make the developer very slow indeed. It is best to use a *nearly neutral* sulphite of soda, and add only enough citric acid to make it just acid to litmus paper. A very alkaline sulphite requires so much citric acid as to spoil the developer. It is better still to dispense with citric acid altogether, and acidify either with sulphurous acid or bi-sulphite of soda (so-called).

115. Amidol—To Develop with.—This developer in many hands is more successful than rodinal, and is recommended for bringing out detail and for snap-shot work. The stock solution recommended to be made up is as follows:

Amidol	20 parts or	80 grains.
Sodium sulphite ...	200 ,, or	800 ,,
Water	1000 ,, or	8 ounces.

The solution is at first fairly clear, but is found to turn to a very dark yellowy brown in a few weeks, quite contrary to what the directions state as to its remaining colourless. The usual amount of dilution is 1 : 5·8, the directions give 1 : 3 to 4, but this for most purposes is too strong. Like rodinal, amidol acts very energetically, and the film seems to veil over at once, but this is only the commencement of the development, and the solution should be allowed to act for a considerable time, when a fair amount of density is gained. If a full exposure has been given, a few drops of ten per cent. potass. bromide will improve matters.

Amidol is an ideal developer for bromide papers, and one cannot do better than adopt it. It gives equally as good blacks as ferrous oxalate, and does not need the troublesome clearing bath after development and before fixation. It is equally successful with Ilford slow, Ilford rapid, and Eastman extra rapid papers, and is used in various formulæ, always, though, adding the amidol dry to the solution just before development, which is far the best plan with this developer. The Ilford Co., in their monthly *Scraps*, gave a formula which works out: Amidol 4·8 grains, sodium sulphite fifty grains, and bromide of potash two-and-half grains, mixed with three ounces of water. This will be found to give good blacks with their slow paper, which yields density readily, but a much stronger developer is best for the quicker brands of bromide paper. In Photography Annual for 1893, Professor Sexton recommends amidol five grains, sulphite fifty, and bromide two grains per ounce of water, which is excellent. A short exposure and strong developer is required for good blacks, and a longer exposure and weaker developer for greys. Too much bromide must be avoided, or the blacks incline to brown. Amidol "cartridges," dissolved in seven ounces water (full strength), used with a little bromide, also work well.

Another writer advises to use dry amidol: It dissolves almost immediately, and can be made any strength required. Keep the dry amidol in a bottle, with a small metal spoon holding just about ten grains when piled (it is best to get a little spoon of this description for the purpose, as it saves the inconvenience of weighing out the chemical every time), and in a large bottle keep a saturated solution of pure sulphite of soda. Use also a ten per cent. solution of bromide of potassium. For use with a properly-exposed bromide print (the right exposure should always be ascertained first by a trial slip of bromide paper), dissolve ten grains of dry amidol in two ounces of the soda solution, and add ten to twenty drops of bromide of potassium (ten per cent.) Previous to development, soak the print in water, removing air bubbles, etc., then pour the developer on, and if the image appears quickly, pour it off and put on water, and the print will then gradually gain density in the water. But if the print is much over-exposed, add more bromide (say thirty to sixty minims or even more) to the developer. For under-exposure a few drops of a ten per cent. solution of carbonate of potassium may do some good, but the best cure for under-exposure is to make another print. One peculiarity of amidol is that it causes the image to flash out in rather a startling manner, and creates the impression of over-exposure to those used to the other methods of development, but this is not so, and the print only requires time to get density. Another experience is: Better results can be obtained with amidol (at

least in many hands) than any of the other developers. Perhaps the following stock solution used without dilution may be useful:

Amidol	50 grains.
Sulphite of soda	1 ounce.
Distilled water	20 ,,

It will be found that the proportions of amidol may be varied to almost any degree.

116. Carbonate of Ammonia Developer—To Make.—Try the following:

A.

Ammonium carbonate	40 grains.
Water	5 ounces.

B.

Pyro	40 grains.
Citric acid	10 ,,
Potassium bromide	5 ,,
Water	5 ounces.

Equal parts. For over-exposed plates use the following:

Pyro	3 grains.
Potassium bromide	5 ,,
Sodium sulphite	50 ,,
Ammonium carbonate	13 ,,
Water	2 ounces.

Should the density be insufficient when all detail is out add pyro two grains, water one dram. For over-exposed plates hydroquinone is better than pyro, giving a better density and pluck. The following is a good formula for ever-exposure:

No. 1.

Hydroquinone	20 grains.
Soda sulphite	100 ,,
Bromide potassium	8 ,,
Water	10 ounces.

No. 2.

Carbonate of ammonia	1 ounce.
Water	5 ounces.

Commence development with No. 1 = twelve drams to one dram No. 2, and add more, if required, as development proceeds. Be sure to obtain the ammonia carbonate in good condition, for it readily spoils, and unless got from a firm who moves it quickly is apt to prove a very much deteriorated article.

117. Combined Developers—How to Employ.—Prepare the *four* following solutions, as the development of all and every kind of subject will be completely under control. But, as it is only *rarely necessary* to use bromide with either of these developers, in cases of over-exposure or on subjects that *require their contrasts to be increased*, and when great density is essential, it will be better to have the bromide in a separate bottle, No. 4 as given below, but if the bromide and the alkali are wanted in the same bottle, do not add a larger quantity of bromide of potassium than *a quarter of a grain to each ounce of that solution*, otherwise chalky negatives may be expected. Mix the following solutions:

No. 1.

Eikonogen	120 grains.
Pure neutral sulphite of soda ...	120 ,,
Distilled or filtered rain water ...	10 ounces.

No. 2.

Hydroquinone	120 grains.
Pure neutral sulphite of soda ...	120 ,,
Distilled or filtered rain water ...	10 ounces.

First dissolve the sulphite of soda in both Nos. 1 and 2 in, say, six ounces of boiling water, and when dissolved add the eikonogen or hydroquinone as the case may be, pouring the whole into a bottle containing the remaining four ounces of cold water; when quite cold it can be filtered through cotton wool until quite clear. No. 1 gives detail both in the highest lights and deepest shadows to a much greater extent than any other developing agent; it, however, has a tendency to give less density than is usually required in order to give nice bright silver prints, with good blacks and whites. But this can be corrected by mixing No. 2 with it in suitable proportions, because No. 2 gives more general density than No. 1, with a little less detail. The advantage of using boiling water for mixing Nos. 1 and 2 with is that better keeping solutions are made by so doing. It will be observed that the proportion of sulphite of soda is much smaller than that usually recommended, but solutions at least four months old mixed as directed above work as well now as when first prepared.

No. 3.—Accelerator.

Carbonate of soda	1 ounce.
Water (as above)	10 ,,

No. 4.—Restrainer.

Bromide of potassium	1 ounce.
Water (as above)	10 ,,

If carbonate of potash is used instead of carbonate of soda in the same proportion, a shorter exposure can be given, and the development effected in a much shorter time. It is impossible to give minute details respecting development in a brief article, but the following hints will be a guide. For a Thomas R.R. quarter-plate, correctly exposed upon a well-lighted landscape with heavy foliage in the foreground, or for portraits or groups in a bright diffused light out of doors, a developer composed thus should give a good printing negative. Take of

No. 1, for detail	1 dram.
No. 2, for density	½ ,,
No. 3, accelerator	2 ,,
Water to make	1 ounce.

If, bromide is used do not add more than one drop of No. 4 solution, at first, at all events. The image should begin to appear in from two to five minutes, after which more of No. 3 must be added, if required. If no bromide is used, the developer will not cause fog, not even if one ounce of No. 3 has been added, *i.e.*, in small quantities at a time, say half a dram at not less than one or two minutes after each other. If the negative is not dense enough, it must be intensified, and more of No. 2 must be used for similar subjects in future; if too dense, use less of No. 2, if there is not enough details increase the exposure, or use more of No. 1 and less of No. 2, say one and a half drams of No. 1, and quarter dram of No. 2, instead of the above. Full printing density, with proper exposure, should be obtained by keeping the plate in the developer for fifteen minutes. If density is wanted quicker, *double* the quantities of Nos. 1, 2, and 3, and then eight minutes might be long enough. Never use the same solution twice if the best results are desired from every plate exposed and developed, because nearly every subject requires a little different treatment, and, therefore, the plate exposed upon it must be treated a little differently. For example, the formula given may produce a first-class negative of the landscape indicated, or of the group portrait or group mentioned, provided they were all dressed in clothes more or less dark in colour, but, if one or more ladies were in it dressed in white or light dresses, etc., and perhaps some in black velvet, and it were known before starting to develop, use two drams of No. 1, and not more than twenty minims of No. 2, two drams of No. 3, and water to make one ounce, by which means the risk of losing the details in the white dresses and black velvet would be prevented, also solarisation, and halation greatly reduced, if not stopped altogether. The two latter never need be feared, except when great over-exposure has been given. Other things also govern the quantity of the developing agent. It may be wise to add to the developer, if the best possible results are desired, as well as those indicated above. For

instance, the quantity of the developing agent necessary to obtain full printing density depends upon the power of the light, the size of the stop, the particular brand of plate, also whether it is thinly or thickly coated, as well as upon the kind of subject. Small stops, weak light, and thinly-coated plates *do not favour density*, therefore a larger quantity of the developer is required than if a large stop is used, the light strong, and a thickly-coated plate employed. In the former case probably *twice* the quantity will be necessary to that required in the latter case. No alum or acid fixing bath is required.

118. Combined Developer—To Prepare.—The following formulæ will be found useful, and this remark may be premised that nine out of ten tyros produce too hard negatives, either from under-exposure or under-development. Take first, then, quinol as density giver and rodinal as detail giver.

Quinol and Rodinal.—The formula for quinol is the one given by Messrs. Thomas for their plates. It was given in vol. i. of the Annual, p. 54, but will bear repeating, especially as there is more bromide in their latest edition.

No. 1.

Quinol	... 160 grains.
Sodium sulphite	... 2 ounces.
Citric acid ...	... 60 grains (or less G.A.)
Potassium bromide	... 40 ,,
Water to ...	... 20 ounces.

No. 2.

Caustic soda ...	... 160 grains.
Water to ...	... 20 ounces.

Sixty grains of citric acid are found more than sufficient, as its only use is to render acid the sulphite. Hence the sulphite being first dissolved in ten ounces of water, add sufficient citric acid to turn blue litmus paper red, and do not add more, as it has a retarding action. Equal parts of Nos. 1 and 2 are used, + a quantity of water according to the temperature. Thus in summer, No. 1 one part, No. 2 one part, water two parts. In cool weather one of each, and in very cold weather no water at all. Now, for development begin with the quinol as above until the image is well out, and then to bring out detail in the shadows add thirty minims of rodinal to each ounce of developer. Mix well and flow the plate. It is astonishing how the detail starts out. Keep it on until there is a deposit (slight of course) on even the deepest shadow, *i.e.*, the whitest part of the negative, then wash thoroughly and fix.

Quinol and Amidol.—The development is commenced as before with quinol, and then either add about ten minims of stock solution of amidol to the developer and continue development, or—and this is probably the better plan—have another measure glass of amidol developer made up as given above. After pouring off the quinol, just drain and flood with the amidol. This will be found very satisfactory for hand-camera shots taken in dull light, although for general work perhaps pyro and soda, with an after dose of any of these three detail givers, eiko, rodinal, or amidol, are preferable. Perhaps it may be well to give the method of mixing the ten per cent. pyro. First, take a ten-ounce measure glass, and place it (dry and empty, and above all clean) on the letter pan of an ordinary pair of scales, then equalise its weight in the other pan. Now take weights amounting to three ounces and add these to the others, while into the glass pour crystals of sulphite of soda until the balance is true. Then add about six ounces of hot water, and stir with a glass rod until the sulphite is dissolved. Then test with a piece of blue litmus paper, adding a little solution of citric acid, and stirring until the litmus paper turns red. Then pour this solution into an ounce bottle of pyro, give it a shake round, and back into the measure. Next add more water up to ten ounces, and pour into the usual ten-ounce pyro bottle, which has of course been washed free from the remains of the last lot it contained. A valuable developer for snap shots is, to start with—

Pyro solution, ten per cent.	... 40 minims.
Carbonate soda, ten per cent.	... 120 ,,
Potass. bromide, ten per cent.	5-10 ,,
(According to circumstances.)	
Water to	2 ounces.

When the image is out add another sixty minims of soda carbonate, and if this does not fetch out the detail one of the new developers may be utilised, either by adding a small quantity to the pyro or by using alternate baths. Generally speaking, however, these newer agents will not work satisfactorily with ammonia *for negatives*.

Eikonogen and hydroquinone :

A.

Crystallised sulphite of soda	... 275 grains.
Eikonogen	... 25 ,,
Hydroquinone	... 15 ,,
Distilled or boiled water ...	... 10 ounces.

B.

Potash carbonate	... 420 grains.
Water	.. 10 ounces.

For use mix equal parts of A and B, and add two drops of a ten per cent. solution of potassium bromide to each ounce of developer.

The following formula was given in No. 69 of *Photography :*

Sodium sulphite	... 30 grains.
Sodium carbonate	... 20 ,,
Sodium hydrate	... 3 ,,
Bromide (potassium) ...	... ½ ,,
Hydroquinone	... 2 ,,
Eikonogen	... 3 ,,
Water	... 1 ounce.

It is claimed to possess the rapid action of eikonogen, combined with the sustaining energy of hydroquinone, and to keep indefinitely.

The very best form for the combined developer is to have them *uncombined*, and to mix them to suit the subject, for the more hydroquinone is used the greater the contrasts are in the negative, and the more eikonogen the greater the detail and delicacy, and so by adding according to judgment enough to form a balance of detail and density, far better results can be obtained than by having a "stock" solution of so much of this to so much of that. The following will be found most trustworthy in working, and, of course, if so desired, mix together at once :

A.

Eikonogen	... 2 drams.
Soda sulphite	... 8 ,,
Warm water	... 16 ounces.

B.

Hydroquinone	... 160 grains.
Soda sulphite	... 1 ounce.
Citric acid	... 20 grains.
Potassium bromide	... 20 ,,
Water	... 16 ounces.

For an energiser use one part of

Soda carbonate	... 6 drams.
Water	... 5 ounces.

to three parts of above for normal exposure.

119. Darkening of Developer—To Prevent.—The change of colour produced upon addition of water is due to oxygen dissolved in water, which, in presence of the alkaline solution, oxidises the pyrogallol, producing a dark colour, which presently diffuses through the liquid. The same colour may be produced in a more intense form by diluting the pyro with water, and then adding alkaline solution undiluted. As it sinks

through the liquid a deep red colour is produced, which shortly diffuses, and is then too light to see. Boiled water, which is freed from oxygen, will not produce the colour.

120. Density—How to Secure by Development.—If the plate before development (using an ordinary gelatino-bromide one) is soaked for a minute in a solution containing three grains of gallic acid per ounce of water, and developed in the usual way, without *washing* off the gallic acid solution, a greater amount of density will be obtained than if the preliminary soaking had been omitted. A *slow* plate gives the best result and Mawson & Swan issue a special brand of plate for this work. It is easy to get any amount of vigour with M. & S.'s plates, but *clear shadows* are another matter. If these be required, it is best to use collodion. Another method is to use a soda developer. The annexed formulæ will work with any commercial plates—No. 1. Washing soda 2 ounces, potassium bromide 10 grains, water 20 ounces. No. 2. A five per cent. solution of potassium bromide. To develop take one ounce of water, half-ounce of No. 1, five drops of No. 2, and about three grains of pyro. For under-exposure more of No. 1; over-exposure, more of No. 2. Be sure and use citric acid in the clearing solution. In developing with alkaline pyro proceed thus—After fixing, drain the negative, but do not wash it; then place it in a dish with the following, viz.: Alum ½ ounce, citric acid ½ ounce, sulphate of iron 1½ ounces, water 10 ounces. It will be found that in two minutes or so the negative will assume a deep black with clear shadows; then take it out and well wash and dry. With some plates this acts very rapidly, so should be carefully watched, or would make them too dense. With ferrous oxalate use the following: A. Gallic acid 1 dram, alcohol 10 drams. B. Silver nitrate 1 dram, acetic acid 20 minims, distilled water 2 ounces. To use the above, take one ounce of A, and mix with four ounces of distilled water, then add twenty minims of B. Having washed the negative after fixing, pour the above solution over it, and when sufficiently dense wash and refix in hypo. Negatives thus treated will yield strong contrasts. Still another method is to use very slow bromide plates, about ten or twelve times wet collodion; give rather short exposure—that is, do not over-expose—and use a hydroquinone developer containing rather a larger proportion of bromide of ammonium.

121. Developing Dishes—To Improvise.—Developing dishes can be improvised very cheaply and readily if required for special purposes, such, for instance, as experimenting with a size of paper or plate larger than any tray the experimenter is possessed of, or if trial developments are required to be made away from home. A simple way is to take an ordinary plate box—not one of the grooved variety—or to make a tray out of a sheet of cardboard by cutting and turning up the sides and pinning them together, pasting the corners over with paper. If these improvised trays be then coated with paraffin wax, which can be obtained of any chemist, and is applied hot, they will be rendered impervious to moisture, and will serve the purpose of trays for photographic work quite as well as a highly expensive piece of apparatus. Another method: The travelling photographer need not carry developing dishes, if he will take with him a few sheets of parchment paper, such as jam-pots are covered with, cut into pieces measuring two inches larger each way than his plates. These are readily made into dishes for temporary use by bending up the edges, and holding the folded corners between American paper clips.

122. Development—Best Method of Procedure in.—Soaking the plate in the alkali has a levelling effect on the subsequent development, causing the detail to appear sooner than it otherwise would, and thus allowing the plate to be removed before the deposit in the lights has become so dense. It is therefore advisable in cases where a harsh result is probable, such as interiors, machinery, and parlour portraiture, especially by artificial light. This method of development is one usually recommended for plates exposed instantaneously, and it certainly seems to produce density in some cases when almost impossible by any other method. Some plates, however, will not stand this preliminary soak. Putting on the accelerator first, and afterwards adding the pyro, is also supposed to assist the development of an under-exposed plate. In some experiments it was found to give the development more quickly in such cases, but very little difference in the finished result, though, if anything, it had the advantage in such cases. In cases of over-exposure, it seems better to put on pyro and bromide first, and afterwards add accelerator very carefully, *drop by drop*.

123. Diamidophenol—To Develop with—Diamidophenol (amidol) is a very good developer for Eastman film. Make up the following: Sodium sulphite 1 ounce, bromide of potassium 20 grains, water 20 ounces; and to every two ounces of this solution add five grains dry diamidophenol. To quicken development add a few drops of a five per cent. solution of sodium sulphite, and to retard it a few drops of a ten per cent. solution of bromide of potassium to the mixed developer. Metol is, however, a better developer in cases of instantaneous work with Kodak films, and has the distinct advantage of hardening the film. Take care that the sodium sulphite used is good.

124. Eikonogen, for Hand-camera Work—To Use.—This developing agent is most useful for hand-camera work; the only drawback, however, being its feeble solubility in water, a three per cent. solution being nearly saturated. This necessitates its being made up in bulk, but if the following directions are followed it will be found to keep well—it has been known to keep seven or eight months. It is best to use a saturated solution in conjunction with sulphite of soda, and prepare it as follows: Take a forty-ounce bottle, and into it empty a one-ounce tin of eikonogen. Then prepare a ten per cent. solution of sulphite of soda with boiling water, and while still hot pour about two ounces into the bottle, give a good shake up, allow the crystals to settle, and decant these two ounces into a cup, etc. If this solution is only of a light green tinge no further washing is necessary, and so fill up the forty-ounce bottle with the hot ten per cent. sulphite solution; lay it on its side after a shake, and give it an occasional shake during the next few hours. The next morning turn it up the right way, and when the crystals have settled at the bottom, decant off ten ounces into the usual-sized developing bottles for use, filling up the forty-ounce bottle with more than ten per cent. sulphite solution. Thus it is always ready for use. For developing take three parts of this eiko and one part of ten per cent. carbonate (soda or potash or both). For portraiture eikonogen is most valuable, as it gives a fine deposit with full detail, erring, however, on the side of thinness. For snap shots, intended for gelatino-chloride or bromide printing, or for enlarging, it is also most suitable. For greater density use it combined with the ordinary quinol developer, or in a combined solution, as follows:

Eikonogen and quinol, when used together, form a most serviceable developer for hand-camera shots, more especially when the shutter has been worked at a high rate of speed. The following is a continental formula, and due to M. Rossignol:

Eikonogen ...	30 grammes ...	132 grains.
Quinol	10 ,, ...	44 ,,
Sodium sulphite	200 ,, ...	880 ,,
Water	1000 c.c. ...	10 ounces.

The sulphite is first dissolved in the water; to this the quinol and eikonogen are added, and dissolved by the aid of heat. The alkali recommended is a ten per cent. solution of carbonate of potash, and they are used in equal parts. This is a most powerful developer, and many plates will not stand it unless diluted with an equal bulk of water. It, however, possesses the advantage of bringing out detail, and at the same time giving density. If, when the solution of eikonogen is cool, crystals be deposited, the clear supernatant liquid is to be used. Carbonate of soda (ten per cent.) will work well with this developer, while if great density is required, equal parts of carbonate of potash and carbonate of soda are to be used.

125. Eikonogen—One Solution Developer, to Prepare:

Sodium sulphite (crystallised) ...	30 grains.
Sodium carbonate	30 ,,
Potassium bromide	½ ,,
Eikonogen	15 ,,
Water	1 ,,

Or the following, which is recommended for very short "instantaneous" exposure (such as $\frac{1}{1000}$ of a second):

Sulphite sodium...	5 parts.
Carb. potassium...	2 ,,
Eikonogen	1 ,,
Water	30 ,,

the dissolution being brought about by *boiling* and stirring. Several other formulæ are given, of which two or three of the best are: A.—One solution. Take five parts sodium sulphite of soda, place in a beaker or flask, and dissolve in about twenty-five parts of water, add one part of eikonogen, and stir the hot solution until it is completely dissolved. When cold add two parts of potassium carbonate dissolved in about five parts of water, so as to bring the whole solution to thirty parts. If kept in a tightly-closed bottle it will preserve its developing qualities for a very long time.

B.—German formula introducing glycerine. Dissolve in the order given:

Potassium metabisulphite	2 parts.
Sodium bisulphite	75 ,,
Glycerine	100 ,,
Eikonogen	12 ,,
Potass. carbonate	60 ,,
Water to	1,000 ,,

C.—Gottheil's one solution:

Sulphite of soda (crystals)	8 ounces.
Carbonate of soda	3 ,,
Distilled water	80 ,,
Eikonogen	1 ,,

All these solutions are to be used as made. A is best suited for exposures of very short duration, such as $\frac{1}{1000}$ sec. The others for exposures down to $\frac{1}{20}$ sec.

126. Eikonogen—To Develop with.—A good developer for general use is—

A.

Eikonogen	80 grains.
Sodium sulphite	80 ,,
Distilled water to	20 ounces.

B.

Sodium carbonate	400 grains.
Potassium hydrate	50 ,,
Distilled water	20 ounces.

To develop, take equal parts. With eikonogen, development should not be carried quite so far as with pyro or hydroquinone, as the colour of the film is more non-actinic. The above is good for ordinary landscape work, but for subjects requiring great contrast (copying line drawings, etc.) the following is preferable:

A.

Eikonogen	1 dram.
Sodium sulphite	4 ,,
Distilled water	8 ounces.

B.

Sodium carbonate	6 drams.
Distilled water	7 ounces.

Take three parts A to one of B. The following is very energetic, and is recommended greatly for instantaneous work:

Eikonogen	60 grains.
Sodium sulphite	300 ,,
Carbonate of potassium	120 ,,
Hot water	4 ounces.

Stir until dissolved. This may be used as an accelerator to the above developers, adding about one dram to the ounce; it will shorten the time of development considerably. If preferred, however, a combined "eiko-cum-quinol" developer could be used, as:

A.

Eikonogen	120 grains.
Hydroquinone	40 ,,
Sodium sulphite	480 ,,
Citric acid	20 ,,
Distilled water to	20 ounces.

B.

Potassium bromide...	5 grains.
Sodium carbonate	60 ,,
,, hydrate	30 ,,
Distilled water to	20 ounces.

Use equal parts. Whatever formula is used, develop tentatively; that is, *don't* begin development using the solutions at full strength, and when over-exposure shows itself throw in half a bottle of restrainer. Take the first formula, for instance. Don't start developing with the solutions at full strength, but take A one part, B one part, and one part water. This will give a developer the *chemical* proportions of which are the same, but the action is merely delayed by the addition of water, which does *not* injure the quality of the negative. Beginners, however, are nearly always recommended to start developing with an excess of restrainer. This is wrong. Take pyro development, for instance. We are told to start development with the full amount of pyro solution, and add the ammonia gradually. This is all very well if the plate is over-exposed, but what if the reverse, *i.e.*, under-exposed? It is simply ruined. Again, develop a *correctly* exposed plate in a developer containing an excess of pyro and bromide, what is the result? Failure. *The high lights gain density out of all proportion to the shadows*, and, consequently, to have them at all printable, development must be stopped before there is any detail in the shadows. Restraining with water has none of these disadvantages; it merely *slows* the developer, without altering in the slightest degree the gradation of the negative. Although the pyro developer is given as an example, the remarks are equally applicable to any other developer. A good eikonogen developer for transparencies and bromide paper is:

A.

Eikonogen	3 grammes.
Sodium sulphite	40 ,,
Distilled water	500 c.cm.

B.

Potassium carbonate	75 grammes.
Distilled water	500 c.cm.

To develop take A 12 drams, B 10 drams, water 13 ounces. When deep enough well wash

and (before fixing) immerse for ten minutes in a five per cent. solution of alum, then wash well and fix. Plates developed with eikonogen are best fixed in—

Hypo	4 ounces.
Bisulphite of soda	1 ,,
Water	20 ,,

It may be interesting to know that the chemical name of eikonogen ($C_{10}H_5NH_2OHSO_3H$) is amido-B-naphthol-B-sulphonic-acid, and that it can be obtained by reducing the dye stuff produced by combining diazo-benzol-chloride with Schäeffer's B-naphthol-B-sulphonic acid. Another method is as follows: The following three-solution developer with eikonogen yields negatives full of the finest detail, and containing withal what is often supposed not to be easily obtainable—good printing density.

No. 1.—Stock solution of eikonogen.

Crystallised sulphite of soda ...	2 ounces.
Eikonogen	1 ,,
Water to	30 ,,

First dissolve the sulphite in the water (hot), then add the eikonogen, dissolve, and set aside to cool. A few grains of eikonogen will probably crystallise out in the cooling process, but the solution will be sufficiently strong, and will keep well for several days.

No. 2.—Stock solution of alkali.

Carbonate of soda	10 drams.
Water to	20 ounces.

In cases of great under-exposure it is sometimes advisable to use carbonate of potash in place of the soda, thereby obtaining greater density in less time. The same quantities will suffice.

No. 3.—Stock solution of bromide.

Bromide of potassium	20 grains.
Water	10 ounces.

For developing a half-plate negative take

No. 1	2 ounces.
No. 2	1 ,,
No. 3	½ ,,

No. 2, the accelerator, and No. 3, the restrainer, may be increased or diminished as the conditions of exposure may require. As already intimated, ample density may be obtained with this developer without the assistance of hydroquinone, and with less than half the time required for the double developer. The deposit on the negative is of a bluish-black colour, akin to that produced by ferrous oxalate. It is not so powerful in resisting light as the deposit on pyro-sulphite developed negatives; consequently the development must be continued beyond the point usually allowed for pyro. This developer is eminently suited to quick exposures, and yields detail equivalent to that obtainable by pyro and soda, or pyro and ammonia, without the risk of frill or fog.

127. Eikonogen—To Develop Wet Plates with.—Try eikonogen 2 grains, citric acid 2 grains, water 1 ounce. The following will give good results with wet plates from an unwashed emulsion and used after coating, washing until greasy lines disappear, and then immediately exposed. Stock solution sulphite of soda 1 ounce, carbonate of soda ½ ounce, water (hot) 6 ounces. When cool add eikonogen (finely powdered) 75 grains For use take stock solution 120 minims, water 1 ounce, and bromide of potassium ten per cent. up to 35 minims. This might succeed with the ordinary wet plate if washed before developing, in order to get rid of the free nitrate of silver which doubtless causes all this trouble. Or again try eikonogen restrained with acetic acid on the lines of the acid pyro developer.

128. Eikonogen—To Obtain Density with.—Some workers find it difficult to obtain density with this, although it will develop a plate when hydroquinone will not, but too thin to print; but after development with eikonogen for detail, if development is continued with hydroquinone (Ilford formula), fine negatives will be obtained, and any amount of density, or a very good result is obtained by a judicious mixture of the two, but it must be used at once. Excellent results are also obtained by using the following formula: (A) Sodium sulphite 2 ounces, distilled water 30 ounces, dissolve and add eikonogen 1 ounce. (B) Crystallised sodium carbonate 1½ ounces, distilled water 30 ounces. (C) Hypo 24 grains, sodium bromide 144 grains, water 3 ounces. For use take equal volumes of A and B, and from four to twenty drops of C, according to exposure. With this formula there will be no difficulty in obtaining full density. Many workers seem to fail in the very point in which eikonogen is strong, *i.e.*, density. The failure may be attributable to one of two causes: (1) Impure chemicals, (2) over-exposure. The former is soon remedied, as the latest form of eikonogen is in yellow crystals, which give very good results. As regards over-exposure, this seems very probably the cause of want of density, as with eikonogen far less exposure is required than with other developers. In fact, a quarter to a half represents the ordinary exposure with eikonogen when unity represents it with other developers. In very special cases where greater density is required, it may be obtained by slightly reducing the quantity of sulphite of soda, as this salt appears to have the same effect in reducing density with eikonogen as with pyro. It is better also not to use ammonia.

129. Eikonogen.—To Use for Bromide Paper.—The following formula will yield excellent prints on Morgan and Kidd's paper. (A) Eikonogen 90 grains, sodium sulphite 480 grains, water 30 ounces. (B) Sodium carbonate (pure) 1 ounce, water 10 ounces. For use, employ three volumes of A to one volume B. Time the exposure correctly, and *do not employ any bromide*. Wash very thoroughly after development, and fix in strong hypo. No clearing solution either before or after fixing will be found necessary. With correct exposure and development, and pure chemicals, the colour of the resulting print will be a warm black and full of detail in the shadows. In this latter respect eikonogen far surpasses ferrous oxalate.

The following also is a most excellent form, simple and reliable: Eikonogen ½ ounce, soda sulphite 1 ounce, water 25 ounces, carbonate of soda ½ ounce, water 25 ounces. For normal exposure use equal parts, for a weak negative use a few drops of a solution of *potassium* bromide five grains, water one ounce. It is necessary to use the potassium salt, for ammonium bromide does not work at all well with this developer. Slow bromide paper requires more carbonate of soda solution than the rapid paper. Soak the prints well before development, or they will come up uneven, for this developer is very rapid in its action, and the perfect soaking of the print equalises its action. If this is found to over-develop or give too much density, mix developer as above, and add as much plain water. In other words, don't reduce the *quantity* of soda carbonate and eikonogen, but *increase* the quantity of water—if, suppose it takes a grain in one ounce of water to develop a print, don't modify it by using half a grain to one ounce of water, but use the grain and *two* ounces of water. A developer weak in eikonogen gives very flat, bad-coloured prints, but an attenuated solution used in *bulk* gives crisp, fine-coloured ones.

130. Enlargements—How to Develop.—The ferrous oxalate developer is the best for these

tones, as hydroquinone is apt to give a brownish black, and eikonogen a greenish black image. A rapid paper will give much blacker tones than a slow paper. The following formula gives the desired tone on many of the papers on the market:

Eikonogen	80 grains.
Potass bromide	10 ,,
Sodium sulphite	200 ,,
,, carbonate	150 ,,
Water	20 ounces.

To get the slate colour magnesium is preferable to oil, and use six pieces of ribbon six inches long placed about one and a half inches apart, to get even illumination, which are lighted together. Care and judgment are necessary in using magnesium, otherwise the enlargement will be spoiled. The following developer is hard to beat: (A) Eikonogen 45 grains, sodium sulphite 240 grains, water 15 ounces. Dissolve the sulphite in the water, test with litmus, and if alkaline add citric acid until just acid, and then the eikonogen. (B) Dry pure sodium carbonate 240 grains, water 5 ounces. (C) Potassium bromide 120 grains, water 1 ounce. To develop, take 3 ounces A, 1 ounce B, 10 drops C. If the exposure is correct the tone will be all that can be desired, but if unsatisfactory it can be made all right by toning before fixing in chloroplatinic acid 10 grains, water 10 ounces, nitric acid ½ dram. The best way to proceed is to develop in the usual manner in a dark room, then wash off the developer for, say, five minutes, in running water, and place the print in ten ounces water acidulated with half a dram nitric acid. When in this solution it may be examined by weak daylight. If satisfactory wash this off and fix; if unsatisfactory, tone as above described, and then fix. The tone depends very largely upon the developer employed, and the following is a personal experience with many formulæ: Eikonogen gave splendid detail, but except with a negative of clear glass shadows, an absence of the rich black produced by oxalate. A combination with quinol produced fair results, but the high lights were not pure—in fact, there seemed a greyness all over the paper. After trying several hydroquinone formulæ the following was found to give rich blacks with plenty of detail and good gradation:

A.

Hydroquinone	160 grains.
Sodium sulphite	2 ounces.
Citric acid	40 grains.
Bromide potassium...	20 ,,
Water	35 ounces.

B.

Caustic potash	140 grains.
Water	35 ounces.

For use take equal parts of each. This formula, which is a modification of Thomas's, is used successfully during the winter, but in warm weather hydroquinone-developed prints are very liable to blister. The above formula works very satisfactorily on being used a second time, and on some occasions it may even be employed a third time without loss of vigour. For excellence of results, however, no developer yet supersedes oxalate. Another says that the solution of paramidophenol known as rodinal is far away ahead of ferrous oxalate, hydroquinone, and eikonogen. The proportions given in the instructions issued with rodinal are usually much too weak. One part of the solution, as put up in bottles diluted with fifty parts of water, will work well under almost any circumstances. By "engraving" colour tones generally a warm black is desired. This is easily obtained by giving a liberal exposure and slightly restraining with potassium bromide—about two minims of a saturated solution to eight ounces of developing solution. This may sound a very small quantity, but the potassium bromide appears to have a very powerfully restraining tendency with rodinal, and if an overdose is applied the image refuses to appear for a very long time.

131. Ferrous Oxalate Developer—To ACCELERATE.—To accelerate the ferrous-oxalate developer it has been suggested that, to each ounce of developer, add twenty drops of a solution of

Hypo	2 grains.
Water	1 ounce.

Ten drops, however, seems the very outside limit that can be added with safety. When very cautiously used, hypo will bring out detail marvellously, but it should not be added in larger doses than two drops at a time, which can be repeated, if necessary, up to the quantity named, ten drops. The use of hypo must be reduced to a minimum, and only resorted to when absolutely necessary. The chief dangers are an unpleasant marbling, fogging, and reversal of the shadows. Some plates will bear as much as thirty drops of the hypo solution, but with others this will cause fog, and demand the addition of bromide of potassium. Hypo as an accelerator should only be used when a plate is known to be under-timed, and then only added after the image has begun to develop, otherwise weak, flat results will only be obtained.

132. Ferrous Oxalate—TO DEVELOP WITH:

A.

Oxalate of potash	4 ounces.
Water to...	16 ,,

B.

Ferrous sulphate	1 ounce.
Water (boiled) to	4 ,,
Sulphuric acid...	2 or 3 drops.

For use add one part of B to three or four parts of A. By all means restrain with bromide; this will give crisp negatives, whilst if the iron be diluted it will yield only weak, soft negatives. To work clean the developer should be very acid, and as an auxiliary restrainer use half old developer and half new; it will then give clearness and density. For under-exposure use one drop of fixing solution in four ounces water, and add a dram or so of this to the developer; this helps development a good deal. With a very prolonged development the iron is apt to deposit on the plate; do not rub it off, or pin-holes may result. Dissolve it with the plain potassium oxalate solution, made acid with sulphuric acid. Development must be pushed to blackness with this developer, or weak prints will result. The iron may be looked upon more as taking the place of pyro than as an accelerator, *i.e.*, more gives greater density, and less gives less density. The hints for its use are, exact exposure is required to get good results, it is also slightly longer than with pyro, measures and dishes must be perfectly clean, and especially free from pyro, quinol, or hypo, and always take care to keep both the ferrous sulphate and potassium oxalate solutions slightly acid; not, however, *too* acid, or it will act as a powerful retarder. Be careful not to use the same quantity of developer too many times over; if used too much in the latter negatives the details get clogged up, and the negatives produced are very inferior. It is advisable to only use the same lot on two negatives, then pour it into a stoppered white glass stock bottle, and when full renovate it by adding three or four drops of a saturated solution of tartaric acid to it, and exposing to sunshine for a day or two. Mr. Hepworth says he developed negatives while out in the country with one pint of developer by adopting this plan.

133. Ferrotypes—To Develop.—Ferrotypes are collodion positives taken on black or chocolate-coloured iron plates, which takes the place of the black backing in ambrotypes. They may be developed by any of the formulæ for developing wet plate positives. For example:

No. 1.

Boiling water	20 ounces.
Protosulphate of iron	1 ,,
Nitric acid	1 dram.

No. 2.

Water	1 ounce.
Pyrogallic acid	2 grains.
Nitric acid	1 drop.

See Wet Plate (No. 171).

134. Flashlight Exposures—To Develop.—If all that is claimed for amidol and metol is true, then they should be *the* developers to use, as it is claimed that they only require one-third or a half of the exposure necessary for pyro, but experience contradicts this, and pyro and ammonia or soda will bring out as much detail as metol, and it certainly seems more manageable. Those who have used both magnesium and aluminium do not find much difference in actinism in them. The formulæ recommended for hand-camera work should succeed also with flashlight exposures—always, however, remembering that the tendency is to over-contrast, so that formulæ which give great density are to be avoided.

135. Fog in Development—To Remedy.—Fog is of two kinds, green fog and red fog. Burton says on green fog: This defect is always due to error in the manufacture of the plates. It generally makes its appearance only in the shadows of the negative. If the negative be looked at by reflected light, a black object being laid under it, the shadows will be seen to be bright green. On looking through the negative they may appear somewhat pink, or sometimes a sort of "muddy" colour. Green fog makes its appearance only with alkaline pyrogallic development, or, in the case of ferrous oxalate, only when the chemicals are impure, and chiefly when the plate has been under-exposed, and development has been "forced"; even with the alkaline developer it seldom makes its appearance except when a caustic alkali (such as ammonia) has been used. A slight amount of green fog is not detrimental to the printing qualities of a negative; but if the defect show itself in an aggravated form, the best means of preventing it is to resort to ferrous oxalate development, or to the use of an alkaline carbonate with the pyro developer. Captain Abney has recently given a means of curing plates afflicted with green fog after development. It consists of bleaching the negative with a solution of ferric bromide, oxalate, or chloride, and afterwards applying the ferrous oxalate developer. Red fog seems to be an aggravated form of the above-mentioned disease. It appears as a deep red deposit, showing itself by transmitted light in the shadows of the negative. It is rarely met with at the present time, although it was common in the early days of gelatine plates. It does not make its appearance in plates developed with ferrous oxalate. Probably Captain Abney's cure for green fog would correct this defect also, viz., treat the plate, after fixing and washing, with

Ferric chloride	50 grains.
Potassium bromide	30 ,,
Water	4 ounces.

Soak the plate in this for a minute or two, when it will be found that the fog will disappear and the image be reduced in density. Rinse well, and then apply ferrous-oxalate developer, and the required density can be obtained. The plate should then be refixed and washed.

136. Glycin—To Develop with.—Glycin, or to call it by its full name, *hydroxyphenyl glycin*, is a developing agent obtained by the action of chloracetic acid on amidophenol. Its formula is C_6H_4 (OH), NH,CH_2. CO,OH, and it is a light powder, readily soluble in water in presence of alkalies, and keeps well with the addition of a sulphite. It is a slow developer, and works very free from fog, giving images clear in the shadows, and of a grey-black colour, being thereby very suitable for photo-mechanical work.

The following formulæ are given:

Glycin—Potash Developer.

Glycin	5 parts.
Sodium sulphite (cryst.)	15 ,,
Water	90 ,,
Potassium carbonate	25 ,,

For use, dilute with three to four parts water.

Glycin—Soda Developer.

Glycin	3 parts.
Sodium sulphite	15 ,,
Sodium carbonate (cryst.)	22 ,,
Water	200 ,,

With a developer composed of

Glycin	1½ grains.
Potassium carbonate...	12 ,,
Water	1 ounce.

Beautiful soft negatives may be obtained by allowing plenty of time in development.

137. Graphol—To Develop with.—Graphol is a "coined" name, and is of American origin. It has taken root in England, and will no doubt be seized upon as a proprietary article under many invented names. It is really a very useful developer, and gives clean, dense negatives with very short exposures. A sample examined was composed of

Anglol (or eikonogen)	60 grains.
Quinol	80 ,,
Soda sulphite	1½ ounces.
Acid citric	40 grains.
Potassium carbonate	6 drams.

Dissolve in twenty-two ounces of hot distilled water, adding the citric acid after all the others are dissolved; this will produce a citrate of potassium in the developer, and being an active restrainer will keep development under control, and the negatives clean. *If required*, an additional accelerator may be used in the form of potassium carbonate six drams, to five ounces of water. The above developer will stand a considerable quantity of this before fogging takes place. If it is desired to keep the ingredients in the powder form for development *en route*, omit the citric acid and add potassium bromide thirty grains; powder the whole in a "mortar," and mix well. If kept in a bottle with a rubber "cork," it will remain good for many months, and simply requires mixing with water, when it is ready for use.

138. Holidays—Best Method of Developing when away from Home.—Eikonogen cartridges are prepared, containing the correct quantities of eikonogen and alkali, which only require dissolving in a given quantity of water, and there you are. These are very convenient for travellers—also pyro and various other agents may be had compressed in *tabloids*, or the following mixture may be made:

Sodium sulphite	30 grains.
Sodium carbonate	30 ,,
Eikonogen	15 ,,
Potassium bromide	½ ,,

and put up in cartridges, each to be dissolved in one ounce of water, or in larger quantities in tightly stoppered bottle and measured out with a spoon.

The plates need not be fixed by using the following bath after slightly rinsing the developed plate: Chrome alum 4 drams, citric acid 1 dram, to be dissolved in 35 ounces of water. The crystals can be carried ready weighed out, to every one dram of chrome alum adding a quarter dram of citric acid, and dissolve in seven ounces of water. Keep the plate in this bath from two to three minutes, and then wash with a little *sugar* (quarter ounce to four ounces of water). Dry and pack. On arriving home, the plates must be well washed, otherwise the acid will decompose the hypo bath.

Another very convenient method of carrying developer consists of a couple of glass tubes hermetically sealed at each end, and containing pyro and bromide in one, and ammonia in the other. To use, the ends are simply broken, and the concentrated developer mixed with the requisite quantity of water. The tubes are enclosed in a block of wood, and can be carried in the pocket easily, and are not liable to get broken in travelling. Sufficient to make twelve ounces of developer is sold for 2s. A couple of trays are required, one for developing and the other for fixing, also a ruby lantern—very convenient folding ones can be bought which take up very little room. The hypo carried powdered in a tin box or cocoa canister. There are also plenty of one-solution developers to be had from the dealers, preferably hydroquinone ones, which are very portable.

139. Hot Weather—To Cool Developer in.—When it is required to reduce the temperature of solutions in hot weather, this may be accomplished by standing the vessels containing the solutions in a pan containing a "freezing mixture." Such mixture may be compounded thus:

Ammonium nitrate	1 part
Water	1 ,,

or—

Ammonium nitrate	5 parts
Potassium nitrate	5 ,,
Water	16 ,,

Chloride of calcium may be used similarly to ammonium nitrate for distillation at a low temperature and to accelerate the crystallisation of salts.

140. Hydroquinone Developer—How to Use.—Hydroquinone (or quinol, as it is more properly called) has of late come much into use as a developing agent. It gives negatives of a blacker character than pyro, and by many is preferred. As a "straight away" developer—"so much of one and so much of another, and away you go"—it is to be preferred to pyro, though for the worker who carefully and thoughtfully studies the development of each plate, it is scarcely so suitable. Below are given two formulæ, which have been found to work well. The first is for normal exposures, the second for "snap shots" and short exposures generally. A hydroquinone developer may be used over and over again until exhausted, its energy becoming weaker each time.

No. 1.—A.

Hydroquinone	90 grains.
Metabisulphite of potash	90 ,,
Water to	10 ounces.

B.

Sodium hydrate (caustic soda) ...	½ ounce.
Water to	10 ,,

To each ounce of developer required, take one dram each of A and B, and make up with water to bulk required.

No. 2.—This is known as Thomas's formula.

A.

Hydroquinone	160 grains.
Sodium sulphite	2 ounces.
Citric acid	60 grains.
Potassium bromide	30 ,,
Water to	20 ounces.

B.

Sodium hydrate	160 grains.
Water to	20 ounces.

For use, take equal parts of each. In hot weather it will be found desirable to dilute with an equal quantity of water, adding an extra three or four grains of bromide of potassium per ounce of developer.

The following formulæ are also variously recommended:

A.

Hydroquinone	30 grains.
Sulphite soda	120 ,,
Bromide potash	40 ,,
Water	10 ounces.

B.

Washing soda...	5 ounces.
Water	10 ,,

Use equal parts.

Another developer for negatives, and also for bromide papers:

A.

Hydroquinone...	2 grains.
Water	1 ounce.

B.

Pure carbonate of potass.	45 grains.
Water	1 ounce.

Mix immediately before using. When the detail is apparent in the shadows, pour off the developer, and flood the plate with a solution of citric acid two grains to an ounce of water, well washing before fixing. Another:

No. 1.

Ammonia ·880	40 minims.
Water	15 ounces.

No. 2.

Carbonate of soda ...	Saturated solution.

No. 3.

Hydroquinone...	80 grains.
Water	10 ounces.
Citric acid	10 grains.

To use take two ounces No. 1, twenty minims of No. 2, two drams of No. 3.

For over-exposed plates add a drop or so of a ten per cent. solution of bromide of ammonium. The reasons why such contradictory experiences are read with regard to this developer is because such different qualities are sold at different dealers, and also because it will not act equally well with all plates. The following is a modification of Balagny's formula, and works well:

A. Sulphite of soda solution two and a half ounces to sixteen ounces.

B. Washing soda one pound to eighty ounces of water.

C. Hydroquinone twenty-four grains to one ounce rectified spirits of wine.

To develop, use half a dram of C, four drams of A, and four drams of B. If over-exposure occurs add two or three drops of a restrainer containing bromide ammonium one hundred grains, water one ounce

141. Hydroquinone Developer—To Keep.—Light and air have an injurious effect on hydroquinone developer in so far that by exposure to them it turns a dark red colour, and although this does not detract from its developing powers, it has the disadvantage that development of the plate cannot be so well watched as with a clear solution. It is, therefore, advisable to keep it in a non-actinic coloured bottle with a glass stopper.

142. Hydroquinone-Eikonogen Developer—To Prepare for Bromide Paper.—Use:

A.

Sodium sulphite	10 drams.
Hydroquinone	40 grains.
Eikonogen	60 ,,
Water to make	10 ounces.

B.

Sodium carbonate	3 drams.
Sodium hydrate	30 grains.
Potassium bromide	5 ,,
Water	5 ounces.

To make two ounces of developer take one ounce of A, half an ounce of B, water half ounce. If half of A is replaced by an old developer, a sepia tone is produced, and if the old developer alone is used a warm sepia is the result.

The following may be used either singly or combined—*Eikonogen:* (A) One ounce crystallised soda sulphite is dissolved in fifteen ounces of warm water, and to the solution is added quarter-ounce eikonogen, which is dissolved by shaking. (B) One and a half ounces crystallised soda carbonate (washing soda) are dissolved in ten ounces of water. For use, mix three parts A with one part B, and add up to twelve parts water as preferred. It is found that equal parts strong developer and water are best, as if the full amount of water is added development is so very slow. The exposure for this developer is from a quarter to one-eighth what would be given for ferrous oxalate. *Hydroquinone:* (C) Hydroquinone 160 grains, soda sulphite 2 ounces, citric acid 60 grains, potass bromide 20 grains, water to 20 ounces. (D) Potass carbonate 2 ounces, crystal soda carbonate 2 ounces, water to 20 ounces. Mix equal parts C and D for use, and dilute with equal bulk of water. For a combined developer take one and a half parts A, two parts C, and one part B, and dilute with equal bulk of water; or leave out half the eikonogen in formula A, and substitute an equal quantity of hydroquinone, proceeding in exactly the same manner as directed for eikonogen.

143. Hydroquinone-Eikonogen—To Use as Combined Developer.—An adaptation of W. K. B.'s developer in *Photography*, March 19th, 1890, is given below:

No. 1.

Hydroquinone	20 grains.
Sulphite soda	60 ,,
Water	3 ounces.

No. 2.

Eikonogen	17 grains.
Sulphite soda	66 ,,
Water	3 ounces.

No. 3.

Carbonate soda	125 grains.
Water	3 ounces.

To develop, take equal quantities of each, but bromide is not to be recommended, as it is too active as a restrainer. An increase of water will be sufficient in most cases.

The following also are a few formulæ of the above developer:

A.

Water	10 ounces.
Hydroquinone	1 dram.
Eikonogen	1 ,,
Potass. metabisulphite	1 ,,

B.

Water	10 ounces.
Potass. carbonate	5 drams.
Soda carbonate	5 ,,
Ferrocyanide potass.	5 ,,

Use equal parts.

Prof. Burton used the following:

Hydroquinone	4 parts.
Sulphite of soda	12 ,,
Saturated solution of eikonogen in ten per cent. sulphite of soda	200 ,,
Carbonate of soda (crystals)	25 parts.
Water up to	1,000 ,,

The following is recommended by Mr. Chapman, of Manchester:

A.

Hydroquinone	40 grains.
Eikonogen	120 ,,
Sodium sulphite	480 ,,
Citric acid	20 ,,
Water	20 ounces.

B.

Potass. bromide	5 grains.
Sodium carbonate (crystals)	60 ,,
,, hydrate	30 ,,
Water (to make)	20 ounces.

For use mix equal parts.

144. Hydroquinone—How to Use for Developing Bromide Prints.—The following answers well:

No. 1.

Hydroquinone	4 grains.
Sulphite of soda	4 ,,
Water	1 ounce.
Bromide of potassium	1½ grains.

No. 2.

Carbonate of soda	30 grains.
Hydrate of potash	4 ,,
Water	1 ounce.

Mix in equal parts.

For bromide papers the following developer gives good results:

A.

Hydroquinone	10 grains.
Distilled water	1 ounce.

B.

Carbonate of soda (granular)	4 drams.
Distilled water	1 ounce.

To use the above, thirty minims of A are mixed with two ounces of water and two drams of B. It is then ready for use. As soon as all the detail is out the prints should be removed to a dish containing a solution of citric acid ten grains to one ounce of water, to prevent discolouration, and well wash before fixing.

At a meeting of the Birkenhead Society (January 10th, 1889) Mr. Wilkinson showed some prints developed as follows, which were admired: (A.) Hydroquinone 160 grains, sulphite sodium 2 ounces, citric acid 60 grains, bromide potassium 30 grains, water to 20 ounces. (B.) Hydrate of potash 1 ounce, water to 10 ounces. Take one ounce A, eighty minims B, and make up with water to two ounces. This is virtually "Thomas's Developer," but it is generally found advisable to add from half ounce to one ounce of water to each ounce of developer. He gave twice as long exposure as for iron development, and the image was still slow in appearing. The great secret of positive development with hydroquinone is the addition of bromide, which slows it much, *and is unnecessary for negatives.*

145. Hydroquinone—To Make One-solution Developer.—Their name is legion, but here are a few:

No. 1.

Hydroquinone	1 part.
Sulphite of soda	2 ,,
Carbonate of soda	10 ,,
Water	67 ,,

No. 2.

Citric acid	5 grains.
Bromide of potass.	10 ,,
Quinol	60 ,,
Sulphite of soda	120 ,,
Water	10 ounces.

When dissolved to be mixed with the following solution:

Carbonate of soda	1 ounce.
Water	10 ,,

No. 3.

Hydroquinone	50 grains.
Metabisulphite of potass.	80 ,,
Water	4 ounces.

To be mixed with the following solution when it has been filtered:

Carbonate of potash...	840 grains.
Water	4 ounces.

For use, dilute with five times its bulk of water.

No. 4.—M. Mercier's.

Qninol	2 grains.
Carbonate of soda	20 ,,
Sulphite of soda	18 ,,
Water	1 ounce.

No. 5.—For bromide prints.

Quinol	8 grains.
Sulphite of soda	45 ,,
Citric acid	3 ,,
Bromide of potassium	1½ ,,
Carbonate of soda	24 ,,
Carbonate of potash	24 ,,
Caustic potash	2 ,,
Water	4 ounces.

146. Hydroquinone—To Use with Alkaline Carbonates.—If an alkaline carbonate is used instead of the hydrate in any developing formula, eighty parts of sodium hydrate will have to be replaced by 106 parts of anhydrous sodium carbonate, or by 286 parts of the crystallised carbonate (containing ten molecules of water of crystallisation); 112 parts of potassium hydrate will have to be replaced by 138 parts of anhydrous potassium carbonate, or by 165 parts of the crystallised carbonate (containing one and a half molecules of water of crystallisation). A good formula with hydroquinone and sodium carbonate is as follows:

A.

Hydroquinone	80 grains.
Sodium sulphite	240 ,,
Water to	10 ounces.

B.—Sodium carbonate, saturated solution.

Take a quarter of an ounce of each, and make up to one ounce. A *little* bromide of potassium to be added in case of over-exposure. There are many good formulæ published of hydroquinone and carbonate of soda, and the following is a good developer for lantern plates and paper:

Hydroquinone	2 grains.
Sulphite of soda	10 ,,
Ammonium carbonate	10 ,,
Potass. brom.	½ ,,
Water	1 ounce.

Gives bromide tones.

For Fry's rough bromide paper the following is recommended:

Hydroquinone	80 grains.
Citric acid	30 ,,

A.

Bromide of potassium	15 grains.
Sodium sulphite	2½ ounces.
Water to	10 ,,

B.

Carbonate of potash	1 ounce.
Water to	10 ounces.

Equal parts of each A and B.

For lantern plates the following formulæ in concentrated solutions are preferable:

No. 1.

Hydroquinone	2 drams.
Potass metabisulphite	1 ,,
Water to make	10 ounces.

Use hot water and mix twelve hours before use.

No. 2.

Carbonate soda or washing soda	4 ounces.
Water to make	10 ,,

No. 3.

Carbonate of potash	1½ ounces.
Water to make	10 ,,

No. 4.

Potassium bromide...	1 ounce.
Water to make	10 ounces.

No. 2 gives full detail with medium density. No. 3 gives greater density, and not so much detail. For use, take of No. 1 solution one part, No. 2 or 3 one part, water eight parts, and add two drops of restrainer to each ounce of mixed developer. Should yellow stain in clear portions of slide occur through under-exposure, use an acid clearing bath.

147. Hydroxylamine.—Developer, to Make.—With regard to this substance a continental chemist, F. Ruschig, describes a method of preparing hydroxylamine as follows: "Hydrogen sulphite in concentrated aqueous solution is added to an alkaline nitrate at a temperature not exceeding freezing if the soda salt be used, or 40° if the potassium salt; or the same product is obtained by passing sulphurous anhydride to excess into a solution of the alkaline nitrate, containing also a carbonate or hydroxide. The resulting solutions being heated for a short time at 130°, or a longer period at 100°, are resolved into hydroxylamine and alkaline sulphates, easily separable by fractional crystallisation." Hydroxylamine cannot be used instead of ammonia in development. It has been used by Messrs. Egli and Spiller instead of pyro, etc. Their formula is as follows:

A.

Hydroxylamine hydrochlorate ...	32 grains.
Citric acid	15 ,,
Bromide potash	20 ,,
Water	1 ounce.

B.

Caustic soda	60 grains.
Water	1 ounce.

To develop, use one dram of A with three and a half ounces of water. Begin with forty drops of B, add presently another twenty drops, or thirty of B, *if necessary*. The hydrochlorate, in conjunction with caustic potash or soda, gives a developer which does not stain, and gives a fine black image, *but* as nitrous oxide gas is liberated in the film the negative is liable to be full of little cracks, besides which the plate must have had a full exposure. It also causes considerable frilling. Chapman Jones, in the "Science and Practice of Photography," gives the following formula:

Hydroxylamine hydrochlorate ...	2 grains.
Caustic soda	3 ,,
Potassium bromide	½ ,,
Water	1 ounce.

If the water is hard, substitute one grain or less of citric acid for the bromide, except in cases of over-exposure, and then use both.

148. Instantaneous Exposures.—How to Develop.—The method of Mr. Paul Lange is given in *Photographic Scraps* for February, 1890. He uses a carbonate of soda developer and applies a developer rather strong in pyro and alkali and weak in bromide from the commencement. Mr. Louis Meldon uses dry pyro and bromide and ammonia, but no sulphite or acid in the developer, as these slow the plates about fifteen per cent. In the opinion of many authorities, however, ammonia is not so suitable for this purpose as the fixed alkalies, and it is strongly recommended to flood the plate with the alkaline solution *prior* to adding the pyro. Eikonogen, according to the latest reports, appears to be also a very good developer for instantaneous work, and used, as in the following formula, *for very short exposures*, gives excellent results with most plates:

Sodium carbonate	30 grains.
Sodium sulphite	30 ,,
Potass. bromide	½ grain.
Eikonogen	15 grains.
Water	1 ounce.

Reduce the eikonogen crystals to fine powder, and dissolve in half-ounce water and add to the others in solution.

149. Isochromatic Plates—To Develop.—A good pyro solution is as follows:

Saturated solution of sodium sulphite	9 ounces.
Sulphuric acid	30 minims.

to which one ounce of dry pyro is added. For ordinary exposure, say on a landscape, use thirty minims of the pyro, with five minims of ammonia, ten minims of bromide of ammonium, and distilled water to two and a half ounces. There is, however, a necessary caution: be careful about the light in the developing room. One thickness ruby glass and two of Edwards's red-stained paper answer well. There is nothing extraordinary about isochromatic plates which should make them difficult to work with any good standard developer, but either of the following formulæ may be employed with pyro:

Carbonate of soda	480 grains.
Distilled water to make	10 ounces.

Or the following:

Potash carbonate	480 grains.
Soda	480 ,,
Potash ferrocyanide	480 ,,
Distilled water to make	10 ounces.

Hydroquinone also will develop these plates as well as any others. For ammonia development the "instantaneous" require about double the amount of bromide recommended by the makers, when they yield good brilliant negatives.

150. Kallitype Developer—To Make.—The Kallitype developer is made as follows:

Nitrate silver	50 grains.
Citrate soda	800 ,,
Bichromate potash...	1 to 2 ,,
Water	10 ounces.

Dissolve and add sufficient strong ammonia to dissolve the precipitate, about one dram.

With reference to sodium citrate, the amount of citric acid required to yield 480 grains of crystallised sodium citrate is 282·35 grains. Citric acid is $C_6H_8O_7H_2O$; sodium citrate, $Na_3C_6H_5O_7$: $5\frac{1}{2}$ H_2O, consequently 357 : 480 : : 210 : 282·35.

As stated in Mr. Hardwick's "Photographic Chemistry," citrate of soda is obtained by neutralising fifty-six grains of pure citric acid with sixty-six grains of dry sesquicarbonate of soda. This will yield ninety-five grains of citrate of soda. Commercial citrate of soda has approximately the composition of the pure salt given here.

151. Kinocyanine—To Develop with.—Kinocyanine (C_{25} H_{12} O_{10}) is a substance formed during the preparation of Paris blue (kyanol); recommended as a powerful reducer of metallic salts, and as an excellent developer for gelatino-bromide plates. The formula is as follows:

Sulphite of soda	50 parts.
Caustic soda	1 ,,
Carbonate of soda	140 ,,
Kinocyanine	10 ,,
Water	1,000 ,,

Development is effected as usual: Four ounces of solution will develop from five to eight plates 5 × 7. It keeps indefinitely, but should be frequently filtered. Negatives developed with kinocyanine are as soft as those developed with ferrous oxalate or hydroquinone, but more energetic than those developed with eikonogen.

152. Lithium Carbonate—To Use as Accelerator.—The lithia carbonate developer is said to be more powerful than when mixed with potash or soda carbonate. The only advantage probable is that much less lithia carbonate is required than potass, about in the proportion of one to two, but lithia carbonate costs about 1s. 6d. ounce, while potass carbonate costs only 8d. pound. Col. Waterhouse, however, has tried borax and lithium carbonate, and reports that with eikonogen it gives lights which are clear and free from stain (though this is also true with other alkalies), and that a good intensity of image is obtained, then another writer in Wilson's *Photographic Magazine* for 1891, p. 60, says that in some respects it is preferable to ammonia in pyro development. It seems to be slightly quicker, and in cases of under-exposure a better printing negative is obtained on a "lithia" plate than on a plate forced with ammonia, which exhibited green fog, whilst the other was quite free from fog. Moreover, the solution was odourless and non-volatile, and it would appear that rather more detail and density can be obtained with it, and in that case it would be very suitable for a combined developer, such as hydroquinone and eikonogen. The amount of the accelerator, as compared with the reducing medium, should be as two to one.

153. Metol—To Develop with.—Metol is the sulphate of methyl-para-amido-meta-cresol. It is a whitish powder, soluble in water; in presence of alkaline sulphites will remain colourless for a long time. Combined with soda or potash, metol forms a very energetic developer, probably the most powerful yet introduced; with very short exposures, it yields softer images than either pyro or hydroquinone. The soda developer works more softly than the potash formula, being, therefore, more suitable for portraiture. The maker advises the following formulæ:

Metol-soda developer—

A.

Metol	1 part.
Sodium sulphite	10 ,,
Water	100 ,,

B.

Sodium carbonate (crys.)	10 parts.
Water	100 ,,

Mix in equal parts; to gain soft images, add more water or less alkali.

Metol-potash developer—

A. Same as metol-soda.

B.

Potassium carbonate	10 parts.
Water	100 ,,

Mix sixty parts of A with twenty parts of B. Potassium bromide solution ten per cent. acts as restrainer.

Another good formula is—

Metol	15 grains.
Sodium sulphite	90 ,,
Potassium carbonate	45 ,,
Water	2 ounces.

A complaint has been made in developing with metol of want of density. In order to remedy this difficulty, a formula is given by Mr. A. R. Dresser. It is as follows:

Half sat. solution sulphite soda ...	20 ounces.
Metol	2 drams.
Ten per cent. sol. carb. of potass	20 ,,

For under-exposure the quantity of bromide may be reduced one half or left out altogether. A better plan, however, is to give full, or even over-exposure, increasing the amount of potassium bromide, and thereby slowing down the development, and in this way density may be readily obtained. However, if density be still insufficient, a few drops of a ten per cent. solution of carbonate of potash will give

any amount of it. In case it is preferred to use the metol in a dry state, a good method is to add six grains of metol to every ounce of saturated solution of sulphite of soda, adding a few drops of potassium bromide to each ounce. This plan works very well, and it has the advantage that the metol, which deteriorates when in solution, may be kept for a considerable time.

Metol, in fact, ought to be treated more like amidol, that is to say, the sulphite of soda used should receive more attention. As it is not only a preservative, but acts much in the same way as ammonia with pyro—in fact, metol and sulphite of soda is a more energetic developer than metol and ammonia it follows that a solution of sulphite of soda should be employed, either by itself or in conjunction with the selected alkali, say carbonate of soda, in addition to the metol-sulphite solution. If this is done there will not be much trouble in getting sufficient printing density in the negative.

154. Metol-glycin Developer—To Prepare.—Some recent experiments with a combination of the most rapid developing agents, metol-Hauff, with the slowest, glycin-Hauff, appear to show that it represents a combination vastly superior to metol-hydroquinone, up to now so popular. Dry plate development is, by the use of metol-glycin, entirely under the control of the operator, and the result no longer depends on the developer, but on the man. The formula which is found to give the most perfect results with gelatine plates is the following:

One solution metol-glycin developer:

Metol	30 grains.
Glycin	30 ,,
Sulphite soda solution ... ... (at 30° hydrometer test)	10 ounces.
Carb. potass. ... ... (at 20° hydrometer test)	10 ,,

Use equal parts developer and water.

Let it be understood that hot water must be used, and the metol-glycin added to the sulphite after it is dissolved, and the carb. potass. solution added to this, so that the carbonic acid gas which is created by the action of carb. potass. on metol may be set free. The above developer will give quicker printing negatives and richer prints than any other, and by diluting to quarter strength will be found an excellent developer for bromide prints. A two solution developer permits even wider latitude in practice, and for those who prefer this method of working, the following formula will be found useful:

A.

Metol	30 grains.
Sulphite soda ... ... (at 30° hydrometer test)	5 ounces.
Carb. potass. solution ... ... (at 20° hydrometer test).	5 ,,

B.

Glycin	30 grains.
Sulphite soda ... ... (at 30° hydrometer test)	5 ounces.
Carb. potass. solution ... ... (at 20° hydrometer test).	5 ,,

For use add to each ounce of A and B two ounces of water. With this formula density is entirely under the control of the operator. A controls detail and B density. Experience has shown that this formula will meet even the most fastidious taste, as it can be adapted to anything from instantaneous work to copying. Care should be taken to have the sulphite solution hot; add metol and then the carb. potass. Unless these precautions are followed the developer will not keep any length of time; but if care is taken in its preparation the developer will keep for ever. The great error made by many experimenters with metol is their failure to secure density. As soon as the details of the subject are out they imagine development to be complete. This is not so. In developing a plate with metol or metol-glycin no attention must be paid to detail, as this will come of its own accord; but the density is the point by which the plate must be judged. If it be left in the solution until it has an opportunity of gaining the required density, it will be found that metol-glycin is a model developer. A freshly-made metol developer, after cooling, throws down a slight deposit, which should invariably be filtered out before using the solution. With the C. P. metol recently put upon the market this deposit is hardly noticeable.

155. Over-exposed Negative—To Save an.—When a plate gives evidence of over-exposure by flashing out too quickly, it should be instantly washed, fixed, and again washed to remove the hypo; then immersed in the following solution:

Bichloride of mercury	20 grains.
Alcohol	½ ounce.

Agitate, then add—

Water	2 ounces.

The plate should remain till quite white, then thoroughly washed, dried, backed with a good black varnish, such as Brunswick-black, etc., and *copied*. Or as soon as a plate shows signs of this oft-recurring evil, at once dilute the developer with double the quantity of water, and work up the density by constantly adding small doses of pyro.

156. Para-amido-phenol—To Develop with.—Para-amido-phenol is said to have the advantage over hydroquinone and eikonogen, as developers, of never discolouring the gelatine. The solution will last a long time, even in open-mouthed bottles; the negatives developed with old solutions never present that yellow tint that is so frequently to be seen when other developers are used. The deterioration of the developer is very slow, so much so that in one hundred grains of the solution given below six or seven plates 5 × 7 can be developed without there being the least appreciable difference between the first and the last.

Water	1,000 parts.
Sulphite of soda	200 ,,
Carbonate of lithia	12 ,,
Para-amido-phenol	12 ,,

or,

Water	1,000 parts.
Soda sulphite	200 ,,
Soda carbonate	100 ,,
Para-amido-phenol	12 ,,

The second formula gives a very energetic developer especially convenient for developing instantaneous plates. Dr. M. Andresen, of the German Chemical Society, who has been studying this product, says that it develops very quickly and powerfully the best make of plates, even without the addition of potassium bromide, yielding absolutely clear and bright negatives, and showing the blue-black tint which is favourable for copying.

Para-amido-phenol forms a most energetic developer with alkaline carbonates. The resulting negative is of a bluish-black colour. According to Professor Stebbing this developer is eminently suitable for bromide papers, the development being very rapid, and the developed image is on the surface of the paper, and so is more brilliant than with other developers. See Rodinal (No. 166).

157. Plates, Long-kept—To Develop.—Plates kept for a number of years would probably be liable to green fog and fluorescence or metallic lustre on development. It is advised to try eikonogen with carbonate of soda well restrained with bromide of sodium. The alkali should be

used sparingly, and plenty of time given to development. This developer seems less liable to fog than hydroquinone. Should the fog appear try Captain Abney's method of clearing:

Ferric chloride	50 grains.
Potassium bromide	30 ,,
Water	4 ounces.

Should this fail to make a presentable negative, it may be worth while to note what Captain Abney says with regard to collodio-bromide plates: "That the introduction of a mineral acid into the emulsion prevents the formation of, or destroys when formed, any oxide or sub-bromide of silver substances, which would inevitably produce fog on the application of the developer." If the plate were placed in a weak solution of a mineral acid, not sufficiently strong to strip the plate, and developed with ferrous oxalate, it might combat the possible cause of fog in the plates.

Another method is before developing to soak the plates for ten minutes in—

Pyro	3 grains.
Potassium bromide	3 ,,
Water	2 ounces.

Develop with a *very* restrained developer, containing, however, the full amount of pyro for density. If the image, as soon as it appears, is still faint and fogged, develop until details are well brought out, and flood the plate with equal parts of the following solutions:

No. 1.

Pyro	64 grains.
Citrate of ammonia	20 ,,
Water	20 ounces.

No. 2.

Ammonia ·880°	8 drams.
Ammonium bromide...	720 grains.
Water	16 ounces.

This (which was given by Mr. B. G. Edwards) gives density to the high lights and prevents development of the shadows, thus turning fogged and over-exposed plates into decent negatives. If, after fixing, the plates are too thin to print from, they must be intensified.

158. P.O.P.—To Develop.—There seems no reason why amidol or metol should not be used for developing printing-out papers, which have been partly printed. It is advisable to shield the paper before and after printing from direct daylight as much as possible, and to soak the print for a quarter of an hour in a ten per cent. bromide of potassium bath, then use a developer well restrained. The Paget Prize Plate Company recommended the following metol developer for their paper: Metol (Andresen's) 10 grains, carbonate of potash 20 grains, sulphite of soda 20 grains, bromide of potash 10 grains, carbonate of ammonia 10 grains, water 8 ounces. As regards amidol, a demonstration of developing Ilford P.O.P. with amidol was given some time ago as follows: Stock solution, hot water 5 ounces, amidol (Hauff) 20 grains, sulphite of soda 4 grains, bromide potassium 20 grains, hydrochloric acid 20 drops. For use take equal parts of stock solution and water. A short exposure with strong solution of amidol gives black tones; a long exposure with weak solution of amidol gives warmer tones. It was recommended that the paper should be treated like bromide paper as regards non-exposure to ordinary light. After exposure soak print in a weak solution of hydrochloric acid (say a few drops to the pint of water) for a minute or two, then develop; as soon as all detail is out transfer direct to hypo bath. Over-development will produce a veil in the surface of the paper.

159. Pyro-ammonia—To Develop with.—Although ammonia was the earliest alkali used with pyro in the development of gelatino-bromide plates, and many attempts have been made to supersede it by sodium carbonate, potassium carbonate, lithium carbonate, ammonium carbonate, and almost every other conceivable form of alkali, it still retains its place in the esteem of many careful (and experienced) workers, as one of the most manageable of developers, permitting the greatest latitude in use, and susceptible of the greatest possible variations. For this purpose it is best to keep the pyrogallol, the ammonia, and the potassium bromide in three *separate* ten per cent. solutions—treating the pyro as the reducer, the ammonia as the accelerator, and the bromide as the restrainer—commencing with a moderate quantity only of the accelerator, and adding further quantities of that, or the restrainer, as development proceeds, and indications of under or over-exposure are apparent. A very convenient form of pyro is Berkeley's sulpho-pyrogallol (which is virtually a ten per cent. solution), or it may be preserved in glycerine as follows: Pyro 1 ounce, glycerine 1 ounce, water to make up 9 ounces. Another way to preserve the pyro in solution is with a few drops of nitric acid, or it may simply be used *dry*, and two or three grains measured out. A good proportion to begin with is pyro 3 grains (= 30 minims), ammonia 2 (= 20 minims), bromide 1 (= 10 minims), in an ounce of water, adding gradually a few minims more accelerator as it may be required.

Another method is to keep the ammonia and bromide in one solution. The pyro may be in either of the forms mentioned above, whilst the accelerator is made by taking ammonia (·880) 1 ounce, potassium bromide 120 grains, water 9 ounces. Begin with pyro 20—30 minims in 1 ounce of water, accelerator 10 minims, and add more accelerator as required. For under-exposure add accelerator 30 minims to 1 ounce of water, soak the plate in this, and afterwards pour off and add the pyro. Ammonia does not lend itself to a one-solution developer. In subjects where there are great contrasts, lessen the pyro and increase the ammonia; with little or no bromide; where there is liable to be flatness, use full dose of pyro with ammonia *very cautiously* and well restrained.

160. Pyro and Sulphite—To Make One-solution Developer.—Here is a very satisfactory formula:

Pyrogallic acid	80 grains.
Potassium bromide	40 ,,
Sodium carbonate	160 ,,
Potass. carbonate	160 ,,
Sodium sulphite	1 ounce.
Water...	5 ,,

For use take one dram of the above, and make it up to one ounce with water. If the plate is over-exposed take one part of the above and twelve parts water, and add a little more bromide; if under-exposed add a little more potassium carbonate. In developers of the above description it is not safe to use ammonia as the alkali, as it will not keep up to strength for any length of time.

The following is recommended by Dr. Eder: Sulphite of soda 5 drams, carbonate of soda (crystals) 2½ drams, dissolve in 2 ounces of boiled distilled water, and after having cooled down, add 46 grains of pyro; keep in well stoppered bottles, and for use dilute with five times its bulk of water. It will be noticed that the formula contains no bromide, except for instantaneous work. It might be better to add potass. bromide ten grains, or have a separate ten per cent. solution when required.

161. Pyro-potash—To Develop with.—Either of the following will be suitable:

No. 1.—A.

Potassium carbonate	240 grains.
Potassium bromide...	30 ,,
Water	20 ounces.

B.

Sodium sulphite	240 grains.
Citric acid	20 ,,
Pyro	120 ,,
Water	20 ounces.

Equal parts.

No. 2.—A.

Sodium sulphite	4 ounces.
Water	4 ,,
Sulphurous acid	4 ,,
Pyro	1 ,,

B.

Potassium carbonate	3 ounces.
Water	8 ,,
Sodium sulphite	2 ,,

Take one dram of A, from ten to thirty minims of B, and mix with two ounces water, adding more of B up to two and a half drams, as development proceeds.

No. 3.—A.

Sulphite of soda	6 ounces.
Hot water	32 ,,
Pyrogallic acid	1 ,,

Having dissolved the sulphite of soda, add sufficient citric acid in solution to cause a piece of blue litmus paper inserted therein to become reddened.

B.

Carbonate of soda	3 ounces.
Carbonate of potash	1 ,,
Water	32 ,,

To develop, mix A and B in equal proportions with two parts by bulk of water, or, if the weather be very hot at the time, even a greater proportion of water.

No. 4.—A.

Sulphite of soda	4 ounces.
Warm distilled water	4 ,,

When cooled to 70°Fahr., add—

Sulphurous acid water (strongest to be had)	3½ ounces.
Pyrogallol	1 ,,

B.

Carbonate of potash	3 ounces.
Water	4 ,,
Sulphite of soda	2 ,,
Water	4 ,,

Mix separately, and then combine in one solution. To make two ounces of developer, pour into a graduate one dram of A, and twenty minims of B, then make up to two ounces with water. If in two or three minutes no image appears in the highest lights, add twenty minims more B, and return to the plate. Do not exceed two and and a half drams of the alkaline solution to the above quantity of developing solution.

A very favourite developer is the Beach potash. Its preparation is as follows:

No. 1.—Pyro solution.

Warm, distilled, or melted ice water	2 ounces.
Sodium sulphite (437·5 grains to ounce)	2 ,,

When cold add—

Sulphurous acid solution	2 ,,

Then add—

Pyrogallic acid	...218 grains.

Which is done by pouring the sulphite solution into the half-ounce of pyro bottle, repeating the pouring until the pyro is dissolved. The resulting solution should then be filtered and kept in a tightly-stoppered bottle, and will measure about five fluid ounces. Its strength will be forty-four grains of pyro to each ounce, or approximately a ten per cent. solution.

No. 2.—Potash solution,

which is made of two separate solutions prepared as follows:

A.

Water	4 ounces.
Carbonate of potash (437·5 grains to ounce)	3 ,,

B.

Water	3 ounces.
Sodium sulphite (437·5 grains to ounce)	2 ,,

A and B are then mixed, and will measure between eight and nine fluid ounces. For an over-exposed or right exposure—

Water	3 ounces.
No. 1	3 drams.
No. 2	1 to 2 ,,

For under-exposure—

Water	3 ounces.
No. 1	½ ,,
No. 2	3 to 5 drams.

162. Pyro Soda — To Develop with.— The following is a good developer for dry plates:

No. 1.

Pyro	1 ounce.
Sulphite of sodium	4 ,,
Citric acid	120 grains.
Distilled water up to	20 ounces.

No. 2.

Carbonate of soda	5 ounces.
Sulphite of sodium	2 ,,
Water to	20 ,,

For use take one dram of each to each ounce of water. The following are the formulæ for two good pyro and washing soda developers. Take as follows:

No. 1.

Pyrogallic acid	40 grains.
Sodium sulphite	320 ,,
Water up to	10 ounces.

No. 2.

Washing soda in crystals	320 grains.
Water to	10 ounces.

Mix equal parts for use, and use restrainer if it be required. Another formula:

No. 1.—A.

Pyrogallic acid	1 ounce.
Sodium sulphite	6 ,,
Sulphuric acid	1 dram.
Water	80 ounces.

B.

Washing soda	6 ounces.
Water	80 ,,

Equal parts for use.

Many workers prefer to use dry pyro as follows:

No. 1.—A. Dry pyrogallic acid.

B.

Washing soda	4 ounces.
Sulphate of soda	4 ,,
Water	2 pints.

Two ounces of solution is made as follows: A.—Three or four grains according to subject; B.—Half ounce, water one and a half. This developer gives a "wet plate" looking negative.

No. 2.—Stock solution.

Washing soda	4 ounces.
Water	1 quart.

For a "half-plate" take two ounces of stock solution, and three or four grains of dry pyro, using a little five per cent. solution of potassium bromide for restraining.

Another is—

A.

Distilled water	14 ounces.
Pyro	25 grains.
Sodium sulphite	10 drams.
Potassium bromide	6 grains

B.

Distilled water	14 ounces.
Washing soda	2 ,,

Use equal parts of A and B.

163. Pyro—To Make Ten per Cent. Solution of.—Take potass metabisulphite three ounces, distilled water eight ounces. Dissolve by heat, and when quite cold add an ounce of pyro, and make up to ten ounces with distilled water. In the above formula let it be borne in mind that ounces of 480 grains each are intended. Another method is to take one ounce of pyro, add to it nine fluid ounces of water. This will give approximately a ten per cent. solution. Add nitric acid, drop by drop, shaking between each addition, until the solution turns blue litmus red. This is a most satisfactory method for keeping pyro in solution, as sulphite of soda is uncertain as an aid to keeping, often doing more harm than good. Other formula are: (1.) Pyro 1 ounce (437½ grains), metabisulphite of potass 1 ounce, water to 9 ounces 1 dram. Dissolve the metabisulphite in six ounces of *cold* water: when dissolved pour over the pyro, and make up to nine ounces one dram with water. (2.) Pyro 1 ounce, sulphite soda 4 ounces, sulphurous acid 4 ounces, water to 9 ounces 1 dram. Dissolve the sulphite of soda, which must be a clean sample free from white dust on the surface of the crystals, in the four ounces sulphurous acid, pour over the pyro, and make up to nine ounces one dram with water. If preferred the sulphite of soda can be omitted, as its only use is to prevent staining when the developer is used more than once. A solution made up by No. 1 formula has been made eight or nine months, and was the same colour as when made.

No. 3.

Pure sulphite of soda	4 ounces.
Citric acid	100 grains.
Water to	9 ounces.

When thoroughly dissolved add—

Pyrogallol	1 ounce.

Fill up small bottles, and grease the stoppers with vaseline.

No. 4.—Edwards's.

Glycerine (Price's)	1 ounce.
Methylated spirit	7½ ,,

When thoroughly mixed add—

Pyrogallol	1 ounce.

This keeps almost indefinitely, though it does not suit some brands of plates.

164. — Pyrocatechin (Catechol) — To Use in Developing.—Pyrocatechin is said to develop bromide plates with greater purity than hydroquinone; it also keeps much better. It was first investigated by M. Benoist, who was struck by its being composed of the same elements as hydroquinone; he was successful with it, and published the formulæ in *La Nature*.

A.

Water, distilled	½ litre.
Soda sulphite	34 grammes.
Pyrocatechin	8 ,,

B.

Water, distilled	½ litre.
Washing soda	75 grammes.

Pyrocatechin is also called *Brenzcatechin*, and is recommended by Dr. Eder.

A.

Pyrocatechin	1 part
Sodium sulphite	4 ,,
Water	40 ,,

B.

Potash, ten per cent. solution.

One volume A is mixed with two volumes of B. Development is very quick, and the image is a coffee-brown colour. According to Dr. Carl Arnold, who has made experiments with the substance, pyrocatechin possesses the following advantages: The negatives obtain a colour which facilitates printing, the plates do not fog, the solution is very non-actinic, and a bright light may be used after plate is in developer. The developer acts energetically at a low temperature, and is simple to prepare. Fifteen and a half grains will develop one hundred plates 7in. by 5in. His formula is—

A.

Pyrocatechin, one part in one hnndred parts water.

B.

Carbonate of potash, twenty parts in one hundred parts water.

Use one part A and five to ten parts B, and add sixty to eighty parts water. For instantaneous exposures increase A to five parts.

165. Restrainer—How to Use.—Citrate of potash, as a restrainer, whilst allowing density, prevents detail. The bromides prevent the excessive deposits on the high lights, and allow of detail. The advantage of citrate is that, after the details are out on a plate, density can be obtained by adding a little dilute solution to developer, and leaving plate in it for a prolonged time without risk of fog. Citrate of potash has, therefore, certain advantages over bromide of ammonium or potassium under certain conditions, viz., when the plate has received a very excessive amount of exposure. Unlike the mild restraining action of the bromides, the citrate of potash will *at once* arrest the action of the developer, keep the shadows clear, and give a good negative, although it may have received five or six times the normal exposure. Bromides of ammonium and of potassium act directly on those molecules of silver not influenced by the light, and while preventing the developer from attacking those portions, and thereby veiling the shadows, do not retard in the violent manner of the citrate of potash, therefore they are more largely used than the latter.

166. Rodinal—How to Develop with.—This developer seems to have power of bringing out detail, though, like eikonogen and the more recent amidol (di-amido-phenol), it lacks the amount of density-giving power which characterises both quinol and pyro. A concentrated solution of *para-amido-phenol* was brought out under the name of rodinal, and this is a convenient form in which to use it, as the solution keeps well, and only needs dilution with water (and perhaps the addition of a small quantity of bromide) to be ready for use. In cases of normal exposure, the instructions say one part of rodinal to thirty of water, but one from twenty to twenty-five has been found none too strong, and works better. The action seems to be very energetic, and the plate flashes out in rather an alarming manner to those accustomed to pyro or quinol. For over-exposure, use old developer or add bromide, and for under-exposure dilute with forty to forty-five of water, and allow the action to continue longer. For developing bromide paper, rodinal is not successful in all hands, but the dilution should be one of rodinal to about one hundred of water. For those who wish to try another formula Dr. Andresen's may be used:

Para-amido-phenol, chlor-hydrate ...	8 parts.
Sodium sulphite	80 ,,
,, carbonate	40 ,,
Water	1,000 ,,

See Para-amido-phenol (No. 155).

167. Saccharate of Lime—To Use in Developer.—This developer should be kept in two solutions, pyro and sulphite of soda—say an ordinary ten per cent. solution in one bottle, and the saccharate of lime in the other. Leon Degoix, who first recommended this developer for the lime solution, employed the following:

Water ... ... 1,000 parts.
Sugar ... ... sufficient to saturate.

To which is added a sufficient quantity of pure lime to saturate the sugar solution. In this way a highly concentrated liquid, very alkaline, and which keeps for a considerable time, is obtained. To develop, to each ounce of water add ten minims of the pyro solution; pour this over the plate for a few moments, then add gradually from five to ten minims of the lime solution. This should be added carefully, as it is a very energetic accelerator. For restrainer either citric acid or potassium bromide may be used. It is claimed that very soft negatives are obtained by this treatment.

168. Single Solution Developer—To PREPARE. Several formulæ have been given under the separate heads of Eikonogen, Hydroquinone, Pyro, etc., but here are two or three more:

No. 1.

Hydroquinone	2 drams.
Sodium sulphite	1½ ounces.
Potassium carbonate	3 ,,
Potassium bromide	4 grains.
Potassium ferrocyanide	1½ ,,
Water	8 ounces.

No. 2.

Hydroquinone	25 parts.
Sodium sulphite	100 ,,
Potassium carbonate	40 ,,
Potassium hydrate	10 ,,
Potassium bromide	2 ,,
Water	1000 ,,

No. 3.

Eikonogen	15 parts.
Hydroquinone	5 ,,
Sodium sulphite	100 ,,
Potassium carbonate	50 ,,
Potassium bromide	1 ,,
Water	1,000 ,,

169. Soda Developer—To MAKE. — A simple developer is as follows: Into a quart bottle put a quarter of a pound of washing soda, and fill up with warm water, add to this twelve grains of bromide of potassium. Put into the developing cup one grain of dry pyro for every ounce of solution required, and pour upon it the soda solution.

Another is—

Saturated solution common washing soda (A)
,, ,, sulphite soda (B)
Bromide of potassium ... ... 20 grains (C)
Water ... ... 1 ounce

For development take ten drams of A, one dram of B, three drops of C, and add two grains of pyro to each ounce of solution. If the pyro is preferred in solution, use twenty minims of any of the ten per cent. solutions. Other formulæ given by experienced workers are: (1.) A.—Pyro 3 grains, potassium metabisulphite 6 grains, water one ounce. B.—Washing soda (crystals) 100 grains, water 1 ounce. Equal parts. (2.) A.—Sodium sulphite 6 ounces, citric acid 120 grains, water 64 ounces, pyro 1 ounce. B.—Sodium carbonate (dry) 4 ounces, water 64 ounces. Equal parts.

Pyro Solution.

Pyrogallic acid	½ ounce.
Metabisulphite potash	½ ,,
Warm water	10 ,,

Soda Solution.

Carbonate of soda (pure)	6 drams.
Bromide potassium	3 grains.
Warm water	10 ounces.

Take one ounce of soda, one ounce of water, and one dram pyro. For *over-exposure*, dilute with double quantity of water. Don't use alum before fixing. After fixing, place in clearing bath, to get rid of green colour.

Clearing Bath.

Alum	½ ounce.
Citric acid	½ ,,
Sulphate iron	1½ ,,
Water	10 ,,

The following is given by an experienced worker, and its advantage is the adaptation to season:

Winter Formula.

Ordinary washing soda	5 ounces.
Potassium bromide	15 grains.
Water	50 ounces.

Summer Formula.

Ordinary washing soda	5 ounces.
Potassium bromide	40 grains.
Water	50 ounces.

To each ounce of the above use one grain of pyrogallic acid for developing. The pyrogallic acid can be added dry, if desired, or ten minims of a ten per cent. solution of it can be used instead. Unless rather a large proportion of sulphite of soda is added to the pyro solution, the gelatine film is usually rather badly stained; this, however, in some special cases, such as in under-exposure, is considered an advantage by some photographers, because it helps to get a print of a little tone and colour. The general tendency of a soda developer seems to be great density, thus giving excessive contrasts; in such cases use less pyro, or add one or two drams of water, or more, to each ounce of developer. It also usually develops rather slowly, which for many, if not all, subjects is an advantage. In extreme cases of under-exposure, twenty or more minims of a ten per cent. solution of either caustic soda, caustic potash, or liquid ammonia, can be added to the soda developer in order to force out detail. In cases of over-exposure, more bromide or more water can be added to the developer.

170. Sulpho-pyrogallol.—To MAKE.—This celebrated formula, introduced by Mr. Berkeley, has met with very general adoption, and appears in a variety of forms, one of which is

No. 1.

Pyrogallic acid	½ ounce.
Bromide of ammonium	150 grains.
Sulphite soda	1 ounce.
Citric acid	15 grains.

No. 2.

·880 ammonia...	1 ounce.
Distilled water	½ ,,

Dissolve the sulphite and citric acid in about one and a half ounces hot water, then pour this over the pyro and bromide, and when dissolved make up with water to three fluid ounces. For use take, for half-plate, two drams of No. 1, make up to two ounces with water, and five drops of No. 2. If no signs of picture in two minutes, pour the solution off and add five more drops of No. 2, continuing this until the picture appears, after which no more need be added unless all details are not out. The picture will come out very distinctly, and then fade away again; when nearly indistinct, wash it well, then put in alum and wash, and afterwards fix as usual. The result should be a negative of a perfectly black colour, with plenty of contrasts, the shadows being nearly clear glass. For this developer an ample exposure is necessary. For over-exposure the developer is treated with a little more water and about three drops of strong solution of bromide of potassium added, but it is hardly ever required to do this. Nearly or quite double the exposure with other developers suits this very well. At the present time probably out of every ten "pyro" photographers, nine use sulphite in their developer. It may, therefore, be said that the great majority of pyrogallol developers in use at the present day are Berkeley's sulpho-pyro

developers. No doubt at the time Berkeley may have recommended some particular formula, but in the interim so much experience has been gained and knowledge obtained as to the action of sodium sulphite in the developer, and so many acid preservatives have been tried, that present-day formulæ are to be preferred to those of ancient times. However, one of Berkeley's original formulæ is as follows:

Pyro	10 parts.
Sodium sulphite	40 ,,
Water	95 ,,
Citric acid sufficient to just turn blue litmus paper red.	

In recent years instead of using both sodium sulphite and citric or other acid, it has been suggested that an acid sulphite would answer the purpose, and the employment of metabisulphite of potassium has met with much success. A good and easily remembered formula is the following:

Pyrogallol	1 ounce.
Metabisulphite of potassium	1 ,,
Water (distilled) to	10 ,,

This will form a ten per cent. solution and will keep well. Any of the usual alkalies may be used in conjunction with the above, ammonia and bromide of potassium in ten per cent. solutions being favourites. Although the Berkeley sulpho-pyrogallol contains citric acid to neutralise the alkaline sodium sulphite, it has been found by mature experience that with some samples of sulphite, being very alkaline, this is apt to slow the developer very much; citrate of soda being a powerful restrainer. This has led to the substitution, as above, of (so-called) metabisulphite of potassium. Other remedies, however, have been proposed for this, one of the best being the substitution of sulphurous acid for the citric, as follows:

No. 1.

Sulphite of soda	4 ounces.
Water	5 ,,
Sulphurous acid (strong)	4 ,,
Pyrogallic acid	1 ,,

Dissolve the sulphite of soda in hot water, allow to cool, add the sulphurous acid and pyro, and make up to ten ounces with water. Each ten minims contains nearly one grain pyro (actually ·91 grain). Keeps well, and is very satisfactory for time exposures.

No. 2.

Sulphite of soda	2 ounces
Water	5 ,,
Sulphurous acid (strong)	2 ,,
Pyro	1 ,,

Dissolve as before, and make up to ten ounces with water. This is better suited for instantaneous work than No. 1, the sulphite of soda acting to some extent as a restrainer. Another method is to neutralise the alkalinity with bisulphite of soda thus:

No. 3.

Sulphite of soda	2 ounces.
Bisulphite of soda	½ ,,
Water	10 ,,
Pyro	1 ,,

Similar to No. 1, but avoids the use of sulphurous acid. The general proportion of sulphite of soda to pyro is 4·1. It should, however, be noted that if ten per cent. solutions are desired when using the *avoirdupois* ounce of pyro the bulk should be made up to nine and a quarter ounces instead of ten.

171. Wet Plates—To Develop.—The wet plate developer is usually composed of proto-sulphate of iron, or pyrogallic acid in an acid solution. The forms are innumerable, but differ slightly for negatives and positives. Some of the formulæ are as follow:

No. 1.—For negatives.

Water	16 ounces.
Protosulphate of iron	320 grains.
Glacial acetic acid	320 drops.
Alcohol	160 ,,

No. 2.—Nor negatives.

Water	12 ounces.
Pyrogallic acid	9 grains.
Glacial acetic acid	3 drams.

No. 3.—For positives.

Water	16 ounces.
Protosulphate of iron	320 grains.
C.P. nitric acid	320 drops.
Alcohol	10 ,,

No. 4.—For positives.

Water	1 fluid ounce.
Nitric acid	1 drop.
Pyrogallic acid	2 grains.

172. Wood Trays—To Coat for Development.—These may be treated with hard paraffin. Melt the paraffin in a cup, and brush over the wood with a short, stiff brush. Afterwards pass a hot laundry iron over it, thus forcing it into the pores of the wood. This will not affect any cold chemical solutions. If hot solutions be used, one or two coats of Aspinall's bath enamel will answer the purpose. Or, for the ordinary photographic purposes (*i.e.*, developing, fixing, clearing, etc.), no better coating for wood trays can be had than a melted mixture of resin and beeswax. Put some of each material in a jampot, stand jampot on a stove, heat the poker red-hot, and stir up the contents of jampot therewith; this will melt the resin in no time. See that the trays are quite dry, and, if the bottoms are of glass, warm the glass as hot as the hand can bear, if the glass is likely to crack with heat of melted mixture. Then coat with broad flat camel-hair brush, let dry, and then coat again. Then take a red-hot skewer, and run the point, after the manner of a soldering iron, over any lumps or places which the brush may have missed, and set the tray in *the open air* till thoroughly cool and hard, say six hours. Then take a good chisel (*not* the household implement used alternately as a screw-driver and box-opener), but one with a keen edge, say an inch wide, and pare down all the inequalities, cut clean the corners, make the surfaces true, and throw back the shavings and dust of resin and beeswax into the jampot. N.B.—If too much resin is used the coating will be too brittle and chip off; if too little, it will prove sticky to fingers; try half and half.

173. Wood Trays—To Fix Glass Bottom.—The wood tray is best made with a rabbet at the bottom to hold the glass (very much the same as an ordinary printing frame). The glass should then be fixed in with red lead, or with ordinary putty. Allow this to harden well, then paint over either with Brunswick black or Aspinall's enamel; the latter is best. If Brunswick black is used it must be allowed to harden well *in a strong light*. It is best to paint the woodwork all over, as ferrous-oxalate developer rots wood very rapidly if not protected. Another method is to make them of mahogany laths, one and a half inches by half an inch; along these, one quarter of an inch from the edge, is cut a groove with a ploughing plane, whose blade is just as wide as the thickness of the glass. The long sides are made two inches longer than the tray required, the ends of the short sides shaped with saw and chisel to fit into vertical grooves, cut with the help of a tenon saw, in the requisite position on the long sides. The concern is fastened together with long thin screws. To avoid leaking, the grooves, before putting together, are partly filled with white lead, the superfluity being squeezed out by the glass, and when this has set hard two coats of French oil varnish are given the wood, going a quarter of an inch on to the glass. Or the glass may be fixed with a cement produced with a mixture of lime, clay, and oxide of iron These should be separately calcined and reduced to a fine powder. They are then well mixed together, kept in a closed vessel, and mixed with the required quantity of water when used.

CHAPTER IV.

ENLARGING AND COPYING.

174. Alpha Paper—To Enlarge on.—Alpha paper as originally introduced was considerably quicker in printing than that now obtainable, and probably if the Britannia Co. could see their way to producing a quicker alpha paper, it would be much used and appreciated. The necessary exposure for enlargements can be worked out by comparing the relative rapidities of the various bromide papers. As regards the Britannia Co.'s papers, the comparative exposures are as follow:

Rapid bromide	...	...	...	1 second.
Slow "	...	...	...	20 "
Alpha ...	...	...	..	300 "

These are according to tests with artificial light; in using daylight the difference is not so great. Probably with a good north light, using stop f/16, the exposure for an enlargement from quarter-plate to whole-plate would be about thirty minutes, but a trial with a small piece of paper first would be desirable. The following method of finding the distance between negative, lens, and paper may be useful to many. Add one to the number of diameters the negative is to be enlarged, multiply the sum by the equivalent focus of the lens, result will give distance of positive from the lens. To find the distance the negative should be from the lens, divide the above product by the number of diameter enlarged. Thus to enlarge a negative four times, lens focus five inches—

$1 + 4 \times 5 = 25$ inches distance of positive from lens.
$25 \div 4 = 6\frac{1}{4}$ " " negative "

Hydroquinone is a good developer for this paper, and the Ilford Company's Universal hydroquinone developer, used as directed by them for alpha paper will give excellent results. The latitude in exposing alpha paper is tremendous; for example, in making a contact print an exposure of from one minute to seven or eight may be given, with a little modification of the developer, and the results may be almost perfect, but the tones will vary all shades from a greenish black to a bright red, these tones being produced by the action of the developer only; then, if the combined toning and fixing bath be used, it will be quite possible to produce as many more tones of a totally different nature, from a rich red to a bright blue, this latter being the last tone reached. Assuming that the aperture of the lens is f/20, which is a good working ratio, and also that the sky is bright (no sun of course), then the exposure for a brown tone would be about five minutes. The brown tone is specially mentioned, as this is the best one for obtaining a great variety of tones in the combined toning and fixing bath. The strength and composition of the developer also greatly influences the results. Unless, however, the sky is *very uniform in brightness*, it would be far better to interpose a piece of the finest focussing ground glass between sky and negative. This precaution, indeed, had best be adopted at any time, as the results are superior, on account of the light being diffused.

175. Black Tones—To Obtain in Enlarging.—If it is desired to get a good engraving black, it is necessary to use a strong developer, well restrained, and give a short exposure, as long exposures and weak developers tend to produce warm tones. With regard to yellow tints, take care the fixing bath is not acid. Again, absolute cleanliness and freedom from hypo, pyro, or silver is a *sine quâ non*. A clearing bath should always be used, and it must be distinctly acid. Also thorough washing must take place between the clearing bath and the fixing solution. The following is a good clearing bath:

Chrome alum ...	...	...	...	1 ounce.
Citric acid	...	...	...	1 "
Water ...	...	...	...	20 "

With regard to exposure, it depends on the lens used, the aperture and strength of light, etc. All these are factors governing exposure. Try a medium exposure, and if incorrect vary it gradually, either more or less. Not on a whole sheet of paper, but on any small piece not required. Over-exposure is always more or less fatal to a rich engraving black. Use this developer:

No. 1.

Hydroquinone	...	...	...	160 grains.
Sodium sulphite	...	...	...	2 ounces.
Potassium bromide...		...	...	25 grains.
Water to	...	...	...	20 ounces.

No. 2.

Sodium hydrate	...	...	...	100 grains.
Water to	..	...	...	20 ounces.

For normal exposure and negatives of average density, take equal parts for use. Another good developer is rodinal. It is the very acme of simplicity. One part of rodinal diluted with fifty parts of water. If print is under-exposed a *little* still further dilute with water. If over-exposed throw off developer, and continue development with a stronger solution, say one to fifteen or twenty parts. The stronger the solution the greater the brilliance or contrast in print (or negative). Experience speaks very strongly in its favour. Hydroquinone is very good, but amidol comes next to rodinal in order of excellence, and oxalate of potash and iron is simply "out of it" altogether, far more trouble to mix, an intermediate acid bath, no latitude in exposure, and a first-class chance of getting a fine lemon-coloured tint all over the print.

176. Bromide Paper Enlargements—To Size for Colouring.—The following will prevent the colours from being absorbed by the paper. Dissolve enough gum arabic in cold water so that it will just work easily, and when it is quite dissolved add a little lump sugar. Two coats may be required, but it will effectually answer the purpose. Another good and easily applied preparation is light drying oil (which may be procured of any artist-colourman), rubbed evenly over surface of dry bromide paper enlargement with a tuft of cotton wool or the finger. When dry (which will take about twenty-four hours in a well-ventilated place) any kind of oil paint may be applied with perfect safety. If, however, the bromide enlargements are in good condition they do not require any sizing or preparation before painting in oil colours, as the slight film upon the surface prevents the colours from sinking. But if they have been badly used and appear somewhat rough, first remove any dirt that may have accumulated thereon with a damp sponge, and then apply a wash of rather stiff gum, starch, or gelatine, all being equally satisfactory, and if mastic varnish or gold size is used as the medium for painting, there can be no fear whatever of the paper absorbing the colours. Another sizing is composed of gelatine, about thirty grains to the ounce, and applied by turning up sides of the enlargement and forming a dish, then pour the sizing into it. After a few seconds pour it off and let dry. If the cardboard is too thick to turn up, then apply the gelatine with a "Buckle's" brush.

177. Canvas or Paper—To Coat for Enlargements.—First free the canvas from greasiness by sponging with dilute ammonia (or carbonate of soda) and water; rinse and dry. Coat with

Water	10 ounces.
Ammonium bromide	150 grains.
Ammonium iodide	20 ,,
Ammonium chloride	50 ,,

Add sufficient hydrochloric acid to render it just acid. Now soak one hundred grains of soft gelatine in cold water, and raise temperature on a water bath to boiling. When all is dissolved, add 450 grains of nitrate of silver (in the dark room), and shake vigorously until dissolved. Replace on water bath, kept boiling for half an hour, then add 450 grains hard gelatine previously soaked in five ounces water, pouring in all the water. When thoroughly dissolved, pour into flat porcelain dish to set; break up, wash, remelt, and filter as usual. To coat the canvas, flow the emulsion over it until it is completely covered; then draw off closely, and keep the canvas frame rocking until the emulsion is set. To develop, the canvas must be removed from the stretcher, and the edges turned up and secured by clips so as to form a shallow tray, and pour in the developer, either ferrous oxalate or pyro, use slightly warm. Development will probably take about ten minutes; pour off and wash, and fix by pouring the solution on and off carefully, so as not to wet the back of the canvas; when fixed float face down on a water that is frequently changed, then float for thirty minutes on a strong alum bath (saturated solution), and wash again thoroughly, remount on stretcher and dry. As the print will probably now show a rough surface, with short fibre standing out all over, it can be smoothed and improved by coating with a solution of gelatine or wax. White wax one ounce, oil of turpentine five ounces. If desirable, the prints can be toned in a "combined" bath. The following also is a very good and fairly rapid formula:

Solution No. 1.

Silver nitrate	154 grains.
Citric acid	154 ,,
Distilled water	28 drams.

Solution No. 2.

Sodium chloride	54 grains.
Potassium bromide	39 ,,
Gelatine	62 ,,
Distilled water	28 drams.

Dissolve the sodium chloride in half ounce of the distilled water, and the potassium bromide in a like quantity. Soak the gelatine in the remainder of the water for ten minutes and dissolve by the heat of a water bath. Then add the solution of potassium bromide to the dissolved gelatine, and shake for twenty minutes; afterwards add the sodium chloride solution and shake for five minutes. Now mix solutions one and two at a temperature of 140° Fahr., shaking constantly. Dissolve by heat in 16 drams of glycerine, 124 grains Nelson's gelatine, and 248 grains Henrich's gelatine, and add this to the previously prepared solution. When thoroughly mixed pour into a flat dish to set. The emulsion must then be divided into small shreds by passing it through a piece of coarse canvas, previously well washed, into a basin of distilled water. A silver or china spoon should be used for breaking up the emulsion, and putting it in the canvas, for it should not be touched with the hand. Stir the emulsion in the basin for about ten minutes, then collect on a filter of washed chamois leather, and drain slightly; repeat twice, collect, and drain thoroughly. Remelt the emulsion at 120° Fahr., add half grain chrome alum dissolved in one dram of distilled water, and add also six drams of absolute alcohol; filter the emulsion through chamois leather, previously washed in caustic potash and water, and then in distilled water. The emulsion is then ready. Artists' canvas will do for enlarging on to. To prepare it it is necessary to first treat with dilute ammonia to free it from grease, and then rub the surface down with tripoli and methylated spirit till quite even, and then wash, and coat with the above emulsion. The best method of coating the paper or canvas is by drawing it over the surface of the fluid emulsion.

The Eastman Co. make a paper called "transferotype," which allows the film to be stripped off and transferred to canvas or to anything else. It is fairly cheap and will suit many. Then there is the carbon process, which is not expensive, though rather tedious. Instead, however, of transferring an enlarged photograph to the canvas upon which a painter has to work, it is now becoming the custom for the painter to set up his prepared canvas in the enlarging room, and to have an image of the desired size projected upon it from a small negative. The painter then, guided by this image, traces in the required outlines with charcoal, but is left at liberty to make any alterations he may desire, and to omit any objectionable details or accessories.

178. Canvas—To Sensitise.—Coating the canvas with gelatino-bromide emulsion is very easy, but it is very liable to peel off, and soon goes stale. The following is very excellent, and the prepared canvas can be kept for months before applying the silver:

Iodide of potassium	80 grains.
Bromide of ammonium	35 ,,
Chloride of ammonium	10 ,,
Gelatine	60 ,,
Albumen...	1 ounce.
Distilled water...	10 ,,

Mix, and gently warm until the gelatine is dissolved; clean the surface of the canvas (if it be prepared for painting in oil) with ammonia half ounce, methylated spirit two ounces; apply with a soft cloth until the greasiness has disappeared, and allow to dry thoroughly; then apply the above solution evenly with a clean sponge, and when dry sensitise with

Silver nitrate	...	...	...	1 ounce.
Glacial acetic acid	...	...	...	½ ,,
Distilled water	...	...	...	12 ,,

Pour a small pool of this in the middle of the canvas, and spread all over with a ball of cotton wool, and in about one minute, and whilst still wet, expose—about one minute is enough for an enlargement of six times—and develop with

Gallic acid	...	...	...	60 grains.
Acetate of lead	...	...	...	10 ,,
Distilled water	...	...	...	10 ounces.

Filter and apply in the same manner as the silver solution, and with the *same* piece of cotton wool (then throw it among the residues), for the little silver it contains will give vigour; when this is completed, rinse, and fix in hypo four to the pint of water, and wash; the fixing and the wash after can be accomplished by allowing the canvas on its stretcher to float face down, and the canvas need not be detached from its stretcher at all by the use of this process, and the image *will* not strip under any circumstances. A modification of development is, after the paper is sensitised, to *directly* apply the developer, and allow it to soak for a minute. Then place the canvas in position, and expose; the development will then proceed with the exposure, and can be watched by the aid of a lighted thin taper, and, when all the details are out, it may be strengthened with a little fresh developer. No loss from incorrect exposure by this method. Another way is by the use of Eastman's transferotype paper. Proceed first by the removal of the preparation on the canvas with the ammonia and spirit, and then give it a coat of plain gelatine one ounce, water eight ounces, and allow to dry. Expose the transferotype paper, and develop, fix, and wash as usual. Then squeegee to the canvas, and leave under pressure for at least one hour, and strip as per instructions issued with the paper. The canvas must be removed from the stretcher for this process.

179. Carbon—To Use for Enlargements.—There are two ways of doing this, either to enlarge a negative or make an enlarged carbon positive from a smaller negative. In any case it will be necessary to make an enlarged negative, but whether in carbon or not in the second case is a matter of taste, and carbon is not advised. Taking the case of making an enlarged negative in carbon, the first proceeding will be to make an enlarged positive on either a collodio-bromide emulsion plate or a gelatino-bromide plate. If the original negative is otherwise than really good, collodion will give the finer result, though requiring far the longer exposure. A good transparency plate on the other hand is all that can be desired for gelatine positives. Again, this positive must *not* be one which will show well in the way of a lantern slide; it should be somewhat thin and flat, but with plenty of detail. Having then obtained the enlarged transparency and rectified any faults by judicious retouching, spotting, etc., the prepared tissue—bought sensitised, or sensitised at home in the following baths and of the tint desired:

Bichromate of potash	...	15 grains	
Water	... ...	1 ounce	
or Bichromate of potash		10 grains	More sensitive but less durable.
Bichromate of ammonia		5 ,,	
Water	... ...	1 ounce	

is placed behind the positive, provided with a safe-edge of black all round, ⅛in. at least, and printed with the aid of the actinometer; the printing quality of the positive having been determined beforehand. Then soak the print in cold water till all the free yellow bichromate is washed away, then squeegee on to the flexible support sold with the other materials, and which has been rubbed over with beeswax 5 grains, to benzole 1 ounce, and polished. This requires care, and is done as follows: The flexible support, after being prepared, is put into the water with the print and brought under it; both are then brought out of the water together upon a glass plate larger all round than the tissue, and squeegeed together carefully. Then put it on one side with a piece of blotting paper over it, and a flat weight on that for about fifteen minutes. Then immerse in hot water at about 100° F., and with a tuft of cotton wool brush off the small bubbles which form usually. Now see if the gelatine will ooze out when gentle pressure is applied. If so, lift one corner of the paper, and, pulling evenly, strip it off, and throw away. Rock the dish and the soluble gelatine, and the colour will come off, leaving the picture on the skin. When it is quite developed—and in some cases a jet of hot water from a kettle is required on certain parts which require reducing—rinse in cold water, and then the negative can be stripped at once, or allowed to dry and transferred at pleasure. The latter course is the best for two reasons: First, the picture will be sharper; and second, the paper will have shrunk to its former size, so that the image will not be stretched. To transfer, coat the glass, opal, or other support with gelatine solution (five grains to one ounce of water), to which add one minim of saturated solution chrome alum. Flow this on like coating with varnish or collodion, and allow to dry. Now place the coated support in water at about 70°F., while the negative, on its support, is soaked in cold water till limp. Then bring the two surfaces together and squeegee, and put in cool place to dry. When dry, the skin should come off easily, and can usually be employed again. The other method, *very briefly*, is: For an enlargement carbon positive, a positive is taken from the negative by contact (the Autotype Company use collodion for this process and for the next), and from this positive an enlarged negative is made, spotted, retouched, etc., and from this the carbon print is produced as before. Remember (1) to leave a safe edge; (2) to keep the positives to be enlarged thin and flat; and (3) to dodge the carbon print, where requisite, with hotter water.

180. Clouds—To Print in Enlargements.—Clouds in enlargements are easily printed in the following way: While the landscape is being exposed a piece of cardboard is moved up and down to shield the sky portion and yet to leave no hard line. The enlargement is then about two-thirds developed and washed. It is then pinned up again, the yellow cap being on the lens and a suitable cloud negative inserted—the position can readily be shifted to suit. The exposure is then made short, of course, for the clouds, but still *remember that the paper is slower after the action of the developer*, the same piece of card being used to shield the landscape, and moved up and down to softly vignette the clouds into the landscape. The development is now completed, and if the exposures have been accurately timed the clouds should be well out at the same time that the landscape is fully developed. Another method is, make two transparencies, one of the negatives to be enlarged, the other of a suitable cloud effect, place one on the other and make a negative by contact. If carefully done, this may be enlarged from on to bromide paper, giving the effect required. Or make a small transparency from the negative to be enlarged, and cover it with a glass bearing the clouds, as suggested by Mr. Davidson in *Photography* No. 17, and make an enlarged negative from this and print by contact. It may also be done by masking the cloud negative with some opaque paper or paint, so as to just coincide with the outlines of the landscape. Then, having exposed for the landscape, remove the

negative and insert the masked cloud, and again expose. The difficulty with this method is to make the two negatives register exactly in the same place. The best way to do this is as follows: Lay the view negative down (film downwards) on a piece of white paper, and upon it place the sky negative (film down) and mark roughly where the sky-line should be with Indian ink and a brush. If there are any trees, etc., above the sky-line, that will not matter, as they will print over the sky. When this is done, place the view negative in the enlarging camera and focus to size required, and note where the sky-line should be so as to form a guide afterwards. Then have a wooden cap made for the lens with a piece of yellow glass in it, which place on the lens, which will show where to pin the bromide paper. Now pin on the paper where required, and cover both paper and screen with a black cloth: then take out the view negative and put in the sky one (have a large piece of cardboard ready to vignette the sky), take off cap and vignette the view part of enlargement, give the required exposure, "which, as a rule, is one to four, viz., sky one minute and view subjects four minutes, but this depends on the difference in the two negatives, and has to be learnt." Put on the cap again, cover over with the cloth, and take out sky negative and put in view negative. Take off the cap and give exposure as required, but this time *vignette* the sky part. A little practice will soon show what exposure, etc., has to be made and how to do it, and one soon learns all about it.

181. Clouds—To Work into an Enlargement.—Charcoal, or a grey crayon, will be found more useful than chalks in matching the tone of the bromide, and for tinting a perfectly blank expanse of sky one of the simplest methods can be executed in water colours, thus: Sponge print lightly over with cold water to ensure an even surface free from grease, rub up a little ivory black in gum water, tinging it slightly with indigo or carmine according to tone of print, apply in bold free touches with a large brush, and the moisture upon the bromide will prevent the clouds drying with any hardness of outline. If powder colours are preferred, rub a charcoal pencil upon a piece of sandpaper to reduce it to a fine powder, and apply with a dry brush or finger-tip, having previously rendered the print rough enough to take the colour by rubbing it over with a piece of flannel dipped in pumice powder. When crayons are to be used this preparation is not necessary. Pumice powder used thus is also a method of obtaining clouds upon dark skies, and splendid effects are easily obtained by slightly grinding off the film in this manner; in fact, almost any defect can be improved by its judicious application.

182. Collodion Transfer—To Make for Enlarging.—Presuming that it is required to make a transfer on glass for use as a transparency, the following process will answer the purpose. Formula:

Ether	2½ ounces.
Alcohol	2½ ,,
Pyroxyline	40 grains.
Calcium chloride	15 ,,
Citric acid	15 ,,
Silver nitrate	60 ,,

Place the pyroxyline in a ten-ounce bottle and cover it with the ether. When thoroughly saturated add an ounce of the alcohol, and shake until dissolved. In a second vessel dissolve the silver nitrate in half a dram of boiling distilled water, let it cool, and add an ounce of the alcohol in small quantities at a time, and warming slightly after each addition. In a third vessel dissolve the calcium chloride and citric acid in the remaining half-ounce of alcohol. In a dimly-lighted room (candle-light is best) warm the solution of silver nitrate and pour it in small quantities at a time into the previously-made collodion, shaking well after each addition. Allow the mixture to stand for an hour, and then add the calcium chloride and citric acid. Lastly, shake vigorously for fifteen minutes and set aside for three hours. Procure some *trebly-gummed paper* (to be had from dealers in photo-litho materials); pin a piece of this to a board, and coat it with the emulsion by pouring it on the paper and returning the excess to the bottle—treating the paper, in fact, as if it were a sheet of glass. Hang up the coated paper to dry for half-an-hour, and then give it a final airing at a fire. It is best used immediately, but can be preserved almost unimpaired in quality in a calcium chloride tin, same as those used in platinotype printing. This paper is printed on from a negative in the usual way, but the printing must be carried somewhat further than if ordinary sensitised paper were being used, as the print loses considerably in depth when transferred. Meanwhile, the glass plate which is to carry the transfer is coated with a ten per cent. solution of gelatine and dried. When the print is ready it is immersed, together with the gelatinised glass, and left there for ten minutes. Both are then taken out of the water and squeegeed together, using a roller squeegee, when after a few minutes, on gently raising the paper, it will come away, leaving the collodion film and the picture on the glass. It merely remains to fix the picture by immersing it in hypo of the usual strength. The picture will, of course, be *reversed*, but this is immaterial, as when provided with a protecting glass it can be hung in such a way that the observer looks at it through the protecting glass. If a reversed negative is employed in the first instance transfers can be effected similarly on porcelain, ivory, or opal.

Another method that has been found successful is the following:

High temperature gun cotton ...	10 grains.
Bromide of cadmium	6 ,,
Iodide	3 ,,
Bromide of ammonium	8 ,,
Methylated alcohol ·820	1 ounce.
,, ether ·720	1 ,,

It will be noted that the bromides are greatly in excess; the reason for this is that for a transfer much detail and little density is required, and bromide gives softness and detail, and iodide density. Pour the alcohol on the cotton, and when saturated add the ether, and then the "salts," shake until dissolved; this will keep a long time, and when required for use powder (very fine) silver nitrate, and add twelve grains to each ounce of collodion in the dark room, and shake well at intervals until dissolved; it is well to let the emulsion stand overnight before being used. To use, clean a sheet of glass as for wet collodion and rub over with wax solution as follows: White wax 5 grains, ether 1 ounce, and polish well. This is so that the film will strip; pour on the emulsion and allow to set; expose, and if it is wished to develop with an acid developer, soak the plate for a minute or two in water (the same water will do for any quantity) and develop. for an alkaline developer or ferrous oxalate, *wash well* under the tap for ten or fifteen minutes, and then develop. This is to get rid of any traces of free silver. The acid developer is: Pyrogallic acid 2 grains, glacial acetic acid 30 minims, glycerine 10 minims, water 1 ounce. The alkaline is: Pyrogallic acid 3 grains, water 1 ounce, carbonate of ammonia 1½ drams, water 1 ounce. Use equal parts, or, if the plate is well washed, the ordinary ferrous oxalate developer may be employed. The *emulsion* will not keep more than about three days. When developed fix in hypo

8 ounces, water 20 ounces, and wash well. It is now ready for the transfer paper, which is prepared with gelatine ½ ounce, water 1 quart. Keep very hot in a dish, and float medium Saxe paper on it for a minute or two. Draw off and hang to dry; when perfectly dry soak for a few minutes in cold water, and lay the gelatine side gently on the collodion film, squeegee as gently as possible until all air-bells are gone, and allow to get thoroughly dry, then strip by raising one corner, and it will leave the glass readily, and is ready for mounting in the usual way. Autotype double transfer paper acts perfectly if it is not desired to make it. By following the above success is certain, but note that being transferred the image is reversed, so if the subject won't allow of this, turn the negative glass side to the plate when enlarging. This, of course, corrects it.

183. Condenser, Home-made — For Enlarging.—Cement a clock covering glass (or even one taken from the face of an old barometer) to a *square*, or rather oblong, of glass with opticians' cement (*vide British Journal Almanac*, 1888, p. 510, for formula). The glass is one-eighth of an inch *longer* than the diameter of the circular glass cover, but same width, as it assists in making the funnel, and when the two plano-convex lenses are finished, leave a small space at top when filling with glycerine to allow for expansion, and mount them in a wooden oblong carrier some three inches deeper than when the two concave surfaces touch. This is found useful, as they can be separated any distance up to this limit, and thus lengthen the focus. The trouble is that they leak unless imbedded in a ring of cement; and it is necessary to paint the edge of the cement for a depth of a quarter of an inch with Canada balsam in chloroform, using it rather thick. This effectually cures leakage. Another trouble is, that the glass inside *will* become soiled however careful one may be, and, of course, when once cemented there is no getting at it. However, the results are fairly good with the condenser up to seven and a half inches diameter.

184. Condenser—Suitable for Enlarging.—The condenser should consist of two lenses, each about 1½in. thick, and the camera surface should be the segment of a circle of 16in. to 18in. diameter. The thickness may be varied, according as a condenser is wanted of long or short focus; increase of thickness giving a short focus, and *vice versâ*. A short-focus condenser collects and transmits more light, but is more liable to crack when in use than one of larger focus. To prevent cracking, as far as possible, make the lenses *thin at the edges* and mount loosely, so as to allow for expansion when heated. A single condenser for this purpose is unsuitable owing to the large amount of spherical aberration it possesses; but if used it cannot well be less than 6in. focus, which, with the diameter necessary of nine to ten inches, is equivalent to a thickness of practically two inches. For convenience in manufacture the curved surfaces of all lenses are segments of circles. The parabolic form would be far superior, but cannot conveniently be got, at least by grinding.

185. Copying—Best Method of Lighting for.—It is doubtless quite possible even to improve on a print in copying, but there are many difficulties to contend with. If the print to be copied is mounted and flat, one is disposed of, but if this is not the case, it must be pinned down as flat as possible, and the lighting will require extra care. This matter of lighting is the chief difficulty, and is to be overcome mainly by the rule of trial and error, the whole apparatus being altered and shifted till the picture on the focussing screen is thought satisfactory. Diffused daylight is the best, but if artificial light is to be used, lamp-light (using two or more lamps) is to be preferred. If possible, the photograph should be placed flat on the floor, with the camera pointing down at it. The first essential is a top light *coming from a small area*, say an opening a foot square in the slanting window of an attic. The object to be copied must be horizontal, and the lens pointed down at it. The object must also be as far as possible from the light (at least ten feet). All this is to hide the grain of the paper, which results from each little irregularity casting a shadow.

186. Copying—Lens to Use for.—The difference in copying with an R.R. and a wide-angle rectilinear of the same covering power, as far as the image is concerned, is *nil*. However, the W.A. is generally more convenient because it enables one to use a shorter extension camera than with an R.R., and this in copying full size is a desideratum. The exposure, however, with a W.A. would be longer than with an R.R., on account of the smaller stop required. With an R.R. and a W.A. of the same focal length the W.A. would cover a considerably larger plate than the R.R., though to the extent that the R.R. covered there would be no difference in the image. For the sake of illustration, suppose that it is desired to copy same size. It will then be necessary in all cases for the map, etc., to be twice the focal length of the lens in front, and the plate to be the same distance behind the lens. Hence, for example, an R.R. of eight inch focus requires a camera to extend sixteen inches in order to copy same size, while a W.A. of same covering power and having a focal length of, say, five inches, would require an extension of ten inches. Nothing is gained when the R.R. and W.A. are of the same focal length; in fact, the W.A. would be wasted as regards covering power, while the R.R. would be much the more rapid. Another point is that the wider the angle included by a lens, the greater difficulty there is in securing equality of illumination all over the sensitive surface. No matter how evenly illuminated the object to be photographed may be, since a W.A. lens is necessarily a short-focus one, there must be a great difference in the lengths of the lines joining the optical centre of the lens and the margins and central portions of the ground glass or sensitive plate. From this reason if the centre of the picture is properly exposed the margins will be under-exposed, or if the margins are properly exposed, the centre will be over-exposed. An examination of any picture made with a lens of this class will illustrate this point. In using such a lens for copying, the difficulty of securing equality of illumination is still further increased, since the camera will have to be placed very near the drawing or map, and will, in consequence, be almost certain to block out some of the light illuminating the drawing, etc. These two reasons have led to the total abandonment of wide-angle lenses for this class of work, and, indeed, for any work in which their use can be possibly avoided.

187. Daguerreotype — To Copy.—Carefully remove the daguerreotype from its frame, and separate from its covering glass, and place face upwards in a dish of clean water. Be extremely careful not to touch the front of the plate, as the slightest touch will leave a permanent mark. Lift the plate by the corners, and remove the paper from the back when sufficiently soaked; rinse the plate thoroughly, and should the water be repelled as though greasy, flow over a little methylated spirit; if the tarnish on the edges is blue in colour, immersion in an ordinary fixing

bath of hypo will remove it, but if any bronzing is visible, make a solution of cyanide of potassium, five grains to the ounce, and keep pouring this on and off till all tarnish is removed. Wash the plate thoroughly to free from cyanide, and rinse thoroughly with distilled water, then take hold of one corner of the plate with a pair of pliers and dry evenly from a top corner downwards over a spirit lamp or Bunsen burner. If any stain or deposit is left by unequal drying, the plate must be rinsed again with distilled water and dried again. The chief point is not to touch the image with anything but the liquids, or a mark will be made which nothing will eradicate. To copy a daguerreotype the best plan is to place it inside a deep box lined with velvet or black cloth, with a hole in the lid for the lens to peep through—and a piece cut out of one side only to illuminate the plate by — sunshine is best, though it can be done with the light from an enlarging lantern at night. In most daguerreotypes the marks of the buffer are seen as fine horizontal lines. In copying, these should be placed vertical, and when in position are not much seen. The process of copying beyond the lighting is, of course, the same as copying any other object. Place the camera as for copying a *carte-de-visite*, using R.R. lens, medium stop and slow landscape plate, or, better still, new rapid chloride plate. To avoid reflection in front, a piece of cardboard, a foot square, covered with velvet and with an opening just showing the glass of the lens, will be found quite effective. To remount the daguerreotype, clean the glass carefully and bind thin gummed paper round both glass and daguerreotype, to prevent air getting in between the plate and the glass, or it will soon tarnish again.

188. Drawings—To Copy.—Black and white sketches may be made transparent by covering them up with freshly ground linseed, and allowing them to remain some time, or by placing them on a hot plate and rubbing them with a cake of white wax; when transparent, they may be printed from on albumenised paper, giving white lines on dark background, or the ferro-prussiate paper may be used, giving white lines on a blue ground, or the ferro-cyanide paper, giving blue lines on a white ground. This may be converted into a dark grey print by floating it on a solution of carbonate of soda (one in thirty), and afterwards on a solution of tannin (one in thirty), or a brilliant green may be made by using a solution of sulphuric acid (one in sixteen). If, however, it is desirable to represent the black lines by black lines direct, this can be done by the black process, one of the formulæ for which is as follows. Procure a piece of well-sized paper, and sensitise with the following preparation:

Gelatine	1 part.
Perchloride of iron	2 ,,
Tartaric acid	1 ,,
Persulphate of iron	1 ,,
Water	30 ,,

Expose under the drawing and develop by immersing in gallic acid one part, water 160 parts. Wash in clean water and dry.

189. Electric Light—To Use for Enlarging.—The most usual way to use artificial light for enlarging is with a condenser of suitable dimensions for the size of the negative to be enlarged. The electric light is, without doubt, the best illuminant for optical projection generally, and for enlarging in particular, the size of the spot of light being small. A simple form of hand-fed arc lamp can be used with a current of five to ten ampères on a fifty volt circuit, the carbons being inclined at a slight angle, so that the light from the crater of the positive carbon (with direct current) may be projected clearly to the condenser. There is no advantage in inclining the carbons when using alternating current, both carbons being pointed. If a condenser is not at hand, there are various methods that can be employed, but all require more current than with a condenser. Perhaps the best of these methods is that of placing two arc lamps in the corners of a light-tight box, opposite to and shining on a piece of opal or *white* cardboard on the inside back of the box, only the reflected light passing through the negative to be enlarged. The negative must be shielded from the direct light of the lamps by placing them in half-round reflectors. Results can be obtained by this means quite equal to daylight, and in some respects a great deal better than with a condenser. This is the method employed in one of the society enlarging lanterns with success. Another method is to illuminate the negative with the light from an optical lantern in which, of course, the electric light can be used to great advantage. The circle of light need not be larger than to cover the negative. The focus of the front lantern lens will then be much lengthened, and the light will have to be moved nearer the condenser. When this is the case it is advisable to place a piece of clean glass a little in front of the condenser to prevent any pieces of incandescent carbon falling on and cracking the same. An incandescent lamp of a higher voltage than the circuit (say a hundred volts on a fifty volt circuit), and connected *across* the terminals of the arc, will help to steady the light. As regards lamps, a focus-keeping lamp is preferable to a hand-fed one, but is more expensive, and, after all, the trouble of regulating the carbon is not very great. A very useful lamp, suitable either for enlarging or ordinary lantern exhibitions, is one of from 500 to 1,000 candle-power. There are two lamps which have been especially adapted to the optical lantern—Davenport's arc lamp (J. H. Steward) and the Dot arc lamp (by F. J. Borland). The former is a hand-fed lamp, requiring a rod to be turned about once in five minutes, the carbons being set on a slant; the best light obtainable is given. The Borland lamp consists of two carbons at the ends of two arms, after the fashion of scissors. It is self-feeding, self-setting, and automatic, requiring no attention. It is supplied to work at from 500 to 2,000 candle-power, and where current is obtainable it can be worked with either alternating or direct currents. The price of these lamps is about £4 each, and they can be used in an enlarging lantern in the ordinary way.

190. Enlargements—Medium for Painting.—Oil of turpentine, which has been exposed to the sunlight for some hours, forms a very quick-drying medium for oil colours. It has been found very useful in sketching in oils, and will probably answer purpose required.

191. Enlargements—To Finish.—The personal experience of an artist would lead him to advise the use of oils upon carbon enlargements by a novice, as, unless water colours are applied in a masterly manner, and prove correct at the first "wash," the surface is in danger of damage by the removal of mistakes or experiments. Platinotypes may be worked with either water, oils, powder colours, or crayons, and certainly present the best surface for colouring of these two types. The tints required for "black and white" are Indian ink, Chinese white, carmine, indigo, and neutral tint. Carbons in sepia are done with burnt sienna, vandyke brown, and sepia, using Chinese white for high lights. Mediums for oils are megilp and turpentine; for water colours, a thin solution of gum water. The actual working up of the face is done in a series of fine stippling and hatching

touches, closely resembling the markings to be observed upon a good engraving (which is the best guide a beginner can study), and all draperies and accessories are improved by slight accentuation of their lights and shadows.

192. Enlargement — To Vignette.—Vignetting an enlargement is a very easy process, all that is necessary being to have an egg-shaped opening cut in a good-sized piece of cardboard. This is then moved backwards and forwards to and from the lens while the exposure is being made. Of course the nearer the hole is to the lens the larger the portion of paper exposed, and *vice versâ*. Moreover, hard portions of a negative can be similarly treated, and be thus given an increased exposure.

193. Enlargement—To Work up.—These are usually worked up in water colour or crayons. The latter can be used on gelatino-bromides, platinotypes, mat surface opals, and paper carbons, but are unsuitable for albumenised papers or collo transfers, unless these are first varnished to give them a tooth. Water colours being the easiest for a beginner to master, these remarks shall be confined to this description of work. Albumenised paper will have to be prepared by treating it with dilute oxgall, and gelatino-bromides on paper or opals, hardened with a weak solution of white alum. Platinotypes may, with care, be worked on direct, but it is better on the whole to give them a wash of Newman's sizing preparation. Carbons on mat surface opals are rubbed down with a little finely-ground pumice. Almost any albumenised paper tint can be got by the following mixtures: (a) Lampblack, lake, sepia; (b) neutral tint, brown madder, sepia; (c) neutral tint, crimson lake, Indian ink. For red carbons Indian red is suitable, for brown carbons madder, and for black prints by any process Indian ink toned down carefully with madder. When working up enlargements on paper, begin by pinning them to a board, and use clean white paper underneath the hand, the slightest touch of which spoils the surface. Before starting it is always advisable to wash over the surface with a damp brush to see how it "takes." If it is all right commence work at once; if greasy or uneven, apply another coat of oxgall or of Newman's preparation. In working upon paper mix the colours with a little gum water, but omit this with carbon opals. On albumenised paper and platinotypes the high lights must be *put in* with Chinese white; on bromides, etc., they can be *picked out* with an ink eraser, the latter being by far the most satisfactory plan. Two plain prints made direct from the *untouched* negative are most useful as guides, one deeply printed for the detail in the high lights, the other lightly printed for the detail in the shadows. These should be constantly referred to as the work progresses. It is assumed, of course, that they are portrait enlargements. Matters having progressed so far, begin by stippling in any white or too light spots, using very little colour. This done, fill up inequalities due to retouching marks, grain of paper, etc.; in other words, commence by toning down the entire, so as to give it an even appearance. Now compare the enlargement with the guides, and very carefully fill in deficiencies due to imperfect drawing or rendering, and soften down all hard outlines. In cases where there is a general lack of half-tone pass a *very faint* wash over the whole picture, and pick out the high lights with a dry brush or, better, if the basis is suitable, let the whole dry and take out the lights with an ink eraser; then rub down shadows by the same means, and soften down junction of shadows and high lights by stippling. The forehead may now be dealt with by stippling wherever necessary in a direction as horizontal as possible, taking care to arrive at depth by a *succession* of *delicate touches* rather than by a few massive ones. Pick out or put in high lights on forehead, and reduce "crow's feet" a little. The eye may then be taken in hand. The pupil will probably want strengthening, but when doing this be sure to keep strictly to the *form* as shown by the guide. When using Chinese white on the lights here be very careful to avoid a glare. The iris will probably want defining, which is done by delicately outlining it, getting depth as before by a *series* of touches. A few faint touches carefully placed will indicate the lashes of the upper lid. These must not on any account be wiry, but rather show their presence by a soft shadow. The eyebrows are similarly treated, and the lines beneath the eyelid softened a little, taking care not to overdo this, or the likeness will be utterly lost. The high light on the nose must next be put in or picked out, care being taken to place it exactly as shown in the guide, and the cavities of the nostrils strengthened with a few dark touches, the nostrils themselves being delicately outlined. A high light is next secured on the lower lip, and if there are any markings due to a defective skin, they must be softened down. The shadows at the corners of the mouth will also require softening, as well as the shadow under the lower lip, which latter must be made to merge into the chin. Finally, soften the lines running downward from the nose, the furrows at the root of the nose, and reduce prominent cheek bones very slightly. Accentuate throughout all upward curves, and soften downward ones. If the hair is not well rendered, it must be toned down, but in most cases a slight wash of colour will be all that is requisite. If little detail is present a few light touches will improve matters, but be careful never to attempt the representation of individual hairs. The draperies and background are best merely spotted and lightly touched here and there, so as to avoid the risk of giving them undue prominence. If the background is a plain vignetted one, and is defective, it can be easily and artistically improved with half-hard crayons mixed with pumice powder, and rubbed on with the finger.

194. Enlarging at Night—Best Method of Illuminating Negative for.—One authority recommends a sixteen-wick paraffin lamp, and finds the result quite equal to enlarging with a condenser, and very little extra trouble. Another says the best thing to use is one of Rippingille's paraffin-oil stoves. Remove the mica from the front, and substitute for it a piece of finely ground glass, against which place the negative, which will then be evenly and brilliantly illuminated. Of course, if an enlarging camera is not used the stove must be placed in a box so as to keep the diffused light out of the dark room. An enlargement can also be made by illuminating the negative by means of magnesium ribbon. A piece of bright tin bent into a half cylinder, and secured by a piece of wire fixed round it, makes an effective lamp. The magnesium ribbon having been rubbed with fine glass paper, is attached to the wire, and in that position is lit from the bottom, and burns up steadily. About two inches of ribbon is sufficient. Lancaster's magnesium lamp is the most simple one in the market, and answers the purpose. Some time ago a paper on "Enlarging without a Condenser" was published by Major B. Baker, who uses a paraffin lamp of forty-two candle power, with an opal globe, and with Morgan and Kidd's paper he succeeded in making a good enlargement in from seven to twelve minutes.

195. Enlarging—Best Method of.—The first question is, whether it is enlarged negatives

that are required or bromide paper enlargements. Fortunately, the proceedings are somewhat similar, the greatest difference being that the direct bromide enlargement is very much easier in every detail. Assuming that an enlarged negative is required, proceed as follows: Make a positive or transparency by contact from the original negative. Be sure not to make one like a lantern slide, as that will be useless. Expose well, and never mind the high lights being clouded and dirty, for such transparencies as the latter-mentioned are *the* sort for reproduction. When this is done satisfactorily spot any defects in film, if *small* and insignificant; if large, discard altogether and make another transparency. Remember every defect will be enlarged, roughly speaking, six and a quarter diameters. It has been laid down that the best method of producing enlarged negatives is to make an *enlarged* positive or transparency, then print negative through camera to size required, no contact printing being allowed The room must be darkened completely by blocking up the whole of the window. Cut out a space just large enough to allow the back of camera to be placed against it. Put the transparency in a cardboard frame, and insert in the place where the dark slides go. Be sure to place the film side towards the lens, otherwise a reversed negative will be the result. Now, get a drawing board and fix it on to a pair of steps – the side is best – as that will make the board parallel to the the negative. This is most essential. A piece of the *finest* focussing glass should be placed between the sky and the back of camera containing transparency. This will help to give uniform illumination. Now focus the positive image on a piece of white paper the size of required negative. This paper must be pasted on to a piece of cardboard the thickness of the plate it is intended to place in same position for exposure to be made on, otherwise the focus will be interfered with. Put the dry plate in *exactly* the same position as the piece of paper focussed upon, use a slow plate and give plenty of exposure, make a trial exposure on a quarter-plate, for it is quite impossible to give the time required. Supposing it is required to make a *bromide paper* enlargement, the following directions are given: Select a window facing north and having an unimpeded view of the clear sky. Place a table with its short edge flush against window, and support the camera on a block of wood so as to raise it about two inches above the table. Push up the camera so that the ground glass touches one of the window panes. Now, with brown paper pasted to the glass and at the edges of the window frame, exclude every trace of white light, except that coming through a portion of the window pane, against ground glass, and same size as latter. Take the greatest pains to exclude the light completely, and if any finds admittance through the door, hang an opaque curtain inside the latter. Now procure a planed-up piece of ½in. pine, 14in. square, and fasten it upright to another piece, about 14in. × 6in. This constitutes the enlarging easel. Placing the camera in position on the table with the ground glass against window, fasten block of wood temporarily to table, and with a screw or two in block of wood and pressing against camera, so arrange matters that the latter is closely pressed against window, and cannot readily shift during subsequent operations. Select two straight pieces of deal nearly as long as the table, and about 1½in. section. Place the enlarging easel in centre of table, so that it is parallel to the ground glass, and with its centre opposite the lens, and screw the two long pieces of wood to the table, one at each side of, and close against the baseboard of, the easel. These serve as guides between which the easel moves to and fro. When ready for work place a negative in the dark slide, place this in camera, draw both shutters, make the junction of camera and windows quite light-tight with a focussing cloth or two, and rack lens in or out until an image is seen on the easel. Vary the size of the image as may be required by moving the easel to or fro. Have pieces of paper cut to size of enlargement—½, 10 x 8, 12 x 10, etc.; pin these to easel, so as to include what is required, and mark their position with a pencil used or the wood. Focus and size being right and position marked, cap the lens. Bring in a sheet of sensitive paper from the dark room, pin it in position, using a ruby lamp for illumination, and expose by removing the cap. Eastman ordinary paper, enlarging from quarter to 12 × 10 with moderate stop, would need about twenty seconds exposure. If there are many enlargements to do, it is easy to paste ruby paper over one of the window panes, and so avoid bringing the ruby lamp in and out of the room. If a room facing north is not available, another must be used, taking care to select a time of day for making the enlargement when the sun does not shine upon the glass. If the available window has not an unimpeded view of the sky, it is necessary to arrange a piece of ground glass outside window about three or four inches from window pane, so as to equalise the light. Sometimes it happens that only the upper portion of the window has an unimpeded sky view. In this case a long board might be arranged on the table so as to tilt the camera and easel to the requisite amount. In this latter case, however, it is difficult to secure even illumination without removing a pane of glass from the window and arranging a frame to take the camera. In placing the negative in position see that the film faces the lens, otherwise the enlargement will be laterally inverted.

198. Enlarging Camera—To Make.—To make a camera to enlarge from half-plate to 12 × 10 first make a box of about ½in. deal, 40in. long, 12in. deep, and 14in. wide, with one end only. This end should have a hole cut in it 6½ × 4¾, to receive the negative. Put thin strips inside, and a strip and buttons outside, to keep negative in position, taking care that the strips or buttons do not project sufficiently to obscure any of the picture. Then cut a piece of wood 13in. × 11in., just large enough to slide inside the box. Make a hole in centre, and fix the lens flange. This is fixed about 12½in. from the negative, but it is better to defer final fixing until arrangements have been tested. Next black the inside thoroughly with dead black. Now make the dark slide. Make a tray of ½in. strips, 2in. wide, 13in. × 11in., making a groove ⅜in. from edge of three strips to carry a sliding shutter of hard cardboard, and cut away ⅜in. from the fourth strip. Cut a board ½in. thick, 12in. × 10in., to carry the paper; this fits inside the tray just mentioned, and thin strips are fixed to keep it in position. A hinged back completes the dark slide, which must be well made so as to be light tight. Fasten ½in. strips inside the camera at end farthest from negative for the dark slide to move in, and cut away the top for same purpose. Put a piece of ground glass 12in. × 10in. in dark slide in place of paper, raise back and shutter of dark slide, and adjust position of board, carrying lens to give best focus, and fix there. The paper should be 25½in. from ens diaphragm. Of course with other sizes same principles apply, only varying details. Another method is as follows: In the first place take a piece of well-seasoned board, 4ft. 6in. long, by 13in. wide, and 1in. thick. This will form the base of the apparatus. Then make the carrier for the negative from a ½in. board, 13in. × 15in., with the centre-part cut out the size of the negative (6½ x 4¾), and across

each corner on the inside fix a strip of brass (¼in. long), to prevent the plate from falling through, and two catches on the outside, as in an ordinary carrier. This is now fixed securely to the baseboard in a perfectly upright position, about 2in. from the end, so that when necessary a sheet of ground or opal glass may be placed behind it to diffuse the light. A similar-sized board carrying the lens is then secured to the baseboard, so that the film side of the negatives will be 12¾in. from the lens (diaphragm slot), whilst at the other end of the board is placed another board on which the bromide paper is placed, so that it is 25½in. from the lens. It now only remains to exclude all light except that which comes through the negative, which can be done by attaching two laths the length of the baseboard—one to each top corner of the three upright carriers, and covering the three open sides with black cloth or thick paper. It will be found a good plan to fix a piece of ground glass - ground side facing the lens —in the carrier for the paper, for focussing for sharpness in determining what stop to use. The above measurements of 12¾in. and 25½in. are approximate, so that before finally fixing the carriers they should be definitely settled by experiment.

197. Enlarging—Distances to Determine in.—Here is a correct and very simple rule for determining the distances of negative from lens and dark slide from lens. To find the distance between the *lens* and *sensitive surface* (dry plate or bromide), add one to the number of times of enlargement *linear*, and multiply by the focus of the lens. Suppose we are enlarging from 2×1½ to 6×4½ with lens 8¾in. focus. The result will be as follows:

Number of times enlargement = 3.
Add one to this number = 4.
Multiply by focus of lens (8¾in.) = 35in.

To ascertain the distance between the *negative* and *lens*, divide this distance by the number of times enlargement, that is, 35in. divided by three equals 11⅔in. Of course the centre of lens is meant, for 8¾in. is the *equivalent* focus of the lens. If reducing from a picture or a negative of 6in.×4½in., then 35in. would represent the distance of the picture from centre of lens, and 11⅔in. would be the distance of centre of lens to sensitive surface, just reversing the above order. By taking an example from Professor Burton's table of enlargements and reductions, and working it out by the simple rules given above, it will be seen that the results are correct. It is simpler in some respects than a table of figures, especially where the focus of a lens is in odd parts or fractions of an inch. It will be seen, for instance, that Burton's table gives a lens of 8in. and 9in., but not an intermediate focus, such as 8¾in.

198.—Enlarging—Factor to Use in.—Supposing it is required to enlarge a quarter-plate to 12 × 10. The factor to use will be three, because it is desired to enlarge to three times, therefore supposing the lens employed to be one of 6in. focus, look at the figure 3 on the top line of table, and 6 in the vertical column, and $\frac{24}{8}$ will be found, therefore the plate or paper to be enlarged upon must be 24in. from the centre of lens (diaphragm slot) and the quarter-plate 8in. from the lens also. If the equivalent focus of the lens is not known, find it by focussing on a distant chimney or tree, and measure the distance from the stop if a combination lens, or from the lens itself if a single one, to the focussing screen; the length in inches is the focus of the lens. Possibly this may be better understood from a consideration of the following: "Linear" means length, and the enlargement of a quarter-plate to 12 × 10 is practically three times linear.

199. Enlarging without Condenser—Best Method of.—The process of either enlarging or reducing without a condenser is exceedingly simple, and more certain results can be obtained with magnesium than daylight, it being possible to gauge the exposure to a nicety, which is, unfortunately, not the case when ever-varying daylight is used. The method of hanging strips of the ribbon behind the negative is most unsatisfactory, because in cases where the negative is thin and little magnesium is necessary, the quantity would be so small as to allow considerable space between the hanging strands, and so cause uneven illumination, it being through actual flame itself burning behind the negative, which is the active agent, active at least in comparison to its rays. With regard to enlarging by the aid of a magnesium lamp, the process is not to be commended as much as burning the ribbon by hand, on account of not being able to gauge the exposure as accurately by time, which would have to be the case were a lamp used, as it would where the exact number of inches could be burnt, and the operation repeated *ad infinitum*. In using an enlarging camera all that is necessary is to place behind the negative a piece of fine ground glass, sufficiently far away to be out of focus, say three inches, then measuring off the requisite ribbon, break it into lengths of about eight inches each; longer pieces than these are unwieldy, and likely to "wobble" about. Take a piece in a pair of pincers, ignite, and move fairly rapidly along the ground glass opposite the negative, beginning at the top with a right to left, then left to right motion down to the bottom, repeating the operation until half the magnesium is consumed; the remainder is used in the same way, only with an up and down movement, the whole operation resembling a species of cross hatching. This process lends itself particularly to masking, a thin part of the negative being "dodged," whilst a dense part may receive an extra share of illumination, the operation, if carefully done, not showing in the finished result. The above can best be carried out where an enlarging camera is used, though, should it be desirable to expose the paper in an open room, it would be a very simple matter to construct a box with eye-holes of ruby glass; the hand could be inserted through a suitable aperture, and the ribbon burnt without any of the rays getting into the room; a funnel would be desirable, as anyone who has used magnesium, either in ribbon or powder form, will have a vivid recollection of the smoke thrown off. Of course, the pleasantest way is a hole cut in the door, through which the camera is pointed, the paper and magnesium being in different rooms, a consummation devoutly to be wished, as the particles of consumed magnesium, if allowed to alight on the paper, will cause black spots to appear on development; the same applying to lantern slides, to the reduction of which the above is as equally applicable as to enlarging.

200. Figures and Designs—To Copy.—The simplest way is by means of the ferro-prussiate or blue printing process, which is very simple and cheap, and which is largely used for copying plans and drawings, etc. The ferro-prussiate paper is easily made, but it is better to buy it ready prepared. Having obtained it, place a piece underneath and in contact with the drawing in a printing frame, such as is used for photo printing, and then put it out in the light to print. It is allowed to remain until the prepared paper assumes an olive tint with metallic reflections, when it should be removed and well washed in cold water, when the

design will be found reproduced in white lines with a blue ground. Should it be desirable to have the copies in blue with a white ground, this first print must be used in future, instead of the original design, to print from. The printing frame may be dispensed with (but it offers greater facilities for examination whilst the printing is going on) by laying the drawing and prepared paper under a sheet of glass, but as this cannot be examined, owing to the difficulty of replacing the design and prepared paper in exactly the same position again, or, "in register," as it is termed, it is necessary to have a smaller piece laid under another piece of paper the same that the design is on, and with a cross or other device drawn on it. Gum two of the edges of these together so that one corner can be raised to look at the prepared paper underneath, to see how it is progressing. Of course, the larger and smaller pieces must be put out at the same time, and then when the smaller one with cross on is done it may be concluded that the other one is also done. The ferro-prussiate paper can be obtained from any dealers.

201. Films—To Enlarge from.—It is best not to use a lantern for enlarging films, as the heat from the lamp employed spoils the film negatives, *but to do enlarging by daylight only*, which is a cool light, and not a hot one, like a lantern light always is. In using a lantern, however, a cell should be constructed of two pieces of plane surface glass suitably framed, and holding a solution of alum well mixed. With the condenser on one side of the cell and the celluloid film on the other, there will be no trouble. A solution of sulphate of copper might be tried, but its colour would, in all probability, counterbalance any advantages it might have. In many cases it will not be necessary to have the film in direct contact with the condenser, but it can, with its two protecting glasses, be placed at some little distance in front of the condenser, that is, so far away that the cone of rays will just cover the picture. The separation will keep the glasses cooler, or if that is not sufficient, a draught of cooler air might be directed between the negative and condenser; of course, it must not be cold enough to cause the breakage of the condenser. Possibly the lantern itself might be more efficiently ventilated to get rid of some of the excessive heat. The film should not simply be placed between two pieces of plate glass, but they should be bound firmly together.

202. Gaslight—To Copy by.—Edwards's isochromatic plates are made of three rapidities. The slow ones are the best for copying. To copy by gaslight requires very great care in making the necessary arrangements for suitable and even illumination. Using a chandelier of six burners, with reflectors (which may be sheets of white paper) placed so as to equally light up the whole picture, the globes of the chandelier being of opal glass, the lens being used without a yellow screen, the exposure would be about eighty seconds, or if the screen be used an exposure of six to seven minutes would be required. This was required in a studio arranged to offer the best conditions under which to operate. Developer used was the pyroglycerine of Messrs. Edwards. But on account of the great variety of oil paintings and their condition, no certain time of exposure can be assumed to be correct. The case mentioned was a portrait of an officer in uniform of dark grey with crimson facings, the portrait being clean and in good condition. Probably a more convenient method of copying at night is by means of magnesium ribbon. A good lamp for the purpose may be easily made thus: A wide-mouthed bottle such as used for bottled fruits is taken, and the bottom cut off with a file. The outside is covered with a single thickness of yellow tissue paper; and when dry a piece of thick brown paper pasted from the top to the bottom over one half of the bottle. A piece of copper wire is bent thus V, and placed in the neck to support the magnesium ribbon. One of these lamps should be placed each side of the camera, and four inches of magnesium ribbon having been rubbed with glass paper and wound round a ruler to make a coil of it, is suspended in each bottle. The picture having been focussed carefully by gaslight, the gas is turned down, the cap removed, and the two lamps lit, the tissue paper side being, of course, to the front. The quantity of ribbon mentioned will be about right, but, if necessary, longer pieces may be used. If the ribbon be not cleaned with glass paper it is liable to go out before being half consumed. If the yellow tissue paper is not used, a yellow screen will be required when magnesium is used. When gas is used, no screen is necessary. Isochromatic plates and gaslight are most valuable for copying old or yellow pictures. With ordinary plates the exposure will be rather long, and will depend on the light and size of copy. In copying a C.D.V. half size with f/11 stop and a lamp about twenty c.p., twenty minutes was about right. It is best to give a little over-exposure rather than under, as when copying one is apt to under-expose.

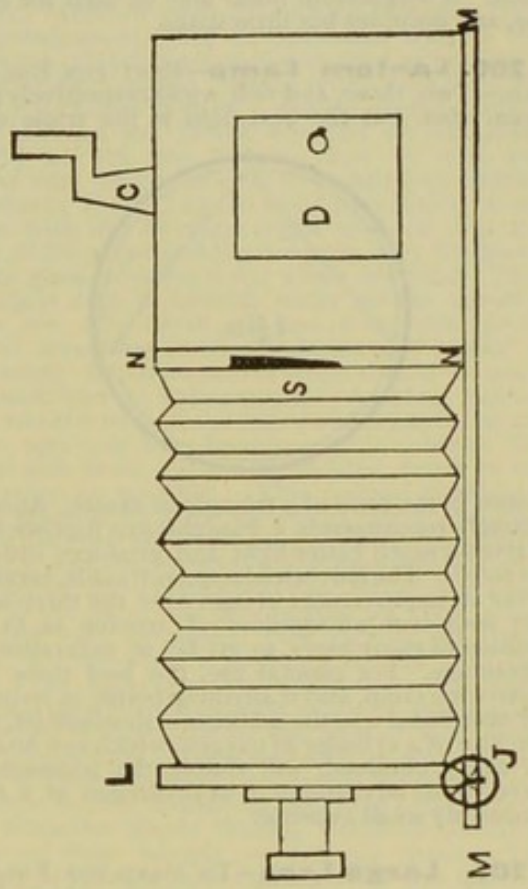
203. Glass Cap—To Make for Enlarging.—A yellow glass cap is almost a necessity for enlarging, and the following is a very easy method of dodging one: An ordinary drop shutter usually contains a groove on either side for the shutter to traverse. This is simply filled in with a piece of yellow glass, and the thing is done. There is no Act of Parliament requiring the cap to be round, and this dodge obviates the troublesome business of cutting out a circular piece of glass.

204. Illumination—Best to Use for Enlarging.—The question as to which is the *best* method is a disputed one, but in any particular case it is best to decide by the circumstances under which it is most convenient to work. Excellent results can be obtained by any of the numerous methods in use, providing *one method* is chosen and adhered to till thoroughly mastered. As to which method is advisable, probably in this variable climate it is best to use artificial light, and if that be decided on, it will be best up to half-plate to use an enlarging camera. For a lamp a Defries or any of that style of lamp is the most suitable, but a good Duplex is almost as good. If expense be no object the limelight, or even the electric light, may be employed with advantage. Another authority who strongly advocates daylight gives the following description of an enlarging apparatus made at home. At about four feet from the floor of the bath room occasionally used for this special purpose, and near the wall an aperture 8in. square was made, and into this was fitted a shallow wooden box, open at one end and carrying at the other a board pierced with a 5 × 4 opening to suit size of negatives. The camera, a square one fitted with reversing back, was provided with an extra frame fitting into the reversing back recess, and into this the negative fits. This extra frame is, of course, open at both ends. The camera is then pushed up quite close to the little window and secured to the shallow wooden box by means of two spring clips. A board, removable at will, spans across the space (6ft. 4in.) between the box carrying the camera and the opposite wall, the board being about 8in. lower than the bottom of the box, and on this board the enlarging easel works. This latter is merely a piece of wood 18in. square fixed upright upon another piece same width as long board spanning across room. This latter long board is provided

with a longitudinal slit 5ft × ¼in., in which works a thumbscrew, the head of which is attached to the bottom of the enlarging easel. Two thin strips of wood glued to the edges of the long board serve to keep the enlarging easel parallel to the negative, and the thumbscrew secures it in position. The centre of the easel is pierced with a hole, into which a focussing magnifier fits, and is also provided with a very simple ledge, on which the paper, glass, etc., rests, capable of up-and-down and to-and-fro motions. The lens (of the R.S. type) being in its usual position, will, under these circumstances, form an enlarged image of the negative on a sheet of thin cardboard same size as enlargement is to be (five sizes are provided) resting on ledge of easel. The image having been focussed as accurately as possible from the front, and the cardboard moved up and down or to and fro until in the right position, an ordinary toilet pin is stuck into the board, so as to touch the edge of the cardboard, and serves as a guide for position of sensitive paper. The cardboard is then removed, and the final focussing effected with the magnifier *from the back*, moving the easel itself very slightly to and fro until the *grain* of the negative is perceived. The lens is then capped, the sheet of bromide paper placed on the easel so as to rest against the guide pin, and secured in position with four toilet pins, one at each corner. The exposure having been made by uncapping the lens, development, etc., follows. In addition to the apparatus elsewhere described, in which magnesium wire is employed as the illuminant, a successful lantern for enlarging without the use of expensive condensers has been described by Major Barrington-Baker. This is a ventilated, light-tight box, with an opening in front to take the negative, and between the negative and the lens of the camera a bellows or other light-retaining arrangement is fixed. Inside the box is placed a Belge duplex lamp of forty-two candle-power, having a ten inch opal globe. The exposure depends on aperture of lens, number of times of enlagement, rapidity of paper, and density and colour of negative, But, as an example, it may be mentioned that, when exhibiting his lantern, Major Barrington-Baker's, enlarging six diameters, and using Ilford rapid bromide paper, and lens working at *f*/4, an exposure of about two and a half minutes was given. Another plan, giving a more even illumination, but needing a longer exposure, consists in using a wider box than the above, and placing *two* lamps, one on either side of the negative, and shading the negative from direct light from the lamps, but using the light reflected from the whitened back of the box. For the best results a properly-curved reflector should be employed, so that the light striking it from the lamps should be transmitted through the negative in parallel rays.

205. Lantern—To Make for Enlarging.—A very cheap and simple enlarging lantern can be made as follows: Procure a large square tin biscuit box, and mount it on a board (M) double in length the side of the tin, take off the lid (L), and in the centre of it fix your lens. The lid must now be joined by bellows to the body of the lantern. Make a door (D) in the side of the lantern, and a chimney (C) on the top. Where the bellows join the body, a piece of wood (N), with an aperture (S) only the size of the plate, must be fixed. A rack and pinion (J) should be fixed to the lens front for the purpose of focussing. The letters refer to the diagram above. Any lamp will do, the stronger the flame the better. Care must be taken that all joints, etc, are perfectly light-tight.

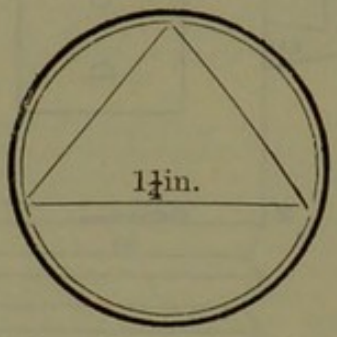
Another method is to make a box, preferably of teak, eighteen inches high, ten inches broad, and fifteen inches deep, all inside measurements. Make a false bottom three inches above the true one, and both must be well drilled to allow of ventilation. The size of the condenser must be easily able to cover the largest negative employed. The receptacle for the condenser must, of course, depend upon the height of the illuminant used. A hole should be cut in the top of the lantern chimney placed so as to allow of ventilation and yet be light-tight. A door should be constructed on one side and glazed with ruby glass. For light an ordinary 1½in. wick tin-backed paraffin lamp can be used.



To enlarge, the room is, of course, darkened, and the camera fitted at the back with the negative is placed close as possible to the condenser, while the front is racked out till a sharp image is obtained. The following points should be well attended to: (1.) All glass, lenses, condenser, chimney, etc., must be scrupulously clean. (2.) The negative must be quite square with the condenser and lens. (3.) The light must give an equally illuminated disc, and this can only be obtained by continual adjustment. (4.) The negative should be somewhat thin. (5.) Take care and have the negative the right way round. A Meniscus lens would hardly do; it would be so slow. A rapid rectilinear answers admirably. As the most expensive item in an enlarging lantern is the condenser, one is dispensed with in a lantern made as follows, though without a condenser the exposure is considerably prolonged. Make a box of half-inch wood, with a door at the back. Cut a hole in the top, and fix over it a metal chimney, constructed so as to cut off all stray light. In the front of the box cut a rectangular aperture of the size required, having a slight rebate, with small turn buckles to retain the negative in position. Holes should be bored in the bottom of the box for ventilation. A bellows with a frame attached to the back is fitted over the negative aperture, and held in

position by two fixed catches below and a turn-buckle above. The front of the bellows is constructed to take the camera front, or a flange fitting the lens used. Or the camera itself, if the front racks, may be fitted to the aperture. Care must be taken that the flame, negative, and lens are properly centred. A Belge lamp, of forty-two candle-power, with a 10in. opal globe, is suitable. Instead of a globe, a piece of flashed opal glass may be fixed behind the negative. A very useful accessory to enlarging is a lens cap, made of cardboard, with a piece of ruby glass let into the front. A magnesium lamp may be used for lighting, and occupies but little space.

206. Lantern Lamp—BEST FOR ENLARGING.—Two, three, and four wicks respectively have been tried, but the best light is the triple wick,



placed in the form of a triangle as sketch. Another strongly recommends a Pamphengos four-wick, as it gives a much better light and produces little or no smell. The four-wick lamp, well made, certainly gives an improvement in light over the three-wick, but with such an increase of trouble as, in the opinion of many users, to go far to neutralise the advantage. For general use, the best thing is a *three*-wick lamp, and if anything better is required for occasional use, the addition of limelight jet, with the hire of a cylinder of oxygen, which can now be so easily obtained, will enable the possessor to have all the advantages of oxyhydrogen at a comparatively small expense.

207. Large Lens—TO MAKE FOR ENLARGING.—Amongst various expedients which have been used at different times for enlarging without a condenser there is an arrangement of gas jets arranged close together in lines one above the other, the second line being a little behind the first, and the third a little behind the second, presenting as nearly as possible a large sheet of flame of the required size. Mr. J. A. Hodges, with such an arrangement, and a piece of opal glass placed behind the negative to be enlarged, has obtained good results. The heat evolved is very great, so there must be a plentiful supply of ventilating holes or apertures. A stronger illumination will be obtained by coating the lantern or tin in which the light is used with white paint. The reason of failure with the water lens is no doubt the use of a single lens of plano-convex form instead of a double combination of two plano-convex lenses, placed with their convex sides close together. The former method was that adopted for very cheap or ancient lanterns, and a great amount of light is thereby lost; whereas by using the double combination, nearly all the light, which would otherwise be lost, is refracted to make a parallel beam of light. There is another way of lighting the negative, and that is to place the source of light on either side of the negative, and reflect the light on to and through it by means of a reflector at the back, but this would require a very strong light or very lengthy exposure.

208. Lens for Enlarging—THE BEST.—As a rule, the higher the quality of the lens the larger the size area it will cover in excess of what it is sold for. It is also found that the larger the aperture of lens the more brilliant the resulting enlargement, of course, it being understood that a sufficiently small stop to get the necessary marginal definition be used. As a matter of fact, lantern lenses are *not really suitable* for enlargements, even if the lens be a portrait combination; the latter will sometimes answer fairly well for enlarging from a head or a portion of a negative which only occupies a small central part of same. The only really satisfactory lens for the purpose is a rectilinear, and if using paraffin it is a great advantage to be able to use it full aperture. Possibly, the cheapest is a single landscape lens, which answers capitally for enlarging, and will work full aperture, and a lens to cover quarter size could be purchased for about fifteen shillings, or even less. Regarding the rectangular condenser, it is much better in every way than a circular one, less loss of light, and more portable than using a five-inch circular one. The lens would act just as well with the 4½ x 3½ rectangular condenser as with a five-inch circular one. It is not so much a matter of condenser as the covering power of the lens. It has been well said that the best lens to enlarge with is the *same one* that the negative was taken with. However this may be, it is quite certain that a rectilinear will answer all requirements in enlargements. Many lanternists use a lens of the rectilinear type for exhibition purposes, and at some very successful exhibitions such a lens was used in the nightly lantern entertainments given.

209. Negative Enlarged—TO MAKE BY CONTACT.—The exposure to a Bray's No. 5 about thirty-six inches off would be about seven seconds. If the positive is an ordinary one, not specially made for the purpose, a certain amount of detail in the high lights is probably altogether lacking, and the density not nearly so great as would be desirable. The first defect is, of course, irremediable, but the second may be overcome or mitigated by a correct minimum of exposure and long and careful development with pyro-sodic carbonate. Subsequent intensification will probably be necessary.

210. Negatives for Enlarging—TO MAKE.—It is often asked whether it is best (1) to make a small transparency by contact, and afterwards an enlarged negative, or (2) an enlarged transparency and a negative by contact. Opinions differ considerably upon these two points, but, from experience, it seems best to make a small transparency by contact, and then enlarge. In the first place, should the negative be weak or over-dense, there is a chance of remedying it by varying the exposure of the positive. Secondly, it is more economical, as the cost of failure in the small size is comparatively *nil* compared with, say, 15 x 12 plate. Thirdly, by careful retouching and spotting on the small transparency defects in the original may be remedied, so that they are scarcely perceptible in the enlarged negative, and may be touched out easily in the prints therefrom. The oxalate developer gives the best results for the positives, which should be neither weak nor hard, as only a perfect result can be obtained from a transparency that has proper gradation. It certainly seems useless to enlarge defects or coarseness, and then have to reduce them by tedious spotting, which on an albumen print is anything but an improvement. Another high authority, however, points out counterbalancing advantages in No. 2 thus: Firstly, because the flaws, if any, of a small transparency are not enlarged; secondly, because a great deal

of work can be put on the enlarged transparency, it being very much easier to work up a large than a small transparency; and, thirdly, because any number of large negatives can be made from the transparency.

211. Negative—How to Enlarge.—The best result that can probably be obtained will be had by projecting the negative, either by the lantern or by daylight, upon a slow thick-filmed plate, such as the Kingston slow, or Wratten & Wrainwright's ordinary. A transparency will, of course, result, which can be retouched and improved upon till satisfactory, when a negative is made by contact.

212. Skies—To Print in Enlargements.—First procure a suitable sky negative of the same dimensions as the one to be enlarged from; then carefully pencil on a piece of black paper the exact outline of the trees or housetops in the negative. Having cut out this mask of the lower portions of the picture, lightly gum it on to the plain side of the sky negative, so as to effectually block out all portions except those clouds that it is wished should appear in the enlargement. The sky negative having been thus prepared, place it in the carrier, and expose, for example, say, thirty seconds, then place the cap on the lens, remove the sky negative from the carrier, and replace by the proper negative, exposing this five times as long, the development and subsequent operations being precisely the same as usual.

213. Tracings—To Copy.—The simplest way would be to expose the tracing in a printing frame with bromide paper (Eastman's B. paper), and work up the lines in the copy, if not black enough, by going over them with a pen and ink; or another process is—

Gum	385 grains.
Sodium chloride	46 ,,
Tartaric acid	62 ,,
Perchloride of iron	123 ,,
Water up to	3½ ounces.

Highly sized and smooth paper is evenly coated with this mixture, dried in the dark, and exposed under the tracing; developed in a saturated solution of ferricyanide of potassium, and fixed in a ten per cent. solution of hydrochloric acid, and washed. The following is a very simple and excellent process for black lines on a white ground:

Water	300 parts.
Gelatine	10 ,,
Perchloride of iron	20 ,,
Tartaric acid	10 ,,
Persulphate of iron	10 ,,

When dry the paper is exposed under the tracing until the greenish yellow tint of the paper has disappeared, except where covered by the opaque lines. To develop, the following bath is used: Dissolve twenty parts of gallic acid in two hundred parts of alcohol and adding one thousand parts of water. Fixation is the same as with the cyanotype paper, viz., simply thoroughly wash the prints in cold water until the water is perfectly clear of colour from the paper. See Drawings (No. 188).

214. Trays for Enlarging—To Make.—One way is to use for dishes of all sizes morocco oilcloth at 2s. the yard, a yard and a half wide. The necessary folds are scored in with a blunt tool, the corners clipped together, and the whole set on a board for convenience in rocking, and the corner clips held apart by any means that may suggest itself. It is found to have no action on either ferrous-oxalate or pyro, nor *vice versâ*. Such trays have evident advantages. The material being opaque and not likely to crack, it can be used for a combined changing bag and "hold-all." Handy for cyclists. Porcelain dishes are not at all necessary for developing and fixing enlargements. A good way is to get some wooden trays the right size, something like those cheap Japanese trays, clean them with washing soda (*not* with soap), dry, and give at least three *very thin* coats of Aspinall's White Bath Enamel, giving a rub down with fine sandpaper between each coat to remove all roughness which might tear the paper. Each coat *must* be hard before applying the next, or the enamel will peel off. Of course, hard varnish or black varnish would do, but is not so convenient on account of the colour. Another method by which porcelain trays for enlargements may be dispensed with is the following: Obtain a piece of stout glass rather larger than the size required. For example, take 16 × 13in. for a 15 × 12 enlargement. A strip of wood, about ¼in. thick and ¾in. broad, bevelled on one edge, should be cut into lengths, two of 15in. and two of 12in. Mitre the ends to fit together, forming a frame 15 × 12. Lay the wood in position on the glass, with the bevelled edges inwards, wet the back of the paper and lay it evenly over the frame on the glass, pressing it flat with a dry brush. Thus a shallow dish is formed, ready for the development, etc. The depth and size of the dish can be varied according to the thickness and length of the strips. Separate sets of strips should be made for each size of enlargement. Another method is to wet the back of the paper and lay it flat on the glass, applying the developer with a broad, flat camel-hair brush—one with as little metal in the mounting as possible. This method requires a little practice to avoid somewhat uneven development, but great control is obtained over the process. A rather ingenious method of simultaneous exposure and development is recommended by Mr. Swanson. Laying the paper face downwards on glass, brush the back with developer; then turning the paper over, the operation is repeated on the emulsion side. The paper remains attached to the glass, which is then fixed in position on the enlarging easel. Exposure is made, and by the light of a red lamp development can be regulated with brushes charged with normal developer, restrained developer, etc. Another method of making trays is to procure from the Willesden Paper Works, Willesden Junction, some of their two-ply or four-ply paper. The former is cheaper and lighter, while the latter is more durable. The paper is sold up to 54in. wide, and the price runs up to about 4s. per yard. Cut pieces 2in. longer and 2in. wider than the size of the enlargement; wet the paper, and turn up ¾in. on all four sides and secure the corners with clips, and there is the dish. Before using, however, it would be well to give the paper a coat of shellac varnish, etc. These dishes are very convenient for travelling or packing away, as they stow away quite flat. There is, however, another dodge sometimes had recourse to, and it consists simply of making the enlargement itself its own developing dish, by turning up about ½in. all round, and placing on a level slab or table. This way, however, is open to objection, owing to the liability to leak or collapse, and the difficulty found in pouring off the solutions, but this latter might be obviated by syphoning with a glass tube, for of course the edges are wasted. Dishes can also be made of cardboard and Willesdenised in the following manner: Take copper or brass filings or clippings, put in a bottle, and cover to about two inches with strong liquor ammonia, commonly said to be of specific gravity ·880, though that can only exist in an ice house under pressure. After a few days the liquid will have turned a deep blue colour; decant the liquid, and brush over the cardboard thoroughly inside and out; allow it to dry, then wash, and the cardboard is waterproofed.

The process depends on the solvent action on the cellulose and its allied substances in the cardboard by what is known as the cupro-ammonium hydroxide (or, if brass be used, a mixture of cupro-ammonium and zinc ammonium hydroxides), and if Willesden paper be sensitised, the filaments on the surface will be found to be, so to speak, welded or cemented together, and water-resisting properties are consequently communicated. Ordinary cardboard so treated becomes surface waterproof, and can be used for dishes, etc. A coating of shellac varnish or some such substance should, however, in all cases be applied before using the dishes.

215. Whites in Enlargements — To SECURE CLEAR.—After development, before any attempt is made to wash off any of the developer with water, the print is well washed with a solution of citric or acetic acid and alum. Of course, the developer is previously drained from the print. By thus thoroughly acidifying the paper before it comes into contact with any washing water, perfect purity is maintained in the whites after washing and drying. Wash thoroughly before fixing.

216. Yacht—TO ENLARGE ON BOARD A.—The best way is to use daylight for enlarging, if possible. Place back of camera against a port-hole, or, better still, have it fixed against a skylight, so as to get direct light from sky, and block out all light except that which comes through camera. Place negative to be enlarged from in dark slide in camera and draw out both slides. Fix a drawing-board exactly parallel with front of camera, with an arrangement by which it can be moved backwards and forwards, nearer or further from the camera, and still be parallel with camera. Pin a piece of white paper to drawing-board and uncap the lens, so that an enlarged picture from the negative may be cast on the paper, pretty much in the same way as a lantern picture is cast on the screen; in fact, the principle is the same in both. After focussing, sharply replace cap on lens and substitute for white paper on drawing-board a piece of bromide enlarging paper, uncap the lens, and allow the image from negative to be cast upon the bromide paper for a length of time previously determined upon by trying different lengths of time on small pieces of trial paper, then develop according to instructions given in most text books, or sent out with the bromide paper. If not possible to use daylight, magnesium ribbon may be used successfully for illuminating. There are two arrangements to be adopted. The simplest is to fix camera against a hole in a door of room with drawing-board opposite, as before, and then burn magnesium ribbon outside the room opposite the hole in door. The other is to cover in the space between the lens and the board on which the paper is pinned, so as to exclude the light. This is easily effected by having a packing case or box with a hole, through which the lens is allowed to point into interior of box, opposite which the bromide paper is fixed. Carefully stop up all places where the light might pass into interior of box. Then burn, with an ordinary printing negative, about two feet of magnesium ribbon, cut up for convenience into lengths of, say, six inches, and wave about behind the negative. Back negative with tissue paper or ground glass, to equalise the light. Be sure to have all apparatus well fixed and firm, or the motion of the vessel may shake it during exposure, and so blur the picture. Presuming lens is about 7in. or 7½in. focus, the distance camera is to be racked out is 10½in., and distance of drawing-board from lens 21in. For calculating these distances a useful table is given at the end of the year books. Another way is to use two cameras. One the camera and lens which has been used to take the picture, and the other a 10 x 8in. camera without lens. The centres of the two cameras are placed in a straight line, with the lens of the smaller camera pointing into the large camera, and making a light-tight junction with it. The negative is placed in the dark slide of the smaller camera, both shutters drawn, and the whole pointed to the sky, when an enlarged image will be thrown on the ground glass of the large camera, the slide of which can be fitted either with a dry plate or a piece of bromide paper.

CHAPTER V.

EXPOSURE AND LIGHTING.

217. Actinometer—Test Papers for, To Keep.—The difficulty arises from dampness, for it is well known how the humidity of the atmosphere affects printing-out papers, and if a paper could be obtained which did not vary in its tint of colour with the atmosphere, it would be most useful for exposure-meter purposes. However, paper is now supplied for this purpose hermetically packed, with a supply of calcium chloride, so that, if similarly preserved after opening, it can be relied upon. The state of the atmosphere for the short time the paper is actually in use will not affect it to any great extent. Possibly a colourless oil varnish could be applied to both sides of the paper; when dry it should be impervious to any atmospheric moisture. A great deal of the trouble so often complained of comes of the fact that the standards are made too dark. It is far better to have them weak and be able to see the test slip approach and pass the depth of colour than to have a difficulty in deciding whether the tint has been reached because it never can be passed. Some of the trouble comes of the use of nitrite of potassium in solution to cause the ordinary gelatine bromide papers to take a depth of colour they would not otherwise attain. The nitrite of potassium being a hygroscopic salt, naturally makes the gelatine and the paper impregnated with it highly sensitive to atmospheric conditions. Capt. Abney gives the following formula: "Take a sheet of plain photographic paper and soak it for ten minutes in a solution of potassium bromide (forty grains to the ounce). Hang it up to dry, and float on a fifty-grain bath of silver nitrate. Then wash the paper and pass it through a bath of potassium bromide of five grains to the ounce, then wash thoroughly, and, finally, soak for five minutes in a bath of tannin, one grain to the ounce." This paper will keep and discolour fairly well in the light. This paper, having tannin as the organifier instead of nitrite of potassium, is not so susceptible to the influence of moisture, but it is, unfortunately, slow in change, and capable of but slight range of colouration. It appears, however, that an emulsion with which the nitrite has been incorporated gives better results than a film soaked in the nitrite solution. Such an emulsion does not give either so blue or so red a colour as some others. Twenty grains of potassium bromide is dissolved in one ounce of distilled water, and twenty-five grains Nelson's No. 1 photographic gelatine is soaked in it for ten minutes. At a temperature of 100° twenty-five grains of silver nitrate in one crystal is added, and the bottle in which all is contained is shaken for fifteen minutes. It is kept at 95° Fahr. for thirty minutes more, and then forty grains of potassium nitrite in one and a half ounces of distilled water at a temperature of 100° is added. Eight pieces of plain Rives paper, 7 × 4, wetted and squeegeed on to glass, and having had their surface moisture removed by blotting paper, are coated with this quantity and dried. The paper is cut into strips as required.

218. Actinometer—To Make. — Procure some Eastman (or any other make of) bromide positive paper, soak each sheet for five minutes by lamp light in a ten per cent. solution of potassium nitrite, dry, cut it up in strips 3in. × ½in., and store them in a tightly-closed tin box. Expose a bit of this paper to diffused daylight sufficiently long to change its colour to a slaty blue, and match the tint in water colour on a piece of white paper. Now get a microscopic slide glass (or piece of white glass 3in. × 1in.) and cut a piece of cardboard same size. At each of the four corners of the cardboard gum narrow pieces of thickish white paper and across the top gum a strip of the coloured paper about half-inch wide. Fasten the glass and cardboard together with thick black paper so as to exclude light, and cut out a little opening ⅜in. × ¼in. through the black paper at the top of the glass, so that the coloured paper beneath can be seen. To use the instrument slip in one of the pieces of bromide paper between the cardboard and glass, and expose until it darkens to the tint. To make another trial pull out the piece a little more. To show how to make a standard, suppose it to be a bright day in June at twelve o'clock. The time taken to darken should be from ten to fifteen seconds: suppose it to have been ten seconds. Burton's tables can be used with this actinometer, and the exposure with Ilford ordinary or any plate registering 13° War. will be exactly table exposure, *i.e.*, for open landscape, stop f/32, it would be one second. Now on another day, at a different time, let the paper take thirty seconds to darken to the standard tint, this is three times what may be called the normal exposure, consequently the exposure for similar subject and stop would be three seconds.

219. Actinometer—To Make Test Paper for.—Mr. C. J. Leaper says: Place half ounce finely-powdered potassium metabisulphite in a ten-ounce bottle, and pour six ounces of cold water over it. Shake vigorously, and set the whole aside for three or four days, with occasional vigorous agitation. At the expiration of that time pour off the saturated solution so obtained from the solid residue, and having transferred it to a clean dish, immerse in the dark room a piece of Eastman B or other bromide paper in it for three minutes. Remove the paper with ebonite forceps, drain, and pin up by one corner to dry. When dry, keep it in

a Platinotype Company's calcium tin, if the paper is wanted to keep good for an almost indefinite period. Failing this, store it between the leaves of a tightly-closed book. The given quantity of solution will serve for only six quarter-plate sheets of paper, if these are intended to darken at a uniform rate. A twenty-grain solution of sodium nitrite is doubtless often recommended, but does not yield so sensitive a result as potassium metabisulphite, nor does the paper keep so well. The more usual method is to make up a solution of potassium *nitrite* (not nitrate), forty grains to each ounce of water, and conduct the following operations in yellow light: Soak any make of bromide paper in solution above for five minutes, *and dry in the dark*. When dry cut into strips of required size. Paper of ordinary rapidity (as Eastman's) prepared in this manner will darken in bright sunlight to standard tint in ten to fifteen seconds. If wanted more rapid a lighter standard tint must be adopted, or use a faster paper, as Ilford rapid. The results, however, will be found much more reliable with the slower paper. By having two standard tints *the lighter one* can be used in a bad light.

220. Bromide Papers—To Determine Exposure for.—There is no better way than to experiment with a small piece of paper, and when the correct exposure is found, book it with all particulars in the note-book. It can then be referred to at any time, with the certainty of being successful. A method of ascertaining exposures required for bromide paper was proposed by Dr. Vos, and is as follows: The illuminant consists of a No. 5 Bray burner turned fully up without flaring. From a point directly under this light a six-foot line is drawn on the floor or bench (a tape measure answers very well), marked off in inches, beginning at 72 under the light, and ending at 1 at the other end of the line. A piece of opal glass sufficiently large to cover the negative whose exposure is to be estimated is the only other piece of apparatus required. To test a negative, place the opal glass behind the negative, and between it and the light. Hold the negative and glass up between the eye and the flame, beginning at No. 1 on the scale, and gradually approach the flame until the smallest details in the negative (such as markings on a wall and lines on the face) are just visible. Note the number of inches immediately underneath on the scale, and this will give the exposure required at two feet from the burner. For instance, starting from one and having to approach to within 3ft. 6in. of the light, the number underneath will be 30; this will give 30 seconds exposure. No doubt good results can be obtained in this way, but it is not suitable for all negatives; for instance, very dense or very thin ones are unsuitable, besides the colour of the negative must also be considered, and an exposure at a fixed distance of two feet will not suit all negatives. Light and opal glass may vary from those used by Dr. Vos, in which case it will be necessary, of course, then to multiply the number of inches obtained by a fraction, either a little more or less than 1—say $1\frac{3}{4}$ or $\frac{3}{4}$.

221. Clouds—How to Expose for.—The best time to photograph clouds is in the spring, say March or April, when, after a storm, the heavy cloud banks assume fantastic forms. To successfully photograph clouds, the photographer is advised to take up a position where the view will be unobstructed by trees, houses, telegraph poles, chimneys, or other high objects. Then focussing upon the extreme distance, and including but a small portion of the landscape in the picture—if the cloud is not yet fixed upon, wait until the effect is most striking, then with a rapid shutter and a medium stop, say f/22, and a slow plate, make the exposure. Development should not be too heavy, and should be stopped when all detail is fully out, and sufficiently dense not to disappear in the fixing. With a suitably selected and properly developed negative of cloudland, landscape pictures can very frequently be considerably improved by the operation of printing-in from the cloud negatives.

222. Distance—To Allow for in Exposure.—Distance, *in itself*, has no influence on the amount of exposure required. After a certain point very near objects require a longer exposure when the camera has to be racked out to focus them; but, though important in portraiture, this point need not be considered in landscape, as the difference is very trifling as a rule. The slight haze, which is apparent in the atmosphere even on the clearest day, makes a great difference in the required exposure; it acts by reducing the depth of the shadows in the more distant objects, and consequently the exposure should be less. This is an interesting point which has not received the attention it deserves. If the atmosphere were perfectly clear, and free from particles of moisture and dust, distant and near objects would require the same exposure. This condition is often met with in the higher elevations of Switzerland, where the sky itself may reflect so little light as to appear quite a dark blue black. In England, however, there are always particles of moisture, etc., in the air, which, quite independently of the objects to be photographed, reflect light to the lens which is additional to the normal image of the object, and, of course, shorten the exposure. The decrease of exposure depends both upon the *condition* of the atmosphere and the *quantity* of it which intervenes between the lens and the object. For instance, in a foggy air an object ten yards away may be merged into the sky and have practically the same light-reflecting value; while, on the other hand, on a clear day after rain, objects a mile away may require as great an exposure as the foreground. It is therefore quite impossible to draw up a table. Roughly speaking, if a near object requires one second, objects two or three hundred yards away may do with half a second, and the extreme distance a quarter of a second. Theoretically, of course, the exposure varies *directly* (because the light varies *inversely*) as the square of the distance of the ground glass from the lens. This would give a longer exposure for a near object, but with a comparatively short-focus lens this distance is so slight for objects situated (say) twenty yards away, that no practical difference can be made on this ground. There only remains the atmospheric effect as above.

223. Electric Light—To Use in Exposure.—Professor Eder, in one of his recent year books, gives a table of the comparative intensities of various illuminants used in photography, taking sunlight with 60,000 candles as unit. The table is as follows:

Sunlight		1
Electric light of a dynamo.	Arc light	10-46
	Ordinary arc light ...	150-300
	Incandescent light (Edison or Swan)	3000-6000
Light of 40 Grove cells		166
,, 48 Bunsen		158
Limelight (oxygen and house gas—ordinary pressure)		666-2608
Limelight under $3\frac{1}{2}$ atmosphere pressure		75
Magnesium wire ·3 mm.		811
,, ,, stronger		300-600
Oil lamp		5454-6000

Gas lamp (fish-tail burner)	6000-10000
,, (Argand ,,)	3530-3750
Petroleum lamp (flat burner) ...	1200
,, ,, (round burner 15 mm. diameter)	9231
Petroleum lamp (round burner, 25 mm. diameter)	4286
Standard wax candle or paraffin candle	60000

For ordinary work a lamp of about 3,000 candle-power will be required. For copying, Dr. Eder states that in the Geographical Institute of Portugal an electric light of 2,000 candle-power is used for the reproduction of diagrams and plans in the camera by means of the wet collodion process. The best arrangement of the light is to place it behind a common lens of about three or four inches diameter, so as to produce a disc of light amply sufficient to cover the diagram to be copied. The light produced in this way is very intense, and an exposure of less than half a minute is sufficient with it. Another table, compiled from the published statements of Roscoe, Pohi, Marx, etc., gives the candle-power of various lights:

	Candle-power.
Light from an electro-magnetic machine	1300-6000
Light from forty Grove cells... ...	362
Light from forty-eight Bunsen cells...	576 (frequently smaller)
Limelight from oxygen and coal gas at ordinary pressure	23-90
Limelight under 3½ atmospheres ...	790
Magnesium light from wire of ·297 mm. diameter	74
Magnesium light from thicker wire...	100-200
Coal gas from fish-tail burner ...	6-10
Coal gas from Argand burner ...	16-17
Normal wax or paraffin candle ...	1

For studio work one arc lamp, with a large white cardboard reflector, 4ft. diameter, behind it, would give enough light; a white enamelled cup, about 6in. in diameter, is fixed in front of the electric spark, about one foot from it, *so as to keep its direct rays off the sitter*, and a five or six feet *looking glass*, in a suitable frame, so that it can be placed at any angle and easily moved to any part of the studio desired, *is used to light up the shaded side of the sitter*. The above is a brief description of the light as fitted up by a professional photographer. The exposure given in this case, when using Messrs. Wratten and Wainwright's instantaneous plates, was eight seconds for a cabinet picture, a portrait lens being used, the distance of the lamp from the sitter being about six to eight feet. It is only necessary to have the *lamp proper, no globe being used*; this being the case its cost would, no doubt, be much less.

224. Exposed Plates—To Restore Sensitiveness of.—It is well known that all oxidising agents—of which the permanganate is one—destroy the latent image. Potassium bichromate is often recommended. For the use of this Eder gives the following formula:

Potassium bichromate ...	1 gramme.
Hydrochloric acid	3 ,,
Water	100-150 ,,

Abney gives—

No. 1.

Potassium bichromate	10 grains.
Water	1 ounce.

No. 2.

Potassium bromide	10 grains.
Water	1 ounce.

Use equal parts of 1 and 2, and soak the plate thoroughly. No doubt permanganate of potassium could be used, and Condy's fluid, as supplied without dilution, would probably be efficacious if used in conjunction with a ten-grain solution of bromide. With the bichromate, however, it is certain that the action takes place in a fairly rapid manner. But note carefully that the sensitiveness of the plate will be decreased—though Eder says this may be remedied by adding ammonia—and the bichromate must be thoroughly eliminated by subsequent washing.

225. Exposure, Wrong (Over and Under)—To Remedy.—To remedy over-exposure commence developing with a normal strength developer, say the ordinary pyro and ammonia (pyro 2 grains, bromide 1 grain, ammonia 2 minims to the ounce). If the plate is over-exposed the image starts to flash out, immediately flood it under the tap, and then soak the plate in a weak bromide solution; while soaking in this wash out another dish and take the plate out of the bromide, rinse under the tap, and place in the clean dish. Now, supposing it is a landscape, tilt the dish so that the sky portion is uppermost, and with the brush and with the same developer (to which has been added some six grains more pyro) bring out the foreground. Remember that overdoses of pyro act as *restrainers, do not give hardness*, and give *density*. Now after each three or four applications of the brush, which must always be on the move and not rest in one place, give the plate a wash. When all the foreground is out wash the plate well, turn the dish round, and attend to the sky. In this way also clouds can be secured in the negative which otherwise would not print. Of course, remedying under-exposure is also, to a certain extent, possible by the same means, using, however, a developer stronger in accelerator. Of course, under-exposed negatives are usually characterised by hardness, and therefore the use of eikonogen, with or without quinol, is strongly recommended for their development. Soaking the plate in a weak bath of alkali or other accelerator, before proceeding to develop, sometimes has a marked effect; but what is perhaps better, use warm water for the developer, if it is known that the gelatine film will stand it. A warm developer is far more powerful than when cold. In connection with this it is always well to *note the* temperature of the dark room, and work with solutions as nearly as possible the same temperature, if uniform results are to be expected. Therefore a jug of hot water in winter is a most useful adjunct to quick and successful work. The most comfortable temperature both for dark room and solutions is about sixty degrees F., and it would be well if the dark room could be always maintained at this.

226. Flash Lamp—Pneumatic Release for.—This, if only wanted to blow off a flash lamp, can easily be made. Get a common (rather thin) indiarubber ball. If with a hole in, so much the better; if not, bore one in with a red-hot skewer. Then cement over the hole a piece of indiarubber tube (such as is sold by chemists for use in babies' feeding bottles) with indiarubber cement, made by dissolving shreds of indiarubber in benzole, till it forms a thick solution. Let this dry and the release is finished. Another method is: Get a child's indiarubber ball, about 2½in. diameter, with a hole in it. Cement in hole (with rubber solution) a small brass tube $\frac{3}{16}$in. diameter and 1in long, leaving outside ½in. Slip one end of three feet of quarter-inch rubber tube over this, right up to ball, and fasten with rubber solution to ball and tube. The rubber solution may be bought from the indiarubber shops, or may be made by dissolving one part pure indiarubber in ten parts benzole. An oval indiarubber ball, fitted with valves and pipe, and made for filling footballs, is sold at the indiarubber shops for 1s.

or 1s. 6d., and would answer the purpose admirably. An old indiarubber syringe could also be easily adapted.

227. Flashlight—How to Work.—The best way is to use a "flash lamp," viz., a contrivance for blowing magnesium powder through a flame, either spirit or gas, of which there are several forms in the market. These lamps use magnesium powder *only* unmixed with either chlorate of potash, picric acid, or any other explosive, and are, therefore, quite free from danger, which cannot be said of the mixtures. In the absence of a lamp, the best substitute is probably to spread the magnesium powder over gun-cotton, which can be ignited with a taper, and is free from danger, but the lamp is best; and some forms are quite inexpensive, one running as low as 1s. 6d., which works very well. From five to ten grains of magnesium is sufficient charge for a single portrait (a group requires one of the larger forms). The light should be diffused by tissue paper in front and white reflector behind, and a white reflector is needed on the shaded side of the subject to soften the contrasts. To obtain good results with portrait flashlight, it is essential that everything employed shall be of the best quality. Rapid lens, large stop, thickly-coated plates, freshly-made solutions, clean dishes and measures, and a cool and collected operator. These preliminaries being assumed, the process is not difficult. From one end of the background, a white reflecting screen, equal in size to the background, is placed at an angle of 110°. At the other end of the background, parallel with the reflector, is placed a table of a height of about 3ft. 6in., upon which the flashing arrangement is placed. The simplest arrangement is a piece of wire strained between two upright pegs fixed in a deal board, distance between pegs being about thirty inches. This is placed on the table, and a screen of tissue paper about twelve inches high placed in front of it. To use this flashing lamp, two tufts of gun-cotton, well divided, are placed on the wire about twelve inches apart, and a little magnesium powder sprinkled over them. The sitter is now carefully focussed in a good light, the dark slide placed in position, and plate exposed. The room is then darkened, and the lens cap removed. The gun-cotton is ignited by means of a wire dipped in methylated spirit and lighted, and the exposure is made; the dark slide being closed, the room is again lighted up, and the plate removed for development. Hydroquinone answers well for the development of flashlight negatives. There is no danger of explosion. The quantities for the gun-cotton and magnesium are ten grains of cotton and five grains of magnesium in each tuft. Another method is to make the following mixture: Potassium chlorate 1 ounce, antimony sulphide ½ ounce, sublimed sulphur ½ ounce, magnesium powder ½ ounce. Powder the potassium chlorate *by itself* very finely in a mortar, and then mix it with the other ingredients on a sheet of paper, using the finger for that purpose. Now make a semicircular reflector of sheet tin by taking a piece of that material about two feet square, and bending it round until the sides are 18in. from each other. A piece of twine slipped over the top and bottom will secure it in position. A muslin screen about three feet square will also be required, and this should be placed about two feet in front of the reflector. The reflector and screen should, when in use, be level with the head of the subject, and a little to one side, and about six or seven feet distant. Two drams of the mixture placed on the bottom of an inverted jam-pot six inches in front of the reflector and ignited by a match will give a fully-exposed negative. The sitter should, of course, have been previously posed and focussed, and this can be readily done by using an ordinary paraffin lamp as illuminant. Care should be taken to screen the lens from the flash by interposing a sheet of cardboard between it and the flash mixture. Development is carried on as usual, only as little bromide as possible is employed in the developer, otherwise the negative is apt to be hard and chalky. Provided care be taken to mix the ingredients in the mixture with the fingers only, and on *no account in a mortar and pestle*, the above process is perfectly safe, and yields good results. A *simple* flash light is made as follows: A piece of lamp-wick three or four inches long, saturated with spirit (methylated will do as well as the pure spirit), and placed on a plate of metal and ignited, will give as strong a flame as the lamps. A block of wood, or any flat surface, dropped upon the wick after use will make an efficient extinguisher. From a sheet over a large clothes-horse a good reflector can be extemporised. For discharging the powder, an old indiarubber pneumatic ball with indiarubber tube attached, will be all that will be required; or the apparatus can be adapted from domestic appliances which may be found in almost every house. Insert in the end of the tube a quill of moderate length; to use it, compress the ball and insert the end of the quill into the powder, remove the pressure from the ball, when a charge of the powder will be drawn up into the quill. The quill can be marked in five-grain charges, so that it may be charged with whatever amount may be desired without the trouble of weighing. To discharge the powder, compress the ball again. Another good lamp was made from the description of Mr. Gratcheff's lamp, exhibited by Mr. Warnerke at a meeting of the West London Society. It simply consists of a tin cylindrical box 3in. in diameter and 1½in. high, a brass tube ⅜in. bore is inserted in one side and at the bottom, and by means of an elbow joint rises in the centre for 1in. The box is filled with rough cotton wool and covered with brass wire gauze, leaving the tube in the middle open, and the other end of the tube is fitted to a pneumatic ball. With this lamp the same effect is obtained with two grains of magnesium powder as with the ordinary blow-through, using twelve grains. With two of these lamps, giving flashes simultaneously, capital results were obtained, using two screens of stout muslin. And no doubt the secret of soft negatives consists in well diffusing and reflecting the light from the flash lamps. Thomas's formula of hydroquinone suits well for developing, and it is found that if the sodium hydrate solution be mixed with half the hydroquinone solution and applied until details begin to appear, something more than faint outlines of the picture, and then the remainder of the hydroquinone solution be added, the resulting negative comes out soft and full of gradation. Pyro has also been used with good results. It is well to keep down the amount of pyro to the minimum if softness is desired. The pyro must be diminished in case of white drapery in the subject, or hardness and violent contrasts will be the result. Employ a weak developer, that is, one with considerable water, but with the alkali in slight excess. For instance, six ounces of water, one dram of pyro (ten per cent. solution), two drams alkali; while the plate is slowly building up in density refrain from adding more pyro, but should it be tardy in gaining strength, cautiously increase the amount of pyro. Secure detail first, and then work for density. A developer with excess of alkali softens the high lights and gives shadows and half-tones a chance; but the amount of alkali must not be so large as to flatten the high lights. The heavy shadows may be to an extent prevented by placing the sitter at some

distance from the background, and raising the light six or seven feet from the floor. Take care to err on the side of thinness rather than density, as the negative, if thin, with plenty of detail, will give a plucky print if printed in the shade under a piece of waxed paper, now so common.

228. Flashlight—To Arrange Group for.—Unless this light is well diffused it always gives hard harsh results; a fair amount of diffusion and a fair result can be obtained by covering one or two (according to size) high clothes horses with blue tissue paper, focus the groups by gas or lamp, insert the slide in camera, cap the lens, draw the shutter, and then advance the tissue-covered clothes horse close up to the back of the camera, and open in the form of the letter V, the angles to be more or less acute according to the size of the group. Have a flash lamp on each side of the V, but a smaller charge on one side; this will give a little shadow, and so not make the picture flat. When all is arranged, and the pneumatic balls of the two lamps placed handy for left and right hands to grasp, turn down gas or lamp a little, uncap the lens, go behind the screen, light the spirit in the flash lamps, and squeeze both balls *simultaneously*. This will give a good result, and as the screen is behind camera and lens, no light can enter the lens except that reflected from the group; this requires care, or the plate is sure to be fogged. It may be added that the tissue is not to be an intense blue, but a reasonable one to tame the vivid flash and soften the result. Make the flash with eyes closed, and use the largest stop. It is best to arrange the group so that those at the sides are nearer to the camera than those in the centre. This is to compensate to some extent for the unequal illumination. Pose the figures so that no one looks into the lens or even in the direction of the camera. Another method is to have ready a piece of wood sufficiently long to reach across the camera, one end resting on lens frame, the other on ground glass frame. Support it in this position, and place another piece of wood, about two inches thick, under the end resting on lens frame. This will cause the board to be inclined towards the group. The board should be long enough to project an inch beyond the lens, and wide enough to reach across the camera. On this board (the cap having been removed after focussing) the following mixture is burnt: Potassium chlorate 1 ounce, antimony sulphide ½ ounce, flour sulphur ¼ ounce, magnesium dust ¼ ounce. The ingredients should be thoroughly dried, the chlorate reduced to the finest powder in a mortar by itself, and then mixed with the sulphur, etc., *on paper* and *with the fingers;* on no account should the final mixture be made in a mortar. About two drams of the mixture will give a thoroughly exposed negative when burnt not more than fourteen feet from group, and using rapid plates, and a lens working at f/10. It is easy to calculate the necessary quantity, if the camera must be placed further off, by remembering that the quantity will vary as the square of the distance.

The following directions are given for *tableaux vivants*. Get as much light both sides as possible, by means of lamps placed at such a height that the light falls downwards at an angle of 45°, but do not let this light shine on the lens. Supposing the flash lamp to be one with pneumatic attachment, get it placed considerably higher than the *tableau* and screen with thin muslins stretched on a frame. Before the *tableau* comes on, get a candle and place it as nearly as possible where the centre of the scene is to be, and focus the flame accurately. The camera should be placed a little to the side of the centre of the stage at the necessary distance to ensure the whole of the actors being included in the picture. Now suppose everything *in situ* and ready, the focus adjusted, the spirit in the lamp ignited, and the curtain rising at the sound of the bell, etc. Remove the cap, and select a moment when the *tableau* has overcome its first excitement and before the applause begins, to give the flash. There are two or three points still to be noted. (1.) Be sure to draw out the shutter of the dark slide. This, of course, is a minor point, but is often omitted, and affects the picture on the plate. (2.) Warn the *tableau vivant*-ers that there is to be a flash, or they may come out all asleep. This has been known to occur, even after warning. (3.) Keep the cap on until the curtain has risen, as a hitch may occur with it, and the result be a *fiasco*. (4.) Two lamps flashed simultaneously, and placed each side, are better than one. (5.) Always screen the light with some thin diaphanous material to avoid heavy shadows. (6.) Do not stop down too much, as the picture becomes unnaturally sharp, and is liable to under-exposure; moreover, be liberal with the magnesium powder; a full twelve grains are by no means too much for each flash.

229. Flashlight—To Produce Blue.—The addition of a very small proportion of finely powdered ammonia sulphate of copper will produce effect needed. Also the addition of an equal quantity of Chestier's copper to the magnesium will give a blue flash. Chestier's copper is ammonio-chlorate of copper, and is prepared as follows: Take any quantity of common sulphate of copper, and dissolve it in as little water as possible; then take an equal quantity by weight of chlorate of potash, and dissolve this also in as little water as possible. Mix the two solutions, and boil gently over the fire until the moisture is nearly evaporated; then dry the green precipitate that remains at a gentle heat. When dry treat it with strong liquor ammonia until it changes to a deep blue colour, and let it dry very gradually in a warm place. If this operation be properly performed the result is a fine blue powder, which is Chestier's copper. Another formula, perhaps rather complicated, is the following:

A.	
Potassium perchlorate	138 parts
Magnesium powder	96 ,,
B.	
Potassium perchlorate	1108 parts.
Acetate of copper	724 ,,
C.	
Potassium perchlorate	831 parts.
Sugar of milk	342 ,,

These are to be mixed for use in the proportions of six parts A to one of B to four of C. This has been much used in Germany lately for photo-micrographic work. A much simpler *approximation* to these proportions would be

Magnesium	4 parts.
Acetate copper	5 ,,
Sugar	10 ,,
Potassium perchlorate	36 ,,

230. Flashlight—To Use Oxygen with.—There should be no danger in employing oxygen gas from a cylinder in place of ordinary atmospheric air for blowing the charge of magnesium through a spirit flame for flashlight work. It was noticed many years ago that magnesium burnt in oxygen gas gave a very brilliant light of great actinic power, but it was not until quite recently that any considerable use was made of this process. Mr. Humphrey has invented a special lamp—designed for platinotype printing—for burning magnesium powder between two currents of oxygen under pressure, which gives a most brilliant light of considerable height. The increase in light is very considerable, as will be seen from the data

cited below. MacLellan found that the light of magnesium burning in oxygen is much more active than that of the metal when burnt in air. He subjected the magnesium to combustion in large glass globes filled first with air and then with oxygen, and estimated the relative photographic activity of the light by placing a scale photometer immediately in front of prepared gelatino-bromide plates which were exposed to the light in question. The following experiments are cited:

Time of exposure.	Distance from light.	Burning substance.	Last visible number on photometer.	Developer.
5 sec.	14	Magnesium in oxygen.	20	Ferrous oxalate.
5 ,,	14	Magnesium in air.	14	Ferrous oxalate.

According to the experiments of Troost (published in the *Jahrbuch der Chemie*, 1865, p. 172), the brilliancy of magnesium burning in air stands to that of the metal burning in oxygen in the relation of the numbers 64, 110.

231. Frost Pictures—How to Expose for.—The beautiful fairyland-like forms which frost often takes on the window-panes of a cold morning form a splendid and attractive subject for camera work. They are best taken when the light falls on them side ways, and not full from the front. Set the camera square with the window, and behind the window-pane, and a foot from it put a board covered with black velvet or other dark non-actinic material. Use a slow plate, stop down until the utmost sharpness is obtained, and give an exposure of three or four seconds, calculated at f/16. Of course, in most cases, to secure these pictures the photographer must be up early.

232. Gas Light—To Use in Exposure.—Ordinary gas light is too non-actinic for use with any but isochromatic plates, but incandescent lamps are now made of about seventy candle-power each, so that by using seventeen of these a candle-power of about 1,200 is obtained, but as diffusers are used some of this is lost. The arrangement of the lamps is somewhat as follows: A diffuser (about seven feet long, five feet high, and supported one and a half feet from the ground), made of oiled tissue paper, is placed at the side of the sitter, and behind it twelve of the lamps are placed in two rows, but the lamps must not be placed immediately over one another, as the air supply would be impaired for the upper lamps. For a top light a similar screen, six feet by two feet six inches, and raised about six feet, is placed at right angles to the side screen, and behind this second screen five lamps are placed in a row. All the lamps have chimneys and reflectors. A large white or tinted reflector, about seven feet square, is placed on the shadow side of the s tter. The exposure required with the above apparatus, using a portrait lens with an aperture of, say, f/4 or f/5, would be from five to ten seconds. A considerable but not uncomfortable degree of heat is given off, and the lights, although powerful, do not emit any inconvenient glare, or dazzle the eyes as other illuminants do. The flames besides are perfectly steady and noiseless. *The exposure of five seconds mentioned above was effected by the aid of a portrait lens working at f/4 and very quick plates.*

233. Light, Artificial—To Measure.—The British unit of light is a spermaceti candle $\frac{7}{8}$in. in diameter, burning at the rate of one hundred and twenty grains per hour. These may be obtained at Sugg's Gas Depôt, Charing Cross. To use set up a rod about 12in. long and $\frac{3}{4}$in. diameter in front of, and near to, a white screen. Light the candle, let it burn ten minutes, and place it at three feet from screen. Place lamp or gas flame so as to cast a shadow of rod on screen alongside shadow cast by candle, move lamp to or from screen until the shadows are equal in intensity; then measure distance between lamp and screen, and square this, also square distance of candle. Divide square of distance of candle into square of distance of lamp and result is candle power of lamp. For example, suppose lamp is ten feet from screen, then—

$$\text{Lamp—Candle} \quad \frac{10\text{ft.} \times 10}{3\text{ft.} \times 3} = \frac{100}{9} = 11{\cdot}1 \text{ candles.}$$

The lamp is therefore eleven candle power. There are more elaborate methods, but this should suit the purpose. It will be found in practice that a good clean gas burner (used with regulator) or a well-kept paraffin lamp will always give approximately the same light. Another way is by the use of a Warnerke sensitometer, thus: Place the instrument at, say, twelve inches from one source of light, and expose an ordinary dry plate behind it for, say, ten seconds. Develop the plate, and note the highest sensitometer number impressed. Proceed in exactly the same manner with the second source of light. The remaining information will be found in the accompanying table:

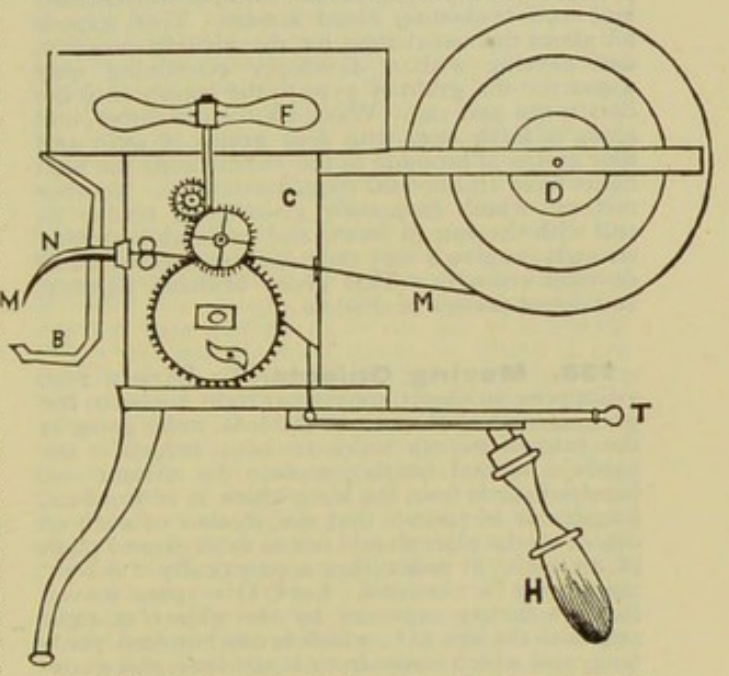
Sensitometer numbers.	Relative actinic powers.
10	1
11	1½
12	1¾
13	2⅓
14	3
15	4
16	5
17	7
18	9
19	12
20	16
21	21
22	27
23	36
24	48
25	53

The latter figures are given on the authority of Dr. Eder in *Photo-correspondenz*, 1883, page 87.

234. Light, Intensity of—To Ascertain.—The actinic intensity of light may be readily estimated by the following simple means: Soak strips of Eastman A bromide paper (in the dark room) in a ten per cent. solution of potassium nitrite (not nitrate), and hang up to dry. When dry expose a small piece to daylight, and when it has slightly altered in colour shield it from further action by placing it between the leaves of a book. At night bring a colour box into requisition, and match the shade of the exposed bromide paper on a piece of white paper. To compare the relative intensities of two sources of illumination, it is only necessary to expose a fresh piece of bromide paper beside the matched tint on white paper to each of the sources, and note the time the bromide paper takes to darken to the tint. The actinic intensities will be in the inverse ratios of the times required, say, in seconds, in each case. There are other more elaborate and expensive methods of proceeding, but the above is quite accurate enough for ordinary purposes. If, however, it is wished to compare the illuminating powers of any two sources of light, a photometer must be used. One of these sources of light is generally a candle burning a fixed number of grains per hour. Take a piece of ordinary writing paper, and in the centre of it make a spot with oil about the size of a halfpenny; fix it on a support so that it is in a vertical plane. Now at one side of this place the candle (burning at known rate),

and at the other side the source of light to be examined. If this is a gas flame it should be emitted from the ordinary bat's-wing burner, connected with the tap by an indiarubber tube. Then move these lights about till the grease spot appears like the rest of the paper. When this occurs there is equal illumination, or the intensity of light is the same on both sides of the paper. Measure the distances from spot to each of lights. Call these d_1 and d_2, then $d_1^2 : d_2^2 :: i_1 : i_2$ when i and i_2 are illuminating powers of flames. Now d_1, d_2, and i_2 are known, so i_1 is easily found by proportion. Another method is as follows: At some distance from the light place a white screen, a few inches in front of which is fixed a vertical rod, casting a shadow on the screen. A candle is then lit and placed so as to throw a second shadow of equal intensity to the first. The relative intensities of the lights will be proportionate to the squares of their distances from the rod. A simple actinometer may be thus made: Make a box about one inch cube, with a hinged lid, in the centre of which is cut an aperture about a quarter of an inch square. Into this aperture fit a piece of glass, so that it is flush with the lower surface of the lid. The upper surface of the lid should be painted a uniform light chocolate-brown colour. Cut a ribbon of sensitised paper about a quarter of an inch broad, and wind it on a reel small enough to go into the box. A slight depression should be cut in the top of one of the sides of the box to allow the paper to be drawn out freely when the box is shut. Place the charged reel in the box, leaving the free end of the paper sticking out. Then close the box. Some experimenting will be necessary to arrive at data. Exposures must be calculated from the time the sensitised paper takes to brown to the tint on the lid.

235. Magnesium Lamp—To Make for Exposure.—Cut a slit in the centre of a reflector made of silvered copper. Behind this fix two wooden rollers to feed the magnesium wire through the slit by revolving the upper roller with the thumb. A handle should be attached to enable the operator to work the roller with the same hand that holds the reflector. Another method is to procure a piece of sheet tin about 6 × 12. Then cut this into two parts, 6 × 7 and 6 × 5. The larger piece should be bent round so as to form the required shape. From the other piece a bottom and a handle should be cut and soldered on, and when in use the wire should be passed through a small hole in the back, and a piece of white cardboard laid half-way across the top. A fair lamp can be made from a sixpenny "bull's eye" lantern by removing the front part and the lamp. Another: From the best tin sheet or, better, silvered copper, cut a circle 12in. in diameter. Then cut this through the middle, and these form top and bottom of lamp. Then cut a piece 12in. × 19in., and bend into a semicircle (12in. forming the height), and solder to the two semicircles formerly made, so that the arrangement forms a semicircular vessel 12in. high, and 12in. wide. Two small hooks soldered to the top near the middle, and about 1in. from front, complete this simple and satisfactory arrangement. To use, hang one or more strands of magnesium ribbon from hooks, put into position to light sitter, and light ribbon. Still another simple and effective way of burning magnesium wire is as follows: Procure a sheet of white cardboard, say 24in. × 12in. Bend this, the long way, into a half-circle, and stretch from side to side a steel wire. The magnesium wire may be easily attached to this cross wire, and the white cardboard reflects it effectively. Any length of wire may be burnt by cutting it into short pieces and burning them simultaneously. "Cassell's Technical Educator" gives the following description of a lamp patented by Mr. Soloman, of Red Lion Square. The mechanism consists of a narrow drum enclosed between two discs of metal D (on the accompanying diagram), capable of holding two ounces of magnesium ribbon when coiled up like a watch spring M which rotates freely on an axis supported by arms that clamp on to a metal case that holds a driving clock C. This clock consists of a train of wheels, which can be set in motion by a clock spring, and in turn these rotate by means of a connecting cog wheel, a pair of delivery rollers, between which the end of the magnesium ribbon is introduced, and by their action is passed through the curved nozzle N, at which point the magnesium is ignited by means of a spirit lamp. The droppings fall into the specially-designed reflector A. The ribbon should be paid out at the rate of combustion, viz., one yard in three minutes, and the clockwork is adjusted for this by two regulating fans F. The clockwork is wound up by a key at the side of case, and is set in motion by raising or depressing a



lever T. This part of the apparatus is supported on a tripod stand, of which one leg forms a handle H, by which it can be carried, or the light directed to any desired point. This lamp is charged by unscrewing a nut that clamps the drum D to its supports, and allows of its removal. A coil of magnesium ribbon is then placed over the drum, after the removal of one side plate of the drum, the tape that confines it is cut, and the inner end of the ribbon is twisted and fixed to the drum itself; replace the drum, taking care that the ribbon unwinds from the bottom, or it is liable to drag and get displaced When the clockwork is in motion pass the end of the ribbon through the slit in the clock case until it is gripped by the delivery rollers, and is passed through the end of the nozzle, when the motion must be stopped by the lever T till such time as the light is to be brought into operation.

236. Magnesium—To Take Portraits with.—Use a plain black background. This will minimise any conspicuous shadows. On one side of the sitter place a large white sheet, and on the other side, but close to the camera, burn two strands of magnesium ribbon, each about one foot long. They should be ignited simultaneously, and should be kept about two feet apart. No lamp will be necessary; hold the ribbon between a pair of pincers. Focus for a lighted candle placed in

the position that the sitter's head will occupy. Uncap the lens, light the ribbon, and after it has all burnt away, re-cap. This will be the exposure.

For satisfactory results, however, employ powder, not ribbon, and use flashlight. If desired to use ribbon, however, burn it by playing it by hand into the flame of a spirit lamp. Assuming the portrait to be a profile, place the spirt lamp two feet above and six feet from the sitter's head, and in such a position that the line joining lamp and sitter makes an angle of 45° with the plane of the ground glass, this latter being parallel to the plane of the face. Under given conditions about two yards of magnesium would have to be burnt to get a properly exposed negative.

237. Moonlight Effects—To Expose for.—The so-called "moonlight" effect is a photographic deception. To secure this effect select a view with the sun almost in front of the camera, but itself hidden or partly obscured by clouds, and preferably a day when the sky is full of well-defined and well broken-up cloud masses. Then expose for about the usual time for the view in question, and develop with a developer containing only a quarter of a grain of pyro to the ounce, until the details are just out. Wash off the developer, and apply a fresh one, with four grains of pyro and four grains of bromide to the ounce, until the high lights have attained the requisite density. Another method which frequently gives good results is, still with the sun in front, and preferably shining strongly, to give a very short shutter exposure, and develop strongly. This gives brilliant lighting, and dense masses of shadow.

238. Moving Objects—To Expose for.—Suppose an object, moving at right angles to the prolongation of the axis of the lens, to be going at the rate of twenty miles an hour (which = ten yards a second nearly), and to be distant one hundred yards from the lens, which is of 8in. focal length. It is known that the motion of such an object on the plate should not at most exceed $\frac{1}{100}$th of an inch, in order that a practically "sharp" image may be obtained. Let O O′ = space moved through during exposure by the object at right angles to the line O L, which is one hundred yards long, and which comes from L, the lens, and a continuation of F L, the focal distance = 8in. Let F F′ = maximum movement on the plate = $\frac{1}{100}$in. Draw O′ F′, passing through L. Then, by similar triangles, we have—

$$O\,O' = \frac{O\,L \times F\,F'}{F\,L}$$

$$= \frac{100 \times 3 \times 12 \times \frac{1}{100}}{8}$$

$$= \frac{36}{8} = 4\tfrac{1}{2} \text{ inches.}$$

Thus the object in motion can only be exposed to such an interval as will restrict its movement during exposure to $4\frac{1}{2}$ inches, so that the picture may be sharp. The object is known to be moving at the rate of ten yards per second. Let X = the time. Then 10 yards : $4\frac{1}{2}$ inches : : 1 second : X or X = $\frac{1}{80}$ of a second. By a similar process, it will be seen that, at the same distance from the camera, but with object only moving at half the speed, the exposure may be doubled; at a quarter the speed, quadrupled; and so on. On the other hand, if the distance be reduced, the exposure must be proportionally quickened.

239. Plates, Sensitiveness of—To Compare.—The following table is partly the result of experiment, or is collected from the best sources. The first column gives name of plate, second gives sensitometer number (Warnerke), and the third rapidity—Ilford ordinary equals one. The rapidity of most plates is liable to variation, so that the numbers must be considered approximate.

Name of plate.	Warnerke sensitometer number.	Rapidity—Ilford Ordinary equals one.
Ilford Ordinary	18	1
,, White Label ...	19	$1\frac{1}{3}$
,, Red Label	24	5
Thomas's Landscape ...	15 to 18	$\frac{1}{2}$ to 1
,, Extra Rapid ...	25	7
Marion & Co.'s Academy	16 to 17	$\frac{1}{2}$
,, Ordinary	19 to 20	$1\frac{1}{2}$
,, Extra Rapid	20 to 21	2
,, Instantaneous	25	7
Mawson & Swan's Castle	20	$1\frac{3}{4}$
,, Mawson	25	7
Fry's Kingston Ordinary	12 to 15	$\frac{1}{3}$
,, ,, Special ...	20 to 23	$2\frac{1}{2}$
,, ,, 60 times...	25	7
Paget's 30 times	21 to 22	$2\frac{1}{2}$
,, 50 times	24	5

The "sensitiveness" of a plate, however, cannot be quite definitely expressed by figures, as the test negative attained from one make is perhaps of a different character to the test negative to be obtained from another make. It is not always that the maker's statement of the rapidity of plates can be relied upon, and, unfortunately, the expression "25 Warnerke" has become a mere trade term, almost meaningless. There are various other ways of indicating the rapidity of plates, which are to some extent superseding the Warnerke sensitometer (which, by the way, is generally indicated as W°), of which, perhaps, Hurter & Driffield's actinograph numbers are the most reliable.

240. Pyrotechnic Light—For Exposure.—The following comes from *Le Moniteur de la Photographique:*

Powdered magnesium	16 parts.
Nitrate of barium	26 ,,
Flowers of sulphur	4 ,,
Beef fat	8 ,,

The fat is added in a melted state, and the mixture cooled in small metal boxes about four inches deep and three inches in diameter; time of combustion is about twenty seconds. All of these compounds give a good deal of smoke, and perhaps magnesium smoke is the least objectionable. Another safe mixture for taking portraits at night may be made up as follows:

Nitrate potash	24 parts.
Sulphur	7 ,,
Red arsenic	2 ,,
Lamp-black	2 ,,

This can be kept mixed up, and is perfectly safe Before using, greater brilliancy may be obtained by adding ten parts magnesium powder, but don't burn it in a room unless on the stove, so that the fumes may go up the chimney. The green Bengal light, sold at one penny a box, are also found to answer fairly well, burning two or three at a time.

241. Sea-side Exposure—To Calculate.—Those who have been accustomed to work in the Midlands or in the neighbourhood of one of our smoky cities, will, if they are not careful, bring back a fine crop of hopeless over-exposures from their first trip to the sea-side. The light in the neighbourhood of the sea or any large body of water is very actinic, and, from April to August, using the "ordinary" plates and stop f/16 between the hours of eight a.m

and four p.m. on bright sunshiny days, an exposure of one-twentieth of a second or even less will be found quite enough for yachts and boats on the water, children paddling, breaking waves, etc., whilst for rocks on the shore and pictures of objects near the shore, one-tenth to one-fifteenth of a second will be ample. If the photographer does not possess a shutter which will enable him to give these exposures, he must reduce the size of his stop and give short hand exposure, taking the cap off and replacing it as quickly as he can.

242. Seconds Pendulum—To Make.—This is a very simple contrivance, and saves trouble. Get a lead bullet, drill a hole through it, and thread it on a piece of string having a large knot at the end. Measure the string so that when a loop to attach it to the tripod screw is made the whole length is 39⅛ inches. This when set oscillating will beat sufficiently exact seconds for all photographic purposes. It frequently happens that when one trusts to counting seconds the exposures go wrong; and when a watch has to be consulted with one eye, and the cap taken off and replaced under the guidance of the other, accidents occur.

243. Sensitometer Numbers—To Compare.—There seems to be a wide margin of uncertainty in the determination of speed values, either by Warnerke's method or Hurter and Driffield's. The difficulty in the Warnerke system comes of the necessity of deciding whether the few ghostly figures, which show the extreme limit of light action, are to be noticed or ignored. In Hurter and Driffield's system variation of the standard candle, or the lamp used in its place, may cause trouble. In these circumstances a comparison between the scales of the two instruments is not so simple a matter as it seems. The following table, which has been compiled by comparing results from either method with an independent standard, will be found to be as nearly accurate as such figures require to be:

Warnerke "Sensitometer."	Hurter & Driffield "Inertia."	Hurter & Driffield "Actinograph."
10	13·6	2·5
11	10·5	3·2
12	8·5	4
13	6·8	5
14	5·2	6
15	4·2	8
16	3·4	10
17	2·6	13
18	2·1	16
19	1·7	20
20	1·3	26
21	1·1	32
22	·8	40
23	·6	52
24	·5	64
25	·4	80

The "Inertia" represents the *slowness* of a plate or its resistance to the action of light, whereas the speed number is the quotient obtained by dividing thirty-four by the "Inertia"– in other words, the unit of speed is a plate whose inertia is thirty-four.

244. Shutter—To Test Speed of.—There are several methods of finding the speed of photographic shutters, and a very simple and accurate way is as follows: The length of a second's pendulum, *i.e.*, of a pendulum which makes one oscillation in a second, is about 39⅛in. Now, for the purpose in question a board is required 24in. long by 8in. wide, and a lath four feet long fastened edgeways and at right angles to the centre of the board. The board should be blackened, for which purpose ordinary stove blacklead will do. On the board describe a curved circle with a radius of 39⅛in. This can be easily done with a looped string and a piece of chalk. The scale should be 20in. long, and divided into ten parts, the centre line being exactly in a line with the lath. To make the bob for the pendulum obtain a piece of sheet lead from the plumber's and cut it circular, with a diameter of 2in., paint this white. Near the edge drill a hole to put the string through, and measure from the centre of the bob and along the string 39⅛in., at which length tie a knot, but leaving besides a few inches to spare. Into the top part of the lath drive a nail at such a height as to allow the bob to come in front of the scale when the string is made fast to the nail, exactly at the knot. Now fix the whole apparatus perpendicularly in the sunlight out of doors, place the camera in front, and focus the scale. Put in a rapid plate. It will be found that the pendulum will give sixty vibrations to the minute, and when its oscillations accurately cover the scale from end to end, let it swing once or twice until it at last goes quite parallel to the board, and then let fly the shutter. On developing this gives a photo of the scale, and somewhere on it there will be the image of the bob, but instead of being circular it will be elongated, owing to its having travelled during exposure, and the measure of this elongation will give the fraction of the second during which the plate was exposed. Thus, supposing that the excess of length over breadth covers, say, two divisions of the scale, then the shutter was open two-tenths of a second, for it is known the pendulum travelled the length of the scale in a second. Another easy method is by the use of a bicycle. When one has obtained the cycle, which is preferably of the safety tribe, turn it over so that it will rest on the saddle and handle-bar. Next wrap a piece of white rag round a portion of the wheel—say, one inch. Now carefully focus the machine, and after setting the wheel spinning at the rate of one revolution per second take a snap shot at it. Of course, the machine must be placed in a good light. On development of the plate a black mark corresponding with the white ray will be found over a portion of the wheel. The angle of this from the centre of the wheel should be carefully measured and divided into 360, the number of degrees in a circle, and the result will be the part of a second at which the shutter works. For instance, if the ray describes an arc of sixty degrees, then the shutter is working at one-sixth of a second. Another way is to use the metronome, set to one beat per second. In this case the arc described by the metronome should first be photographed, giving, say, two seconds exposure; another plate should then be inserted and the shutter released. It will then be very easy, by dividing the number of degrees described by the metronome by the number described on the second plate; thus, the number of degrees described by metronome is supposed to be one hundred and twenty and the number described on the second plate ten, then the shutter was working at one-twelfth of a second. Still another, but rather more complicated, method is to obtain two discs of ebonite; in one of these, at regular intervals, bore a hundred holes, and in the other one hole. The two discs are arranged so that the one with the one hole will revolve in exactly one second. The arrangement is then mounted at the end of a box, so that no light will find access to the lens except through the holes. Now, take a snap shot at the discs, and the speed of the shutter will be determined by the number of holes showing on the developed plate. Thus, if one hole is showing, the shutter was working at one-hundredth part of a second, and so on.

245. Snow Scenes—How to Expose for.—After the photographer has been working during the bright days of summer, and has probably put away his camera for a month or two, he naturally goes for it when the snow comes down, but the exposure—well, "that's what puzzles the Quaker." He knows that the light in winter, perhaps he has made a few experiments, is very dead, and that four or five times the exposure of his summer pictures is the rule, so he starts away and gets poor results. The rough and ready rule for photographing snow scenes is to give them the same exposure as would be given to the same view in summer. Really, what one has to do to get the finest effect is to photograph the snow, and leave the uncovered patches to take care of themselves. Snow, being white, reflects a great deal of light, and, therefore, the exposure must be very short.

246. Solariscopic Enlargement—Exposure for.—It seems impossible to give anything like a *reliable* estimate of the time of exposure, as there are such varied ideas as to the density of negatives, and the definition of brightness of light, to say nothing of how much the actinic power of the light varies between that of large towns and the open country. The only *sure* method of ascertaining the correct exposure (daylight enlarging) is to expose a small trial piece of paper, and develop it, and expose the whole sheet directly afterwards, making such alterations as the trial paper shows necessary. As the result of several experiments, however, in which by means of placing a whole-plate negative in a dark slide with Ilford rapid paper, and a piece of glass over to keep it in contact, placing in a camera with the *same lens* used in making an enlargement of four diameters, and the camera racked out to the same distance and exposing to daylight, a *contact* print was obtained by means of the light passing through the *same* lens at the *same* distance as required to make the enlargement, the proportion of time between that required to make *contact* print by light received through the lens, and that necessary to make enlargements from same negative, was fairly fixed as sixty to one for four diameters.

247. Studio—To Determine Exposure in.—The simplest way of obtaining the exposure necessary is to expose three or four plates on a subject, with varying exposures, noting the intensity of the light by an actinometer. One of the negatives will no doubt be right, and form a guide for a similar experiment on another occasion, say later in the day. Three or four experiments, carefully noticing the actinometer, will suffice to form a table guiding the studio exposures, and by practice proficiency will be attained as it were by instinct. It will probably be found that, with a good plate and an Optimus portrait lens, the exposure on a bright day in summer would vary from two to fifteen seconds, according to the amount of light used and the colour of object (and size) to be taken. With regard to lighting, it is difficult to give more than a few generalities, as the face of each individual sitter requires more or less special treatment to produce the most agreeable result. As a general principle, a high side light, a little in advance of the sitter, is the most important direct light; excess of vertical light is, in most cases, to be avoided. In a studio with four blinds the two central divisions should be of ground glass, or covered with tissue paper or fine muslin. This has a softening effect in lighting. Supposing the sitter has been posed at three-quarter face, about three or four feet from the background; blinds Nos. 1 and 4 should be pulled half-way up, while Nos. 2 and 3 should be pulled right up. Too deep shadows on the shadowed side should be corrected by means of a reflecting screen (preferably grey). In this way good lighting can generally be obtained. Modifications of this arrangement may be made as required by the physiognomy of the sitter, the amount of light, etc. Good practice in lighting can be obtained by experimenting with the different methods on a plaster bust (the nearer life-size the better). All deep shadows should be avoided, and as much roundness and gradation as possible aimed at.

248. Sunshine Recorder—To Make.—The cheapest sunshine recorder is made by removing the minute hand of a clock and fastening a disc of thin black card to the hour hand, with a slot outside the end of the hour hand; under this is placed a sheet of sensitive paper, and, as the disc revolves, the sensitised paper is darkened when the sun shines, and the time can be read from the clock face. To prevent darkening by diffused light, the slot is covered with a semi-transparent material. To allow for the weaker sunlight early in the morning and late in the evening, the semi-transparent material consists of a graduated screen fixed outside the revolving disc, and so arranged that the part in use at noon is more opaque, and the part in use early or late in the day more transparent. This machine wants setting twice a day. A more complicated and expensive machine is fixed on a heliostat, so as constantly to face the sun, and a spool of sensitive paper passes behind the aperture. The same or a similar device of a graduated screen is required to allow for the variation in sunlight intensity. The Jordan Sun Recorder consists of a hollow metal cylinder mounted upon a stand so that its axis is at right angles to the plane of the sun's motion, and having movable ends for the insertion and removal of the recording diagrams. On the inner circumference of this hollow cylinder is affixed the diagram or chart, printed on a sensitised paper. In the side of the cylinder are three small apertures so arranged that they admit the sun's rays into the interior at successive hours of the day, each aperture acting during a certain time only, so that no two are in operation at one and the same time. The aperture facing E admits rays before eight in the morning, and the W aperture admits the rays after four p.m. The third and central, which faces S, admits the rays which occur between eight a.m. and four p.m. As the earth rotates, the rays of the sun entering the aperture travel over the inner wall of the cylinder and record their presence and intensity of action by acting on the sensitised surface of the chart. If necessary a more sensitive paper might be used—perhaps a slow bromide paper. It is true no visible image would be made, but the development would take but a short time.

249. Welsbach Lamp—Exposure with.—The following shows the relative intensity of the Welsbach light:

Coal gas from ordinary fishtail burner ...	6-10
,, ,, ,, Argand burner ...	... 16-17
,, ,, ,, Welsbach burner ...	... 25
Normal wax or paraffin candle ...	... 1

For enlarging, etc., a light of greater intensity is obtained by using it behind a common lens of about 3in. or 4in. in diameter, so as to produce a disc of light to cover the plate. The following excerpts from a notebook will help in estimating exposure. The exposures were on Ilford ordinary plates, and a large stop was used to shorten exposure. (1.) Copying by gaslight; Bray burner, light just behind lens, f/5·6, reduction one half, 10m. (2.) Copying by gaslight enlarged to two diameters, f/8; 15m. (3.) Copying by Welsbach, to two diameters,

f/8; 8m. (4.) Copying by Welsbach, reduction one half, f/5·6, 2½m. It may be added that if the Welsbach light is not turned on too full it appears to give a more actinic light. There is, however, a new pattern Welsbach lamp, some experiments with which gave the following results: Ordinary London gas, at one inch pressure, burnt in a No. 6 Bray burner, consuming 7·5 cubic feet of gas per hour, gave fourteen candle power. Old pattern Welsbach lamp, burning same gas at same pressure, and consuming three cubic feet of gas per hour, gave a twenty-five candle-power light. New pattern Welsbach lamp, burning same gas at same pressure and consuming three cubic feet of gas per hour, gave a sixty candle-power light. The old pattern of Welsbach lamp could be used for about eight hundred hours, after which time the light decreased, and a new mantle was required, but the new mantle, as now used, is good for from two thousand to three thousand hours, though in this case, after about two thousand hours, its light decreases from sixty gradually to about forty candle-power, before a new mantle is required. If a very intense light is required, it can be obtained by increasing the pressure of the gas; thus, at a pressure of three to 3·6 atmospheres, a light of about two hundred and fifty candle-power can be obtained at an expense of 9·5 cubic feet of gas per hour at the meter, but, of course, at the expense of part of the life of the mantle, that is to say, that used in this way, a new mantle will be required after about fifty hours' use. The mantles cost 10s. 6d. each. As the above results are those obtained by experts, perhaps an ordinary user might not get such a high candle power, but with careful use and attention there should not be much difference.

CHAPTER VI.

FIXING.

250. Bromide Prints—To Ensure Perfect Fixing of.—The simplest plan would be to test one of the prints by taking it out of the fixer, and exposing it to non-actinic light, but in all probability the prints will be properly fixed if immersed for twenty minutes in hyposulphite of sodium 4 ounces and water 20 ounces. An experimenter finds that twenty-four prints may be fixed with safety in hypo 3 ounces, water 15 ounces. Another point is that bromide prints when fully fixed have a somewhat translucent appearance when examined by transmitted light. If not thoroughly fixed, patches somewhat darker than the surrounding parts may be seen. If, after remaining in the hypo bath for the time recommended by the manufacturers, the prints, examined as above, should not appear to be fixed, the bath should be tested for acidity, and if acid a few drops of ammonia should be added. It is better not to overtax the fixing powers of the bath, and avoid running the risk of having spoilt prints.

251. Cyanide of Potassium—To Use in the Fixing Bath.—In the earlier days of photography this agent was much used for the fixing bath, although it has, at the present time, been almost entirely superseded by hyposulphite of sodium. It is unadapted for chloride of silver papers, and on account of its more violent action, and especially its exceedingly poisonous nature, is not to be preferred to hypo, which is also cheaper. For fixing collodion positives such as ambrotypes, ferrotypes, etc., a solution of cyanide of potassium may, however, be employed of the following proportions:

Cyanide of potassium	½ ounce.
Water	1 pint.

It is also used for removing stains of nitrate of silver from the hands, but should be employed with great care on account of its poisonous nature, and not at all if the skin be broken.

252. Discolouration in the Fixing Bath—To Avoid.—Thiocarbamid has been strongly recommended by Hauff for use in the fixing bath to prevent discolouration of the plates or papers used. Dr. J. M. Eder reports as follows: "Thiocarbamid possesses the property (when added to the fixing bath) of preventing bromide of silver gelatine plates, as well as chloride of silver gelatine plates and bromide of silver papers, from colouring the gelatine layer yellow, and prevents the formation of so-called green fog. The preparation consists of white crystals, and gives in water a colourless liquid. It is found that it acts (in acid solution) as a preventive against yellowish negatives. For fixing the following formula is very useful:

Water	1,000 parts.
Hyposulphite of soda	200 ,,
Thiocarbamid	10-15 ,,

To this solution is added fifty parts of bisulphite of soda. The plates, however, as well as papers, before fixing, must be washed sufficiently to remove all traces of the developer. As the action of thiocarbamid in the fixing bath is only of proportionately short duration, it is recommended to use the ordinary acid fixing bath, which, as is known, will, to a certain extent, itself prevent the formation of green fog; and after the use of this, if necessary, the above discolouring bath can be applied."

The above recommendation seems to point to a preferable method of working, which is to keep thiocarbamid in a ten per cent. solution—to fix in the ordinary *acid* fixing bath, and afterwards, *if necessary*, to add one part to ten of the bath, and pass the negatives into this for a second time.

253. Films—How to Treat in Fixing.—A film dried in an imperfectly washed state in no way prevents the thorough elimination of the hypo afterwards, and one so treated will be as permanent as one treated in the ordinary manner, provided an unreasonable length of time does not elapse between first and final wash.

The best way to eliminate hypo from the film after drying is by washing well and then treating with the alum solution. This may be repeated a few times to ensure total elimination. After all, wash well. If this be done the drying will then have no effect on the plate. It is best, however, not to treat negatives developed with hydroquinone and caustic soda in the above-mentioned manner, as it is found (without an exception) that if the hypo and caustic is allowed to remain in the film for, say, two days, that on being put into the washing tank they come clean off the glass.

254. Fixing Bath, Acid—To Make.—The following fixing bath has been employed for some time, and has been found very satisfactory. Hypo 4 ounces, bisulphite of soda 1 ounce, water 1 pint. It has the following advantages: (1.) *Permanence.*—Lantern slides and negatives fixed in it more than twelve months ago are at present unchanged. (2.) *Clearness.*—The shadows or high lights in lantern slides are beautifully clear, so much so that the use of the clearing bath is discontinued as unnecessary. For lantern slides it is unequalled. On leaving the slide or negative in this bath for some time after fixing is complete a slight reducing action takes place, which will clear up fog, etc. (3.) *Freedom from staining power*—This bath certainly *does not stain* the film and will remove to some extent the yellow stain due to pyro, etc. The fixing takes place very quickly; perhaps

nearly twice as fast as with plain hypo. The bath remains quite clear and colourless for a long time, and does not become discoloured and muddy, as with plain hypo. It may be used repeatedly for negatives, until it ceases to fix in a reasonable time; but it should be fresh each time for lantern slides. Eder's formula is hypo 1 : 5, one quart; tartaric acid 1 : 2, six drams; sulphite of soda 1 : 4, 2½ ounces. Mix the two last, and then add them to the hyposulphite of soda. Another formula is to a strong solution of sodium sulphite add enough sulphuric acid to cause evolution of sulphurous acid, and not much more; pour this solution into five or six times its bulk of ordinary hypo fixing solution, and it is ready for use. This bath in use is found satisfactory. Some experiments have been made to test the other acids—tartaric and acetic—commonly used as clearers after iron development, by substituting each of them in turn for the sulphuric acid in the above formula, and developing a plate slightly after cutting it into four strips, three of which were soaked in strong alum and sulphuric acid, and fixed in the baths prepared with the three different acids. The fourth strip was washed thoroughly, and fixed in pure hypo. They all turned out satisfactorily clear, the pure hypo and the hypo and sulphuric being best, and the acetic, perhaps, not quite so colourless as the tartaric. Bromide prints may safely be put into this fixing bath straight from the clearer, and there would probably be no harm in omitting the clearing bath altogether, and putting the prints from the iron developer into the acid fixing bath. If it is wanted to keep the solution for another time it must be bottled and corked down. There appears, however, to be some danger of the formation of sulphur in the gelatine film. This is caused most likely by the bisulphite of soda, which contains a considerable amount of free acid. The following is recommended by Mr. Cramer (New York): After dissolving four ounces of sulphite of soda in one quart of water, add half an ounce of sulphuric acid and three ounces of powdered chrome alum. After these are dissolved, pour the solutions in one in which two pounds of hypo has been dissolved in three quarts of water. This bath has the following advantages; It remains clear after frequent use, it does not discolour the negatives, and forms no precipitate upon them. It also hardens the gelatine to such a degree that the negatives can be washed in warm water, provided they have been left in the bath a sufficient time. The plate should be allowed to remain in the bath five to ten minutes after the bromide of silver appears to have been dissolved. The permanency of the negative and freedom from stain, as well as the hardening of the film, depend upon this. As long as the fixing bath has an acid reaction it is active, but, at the same time, it must be remembered that the more saturated a solution of hypo gets, the slower and less effectually it performs its work; therefore it is always advisable not to use the fixing bath too long. The acid fixing bath can be used for bromide paper.

255. Fixing Bath, Efficient Working of—To Ensure.—The difficulties in the way of working the fixing bath and consequent fading of prints are to a great extent explained by the action of hyposulphite of soda on silver salts. When silver nitrate and hyposulphite of soda are mixed in equivalent proportions, about twenty-one grains of the former to sixteen grains of the latter, a precipitate of hyposulphite of silver is formed, which is white and insoluble in water, but which gradually changes to yellow, brown, and black, as it alters to silver sulphide. In presence, however, of excess of hyposulphite of soda a double salt is formed which is very soluble in water, and may therefore be completely washed out of the print and is sweet to the taste. Now the conditions of permanency are (1st) that this double salt should be completely formed, and (2nd) that it should be completely washed out. If, through weakness of the bath or insufficient fixing, any of the insoluble hyposulphite of silver is left in the paper, which may be shown by the white parts of the print appearing spotted when held up to the light, those portions will undergo changes resulting in brown and discoloured patches. The following precautions therefore should be observed: (1st) The free nitrate of silver should be completely washed out of the paper before fixing. (2nd) The fixing bath should be fresh and of sufficient strength. (3rd) The prints should be left in a sufficient time, *at least till* all patches dark by transmitted light have disappeared. In order to ensure complete action, it is desirable that after the prints are apparently fixed in the original bath, they should be removed for a few minutes to a perfectly fresh and new bath so as to ensure complete fixation. Albumenised paper also requires a longer time than plain paper.

256. Fixing Bath—To Use for Plating.—It is not necessary to use a battery at all for plating with old fixing baths. Put the metallic article, presumably quite clean, in the old bath, let it remain therein for, say, three hours, remove, wash, and polish with chamois and rouge. If, however, a battery is at hand attach a piece of sheet copper to one of the wires of the battery, slightly acidulate the hypo, and immerse both wires in it. The silver will be precipitated on the copper, the copper being eaten away by degrees. The same method is used for plating metal articles. The metal is well cleaned first, and, of course, the action is only allowed to continue a short time, as the deposition of silver is rapid. Baths which have been used for fixing negatives do not give satisfactory colour of deposit, but the hypo used for fixing prints answers well.

257. Hypo Bath—To Keep.—Fresh made solution is recommended because it does its work quicker, and in the case of silver prints it is necessary, because old solution is practically the same thing as the old sulphur toning bath, and it gives the prints a tone which is not very permanent, and which leads to the destruction of the print. If the baths are made slightly alkaline with ammonia, that is, add ammonia till they smell slightly, they will do for fixing negatives until exhausted, and they will have no effect on them. The only drawback is that when the baths get older they take longer to do the work. The ammonia prevents the hypo or silver hyposulphite from decomposing, which they do if slightly acid or even neutral. So long, however, as the negatives are left *long enough* in the fixing bath they will be as properly fixed in an old bath as in a new one. After a considerable time, old hypo baths liberate sulphuretted hydrogen, and throw down a precipitate of silver sulphide. When this occurs, they become quite useless, as they have not only lost their power of fixing the negative, but the sulphuretted hydrogen they now contain will fog a dry plate very badly by blackening the unaltered silver bromide it contains. There are two points to note: (1.) New-made hypo bath fixes quicker. (2.) New-made hypo bath does not stain. As regards discoloured hypo baths, so long as they are alkaline and work well they have no prejudicial effect upon the negatives beyond a slight staining, which is easily cleared. A good plan of working is to use two fixing baths, leaving the negative in No. 1 until all opalescence has gone, and then five minutes in No. 2. When No. 1 won't work *well* throw it into the residue tub, and No. 2 becomes

No. 1, while a new No. 2 is mixed. The secret of hypo baths is filter, keep alkaline, and in the dark, and always return to the bottle and cork up when not in use. Moreover, never put alum into a fixing bath.

258. Hypo—Best Method of Keeping.—This is a deliquescent substance, and therefore difficult to keep unless well protected from the atmosphere. It has been kept two years almost unchanged in a stone jar, opened as seldom as possible, keeping it from the action of the air by a rim of paraffin just under the edge of lid. It was found best to dissolve a couple of pounds at once, which filled eight wine bottles; these, well corked, underwent no appreciable change for certainly six months. Another good way is to keep it in solution, when it may be preserved for a very long time as under : Procure a wide-mouthed bottle fitted with a good cork. Bore two holes through the cork to admit two glass tubes. The first of these tubes should reach to within an inch of the bottom of the bottle, and the portion outside the bottle, bent into the form of a syphon; the other tube should reach just through the cork, leaving a few inches on the other side. Having prepared a solution of hypo, nearly fill the bottle with it, and dip the long tube under the surface; then pour on one or two ounces of the best almond oil, fix the cork in, and it is ready for use. When required to use it, any quantity may be forced through the long tube by simply blowing in the shorter one. The oil effectually protects the solution from the action of the atmosphere. The end of the long tube may be closed by slipping on an empty chloride of gold tube, which just fits a size of glass tube in common use. It is also recommended to make up the salt in one pound packages in white paper with thick brown paper outside. The solution deteriorates in a very short time, particularly if concentrated. It is said that a lump of camphor placed in the bottle will preserve it.

259. Hypo Dish, Deposit in—To Prevent.—This is some of the oxidised developer remaining on the plate owing to imperfect washing. A moment's thought will show that the longer the plate remains in the developer the more of the oxidised developer will it absorb, and that consequently a *slow* developer like hydroquinone will necessitate giving the plate a more thorough washing after development than if pyro had been used. The thick brown deposit in question has been frequently noticed both with hydroquinone and pyrogallol development. It must be attributed to the oxidation products of the hydroquinone, which are of a very dark colour, thus explaining the staining of the negative when sulphite of soda is not used, not being thoroughly washed off before fixing. The plate may seem in the light of the dark room to be quite clear, but if the last washings are preserved and examined by white light it is astonishing how dark coloured they will be. A *rinse* in water is quite insufficient.

260. Hypo Elimination—The Best Method of.—Unless used carefully, hypo-eliminator may prove hurtful to prints in many ways. *Firstly.*—By depending on the eliminator used, and neglecting washing, the operator will produce prints certainly not permanent. *Secondly.*—If the eliminator be used in too strong a solution, the prints will have a bleached appearance, and lose tone. *Thirdly.*—The eliminators frequently suffer decomposition by keeping in stock, and so vary very much in their chemical qualities. Of course, such solutions as peroxide of hydrogen, chloride of zinc, etc., are referred to. There is no doubt that the best eliminator of hypo is cold water, and plenty of it. Such agents have doubtless a tendency to attack the print if the action is unnecessarily prolonged, but not otherwise. Their action is to oxidise the hyposulphite into harmless compounds. Undoubtedly slight differences result with different agents, but the following might be used with impunity: Make a strong solution of potassium iodide in water, and add as much iodine as will make it turn black. To use, add a drop or two to a bulk of water, sufficient to turn it a pale sherry colour. After the prints are washed, place in the iodine solution. If the prints take a uniform and persistent blue colour on their backs all is well, otherwise they must be put into a similar bath as soon as the colour of the first has been discharged. The blue colour shows excess of iodine and therefore absence of hypo. To get rid of the blue colour a few drops of sodium sulphite solution may be added to the water, and the prints are then rinsed and dried.

261. Hypo-eliminator—To Make.—For negatives the following is a good bath:

Peroxide of hydrogen (10 vols.) ... 2 drams.
Water ... ... 6 ounces.

After well washing the negative, immerse for a few minutes in the hydroxyl solution, and again wash in water. For prints the solution must be very much weaker.

Peroxide of hydrogen (10 vols.) ... 2 drams.
Water ... ... 20 ounces.

The prints should be washed in four or five changes of water, and then left in the solution of peroxide of hydrogen for five minutes, and washed once more with water. The action of peroxide of hydrogen depends upon the fact that it is a very unstable substance, readily decomposing into water and oxygen, thus—

$$H_2O_2 = H_2O \text{ and } O$$

Hydrogen peroxide. Water. Oxygen.

The oxygen, liberated, combines with hypo, forming hydrogen-sodium-sulphate, which (photographically) is a harmless salt.

$$Na_2S_2O_3 + 2O_2 + H_2O = 2\,NaHSO_4$$

Hypo sulphite of soda. Oxygen. Water. Sodium-hydrogen sulphate.

The objections to the use of hydrogen peroxide are: (*a*) Being such a powerful oxidiser it is very liable to attack and bleach the silver. (*b*) It will only keep for a comparatively short time. It is wiser to depend rather upon *thorough washing* than any of the so-called eliminators, as most authorities agree "that a hypo-eliminator can only be used with perfect safety after a sufficient amount of washing to remove all hypo; in other words, that *such applications* are *practically useless.*" Another recommendation for "hypo-eliminator" is *javelle water.* This is a liquid composed of one part of good dry chloride of lime, and fifteen parts rain water, well shaken, to which is added a solution of two parts carbonate of potash in five parts rain water. The mixture is allowed to settle, when the clear liquid is decanted ready for use. Serves to remove the last traces of hypo-soda. For this it is used very much diluted. *Labarraque's* solution is also employed for the same purpose. It is similarly prepared by substituting carbonate of soda for the carbonate of potash.

262. Hypo—To Dissolve Rapidly.—Procure a wide-mouthed bottle and insert a funnel, the neck (of funnel) being *loosely* packed with tow or cotton wool; place hypo in funnel, and pass warm water through till hypo is dissolved and the solution reaches a mark previously made on the bottle to indicate the quantity wanted, *e.g.*, four ounces to the pint.

263. Hypo—To Keep in Saturated Solution.—Procure a large stone pickle jar, fill it half way up with hypo, and then add hot or cold water until the jar is full. After a few days the solution will be found to be saturated and extremely strong; stronger, indeed, than if it had just been dissolved in boiling water. Keep on adding water as the solution is used until the hypo has all been dissolved, when the solution is no longer concentrated, and fresh hypo crystals should be added. It is preferable to use a jar rather than a bottle, for the wide mouth of the former admits the large crystals without giving the trouble of breaking them up, as would be necessary in the case where a bottle was used. Another way, though not so simple, is to cover the mouth of the jar losely with muslin, so that the latter is "baggy" in the centre, and suspend the hypo in the water with which the jar is filled. In this case a tap is necessary to draw off for use the saturated solution, which sinks on account of its weight to the bottom of the jar. When prints are to be fixed, two to three parts of water should be added, but this is not necessary in the case of plates. Another method is to take a large vessel—shape immaterial—in this place a large quantity of hypo crystals, and fill up with water. Give an occasional shake (if there is a stopper, or a stir up with a clean stick will do), and if all the crystals are dissolved add more until the water will dissolve no more, *and there are a quantity of crystals left at the bottom.* This is then a saturated solution at the ordinary temperature. The only real drawback to this method is that when the temperature falls, a quantity of hypo crystallises out, but if the solution be kept in a room at an even temperature it will be of a fairly constant strength, namely, five ounces will contain two ounces of hypo, *i.e.*, a forty-nine per cent. solution. For negatives, use half of this to half of water, and for prints, one of this saturated solution to two or more of water. To preserve the saturated solution, always keep it distinctly alkaline with ammonia, *i.e.*, to smell distinctly, and in that state it seems to keep indefinitely. A good way is to put a good-sized lump of carbonate of ammonia in the vessel, and when this is dissolved—and it takes a long time—put another lump in. Fixing baths are readily made from a saturated solution of hypo of soda made in a wide-mouthed bottle, on the neck of which is kept a footless wine glass, to be used as a measure, and keep out dust. Saturation is maintained by always having undissolved crystals in the bottle. When fixing according to the usual formulæ, a glassful is the "one part," and "—parts" so many glassfuls of water. As regards the strength of "saturated solution," note that according to the table of solubility, hypo is soluble in one and a half times its weight of cold water. Therefore twenty ounces of water will dissolve 13⅓ ounces avoirdupois. But as at 60° F. 102 parts by weight of hypo dissolve in 100 parts by weight of water, practically hypo may be considered to dissolve in its own weight of water, and a pint of water will dissolve eighteen ounces eleven grains (apothecaries' weight) of *hypo.* A solution of one pound of hypo in sixty-four ounces of water = one ounce in four ounces will be found much easier to prepare, and sufficiently strong for all purposes.

264. Hypo—To Postpone Washing out.—If an acid developer as ferrous oxalate be used, and it is wished to postpone thorough washing after fixing, it will be necessary to immerse for a few minutes in weak ammonia to neutralise any residual acidity, which would on drying (in this case drying means concentrating) cause with the hypo a deposit of sulphur, and the negative is doomed; by using an alkaline developer, this, of course, is avoided. Now as to how long they can be kept this may best be answered by an experiment. Two half-plates were fixed, one was put into ten ounces of water, *face* down, slung on two strings, and left thus for twenty minutes, then drained and dried. The other was washed for four hours under a "rose"; particulars were scratched on the back of each with a diamond. When both were quite dry they were wrapped up separately. The notes are as follows: First month, no difference; second, a slight fading appeared; third, "doubtful"; and fourth, the "short timer" was cut in two and one half was placed in a damp cellar; *in a week it had faded very much,* whilst the other half remained unaltered, and it required nine months to make it fade perceptibly. Of course, the conclusion was that if the plates were kept dry a fair amount of hypo could be left in them for certainly three months; but if damp was allowed to get at them a week would *commence* their ruin. If the plates are soaked after a brief washing in "spirits" (methylated or otherwise), it allows quicker drying, and also takes most of the hypo-charged water away with it, and the final washing can be postponed still further.

265. Hypo—To Detect Traces of.—It is useful to have some means of determining whether the negatives and prints have been washed thoroughly. The following tests will indicate whether any hypo still remains in them.

The Permanganate Test.—Dissolve two grains of potassium permanganate and twenty grains of potassium carbonate in one quart of distilled water. This solution is of a fine pink colour. Take the water in which the negatives or prints have last been soaking for ten minutes or more, and pour it into a clean glass bottle, which will hold, say, one pint. To this clear water add five or ten drops of the pink (permanganate) solution. If the water be pure it will assume a pale pink tinge, but if any hypo be present the colour will change to a light shade of green. The bottle should be shaken well, and allowed to stand for ten minutes.

The Starch Iodide Test.—Powder and boil a piece of starch the size of a pea in a quarter of an ounce of water until a clear solution is attained. Add to this one drop of tincture of iodine (iodine dissolved in alcohol), which will produce a dark-blue colour. Fill one test tube with distilled water, and another with the water to be tested for the presence of hypo. Add to each test tube one drop of the blue solution. If any hypo be present the blue colour will disappear. The tubes should be shaken well, gently warmed, and examined side by side in front of a piece of white paper.

Hypo in Prints.—The paper used for printing photographs upon is all but invariably sized with starch. Make an extremely weak solution of potassium iodide, and apply it with a brush to the back of the print to be tested. A blue colour will indicate the *absence* of hypo.

An Electrical Test for Hypo.—In 1866 Dr. Reissig, of Darmstadt, used a test which showed that the "amount of sulphur was very large," in several faded prints examined by means of it. The prints were soaked in water, and two strips of polished silver, connected by wires with a single galvanic cell, were then dipped into the solution. The presence of sulphur was indicated by a black stain upon one of the silver plates. Reissig patented this process in England (March 10, 1865).

Rough Test for Hypo.—If the amount of hypo remaining in a print or in a negative be at all large it may be detected by allowing the last few drops, which will fall from either when drained, to drop into the mouth. Mention has often been made of the intense *sweetness* of the double salt of soda and silver which the hypo forms, and which it is the

great object to remove from negatives and prints. The absence of any sweet taste would, however, only indicate that the *greater part* of the dangerous salt had certainly been removed.

Nitrate of Silver Test.—Dr. Bannon finds that silver nitrate is a delicate test for discovering traces of hypo in prints or films. The water from the prints, etc., should be allowed to drain into a test-tube and heated, and then a few drops of silver nitrate solution added to it. A black precipitate will be formed if one one-ten-thousandth part of hypo be present; while a still smaller amount will give a yellow precipitate.

266. Hypo—To Test for.—Hypo, according to modern chemical nomenclature, is sodium thio-sulphate, and has the formula $Na_2S_2O_3$. Several tests are given below of which the last (d) seems the most satisfactory. In presence of $Na_2S_2O_3$—(a.) Hydrochloric acid on heating gives a precipitate of sulphur. (b.) Lead acetate gives a white precipitate which turns black on boiling. (c) Silver nitrate gives a white precipitate which rapidly turns black. (d.) Ferric chloride produces a reddish violet colouration, which disappears on heating. Other tests are (especially for traces): In the solution to be tested place a piece of pure zinc, and add dilute hydrochloric or sulphuric acid, warm and test with lead paper, which, if hypo be present, will blacken in five minutes. Lead paper is made by dipping strips of blotting paper into solution of sugar of lead (plumbic acetate). Another test is given by Capt. Abney, in which the English measures are substituted. Take a small piece of starch, the size of a pea, powder, and boil in one hundred and seventy minims of water till a clear solution is obtained, add eighty-five minims of a saturated solution of iodine in alcohol. A dark blue colour is the result. Drop two drops of this into two clean test tubes, fill one up with distilled water, and the other with the washing water. The first will be perceptibly blue, while the second, if hypo be present, will be bleached white. The comparison of the two solutions is rendered easier by placing a sheet of white paper behind them. The bleaching is due to sodium iodide and sodium tetra-thionate being formed.

267. Permanganate—To Use as Test for Hypo.—The following is the manner of testing for hypo with the permanganate test, which is described by Hardwick as a most delicate one :

Permanganate of potash	... ...	4 grains.
Carbonate potassium	... ...	20 ,,
Pure water	... ...	30 ounces.

This should be kept bottled in a dark place. To test the water for hypo take four or five ounces of the permanganate solution in a measure, and, taking some of the washing water (preferably from the bottom of tank) to be tested in another measure, add two or three drams to the test solution. If free from hypo it will retain its beautiful pink, but should there be the slightest trace of hypo it will turn brown.

268. Plates—A Quick Method of Drying.—To dry plates when wanted in a hurry, after fixing and washing, take a good-sized dipping bath of glass or porcelain, furnished with a dipper of the same material. Lower the plates into the alcohol, where they should remain for about two minutes. They are then taken out and stood up on one corner, that corner resting on blotting paper. If the spirit is strong they are dry in two minutes after lifting them out of the bath. The one thing needful is to see that the plate is thoroughly washed. After washing the plate should be drained to free it from as much moisture as possible, and the back of the glass should be thoroughly wiped in order to keep back the deterioration of the alcohol as much as possible. The methylated spirit sold by the wholesale chemist is good enough for most photographic operations. The methylated spirit sold by oilmen contains too many impurities to render it fit for photographic use.

269. Prints—To Free from Hypo.—After experiments with a very delicate test, which showed trace of hypo in most bought prints, it has been found that squeezing them between boards as hard as possible in a copying press four times left hardly a trace of hypo. The prints will come out of the press dry, and like a mass of *papier maché*, but will separate in water. Between each squeezing they should be separated and allowed to take up as much water as they will. The whole operation is done in an hour. The greater the number of prints squeezed at once the better.

270. Residues—To Recover from Old Hypo Baths.—To obtain the silver from the old fixing baths is very easy. Proceed as follows: Make a strong solution of potassium sulphide, otherwise known as liver of sulphur. It is an evil-smelling substance, and should be used in the open air. Now add a little of this solution to the old fixing bath, and if there is any silver present it will be precipitated in the form of a dense brown flocculent cloud, which should be well stirred round and allowed to settle down. Further additions of the solution of sulphide of potassium must be made until no more precipitate is thrown down. The brown deposit, which is sulphide of silver, must be allowed to settle down, and the supernatant solution carefully poured off. The resulting sulphide of silver had best be sent to the refiners, who will allow for it in cash. Liver of sulphur is made by fusing together one part of sulphur and four parts of carbonate of potash. When cold, break up the mass and keep in tightly corked bottle.

271. Sulphur—To Prevent Deposit of in Fixing.—The cause of the sulphur deposit is no doubt acid in the fixing bath. Either the bath has become acid or the negatives, after development, are soaked in alum and not thoroughly washed before fixing. If alum is used at all before fixing—and very few plates nowadays require it—it must be thoroughly washed out. It is a great mistake to mix alum with the fixing bath. After fixing it is desirable to use alum and citric acid, which both harden gelatine and remove stain.

CHAPTER VII.

LANTERN SLIDES.

272. Aphengescope—To Make for Lantern.—This is quite a simple instrument to make, and need not cost more than sixpence and some trouble. It consists of a five-sided box, with top and bottom, as seen in figs. 2, 3, and 5. In two of the sides are circular holes, and one side is left open about two-thirds of its length, which opening is closed by a door or shutter, revolving on pins top and bottom to carry the object to be viewed.

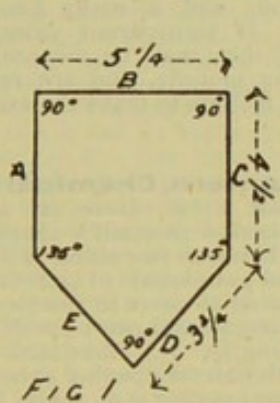


FIG 1

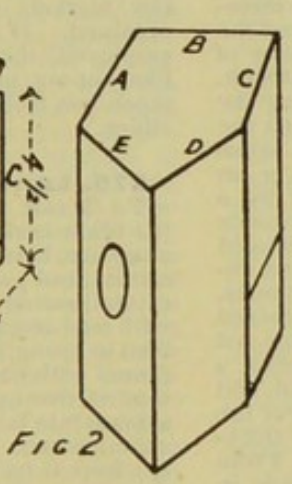


FIG 2

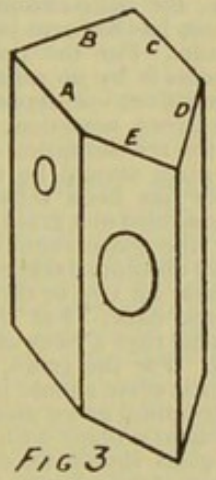
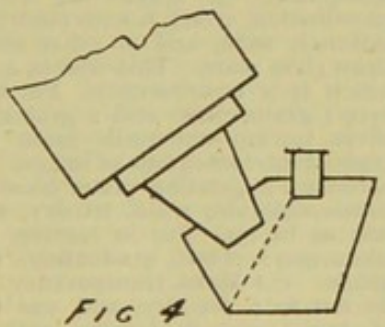


FIG 3


FIG 4

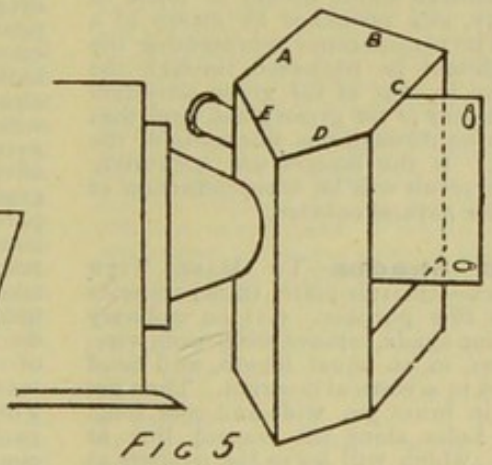


FIG 5

To construct the instrument, get some thin wood—cigar box does well if of sufficient size, and cut two pieces for top and bottom, as fig. 1.

The sides A and C are 4½in. long
B is 5¼in. ,,
D and E each 3¾in. ,,
} Or multiples of these.

The angles where B joins A and C are 90°
,, ,, E ,, A to be 135°
,, ,, D ,, C ,, 135°
,, ,, E and D join ,, 90°

So far for top and bottom. Now for sides, take strips 8in. long, and a little less in width than the edges of top and bottom that correspond, so that when put together, the outside of the box is just flush with top and bottom. The points can be glued together, and fastened with small pins or French nails. The side C is not to be covered in all the way up, but for about 2in. from the bottom, this depending on the height that the nozzle of the lantern comes up this side when placed against it, for the centre of this must also be the centre of the opening. Fig. 2 explains this, and shows the hole cut in the side E to take the nozzle. At the same height on side A a hole must be cut to take the nails of the lens (or its screw flange). By the same height is meant the centres of these holes must be at the same height, and also each hole must be in the middle of the breadth of the side. The nozzle must be inserted as far as it will go without cutting

off any of the picture from the lens (see fig. 4). Now the shutter to hold the object is to be just the same size as the opening left in the side C, and is to be of ¾in. board, and quite square at the edges. Now having measured the distance of the centres of the holes in E and A from the top of the box, the shutter for opening in C must be twice this length. On each side of the shutter fasten in each corner a small button. Mark the middle of the top and bottom of the shutter, and through the top of the aphengescope and the middle of side C bore small holes to take two pins, one of which is driven into bottom of shutter, which is then placed *in situ*, and the other pin is driven in through the hole in the top, fixing the shutter so that it may revolve around its median line, alternately exposing its sides. Fig. 5 shows how the lantern is adopted to the aphengescope, and, of course, the pictures, etc., must be held by the buttons upside down. By means of the revolving arrangement, while one picture is being shown another can be placed ready. The light, however, *must* be strong, or the disc will not be distinct if over two or three feet diameter. With a blow-through jet, however, a six foot disc is well illuminated.

273. Heliochromic Lantern Slides—To Produce.—Among the many attempts that have been made to secure the reproduction of objects in the colours of nature, the helio-chromic or three-colour sensation process has hitherto produced the most successful results. For the production of lantern slides the process is by no means difficult. We require three negatives—(*a*) representing the red sensation, (*b*) the green sensation, and (*c*) the blue sensation. For the red sensation a red sensitive orthochromatic plate should be used, or an ordinary plate which has been sensitised by a solution of cyanine, one-third of a grain in an ounce of absolute alcohol; the plate should be flowed over with this, dried in absolute darkness, then immersed in distilled water for two or three minutes, and again dried in the dark. For the coloured screen to cut off the blue rays a piece of orange-red glass should be used. For the green sensation a commercial isochromatic plate should be used, and two thicknesses of chromium green glass. For the blue sensation an ordinary plate with two thicknesses of cobalt blue glass should be used. From these negatives, lantern slides should be made in the ordinary way, and projected by means of a triple lantern. The transparency representing the red sensation should be projected through the glass used to take it, that of the green sensation through one thickness of the green glass, and that of the blue sensation through one thickness of the blue-violet glass. If the images are accurately superimposed the result will be a reproduction of the objects in their natural colours.

274. Lamp Shades—To Make with Lantern Slides.—Quarter-plate transparencies are the best for this purpose. Get an ordinary six-sided wire lamp shade, remove the bottom wire, cut the six wires to an equal length, and bend about four inches to a vertical position. Then get two strips of thin brass ⅝in. wide and 29in. long, and punch six holes along the central line at intervals of 4¾in., which will leave ½in. to spare at one end. Along one side of each strip, and at ⅛in. on each side of each hole, make cuts ⅜in. deep, between which just touch the brass with solder. Bend the strips lengthwise over the edge of a piece of wood ¼in. thick, so as to make a long trough. The strips can now be threaded on the wires, and when adjusted at the right distances can be fixed by a touch of the hot iron. The two ends of each strip will overlap, and can be fixed in the same way. The transparencies can now be placed in position from the inside, and should be backed, if on opal by plain glass, if on plain glass by opal or ground glass, or by plain glass coated with matt varnish (varnish side next the film). Both transparencies and glasses should be thoroughly dried by warming in front of a fire, otherwise the heat of the lamp might melt the gelatine. Another way to make a very effective lamp shade: Obtain a cardboard frame similar to the ordinary green shades, only hexagonal—*i.e.*, with six flat sides. At about three inches from the bottom and on the outside place a hexagonal ring made of thin whangee cane. It can easily be bent into the required shape by cutting nicks at the bends, and bending whilst steam is blown on to it from a kettle. Three inches above this place a similar ring made of the same material. The slides are now to be attached to these two rings at top and bottom, one for each flat face of the rings. This can either be done by cutting away the undersides—the parts next to the cardboard—to the width of the slide, and attaching the slides by small pins or wire, or slots the size of a lantern slide may be cut through the top ring, so that the plates may be dropped through them into recesses cut into the lower ring, and they may be further secured in any suitable way. It is then only necessary to cut away the cardboard under or behind the slide, and to paint the cane with one of the numerous metallic paints now on the market, and a really handsome shade is obtained. If transparent prints on paper be employed, they may be mounted on the shades like cut-out mounts, and are very effective, and much less trouble to make than the shade for glass slides.

275. Lantern, Chemical Experiments—To Make with.—Here are a few nice ones. (1.) Make tank with small V-shaped glass cell fixed at centre, between two sides. Fill tank with silver nitrate, and put globule of mercury in cell Result, crystallisation of silver in needles. (2.) Repeat (1) with lead acetate and zinc; result, crystallisation of lead in spangles. (3.) Make tank with small thistle funnel with narrow opening at bottom arranged so that narrow opening is at centre of tank. Put lead acetate into tank, and drop in potassium iodide or common salt. Result, yellow or white precipitate. (4.) Repeat (3) with mercuric chloride in tank, and drop in potassium iodide; result, yellow or scarlet precipitate. (5.) Make very feeble transparency on collodion, attach it with pitch to strip of rubber half-inch wide, and at other side of rubber fix clean glass plate. This makes a cell, one side of which is a transparency. Put into lantern with pyro 1 grain, citric acid 2 grains, water 1 ounce, silver nitrate one-tenth grain in tank; result, gradual intensification of image. (6.) Make transparency on gelatine plate, bleach out image with cupric chloride, wash, let dry, and make tank of this as in (5). Put in lantern with very dilute eikonogen; result, graduation, re-appearance of image. (7.) Make transparency on gelatine, but do not fix; let dry, and use this for one side of tank; put in lantern with hypo in tank; result, gradual clearing of image. Others are—Fill the tank about three-quarters full. First experiment: Add a little solution of sulphate of copper to the water in the tank, squirt some diluted ammonia into it bit by bit. This will seem like a gathering of dark storm clouds, which race round and round, but as the action stops all will become a beautiful sky-blue. Add some diluted sulphuric acid, and the experiment can be performed again. As soon as the tank is clear with excess of acid, add a few drops of a solution of yellow prussiate of potash from a pipette, and brilliant vermilion clouds of ferrocyanide of copper will appear. Second: Drop slowly into

water a strong solution of the acid perchloride of tin. The effect is that of an eruption of a submarine volcano. When a strong solution has thus been made, put in a strip of sheet zinc, and long blades of tin will shoot out. Third: Put some methylated alcohol in the tank and then drop down the side a little aniline colour, when a tree of the same colour as the dye will appear, shooting out into endless branches Fourth: Substitute fusel oil for the aniline colour, and paraffin for the alcohol. Fifth: Make a mixture of chloride of cobalt and gelatine, and coat a cover glass with it. Place this in front of a slide and it will give a pink effect, which will gradually change to purple and blue as it dries. Damp it again and it can be used again and again. Sixth (Dr. Eder's): Mercury oxalate photometer. The solutions are made as follow:

No. 1.

Crystallised oxalate of ammonium	4 grains.
Distilled water	100 c.c.

No. 2.

Mercuric chloride	5 grains.
Distilled water	100 c.c.

Two volumes of 1 are added to one volume of 2, and the clear solution poured into the tank and placed in the lantern. Soon the shining white crystalline mercurous salt separates out and forms a striking demonstration on the screen. Seventh: A hot solution of potassium dichromate, acidified with sulphuric acid and of a distinct orange colour, is poured into a tank and placed in the lantern. Alcohol is then dropped into the solution, which gradually becomes reduced and the colour changes to green, though this is *red* by transmitted light—showing that the alcohol has been oxidised to aldehyde, and the dichromate reduced to chromium sulphate. Eighth: Expose a lautern plate by contact with negative to magnesium light and develop as follows: Place two tanks in the lantern, the one nearest the condenser being filled with either ferrous oxalate developer or with an orange solution of a dichromate. The plate can then be easily developed with any developer in the second tank, as it is shielded by the orange fluid in the first tank. An amusing ending can be had by taking the slide—especially if a portrait—and after it is fixed and shown as a portrait, allow it to remain while wet next the condenser, when the gelatine melting will cause the portrait to undergo *peculiar* changes of expression. There are many more experiments on the same lines. Hot saturated solutions of different salts will crystallise on the introduction of a filament of cotton, and as the crystals form, if the lantern is provided with a polarising apparatus (a very *valuable* addition in more senses than one), the change and play of colours is most wonderful. Solutions of ferrous sulphate, cupric sulphate, barium chloride, potassium chlorate, and many others show well. Again, if the lantern is fitted with a prism and slit for spectrum work, the absorption bands of flasks of gases, such as nitric oxide, or of coloured glasses, or of solution such as dichloride or permanganate of potassium, afford instructive and beautiful demonstrations.

276.—Lantern Disc—To Calculate Size of.—The distance with a lens of given focus to get any required size of disc is very easily calculated by the following rule: Add one to the number of times the circle of the slide is required to be enlarged, and multiply by the focus of the lens. Thus, with a lens of 9in. focus, to get a 6ft. disc, since the slide circle may be taken as 3in., it would have to be enlarged twenty-four times to make 6ft. Twenty-four and one equal twenty-five, which, multiplied by nine, gives 225in., or 18ft. 9in.

If 3¼ × 3¼ slides are used the following formula expresses the relation:

$$D = \frac{f(4d + 1)}{12}$$

Where D = distance from lens to disc in feet.
f = focal length of lens in inches.
d = diameter of disc in feet.

In practice it becomes nearly—

$$D = \frac{4 \times d \times f}{12}$$

Thus, if the focus of the objective be 4in., and we require a disc 12ft. in diameter, we have as the distance of lens from screen—

$$D = \frac{4 \times 12 \times 4}{12} = 16$$

That is 16ft.

Equiv. focus of front lens.	Size of disc required.						Size of disc.
	10ft.	12ft.	14ft.	16ft.	18ft.	20ft.	
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	Distance from screen to lens.
4in.	13 8	16 4	19 0	21 8	24 4	27 0	
6in.	20 6	24 6	28 6	32 0	36 6	40 6	
8in.	27 4	32 8	38 0	43 4	48 8	54 0	
10in.	34 2	40 10	47 6	54 2	60 10	67 6	
12in.	41 0	49 0	57 0	65 0	73 0	81 0	

277. Lantern Plates — Albumen, To Make.—Sensitised albumen plates do not seem to be commercially obtainable. By following the directions here given anyone will be able to prepare the plates for himself. *Resumé* of process: A collodionised glass plate is coated with a solution of albumen containing ammonium iodide and bromide, dried, and sensitised in a bath of silver nitrate, dried, exposed, developed, fixed, and toned. Details: The glass plates to be used are cleaned in the usual way with some tripoli powder made into a thin cream with alcohol with addition of a little liquor ammonia, they are rinsed first with tap water and finally with distilled water, and are set aside to dry in a place as free as possible from dust, which is the *bête noire* of this process. In order to ensure the adherence of the collodion film to the glass, it is advisable to give the plate a substratum. A very suitable mixture for this purpose is made as follows: Prepare a solution of fifty grains of gelatine in half an ounce of acetic acid by warming the two together in a bottle until solution takes place. Prepare also a solution of ten grains of chrome alum in half ounce of water. To make the liquid producing the substratum, take two and a half parts gelatine solution, one part chrome alum solution, and seventy parts methylated spirits. Flow this mixture over each plate, and allow to dry. Another very excellent substratum is obtained by flowing the plate over with a solution of one grain of pure indiarubber dissolved in one ounce of rectified benzine. Having received its substratum, the plate is coated with a good and ripe bromo-iodised collodion. The success of the process lies mainly in the solution of a suitable collodion. Collodion giving a horny film must be avoided, as it is liable to cause blisters, whilst one producing a film upon which a name can be written with a pin without tearing the adjacent portions will probably be found all that can be desired. The plates are coated with the collodion, and well washed under the tap. They are then treated with an albumen mixture made as follows:

Albumen from fresh eggs 10 ounces, acetic acid 1½ drams; to prepare this the albumen must be well stirred with a rod and then allowed to stand twelve hours, when it is filtered through sponge or washed cotton wool; forty minims of strong ammonia (·880) are then added to it, together with sixty grains of ammonium iodide and ten grains ammonium bromide dissolved in six drams of water. This solution, if kept tightly corked, will remain fit for use for a couple of months. After rinsing, the plate is coated with this albumen mixture and allowed to drain, thus carrying away all superfluous water. The albumen mixture is then again applied, pouring off and on from each corner in succession; finally it is allowed to rest on the plate for a minute, after which it is returned to the bottle. The plate is then set up to dry, standing on five or six thicknesses of blotting paper. When thoroughly dry it is slowly, and without stoppage, dipped into a bath containing four hundred and eighty grains of silver nitrate, three ounces of acetic acid to eight ounces of water, and kept in it for not longer than a minute, and, after withdrawal, rinsed under the tap for a minute, and finally washed in distilled water. At this stage it is advisable to examine the film for any defects. Streaks may be removed by gentle application of a tuft of cotton wool soaked in water. The plate is now set up to dry, and care must be taken that it is not touched until thoroughly dry. The films of these plates being very translucent the resulting transparencies are liable to halation. This may be prevented, however, by applying a backing to the back of the plate, the most suitable preparation being a solution of asphaltum in benzine or chloroform, which may be applied with a brush. The exposure may be made to daylight (diffused) or magnesium. For daylight, exposures vary from ten to twenty-five seconds. For development, an acid pyro developer, as used in wet-plate development, is employed. Mr. Andrew Pringle recommends the following formula:

A.

Citric acid	10 grains.
Acetic acid	30 minims.
Water	10 ounces.

To which add

Pyro	30 grains.

B.

Citric acid	5 grains.
Silver nitrate	5 ,,
Distilled water	1 ounce.

Before development, it is advisable to give the plates an edging of rubber solution, and to warm them well afterwards. This may be done in safety by heating a large iron plate over a circular gas burner. It is highly advisable also to heat developer to about 120° Fahr., as development takes place more evenly, and there is very little tendency to the formation of blisters. First immerse the plate in hot distilled water; then pour into developing cup one ounce of A, and add two drops of B. Flood the plate in a dish with this, and watch the progress of development, adding B solution a drop at a time until sufficient density is obtained. A scum of precipitated silver is sure to form on the film during development. Remove it every now and then by gentle rubbing with a tuft of cotton wool. It is very easy to overdevelop. Remember also that toning increases the opacity of the deposit. After development, rinse the plate under the tap for half a minute. The best toning bath is the old sel d'or, which first fixes and then tones the slide. It is made as below:

Sodium hyposulphite	16 ounces.
Water	22 ,,
Chloride of gold	4 grains.

This bath should not commence to tone the plate under fifteen minutes. If it tones before this, dilute the bath. Too rapid toning produces an unsightly blue colour. After toning wash thoroughly for half an hour and allow to dry. Transparencies may also be toned in a strong acetate bath. In this case they should be first fixed and thoroughly washed. Slides that are too thin can be intensified by a further application of the acid-pyro and silver solutions used for development. Slides that are too dense are best reduced with Farmer's ferricyanide and hypo reducer. This reducer acts very strongly on untoned plates. On toned plates it acts much more powerfully on the high lights than on the shadows. Hence by this means a slightly degraded slide can be improved.

278. Lantern Plates—Best Methods of Making.—Good lantern slides may be made by any of the photographic processes capable of yielding pictures on glass. A process which may fail altogether in some hands will yield excellent results in others. It may seem therefore superfluous to give instructions, and it might suffice to say, "Use the process you know best how to work." Some of the best lantern slides were made by Ferrier of Paris. The process appears to be a secret, but it is believed to have been the old albumen process. Wet collodion will give pictures of the very highest quality, and if amateurs would take the trouble to acquire a knowledge of this process, they would probably give it the preference over all others for making lantern slides. Carbon tissue prepared specially for transparencies and the Woodbury process give beautiful results. Gelatine plates in some hands are successful, and now that special attention is given by makers of plates to the preparation of plates for this purpose, slides equal to the wet process can be produced. Gelatino-chloride plates (see No. 497) are generally preferred. With care in developing, very beautiful pictures and variety of tone may be obtained.

279. Lantern Plates, Emulsion—To Prevent Spots in.—Clear spots on the developed plate may be due to particles of dust or air bells while developing; spots that show before the plate is developed are most likely due to greasy gelatine. To cure this wash the gelatine in water, and then swell and dissolve, add twenty minims of ammonia to each ounce, allow to set, cut up small, and wash. If canvas is used to squeeze through, it must be thoroughly boiled first, to remove the size and dressing, but it is better to make (better still, get someone else to do it) a square of fine net. A mixture of hard and soft gelatines is best for lantern plate emulsion, say half Nelson's No. 1 and half Heinrich's. It is as well to clarify the gelatine with albumen for lantern plates, dissolve the gelatine in water with a little albumen added, and raise to boiling point; the albumen will coagulate and precipitate with the impurities. Spots on lantern slides may also be caused by the silver not being properly mixed in the emulsion. This part of the process is the chief, and it is of the utmost importance that it should be done thoroughly.

280. Lantern Plates, Gelatino-chloride—To Treat.—An authority who has used gelatino-chloride plates rather extensively says he tried many kinds of developers in order to get at the best results. The formula given on the box containing them did not answer his expectation. The quantity of ammonium bromide ordered seems too small. He used as much as half grain to each ounce, but his best slides were made by using the ferrous-citrate developer, made by mixing half ounce of saturated solution of ferrous-sulphate (acidified with citric acid) with one and a half ounces

of a solution of ammonium citrate, made by neutralising a solution of citric acid (one in four) with strong solution of ammonia. After developing he washes for a minute or two, then places the slides in a weak solution of common salt for a few minutes, another wash, and they are ready for fixing in the usual manner. An essential point in the manufacture of lantern slides is freshly made and perfectly clear bright solution, which should be made with distilled water. Hydroquinone has been tried for chloride plates and found quite unsuitable for the purpose. On the other hand, all plates, whether negative or positive, when developed with hydroquinone and a carbonate, require clearing from the deposit of carbonate of lime if ordinary water is used; a dip into weak hydrochloric acid will do this.

281. Lantern Plates—How to Clear.—This is nearly always necessary to give sparkle and brilliancy. For general use, Edwards's iron clearing solution is the best:

Protosulphate of iron	3 ounces.
Alum	1 ,,
Citric acid	1 ,,
Water	20 ,,

Take the slide out of the fixing bath, and, without rinsing, immerse in the clearing solution until the desired effect is attained. But this iron bath has a considerable effect on the colour of the slide, generally cooling it to a great extent, and if the action be prolonged making it a lurid blue. Therefore, note this in reference to moonlight effects.

282—Lantern Plates—Hydroquinone, To Use for.—It is best to use a developer weak in hydroquinone (one and a half to two grains per ounce), to substitute potash for the alkali, and use a bath of citric acid (five grains per ounce) immediately after development, this avoids stains; a good formula is—

No. 1.

Hydroquinone	4 grains.
Sulphite of soda...	4 ,,
Distilled water	1 ounce.
Bromide of potassium	1 grain.

No. 2.

Carbonate of soda	30 grains.
Caustic soda	4 ,,
Distilled water	1 ounce.

Mix in equal parts.

Another writer can thoroughly recommend Thomas's developer for lantern plates. Develop, fix, and wash, then place in following clearing solution for about five minutes, then wash well:

Alum	3 ounces.
Protosulphate of iron	2 ,,
Citric acid...	½ ,,
Water	1 pint.

Or try two solutions:

No. 1.

Hydroquinone	60 grains.
Metabisulphite of potash	90 ,,
Water to	8 ounces.

No. 2.

Carbonate of potash	450 grains.
Water to	8 ounces.

Use equal parts for development, increasing No. 2 for under-exposure, weakening with water for over-exposure. This never gives stained films, and clearing solution is rarely required.

Staining may be caused by omitting the use of sulphite. With sodic sulphite and carbonate of sodic soda as the alkali, it will not stain. Most formulæ work very well if a drop or two of solution of ammonium bromide 100 grains, water 1 ounce, be added. This helps to keep the lights clear, which is particularly desirable in lantern slides.

283. Lantern Plates—To Develop.—The developers usually given in the instructions are supposed to suit the particular plates, but if the tyro wants a simple developer which gives fine warm sepia tones, let him make up for stock solutions some ten per cent. sulpho pyro, ten per cent. bromide of ammonium, ten per cent. caustic potash, and ten per cent. carbonate of ammonium. These are solutions which are used in almost all instructions. Now of these to form the developer take

Pyro	30 drops.
Bromide	30 ,,
Potash	50 ,,
Carbonate	60 ,,
Water to	1 ounce.

Of course, this is only intended for gelatino-bromide plates.

284. Lantern Plates—To Make by the Wet Process.—Thoroughly clean a piece of thin glass, coat it with a ripe sample of collodion bromo-iodised as usual, and plunge it into a holder containing a solution of silver nitrate of the strength of thirty-five grains to the ounce of water, to a pint of which one grain of potassium iodide in half-an-ounce of water is added; stand the liquid in the sun for a day, filter, and slightly acidify with a minim of nitric acid. After an immersion of two or three minutes the plate is ready for the camera. Its exposure should be a full one, and its development effected in a solution of protosulphate of iron ten grains, and glacial acetic acid ten minims per ounce of water. The plate is then to be only slightly rinsed, and immediately fixed in hypo of the usual strength, and thoroughly washed.

285. Lantern, Polariscope and Microscope—To Make for.—The following details will enable anyone to make a polariscope for the lantern. Make first a tube of tin or brass, about 4in. diameter, to fit tube of the lantern, and at an angle of 56° 45′ fix a similar tube 4in. long. Part of the elbow is cut away to introduce a bundle of ten or twelve plates 4¼in. × 3¼in. of thin patent plate glass. The lowermost of these is blackened. A hole for stage 2in. × 1½in. is cut on each side of this tube, and a plate is fixed in tube here with a 2in. hole in centre. This forms the stage. A sliding tube with a similar plate at end and a spiral spring serves to keep objects in position. At the end of tube fix a flange and another short tube about 3in. diameter, which carries the objective, which is of short focus—about 4in. The objective moves in this tube with a sliding or rack and pinion motion. Beyond this, again, is still another tube 2in. diameter and 2in. long. In this slides a smaller tube, in which is fitted a Nicol's prism, the largest the buyer can afford. This fits in cork, which cork fits in small tube, and the smaller tube rotates in the other. Lantern microscope: Get a brass tube 3in. long and 2in. diameter, and at one end fix a screw fitting flange of the lantern. Two inches from this end cut holes on either side 2 × 1½, and fit for stage as in the polariscope. At about 1½in from end is fitted a lens about 2½in. focus, which acts as an additional condenser. To other end of the tube fix a plate, in centre of which fix a tube 1in. diameter and 1½in. long. In this slides a smaller tube carrying the magnifying lenses, which may be two lenses each about 2in. to 3in. focus. If these are not achromatic a diaphragm with ¼in. hole must be placed about ¾in. in front. The best position is determined by experiment. Achromatic lenses, of course, will be best. Micro-objectives of 1in., 1½in., or 2in. focus may be utilised with advantage by fitting them by means of a cork in the sliding tube in place of those mentioned

Instead of a sliding tube a rack and pinion will be a great advantage.

286. Lantern Screen—To Make.—The following are the necessary instructions for making one both good and cheap. Obtain nine yards of brown paper, six feet wide, and cut it into two equal parts. Also two rolls of white "lining" paper, as used by paperhangers. Two rollers, 12ft. 6in. long by 1¼in. diameter, will also be wanted, and these must be cut down through the middle, making four pieces, semicircular in section. Now lay one of these pieces on the floor, and tack one end of each of the pieces of brown paper to the flat side, and then screw another piece on it, making the roller complete again, with the paper firmly fixed in between the two halves. The other ends of the paper are done in exactly the same way, keeping the two pieces stretched equally. One roller must be now fixed against the wall high enough, so that the other clears the floor. The latter is then weighted, so that the paper is stretched quite tight, and while it is kept so it is papered with the lining paper. This is easily done by cutting it in lengths and pasting them one by one, and smoothing them down with a brush or soft cloth. If carefully done, no white-washing is necessary, but if it is decided to do it, through the paper being made dirty or otherwise, it is only necessary to powder some lumps of whiting, and allow it to soak in just enough water to cover it for a night, then add enough boiling water, in which a small quantity of glue has been dissolved, stirring all the time, and finally stir in as much blue (washing blue will do) as will lay on a sixpence, and the whitewash is ready for use. It should be laid on liberally with an ordinary brush, and will require no smoothing off, as it flows together after it is on, completely obliterating all brush marks. The above method makes a better screen than any kind of canvas, besides being cheaper and easier done, and it can be rolled up out of the way, there being no fear of its cracking. Another method, though more expensive, is to make it of *cotton* sheeting. This can be bought at from 1s. 9d. to three shillings a yard, 100in. wide, so that for a twenty-five feet screen it would require twenty-five yards (cut into three equal lengths of twenty-five feet each), costing from £2 to £3 15s., although, no doubt, it is practicable to get a job lot at the draper's at a considerable reduction. If a more expensive article be required, linen can be used, or for a more opaque screen, calico. Now, as regards making the screen, joins in the centre of the sheet should always be avoided, and the seams should run horizontally, not vertically, as the sheet will then hang straighter. By buying cotton sheeting of the above-mentioned width, *i.e.*, 8ft. 4in., and 75ft. in length, and cutting it into three pieces, any centre seam will be avoided, as there will be a centre piece 8ft. 4in. with a similar strip at top and bottom. The joins must be made with as little overlapping as possible (the correct term is "sewed"). As regards hanging the screen, rings round the outside of the sheet are strongly recommended, about eighteen inches or two feet apart, and four screw hooks to be screwed into the floor and wall or roof of the building, some two feet or more wider apart than the corners of the screen. Attach a long cord to one top corner of the screen, pass it over the top hook in the ceiling, or wall, then down under the hook in the floor, then along the floor to the other hook, then up to the other top hook, thence to the other top corner of the sheet, pull it up to the desired position, and fix it off. Then with another finer cord lace the sheet to the surrounding cord, starting at one top corner hook, then through the first ring on the sheet, then round the surrounding cord, then through the second ring, and so on—first down one side, then along the bottom, then up the other side. In this way a screen may be fixed in almost any building and in any position, and all that is required are four screw hooks and plenty of cord, which must be strong.

287. Lantern Screen—To Whiten.—The usual linen or calico screens may be made more effectual by either of two methods. First, the screen may be covered with good white lining paper, which may be obtained from the paperhanger's under the name of "mineral-faced" paper. The screen should first of all be stretched well on a light frame, and the paper then pasted on and left until quite dry, when the screen may be taken off the frame and rolled up on a roller. To make the screen still whiter, the paper surface may be coated with oxide of zinc. This will give it a splendid surface, and screens made in this way are used at the Crystal Palace and other places by our principal lecturers. A less expensive, though inferior, screen may be made by coating the calico or sheet with size, and when dry apply several coats of the cleanest whiting mixed with size according to the following directions: Strain the screen tight on a frame of the required dimensions, give it a coating of size, and when dry give two or three coatings of the best whiting mixed with size and to which a little blue colour is added. Suitable proportions are: One ball of whiting, half pound of size, and about one dram of celestial blue to half a pail full of water. Dissolve the size in hot water, then put in the whiting and stir up to a cream, dilute with more water and add blue. For a portable screen, the above will not answer well. In that case it will be better to cover the screen with white *mineral-faced* paper, obtainable from the paperhanger's, and, unless the operator is skilled, it may be well to retain him to do the job. If a very white surface is required, substitute for the whiting either two pounds of barium sulphate (precipitated), at about 1s. 6d. per lb., or two pounds of zinc oxide (commercial white oxide), at about 1s. per lb. These will be more expensive, but will last far longer. If the cloth has been faced with paint, make the surface just tacky with a coat of turpentine and boiled oil mixed in equal proportions, then dust over with either the above whites, *i.e.*, barium sulphate or zinc white from a flour dredger, and finish with a dry brush. If the cloth has been faced with paper, the best way will be to clean with stale bread, *using flour on the bread*—a tip from wall paper cleaning. Then, if not white enough, give a coat of thin size, and dust as before.

288. Lantern, Small Screen for—To Make.—Nothing forms a much better lantern screen than a sheet of pure white paper, when the screen is of small dimensions, such as those generally used in the drawing-room. A thick and strong paper, well suited to the purpose, is sold by most artists' colourmen, and is known technically as continuous cartridge or drawing paper. A couple of yards of this paper, cemented at one end to a common blind roller, and the other to a lath, forms one of the most effective lantern screens that can be had. When out of use it is rolled up.

289. Slides (Lantern) by Reduction—Apparatus for.—Without knowing the focus of lens it is impossible to give measurements for camera; however, the following may help anyone desiring to construct his own apparatus: Make a wooden light-tight box, measuring internally 6⅜in. × 4⅜in., and of a length to suit the focus of the lens, *e.g.*, with a 5½in. focus lens, reducing half-plate to lantern size, *i.e.*, about three times. There will have to be about 22in. between the lens and

negative, and about 7¾in. between lens and lantern plate, or about 29-30in. together. This, however, will have to be determined, as focus is not known. Having made the box, fit into it a piece of wood carrying the lens. This should move at first so as to get focus, but may be fixed when it is found. Now, at one end of the box make a pair of grooves to take the half-plate negative, and at the other end make a carrier to take the lantern plate, and make a sort of box about 3in. deep and lined with black velvet, and of a size to fit over the lantern plate end of the long box, so as to make this end light-tight. To find the length of the camera box, put a half-plate negative in the grooves at the end, put in the sliding partition carrying the lens, and then at the end where the lantern plate is to be place temporarily a piece of ground glass having a mark 3¼in. × 3¼in. on it; now adjust the lens partition and ground glass so that the image of the negative falls on the marked space on the ground glass, correctly focussed. Fix the lens partition, and mark the place where the ground glass is; at this mark fix the lantern plate carrier, cut the box off here, and slide the velvet-lined shallow box over the end. If a lantern plate is put in the carrier, and a negative put in the grooves, and the box taken into the light, and pointed at a clear space, the image will fall on the lantern plate, and can be developed when taken into the dark room. All the above may sound complicated, but is really very simple; of course, a bellows camera can be used, but it is much more difficult to make. The following is another apparatus which anyone with a moderate degree of constructive ability can make in a few hours at an outlay of not more than half-a-crown. First, get two 4ft. lengths of ⅜in. wood, 2in. wide, grooved down one side. Get two similar pieces of wood, 2in. wide, and form a parallel frame by nailing these to the ends of the longer pieces, taking care that the grooves are inside. The frame when made will be 4ft. long by 8in. broad, and the opening reaching from end to end will be 4in. wide. Get a piece of wood 4in. square tongued on two sides, and fit this into the grooves. This will now slide from end to end, and by making a hole through the centre an ordinary quarter or half-plate camera can easily be attached to it. Then make a box, 8in. square, of similar wood, leaving the two ends open. Fasten this to the framework at one end, with the open ends in the direction of the length of the frame. One of these ends may be covered up with a piece of ½in. wood in which provision has been made for holding the half-plate negative. At the other end should be fastened a taper bellows, 8in. at one end and 4in. at the other. At the narrow end attach a piece of wood, 5in. square, with circular hole in the centre for lens head. The apparatus is now complete, and can be used with lenses from 4in. to 8in. focus for copying or reducing.

290. Slides, Collodion—To Tone.—The following formula is excellent for toning lantern slides:

Solution iron perchloride	30 minims.
Potassium bromide	20 grains.
Water	10 ounces.

The slides must be a little over-developed, and after fixing must be well washed before immersion in above, as the slightest trace of hypo would destroy the slide. After toning, wash well and let dry. Or try the following formula:

No. 1.

Ten grain solution of platinum tetrachloride	1 dram.
Nitric acid	12 drops.
Water	10 ounces.

No. 2.

Gold trichloride	1 grain.
Hydrochloric acid	6 drops.
Water	10 ounces.

No. 3.

Iridium chloride	1 grain.
Hydrochloric acid	12 drops.
Water	10 ounces.

A mixture in equal quantities of Nos. 1 and 2 will give a pleasing tone.

A considerable variety of tones can be obtained as follows: After the slide has been developed, fixed, and washed, immerse for one minute in sodic sulphite 1 ounce, sulphuric acid ½ dram, water 3 ounces. Rinse the slide and apply the following: Uranic nitrate 15 grains, distilled water 2 ounces, methylated spirit ½ ounce, to which add a few drops of the following, according to the tone required: Ferrocyanide of potassium 15 grains, water 1 ounce. The slide will go brownish black, chocolate, reddish brown, and a bright orange. By using different proportions of the chemicals a much greater range of colours can be obtained. The action can be stopped at any tone by well washing the slides, whilst a fine black tone, which is thoroughly permanent, can be imparted to the slides after being fixed and washed by the following toning bath:

Bichloride of platinum	3 grains.
Distilled water	20 ounces.

When the slide has been toned throughout the entire body of silver forming the image it should be washed and varnished. A great many failures result from this excellent method of toning from a want of knowledge of how to use it. The platinum salt, as commercially supplied, contains hydrochloric acid. If used in this state, instead of assuming a black tone, the slide bleaches and becomes white. Therefore, it is imperative that the platinum must be neutralised by adding carbonate of soda until neutral, and then *nitric* acid till it slightly reddens the litmus paper. Another method is to immerse the slides in a weak solution of sulphide of potassium.

291. Slides (Lantern), Copying—Best Method of.—It is not easy to make from these as good negatives as the originals, as a transparency for reproduction requires to be developed much farther than a good lantern slide. However, as the chief difficulty in so many reproductions is the loss of half-tone, each reproduction further from the original tending to become an image in black and white, it is best to adopt a good plate that will give a good range of half-tone.

The following will be found a very satisfactory method: Make a negative slide by contact. The printing frame will doubtless be too large; get two thicknesses of cardboard that will fit into the frame, and preferably blacken them. Cut out a space large enough to let the edges of the slide just rest upon it, place the other slide on top, and, to prevent them moving, drive four French nails through, so that their heads will just catch the sildes. The exposure will be the same as for making slides, and developing is carried on as usual. After fixing, soak for five minutes in 1 ounce hydrochloric acid, 10 ounces water, 10 ounces saturated alum solution. The film will then float off the glass. To enlarge (preferably to quarter-plate size), immerse in 1 ounce hydrochloric acid to 20 ounces water. Then float on to a plain glass support. A much softer enlargement is obtained by making a preliminary print on albumen paper. Print very deeply, wash and fix. Wax it, and proceed as before.

The best plates for copying lantern slides to make negatives are chloride lantern plates, as the deposit of silver is very fine, and there is a great

absence of grain. Proceed as if going to make a transparency, printing off the slide, and work with the following developer:

A.

Hydroquinone	80 grains.
Sodium sulphite	2 ounces.
Potassium bromide	40 grains.
Citric acid	60 ,,
Water	20 ounces.

B.

Sodium hydrate	160 grains.
Water	20 ounces.

For use take equal parts of A and B, and add the same quantity of water, develop, fix, and clean with the following:

Chrome alum	1 ounce.
Citric acid	1 ,,
Water	20 ,,

Wash, dry, and then place the negative on the top of a glass in the printing frame, cover it with a transparency plate, and proceed as usual. Another way is to copy them by the aid of the camera the same way as in reducing, and then make slides by contact, as that will save unbinding the slides. To make the negatives a rather slow and clear plate is required. The plate recommended is the Castle, as it gives a very fine and clear image. The developer is as follows:

A.

Pyrogallic acid	40 grains.
Bromide ammonium	40 ,,
Metabisulphite potash	120 ,,
Distilled water	20 ,,

B.

Ammonia ·880	2½ drams.
Distilled water	20 ounces.

Mix equal parts before using. This will give the negatives with all the gradation that was in the slides they were copied from. To make the slides, if warm tones are required, use Thomas's lantern plates, with their hydroquinone developer, but using it half-strength. Another way to reproduce the slides is by the carbon process, which gives splendid results. But for that it would be necessary to unbind the slides.

292. Slides (Lantern), Dry Plate—To Tone with Platinum.—The following are a few formulæ by which gelatine lantern slides may be toned with platinum. The toning takes place *after fixing* and well washing.

No. 1.

Platinum chloride ($PtCl_4$)	1 grain.
Hydrochloric acid	1 minim.
Water	10 ounces.

This tones rapidly and reduces the slide somewhat, so that rather dense slides should be used. Dilute with water if action is too rapid.

No. 2.

Platinum chloride	1½ grains.
Nitrate acid	12 drops.
Water	10 ounces.

Gives rather inky tones, which are much improved by mixing it before use with an equal quantity of

Gold chloride	1 grain.
Hydrochloric acid	6 drops.
Water	10 ounces.

No. 3.

Potassium chloro-platinite	4 grains.
Nitric acid	2 minims.
Water	10 ounces.

This does not reduce so much as the formula above. In the absence of potassium chloro-platinite use platinum chloride two grains, and add to the solution five minims of sulphuric acid, and a small crystal of sulphite of soda. Many workers, however, find it much easier to get satisfactory tones by choice of suitable plates and modification of development.

Mr. Leaper gives the following *new* process: Develop the positive with ferrous oxalate (so called), and fix in the usual way. Whilst it is washing make the following solution: Take twenty grains bleaching lime (calcium chlorohydrate or bleaching powder), stir it up with a glass rod with an ounce of water, and add strong nitric acid, drop by drop, until a perfectly clear solution is obtained. Into this *freshly made* solution immerse the hypo-free and wet transparency, and leave it therein until completely bleached, *i.e.*, until the reduction product of silver bromide produced on development has been wholly converted into silver chloride. When this occurs, wash again for several hours to remove all traces of chlorine compounds, bring the slide into strong daylight, and redevelop it with an ounce of the usual ferrous oxalate mixture. Whilst development is proceeding, put six drops of twenty per cent. solution of platinic chloride (*not* platinous chloride or the red salt of the Platinotype Co.) into the measure, and when development is complete mix the ferrous oxalate from the dish with the platinum solution, and return the mixture to the plate, upon the image of which the platinum slowly reduced by the ferrous oxalate will be gradually deposited, as evidenced by the change of colour and increased density. That a deposition of platinum has actually occurred can be proved by—(1) Acting upon the image with mercuric chloride, and noticing that little or no bleaching occurs; (2) acting upon the image with the solution of bleaching lime mentioned above, and noticing that little or no bleaching occurs, but that instead the image itself gradually disappears.

293. Slides (Lantern)—To Make by Contact.—Exposing lantern plates by contact is not so easy as it may appear at first sight. To get a good slide the exposure must be made to balance the development. For most average negatives there is nothing to come up to magnesium ribbon, as by varying the distance, increase or the reverse of exposure may be given, while there is a great economy in time. Now, in order to gauge the necessary exposure for the particular brand of plates employed, it is necessary to bear in mind that one inch of magnesium ribbon burned at three feet from the negative is equivalent to thirty seconds exposure at one foot from the ordinary Bray burner. To get black tones, then, this distance is the correct one for all plates for which thirty seconds at one foot is given as the correct exposure in the instructions sent out by each maker. To vary this to suit other plates, it is only necessary to calculate distance for magnesium against time for gas, thus—

Magnesium.	Gas.
1 inch at 3 ft.	= 30 secs. at 1 ft.
1 inch at 2 ft.	= ($\frac{9}{4}$ × 30 secs. =) 67 secs. at 1 ft.
1 inch at 1 ft.	= 270 secs. at 1 ft.

and so on, remembering that the exposure varies inversely as the distance squared. Of course, for thin negatives the distance must be proportionately increased. While for very slow plates, such as Alpha warm tone, one inch at about seven inches is not too much. Most lantern plates, however, allow of great latitude of exposure *provided* the developer is proportionately compounded, the only difference being in tone.

294. Slides (Lantern)—To Make by Reduction.—To make lantern slides by reduction is, in the opinion of many workers, by far the best way, even though the negative be a quarter-plate. There is a something in a slide by reduction which a contact slide lacks, and no doubt this is due to the fact that the former is made by the agency of daylight. Now, although there are many cameras sold for the purpose, there is no real need to buy

one. With a quarter-plate camera and a wooden box sufficiently large, a little management will be all that is required. Suppose it is wished to get a slide from a half-plate negative. The lens (preferably a 5 × 4 R.R. or W.A.R.) of the quarter-plate camera has a focal length, say, of x inches, and on the slide must be got all the view on the half-plate negative, *i.e.*, a reduction of two dimensions linear measurement. The length of the box can be calculated from the well-known formula:

Distance from lens to negative $= (n + 1)\,x$

where n = number of times reduction (or enlargement) required, and, therefore, length of box is $3x$, or if x is five inches, box must be fifteen inches. In the bottom of the box cut a central aperture to take the negative, and in the opposite side a central hole to take lens of the camera; propping the latter up to the right height, focus the negative on the ground glass of the camera, see that it is sharp and central, and all vertical lines *are vertical.* Then in the dark slide insert two pieces of wood half inch wide and three and a quarter inches long, and just thick enough to fit the slide when closed, one at each end, and between them put the lantern plates. The box and camera are for convenience sake mounted on a long board, and this is tilted so that the negative is illuminated by the open sky; put in the dark slide and expose, say, for one minute. Then develop and see if the exposure is about right. To give some idea, using a 5 x 4 portable symmetrical of three and three-quarter inch focal length and from half-plate to lantern size, it is found from forty seconds to two minutes is about the range of exposure, using f/11 stop.

295. Slides (Lantern) — To Make by Reduction with Magnesium Ribbon. — The exposure in such a case as the above is obviously dependent on several conditions. In the first place, some screen must be introduced between the magnesium and the negative to be reduced. It will not do to expose the negative to the light of the naked flame, since such an arrangement leaves very unequal illumination. Several media have been proposed for screens to diffuse and equalise the light. The best thing to use is thin pot opal. Opal varies considerably in quality, and some samples intercept much more light than others. A piece of $\frac{1}{16}$in. in thickness and considerably larger than the negative used is required. It is placed against the negative, and the magnesium ribbon is burnt about six inches behind it. The ribbon is slowly moved from one side to the other during its combustion so as to get even lighting. Supposing that a rapid plate is used with lens at f/16, the negative being backed up by the sheet of opal, then a little over a foot of magnesium ribbon will be sufficient. For developer, nothing is better than Thomas's hydroquinone formula, which can be used in two ways: the one for lantern slides from line negatives made from book illustrations, and the other for slides from landscape negatives.

The two solutions are—

Hydroquinone	80 grains.
Sulphite soda	1 ounce.
Potass. bromide	20 grains.
Citric acid	30 ,,
Water to	10 ounces.

Caustic potash	100 grains.
Water	20 ounces.

For the first way, develop with equal parts of each solution. This is a strong developer, working quickly, and giving very black tones. For the second way, immerse in the same developer until detail just begins to appear. Then remove the plate at once, and place in a solution containing one part of the caustic potash solution in four parts of mixture. In this bath the density does not increase so fast as if plate had been left in the strong developer. The result is, more detail and clearer shadows, with a very pleasing tone. It is a most difficult matter to say which is the most suitable plate to use, especially as there are so many good plates on the market that it would be easier to say which is a bad brand of plate than a good one. Regarding the clear lights, it is found that the "Beechey" dry collodion emulsion plates are the ones to use for this particular good quality. Using a lens with an intensity of f/16, and reducing from a half-plate negative and the above plates, about a yard of magnesium ribbon would be required. But sometimes, especially in the case of negatives of landscapes with dense skies, it may be distinctly an advantage to keep the light moving to and fro exactly opposite the sky portion of negative, thus giving really a larger exposure (or what is similar in effect) to the densest part of negative. This is what is called, to use a slang expression, "faking a negative," and should be only resorted to in extreme cases, otherwise it is quite easy to lose the whole effect of lighting in a picture. For example, if a sky is very bright when taking a negative, certain effects of light and shade will be obtained, and the sky portion of negative will be very dense, but it is quite possible to print the negative so that the sky may be printed quite dark and the foreground kept light, and thus almost reversed effects will be the result. The hydroquinone developer will develop the collodion emulsion plates beautifully, the colour being a rich black.

296. Slides (Lantern)—To Make without Camera.—Thin, flawless crystal plates are coated with a varnish made as follows:

Gum sandarac	2 parts.
Gum mastic	2 ,,
Sulphuric ether	100 ,,
Benzole	20 ,,

This dries rapidly and gives a mat surface suitable for working upon with chalk or pencil. When the drawing is completed the slide can be made transparent by flowing with:

Gum sandarac	3 parts.
Gum mastic	3 ,,
Sulphuric ether	100 ,,

The drawing is thus protected by two coats of varnish.

297. Slides (Lantern)—To Mark.—The best way of marking slides is to adopt what was agreed upon by a committee of the Photographic Club. It is simplicity itself: The slide is held up to the light so that the scene appears as it did in nature, and then two small white paper dots (having been previously cut to about one-eighth of an inch in diameter) are affixed to the face of the slide, quite near the top edge. By this means the operator merely looks at the position of the spots, which are easily seen in semi-darkness, and places the slides in the carrier with dots downward and facing the condenser. The title of the slide should be written on a piece of white paper, and fastened with a mixture of water, dextrine, and sugar to the front of the slide, taking care, of course, not to cover any of the picture. The dextrine solution mentioned is composed of

Dextrine	1 ounce.
Sugar	1 ,,
Methylated spirit	½ ,,
Boiling water	3 ,,

298. Slides (Lantern) — To Paint. — There are three methods of colouring these—(1.) Oil colours mixed with a little turpentine and

mastic varnish, using only the transparent ones, such as Prussian blue, gamboge, rose madder, burnt sienna, etc. This is the plan usually adopted by the profession, the only difficulty being that they are so long in drying, unless the paintings are put into an oven to dry. (2.) Water colours: These should be the moist ones in pans and dry quickly. (3.) Aniline dye colours: For the first method the following necessarily brief hints may help. Never work by artificial light, as colours do not appear the same as by daylight. A piece of opal glass makes a good palette, as the effect must be judged by transmitted light, all the colours being transparent. The most suitable brushes are *water colour* sables, the usual *oil* brushes being too stiff. The following selection of *oil* colours should be purchased in small collapsible tubes—Blues: Prussian (d), indigo (d), Antwerp blue, French ultramarine. Yellows: Italian pink (d), yellow lake (d). Browns: Burnt sienna (d). Reds: Crimson lake (d), madder lake. Blacks: Ivory black (d). The (d) means that such colours, being of good body, can be dabbed, the others being for brushwork only. Prussian blue is useful for skies, and French ultramarine for water. Verdigris for foliage, adding a little Italian pink to it where necessary. Italian pink gives with Prussian blue a good green, and with crimson lake a scarlet. Yellow lake is useful for golden jewellery, etc. Burnt sienna and Prussian blue give an olive green useful for foliage in deep shadow. Crimson lake is generally used for the darker shades of red, and madder lake for the lighter ones. For mixing the colours, Robinson's medium, thinned with turpentine as occasion demands, is easiest to work with. For small areas the colours are laid on with the brush; to cover large areas dabbing must be resorted to. To do this the colour is mixed with medium to the consistency of stiff paste, a little of it put on the slide, and spread with the aid of the dabber. This consists of a thin short stick, over one end of which a piece of small kid is tied, a pledget of cotton wool being between the two. A succession of taps given with this will spread the colour with the greatest nicety. Some colourists use the tip of the third finger of the right hand for the same purpose. The slides to be coloured are best unvarnished, as with most varnishes it will be found difficult to get the colours to take. The chief difficulty will be found with the skies. These are done by dabbing on Prussian blue very evenly, a little crimson lake being added if it is desired to give a sunrise or sunset effect, this latter colour to be used, of course, only on the horizon. Having practised colouring skies of one tint, clouds may be attempted. Of these cumulus clouds are easiest, and are put in as follows: A penholder is cut to a tapering wedge, and over this a piece of kid is stretched and held in position with the fingers or tied. With this wedge the fresh paint is wiped off where required, leaving a clean edge for the upper part of the cloud, the lower part being then dabbed into the sky tint. Long, thin white clouds are made by gently running the corner of the wedge over the sky tint so as to displace the colour and leave an irregular line, this latter being afterwards softened by dabbing. The wedge is also very useful for removing the sky tint from roofs, steeples, trees, etc., over which it had in the first instance been carried. Second method: Moist water colours can be easily used for painting slides upon plain glass, and should be mixed with gum water of sufficient strength to give the work a glossy surface when dry. A few drops of ox gall in the bottle containing the gum water will ensure its working smoothly should the glass repel the colours. To further brighten and protect the painting when finished, pass over it a coating of copal, mastic, or even ordinary negative varnish, as water colours when used for this purpose will not bear much handling. Pretty slides are quickly made by placing the glass over any design wished and tracing the outline in lampblack, applied with a fine brush; varnish the drawing thus obtained, and, when dry, colour to taste, and repeat the varnishing as a protection to the whole. This simple method of manufacturing lantern slides will provide a fund of entertainment for the juveniles during winter evenings. It is, of course, understood that the water-colour process will not suit slides made on gelatine plates; they must be tinted with oils, and the medium in this case would be gold size diluted with a little turpentine. As this would dry bright and glossy enough, the final coating of varnish could be dispensed with, and whether oils or water colours are used it must be borne in mind that the only pigments available are the transparent and a few of the semi-transparent. The transparent include (beginning with the best for the purpose) Prussian blue, gamboge, carmine, verdigris, madder brown, indigo, crimson lake, and ivory black. The semi-transparent include raw sienna, burnt sienna, cappah brown, and Vandyke brown. No particular method of mixing the colours is requisite. Ordinary oil or water-colours will do, but they must be ground extremely fine. The pencils must be small and their points unexceptionable. Camel's hair is preferable to sable for painting upon glass because its elasticity is less, and the trouble of working out the brush marks, which must always be carefully attended to, not so great. Third method: The novice, however, is far more likely to colour his slides to please himself if, instead of attempting to practise lantern slide painting as usually taught, he will be content to stain them with aniline dyes. These may be such as are sold for the purpose, or the Judson's dyes, or the penny packets may be used. Water is stained with the appropriate tint and laid on with a camel-hair pencil. The transparency of the colour makes the result very satisfactory, if ordinary care and taste be devoted to the work. It is necessary to avoid colouring close up to any portion which has not become dry. Some of the dyes may, in course of time, show a tendency to fade. This may be set against the certainty that, should the tyro try the daubing method, he may be thankful if his early efforts fade altogether.

299. Slides (Lantern)—To Remove Oil Colour from.—It is found that methylated spirit will remove oils from a bromide print without injuring the surface, and, therefore, it would no doubt also answer upon a slide, its surface being of a similar nature. There should be sufficient spirit to quite cover the slide, and when immersed a few seconds, gently assist its action with a camel-hair brush. The colours will come off in little rolls. Should this be considered dangerous to the film of slide, try soaking all night in ordinary turpentine, which is harmless to gelatine, and should remove oils unless of very long standing.

300. Slides (Lantern) — To Tone.—In some cases toning a slide is a necessity. For instance, when either the colour is unpleasantly red or brown, or when from too flat a negative, or under-development, only a poor slide results. For Alpha plates, the best toning bath is that used for Alpha paper, and is a combined toning and fixing bath. It is as follows:

Water	ounces.	
Hypo	2½ ,,	(avds.)
Acetate of soda	½ ,,	
Sulphocyanide of ammonium	½ ,,	
Chloride of gold	4 grains.	

To be dissolved in the order named. For bromide plates, the following bath is capital:

Sulphocyanide ammonium ...	½ ounce.
Carbonate of ammonium	20 grains.
Water	20 ounces.

When dissolved, add—

Chloride of gold	8 grains.
Water	4 ounces.

This lasts well, and may be used over and over again.

A considerable variety of tones may be obtained at will in lantern slides, either by toning or varying the development. Some general hints follow, but fuller particulars are given under the head of each colour separately as follows: For blue tones. After developing the slide, fix and tone in the combined toning and fixing bath recommended by the Ilford Co. as follows: Water 10 ounces, hypo 2½ ounces, acetate of soda ½-ounce, sulphocyanide of ammonium 4 ounces, gold chloride 4 grains. Dissolve the chemicals in water in the order given, and allow the developed and washed slide to remain in this until the required colour is obtained. Another method which gives deep blue tones is to dissolve one ounce best gelatine in twenty ounces hot water, and filter through cotton or flannel, coat well cleaned plates with this, and allow them to set on levelled surface, and dry free from dust. Then mix sensitising solution. Dissolve A, citrate of iron and ammonia seven and a half drams in four ounces water; and B, ferricyanide of potassium five drams in four ounces water. Mix in equal quantities, and filter into a dish, and by lamp or candle light immerse plates for five minutes, avoiding air bubbles. Dry and expose under negative to daylight, they will require about twice the time for albumenised paper. Afterwards wash thoroughly, and a fine blue transparency results. Mix solutions fresh for each time. For red tones one of the following will be found to answer: Using Thomas's lantern plates, and increasing the exposure about four times with pyro developer, and doubling the quantity of bromide and ammonium carbonate stated in their formula, warm tones *right up to pink* may be obtained. Full particulars will be found on each box of plates sent out. Red tones may also be obtained by *well washing* the plate after fixing, and using the uranium toning solution. Still another method is, after fixing and washing, to immerse in a bath of iodine in iodide of potassium (of a port wine colour) until the whole of deposit is changed into silver iodide, when the plate looks yellow at back. Then wash about five minutes, and put in bath containing sulphide of ammonium 1 ounce, and water 24 ounces. The image now becomes a rich chocolate brown. If a still warmer tone is required, put in another bath containing—

Gold chloride	1 grain.
Potassium ferricyanide	1 dram.
Uranium nitrate	1 ,,
Water	20 ounces.

Leave in this till required tones are obtained, and wash to complete.

To obtain red tones with the ferrous oxalate developer the exposure with a chloride plate should be about fifty times the normal, and use the following developer:

A.

Oxalate of potash	13 ounces.
Water	50 ,,

B.

Ferrous sulphate	5 ounces.
Water	15 ,,
Sulphuric acid	15 minims.

C.

Bromide of potassium	240 grains.
Water	1 ounce.

Now, for above exposure, mix developer as follows: Take two ounces of A and pour into it half an ounce of B and three drams of C. Development will take place fairly quickly, and the resulting tone will be crimson.

301. Slides (Toning)—To Produce Black Tones.—The addition of mercuric chloride to the hydroquinone developer would make the tone blacker if the developer contained sodium sulphite, as the mercuric chloride would convert the silver image into silver chloride, and become mercurous chloride. The sulphite of sodium reduces this to black metallic mercury, and dissolves away the silver chloride. Good black tones can be got by giving as *short* an exposure as the negative will allow, and using the hydroquinone developer rather strong, or, still better, after the slide is dry, whiten it with mercury, *well wash*, and redevelop with hydroquinone developer, when, by watching it, a pure black tone results.

302. Slides (Toning)—To Produce Blue Tones.—Clean the glasses carefully and then coat them with a gelatine solution, made by soaking 120 grains of gelatine in water for about twenty minutes, when the water should be poured off and the gelatine dissolved by heat. When quite dissolved add water to make one ounce. Warm the plates and coat with the warm gelatine. Of course, it is understood that the plates must be levelled, and also that care should be taken to prevent dust falling upon the coated glasses; as soon as the gelatine is quite set, immerse the plates in a solution made as follows:

A.

Ammonia citrate of iron ...	64 grains.
Water	1 ounce.

B.

Ferricyanide of potassium ...	48 grains.
Water	1 ounce.

For use, mix equal parts of A and B and filter, leave the plates in for five minutes, be sure to have enough solution to cover the plates, dry the plates in an upright position in a warm dark room, when dry expose to light under negative until well printed, develop in cold water until quite clean. This formula gives a good rich blue, but if a deeper blue is wanted immerse in a bath of sulphuric acid 1 ounce, saturated solution of iron protosulphate 1 ounce, water 1 ounce; or in acetate of lead ½ ounce, water 2 ounces. The process can be worked either by the aid of collodion or gelatine. To use collodion, first coat the cleaned and edged (indiarubber in benzole) plates with plain collodion made thus:

Pyroxyline (high temp.)	60 grains.
Meth. alcohol (·820)	3 ounces.
Meth. ether (·725)	2½ ,,

Make this a few days before using, and allow it to settle, using the clear liquid. When the collodion has set, sensitise by immersions, first in –

Ammonio-ferric citrate	1 dram.
Water	1 ounce.

Or more in same proportion, and then in—

Ferricyanide potass.	1 dram.
Water	1 ounce.

Or more in same proportion.

Or better, take equal parts of the two solutions and immerse the plate for about ten minutes. This can be quickly managed by proceeding thus: Take two whole-plate dishes, quite clean, and pour into them a sufficiency of the sensitising solution, then coat a plate and immerse, coat another and so on until both dishes are full up, *i.e.*, there will be eight lantern size plates sensitising. By this time the first one will be ready to take out. Drain it carefully and put it in a rack to dry, then the second, and so on until the dishes are ready for the next eight. All this can be done by gaslight, and the

plates are soon dry. When dry expose under the negative (as for ordinary silver printing) in the sun for about twenty minutes. To develop simply wash in clean water until the high lights are clear glass and it gives a blue slide. Do not wash too much, as the slide is thereby reduced considerably. If, however, the slide is too dense, the remedy is simple; wash it until thin enough. This collodion method may be recommended as being far easier than using gelatine, obviating, as it does, careful levelling while the gelatine sets. To alter the tones immerse the slide in caustic soda, fifty grains to one ounce of water, until yellow all through; wash well and immerse in tannin, ten grains to one ounce of water. The result is blue-black. A ten per cent. solution of ammonium carbonate alone, with subsequent washing, gives a violet blue. There are other proportions for the sensitising thus:

No. 1.

Ammonio-ferric citrate	64 grains to 1 ounce water.
Ferricyanide ...	48 grains to 1 ounce water.

No. 2.

Citrate	1 ounce to 3½ ounces water.
Ferricyanide ...	1 ounce to 6 ounces water.

No. 3.

Citrate	7½ drams to 4 ounces water.
Ferricyanide ...	5 drams to 4 ounces water.

In all cases equal parts are used.

To convert an ordinary gelatine lantern slide into a blue tone, the transparency should be first of all thoroughly fixed and washed (this is important) to prevent reduction of the image when ferric chloride is used. It is then immersed for from five to ten minutes in a weak solution of ferrous sulphate (eight grains to the ounce of water), wash under the tap and place in a bath of ferricyanide of potassium (ten grains to each ounce of water). In a very short time it will be found that the film has become a deep blue colour. Instead of ferrous sulphate and ferricyanide of potassium, ferric chloride and ferrocyanide of potassium may be used. Blue tones can also be obtained by bleaching the slide with bichloride of mercury, and toning after washing in an old sulphocyanide bath. The following formula answers well:

A.

Sulphocyanide of ammonia ...	20 grains.
Hyposulphite of soda	2 ,,
Water	7 ounces.

B.

Chloride of gold	5 grains.
Water	2½ ounces.

Take two ounces of A to half an ounce of B. The slide can then be turned through a variety of colours from yellow to blue and black. A blue suitable for seascapes and moonlight effects is obtained by toning in equal parts of one per cent. solutions of uranium nitrate and ferricyanide of potassium, until of very dark colour, wash and immerse in a ten per cent. solution of ferric chloride for five minutes, wash and dry.

303. Slides (Toning)—To Produce Chocolate Tones.—They are most readily and certainly made by using the transparent tissue of the Autotype Company, which can be obtained of a chocolate brown colour. The lantern plate is coated with a substratum made by adding a little bichromate of potash to a five per cent. solution of Nelson's No. 1 gelatine. The glass is coated with this solution, allowed to dry in daylight, and the exposed tissue squeegeed down to the surface thus prepared. The development with hot water is then conducted in the usual manner recommended for single transfer pictures. To obtain chocolate tones on gelatino-bromide lantern plates, the best method is with uranium ferricyanide. The process is applied after every trace of the hyposulphite used for fixing has been washed away, and is found to succeed best with transparencies of less density than usual, since the subsequent treatment intensifies them. The following are the operations: Wash the plate until *entirely free from hypo*, and then apply the following solution:

Uranic nitrate	15 grains.
Water	3 ounces.

To which add, as required, a few drops at a time of the following, according to tint required:

Ferricyanide of potassium	15 grains.
Distilled water...	1 ounce.

The action of this is very quick: first, brown black tones are given, then chocolate, and finally tawny orange. The action can be stopped at any stage by washing, or the whole operation can be abolished, and a fresh start made by immersing in a solution of ammonia or ammonia carbonate, so that if the desired stage has been overstepped, the error can be rectified. To complete the operations, the slide is well washed, and dried as quickly as possible. Very good warm tones approaching to chocolate are easily got by over-exposure of the lantern plate and restrained development. For instance, on such a subject as a village church interior, where there is a good deal of woodwork, expose on a rather dense negative, on a Thomas's lantern plate, for a time equal to four and a half inches of magnesium ribbon, at one foot distance, and develop with fifty minims of pyro ten per cent. solution, fifty minims ammonia ten per cent., 150 minims of bromide solution ten per cent., and 120 minims of ten per cent. carbonate of ammonia, made up to two ounces of water. A slide results which is far more pleasing and truthful than the old tone, produced by normal exposure and development. Another simple plan is, obtain the required tone direct in development. There are two makers' plates amenable to this—the Ilford Alpha plates and Thomas's lantern plates. Although both are good, the Alpha are very suitable in cases where a *variety of tones* are wanted. They can be toned after fixation, and the tones obtained by varying the time of exposure. It may be desirable also to give a very rough idea of the approximate exposure required with an Alpha lantern plate. With an *average* negative (and this term is about as vague as it well can be) the exposure would be about two minutes at nine inches from an ordinary burner consuming five feet per hour. The developer to be as given in the instructions issued with each box of plates, which is a very dilute hydroquinone formula. Another method is to use the Beechey dry collodion emulsion plates. The developer which suits best is given. The formula is—

A.

Pyro	96 grains.
Methylated spirit	1 ounce.

B.

Potassium bromide	12 grains.
Water (distilled)	1 ounce.

C.

Ammonium carbonate	60 grains.
Hot water	1 ounce.

For use take—

A	30 minims.
B	60 ,,
C	1 to 2 drams
Water	2 drams

The exposure that is generally successful is about one and a half minutes at a distance of one foot six inches from gas burner. It may be added that for quality of image and *almost* clear glass in high lights *nothing will touch* collodion, either as emulsion or by the wet process. Above exposures are for contact printing. For a very deep chocolate give very long exposure and develop in following:

Magnesium carbonate ... ... 76 grains.
Citric acid ... ... 120 ,,
Common salt ... ... 2 ,,
Distilled water ... . 1 ounce.
To every three parts of above add one part of
Ferrous sulphate ... ... 140 grains.
Sulphuric acid ... ... 1 drop.
Distilled water ... ... 1 ounce.
For not quite so deep a chocolate, give a shorter exposure and develop in
Citric acid ... ... 180 grains.
Ammonium carbonate ... ... 60 ,,
Common salt ... ... ½ ,,
Distilled water ... ... 1 ounce.

304. Slides (Toning)—To Obtain Cold Tones in.—The following is the usual method of obtaining cold tones on collodion slides. Give just enough exposure, use the iron developer, and intensify with the following solution:

No. 1.
Silver nitrate ... ... 130 grains.
Water ... ... 6 ounces.
No. 2.
Pyro ... ... 12 grains.
Citric acid ... ... 12 ,,
Water ... ... 6 ounces.

Use about four drops of silver solution for every ounce of the acid pyro, be careful of the shadows, the plate is then washed and fixed in a solution of hypo, one in six. Cold tones can also be produced thus: A warm tone is first obtained by suitable exposure and development—pyro, potash carbonate, and bromide generally used—and then if the colour be too red the slide is toned in a bath of platinic chloride one grain to water six ounces, and note if toning proceeds too far a blue result, and if the toning bath be not slightly warmed, say to 70°F., this stage is reached without any intermediate change. This refers to slides made by a washed emulsion process.

305. Slides (Toning)—To Produce Green Tones.—There are several ways of obtaining this. Probably the uranium process, by which almost any tone can be obtained, will be the most satisfactory. It is as follows:

No. 1.
Uranium nitrate ... ... 1 part.
Water ... ... 100 ,,

Filter in case the solution is not clear; this is generally unnecessary.

No. 2.
Ferricyanide of potassium ... ... 1 part.
Water ... ... 100 ,,
No. 3.
Ferric chloride ... ... 1 part.
Water ... ... 10 ,,

Take equal parts of Nos. 1 and 2 and tone slide until it is of a very dark colour, and very dense. Rinse for three or four minutes, and then plunge into a solution of one part of No. 3 and seven parts of water, in which solution it is allowed to remain for at least seven minutes. It is then washed and dried. In case the resulting tone is not satisfactory, it is easily brought into its original state by dipping it into a dilute solution of potassium cyanide for a few seconds, upon which the slide regains its original tint. Do not allow the slide to remain longer than is absolutely necessary to remove the toning stain, as the solution is a powerful reducer, and would in a short time eat away the whole picture. After washing it may be re-toned again. Another method is to immerse in a weak solution of aniline green or an old lead intensifier:

Nitrate of lead ... ... 4 parts]
Ferricyanide of potass ... ... 6 ,,
Distilled water ... ... 100 ,,

Wash well and immerse in a ten per cent. solution of neutral chromate of potash, wash well and immerse in a ten per cent. solution of ferric chloride. If the dyed slide should dry dull, a little gelatine solution poured over it will restore the brilliancy, care being taken to avoid dust in drying. It is also possible to obtain greenish tones by leaving traces of iron in the film, and dipping into ferricyanide of potassium. Another method is: As soon as the slide has been developed, fixed, and washed, immerse it while still damp in a three per cent. solution of potassium ferricyanide for a minute, then take out and wash rapidly for a second, and then immerse in a two per cent. solution of iron sulphate. A deep blue forms on the gelatine, which will darken a little in drying. Wash well, and immerse the slide in a weak solution of picric or sulphuric acid, or, better still, of sodium chromate. A green print, well adapted for seascapes, will result. Undoubtedly, however, the best and finest methods of producing lantern slides having a green tone is by the carbon process, using the sea-green tissue, which can be purchased in an unsensitised state from either the Autotype Company or Elliott and Sons. It can now be purchased already sensitised in shilling packets of twenty-eight pieces. The process is extremely easy to work, and the results are hard to beat. The best kind of negative for carbon work is such a one as would print well in hot bath platinotype. Using such a negative should produce a lantern slide quite clear in the high lights. Of course, the method can only be used for contact printing, but they may be obtained direct by reduction as follows: Slightly under-expose Alpha plates and develop with an iron developer made as follows:

Saturated solution oxalate of potash 4 parts.
Saturated solution sulphate of iron ... 1 ,,
Ten per cent. bromide potassium ... 10 drops.

The slides will develop very quickly, finishing in about two minutes. Wash well and fix in clean hypo. This will give slides of a very nice green colour and very clear; should the slides have a slight milkiness, it can be cleared with a very weak solution of hydrochloric acid, say, water ten ounces, acid half a dram—rub the slides with a piece of cotton wool

306. Slides, Toning—To Produce Red Tones.—To produce red tones in lantern slides requires more than a special formula; in fact, more depends on the exposure than on the developing—the exposure must be prolonged considerably, and the development must be tentative. Almost any brand of plates will give a reddish tone, but that which many find most successful is the Alpha. With this make, the exposure under an ordinary negative would be twelve inches of magnesium ribbon burned about a foot from the printing frame. As this is a pretty long exposure, extra care must be taken in the developing. It is advisable to use a yellow medium in the developing lamp, in place of the ordinary ruby glass, as, with the latter, it is almost impossible to tell when the plate has reached a proper density. The formula given with the plate should be used, but it is necessary to add a little bromide solution to slow the development, which should be carried on until the films become somewhat opaque. It may be found necessary to use a clearing solution after development. The following is very satisfactory: Ten per cent. solution of potassium ferricyanide 2 drams, ten per cent. solution of acid sulphuric 2 drams, ten per cent. solution of acid hydrochloric 3 drams, water up to 10 ounces. If the colour of slide is not bright enough, two or three drams of a ten per cent. solution of uranium nitrate may be added to the above bath. Dark red or purple may be obtained by means of the gold toning bath.

Another method is by using chloride plates or plates especially prepared for the production of warm tones. Now that so many makers prepare slow and rapid series of lantern plates, any of the former may be made to give almost any tone required between black and red. It is, of course, impossible to lay down any definite exposure and strength of developer for all negatives, seeing how much they vary in density and colour, but for producing very warm tones it is better to err on the side of over-exposure. However, taking the normal exposure for black tones to be thirty seconds at one foot from an ordinary gas burner, or one inch of magnesium ribbon at one yard, an exposure of fifty times that may be given, say six inches of magnesium ribbon at one foot. Any ordinary reducing agent may be used—perhaps hydroquinone or pyro give the best results, in conjunction with carbonate of ammonia. For a hydroquinone developer, that recommended by Thomas & Co. may be used. (1.) Hydroquinone ½ ounce, sulphurous acid ½ ounce, potassium bromide 60 grains, water to 20 ounces. (2.) Caustic soda ½ ounce, water to 20 ounces. (3.) Bromide of ammonium 2 ounces, water to 20 ounces. (4.) Carbonate of ammonium 2 ounces, water to 20 ounces. Take ½ ounce each of Nos. 1 and 2, 1½ drams each of 3 and 4, and make up to 2 ounces. Develop further than usual, as the image loses in fixing. Good deep red tones can also be obtained from an ordinary black lantern slide by using a uranium toning bath. For this purpose, make a rather light slide in the ordinary way (uranium intensifies as well as tones), wash thoroughly free from hypo, and tone in the following bath: (1.) Uranium nitrate 20 grains, glacial acetic acid ½ ounce, water up to 10 ounces. (2.) Potassium ferricyanide 20 grains, glacial acetic acid ½ ounce, water up to 10 ounces. For use, take equal parts of each. Tone to desired colour, and wash in a gentle stream of water.

307. Slides, Toning—To Produce Sepia Tones.—A warm sepia tone can be obtained on lantern slides by the use of a toning bath as follows: First bleach the slide with mercuric chloride, wash and immerse in a bath composed of one ounce saturated solution of sodium sulphite, and one ounce saturated solution of washing soda until the required tone is produced. Long exposure and weak development will give warm tones without aid from toning bath, or thoroughly wash the positive, and then lay in a bath of

Chloride of mercury	20 grains.
Chloride of ammonium	20 ,,
Water	1 ounce.

till bleached. Again thoroughly wash and tone in a solution made of liver of sulphur 20 to 50 grains, water 1 ounce. Allow the slide to be immersed till the desired tone is gained, then again wash and dry. Another method to obtain sepia tones on lantern slides is to expose three or four times necessary for the black tones generally seen on the screen. Moreover, the developer must be very restrained, and the following hydroquinone formulæ give good results:

No. 1.

Hydroquinone	160 grains.
Sulphite soda...	2 ounces.
Citric acid	60 grains.
Ammonium bromide	20 ,,
Water to make	20 ounces.

No. 2.

Potassium carbonate	2 ounces.
Sodium carbonate	2 ,,
Water to make	20 ,,

For use take equal parts of each for an ordinary exposure, but for the abnormal one necessary for sepia tones reduce No. 2 by a quarter, and add eight or nine drops of a ten per cent. solution of potassium bromide for each ounce of developer. The hydroquinone developer, however, rather tends to black tones, but good sepia tones can be obtained by giving a rather long exposure and developing with the following in place of No. 2 above:

Citric acid	160 grains.
Ammonium carbonate	65 ,,
Chloride of sodium (salt)	3 ,,
Water	1 ounce.

308. Slides (Toning)—To Obtain Warm Tones.—All depends on exposure given to the slide. The general rule runs—"Short exposure and rapid development give black tones; full exposure and weak development give warm brown or ruby red tones." Now, weak development may mean diluting the developer or adding a restrainer. The latter plan, however, seems preferable. For instance, using the following developer and restrainer: Oxalate of potash (neut.) thirteen ounces to fifty ounces of distilled water, sulphate iron five ounces to fifteen ounces of distilled water, and fifteen minims of sulphuric acid. For use, pour one part of iron into four parts of oxalate. Restrainer: Bromide of potass. 240 grains to one ounce of distilled water. For normal exposure and black tones, add two drops of restrainer to the ounce. While if the exposure be, say, fifty times the normal, and using three drams of restrainer to the developer, a bright crimson tone can be obtained. Generally, however, with gelatino-chloride plates, warm tones are obtained with exposure of about ten seconds in diffused daylight, and with sixty drops of restrainer to the ounce of developer.

309. Slides (Wet Plate)—To Tone.—Try the following, if warm tones are wanted: After developing, fixing, and well washing, immerse the plate in a bath of iodine and iodide of potassium, until the whole of the silver image is converted into yellow iodide, which can be ascertained by examining it at the back. Then wash it under the tap for five minutes, and after that place it in a bath of hydro-sulphuret of ammonia (ten drops to one ounce of water). This will turn the image to a rich chocolate-brown colour, and it must again be well washed under the tap. Still warmer tones can be obtained by now placing it in a bath made as follows:

Chloride of gold	1 grain.
Potassium ferridcyanide	1 dram.
Nitrate of uranium	1 ,,
Water	20 ounces.

The plate can be left in this until it turns to a bright Indian red, or it can be taken out before if wished; but it must be washed thoroughly, and the tone can be modified, if desired, by placing it in an ordinary toning bath for a short time. The whole success of the above consists in allowing the solution to penetrate quite through the films, and in giving a thorough washing between each operation. On the other hand, if the tone is too warm it can be changed to a purplish black by immersing in a bath of tetrachloride of platinum, four grains in four ounces of water, until the desired tone is reached, remembering that the tone will be colder when dry. This is a strong bath, and probably a weaker solution will be preferred, but it has many advantages. A weak solution of chloride of gold may also be used for toning. If a slide is too thin, and only requires toning, sulphide of potassium should be used, as in addition to toning to a fine purple brown colour, it also intensifies the image. Care, therefore, should be taken that the solution is not too strong, or the intensification will proceed too rapidly. In fact, it is better with the above toning

baths to have them quite weak, so that the toning action may be easily watched and checked. A reddish brown colour may be obtained by bleaching the image in a bath of potassium bichromate ½ ounce, water 10 ounces, to which a few drops of hydrochloric acid are added. After wash, immerse in a weak solution of sodium sulphantimoniate (Schlippe's salts), in which it at once takes a red tone. A good gold bath for blue-black tones is the following: After fixing and washing, well bleach image by mercuric chloride, again wash well and tone with—

Hot distilled water	8 ounces.
Sulphocyanide ammonium ...	30 grains.
Carbonate soda	3 ,,
Saturated solution of hypo... ...	1 minim.

When tepid, add—

Distilled water	2 ounces.
Gold	4 grains.

They may also be toned by the uranium process, for which the following is a good formula. Develop, fix, and wash the transparency, and immerse in the following for one minute:

Sodic sulphite...	1 ounce.
Sulphuric acid	½ dram.
Water	3 ounces.

Wash, drain, and apply—

Nitrate of uranium	15 grains.
Distilled water	2 ounces.
Methylated spirit	½ ,,

To which add a drop or two as required of

Ferridcyanide potassium	15 grains.
Distilled water	1 ounce.

Action is very quick, and a variety of warm tones are obtainable from brown-black to orange. When desired tone is reached, wash well and dry.

310. Slides (Lantern), Wet—To Tone with Platinum.—After the slides have been fixed and washed they can be toned in the following bath: Bichloride of platinum 2 grains, water 10 ounces. It is advisable to first neutralise the bath with carbonate of soda, and then render slightly acid with nitric acid, otherwise the hydrochloric acid present in the platinum salt will have a bleaching effect. For fine black and white tones the slides may be toned fully with acid platinum, washed, and intensified with

Iron protosulphate	1 part.
Glacial acetic acid	2½ ,,
Water	40 ,,

To half an ounce of the above add twenty minims of a ten per cent. solution of nitrate of silver, and flow over the plate once or twice. Captain Abney says that the tone given by platinum alone is very apt to be inky, and that better results and more pleasing tones are obtained by a mixture of platinum and gold, as below:

Two per cent. solution of platinum tetrachloride	1 dram.
Nitric acid	12 drops.
Gold chloride	1 grain.
Hydrochloric acid	6 drops.
Water	20 ounces.

The most satisfactory toning bath for platinum is the ordinary one containing platinic chloride one grain, nitric acid one minim, in three ounces of water. The slides should be over-developed, fixed, and washed as usual, and placed in the above toning bath until the desired tone is produced.

311. Slides (Wet Plate)—To Tone with Uranium.—There is no particular formula for uranium toning of wet plate slides; upon the strength of the solution depends the rapidity or otherwise of toning. The following somewhat weak bath will be found to be well under control: Uranium nitrate 6 grains, potassium ferricyanide 6 grains, glacial acetic acid ½ ounce, distilled water 10 ounces. By increasing the proportions of the first two ingredients a quicker acting bath is obtained. When the required tone is reached wash and dry.

Another uranium toning bath for this purpose is made as follows: Chloride of gold 1 grain, potassium ferricyanide 1 dram, uranium nitrate 1 dram, water 20 ounces. This bath is used after well fixing and washing the transparency. It gives a variety of tones up to a bright Indian red. The final tone can also be modified by placing the plate in an ordinary gold or platinum toning bath for a short time. It is worthy of remark that the transparencies on wet collodion most suitable for toning are obtained by using a moderately thin collodion, containing a rather large percentage of bromide, *i.e.*, one that will give a soft delicate transparency without much contrast.

312. Slides (Lantern)—White Ink for Marking, To Make.—Ordinary Chinese white can be used for marking lantern slides, or the following solution can be employed for writing on the film:

Iodide of potassium	10 parts.
Water	30 ,,
Iodine	1 ,,
Gum arabic	1 ,,

Use an ordinary pen, writing on the dark portions of the film. The solution converts the silver into silver iodide, thus producing white letters on a black or dark ground. Another white ink that answers very well is made by grinding zinc white (oxide of zinc) with water till quite smooth, and adding a little clean gum arabic, enough to give it a body and bind it. Try four parts of picked gum to a hundred and twenty parts of water, adding enough zinc to give good brilliant white. The following is also an excellent formula:

Chinese white	1 ounce.
Isinglass	2 drams.
Alcohol	1 ,,
Water	q.s.

Soak the isinglass in a little water until soft, then heat on a water bath until dissolved. When thoroughly dissolved mix into a paste with the Chinese white, well stirring it around with a piece of stick. When well mixed, add water in small quantities, well stirring at each addition, and trying it with a clean steel pen until it writes satisfactorily, then add the alcohol; or use

Sulphate of baryta	1 ounce.
Isinglass	2 drams.
Water	q.s.

Mix as above. The worst of all white inks is that they rub off when touched; this can only be prevented by giving the writing a protective coating of varnish. The best to use for the purpose is that known as "Water Varnish"; it can be bought at most photo dealers or made by boiling

Shellac	16 ounces.
Borax	3 ,,
Water	3 pints

together until dissolved. When thoroughly dissolved it may be thinned with water if too thick.

313. Slides (Lantern)—Woodbury Process for Making.—These slides are printed from the mould in the same manner as an impression would be pulled on paper. A special coloured ink is used, the nice brown of which is obtained by collecting the smoke from the tip of the flame of a small lamp burning benzine. This colour is very rich, and is undoubtedly permanent. As the glass plates have to be printed on a Woodbury type printing press, it goes without saying that the glass must be perfectly flat. Altogether, taking into consideration the enormous pressure required to make a mould, the cost of printing presses, etc., it is not a process that anyone can be advised to take up in

a small way. The carbon process of making lantern slides is much more suitable for working on a small scale. The following is a brief description of the Woodbury process: An image in relief is obtained on gelatine, sensitised with bichromate of potash. When hard and dry, it is placed against a sheet of lead, and enclosed in a steel frame. It is then put under hydraulic pressure, with the result that the image is forced into the lead. The lead is placed in the bed of a printing press of special construction and inked with a gelatinous ink. A square of glass, 3¼ × 3¼, is placed on the image and subjected to moderate pressure. In a few minutes raise the glass, and a beautiful clear slide will be the result. Under the name of Stannotype this process has been simplified, but the results are not so good.

314. Slides (Lantern)—Yellow Colour of, To Remedy.—The yellow colour may be due to iron deposited in the film, owing to insufficient washing. If so, a soaking in weak sulphuric acid may do good (use one ounce of acid to eighty ounces of water). If, however, the gelatine be stained owing to sulphuration, etc., nothing will take out the stain, and then the only thing to be done, if the stain is fairly even over the whole plate, is to make a negative by contact on another lantern plate, and from this make the slide again by contact. In doing this a good wrinkle is to use the mask when making the contact negative, so that the edge in the negative comes out transparent; then when the new slide is made, mask and slide are developed at once, saving the use of a mask. If the stain is uneven, coat the glass side of the slide with collodion, stained to the proper depth with aurine or turmeric, and scrape away the part not required, so as to even up the whole stain. Another plan is to try Edwards's clearing solution made as follows:

Alum	1 ounce.
Citric acid	1 ,,
Sulphate of iron	3 ,,
Water	20 ,,

The sulphate of iron prevents the solution from reducing the plate too much. In many cases, however, it is noticed that "in some of the slides the defect has not appeared until two years after making." This serves to confirm an impression that some authorities have formed concerning the development of all dry plates, viz., that though they be apparently developed and fixed right through to the glass, they are not so, and it is the trace of silver left in the film which, on exposure to light, becomes converted into sulphide of silver, and the action once set up within the film goes on after the negative has been printed from and put away. The only *real* remedy that has been found of service is, after development and well washing the plate, to rapidly dry the same by immersion in methylated spirits for five minutes, then stand up to dry in the dark, and put away in a box with others for at least a week; then to take out and again well wash, and proceed to fix in hypo 5 ounces, water 25 ounces, sulphite soda 1 ounce, for ten minutes, and on plate appearing to be fixed to put into a second bath for the same time as the first. Then to wash *face down* on angles in running water for two hours. Plates treated thus have all the characteristics of wet plates without any of the many defects incident to the dry, negatives taken ten years ago being now in as good a condition as when taken. Should varnished negatives have darkened and yellowed, the varnish may be removed with spirit, and by adding a little liquor ammonia P.B. to the same after standing a little time, the negative becomes washable with water, *face down*, when it can again be fixed in the two baths, or treated for reduction by Mr. Howard Farmer's excellent reducer of ferricyanide of potassium and hypo used weak. By fixing negatives in hypo and sulphite of soda the clearing bath may be dispensed with, and by fixing them *face down* on "angles," the salts contained in the film fall by gravitation to the bottom of the tray, and the plate is thus rendered quite free from hypo, and when washed in the same way in a trough fitted with a syphon, which sucks the water and salts from the bottom of the tray, even though only one inch or less deep, and which may be regulated with the inflow to run at any speed, perfect washing is obtained with pure water. Many plates of varied sizes may be washed together, as also films and pictures at the same time, thus effecting a saving of time and water.

315. Strips (Binding)—To Prepare Dextrine for.—Dextrine, or British gum, or starch gum as it is sometimes called, is a substance prepared from starch by the action of heat, acids, or diastase. It is a whitish powder, soluble in cold and hot water, and in very dilute alcohol, but insoluble in strong alcohol and ether. This is made into a smooth, but rather thick, paste with cold water. Some workers prefer hot water, however, in which case it is best kept hot in a saucepan, *i.e.*, the jampot or other vessel containing the dextrine is placed into it; a piece of wood is put into the saucepan previous to the jampot for it to stand upon, after which it is about one-third filled with hot water, and the whole kept hot over a Bunsen burner or lamp stove, while the dextrine is being used. It is usual to give the strips of binding paper two coats, allowing the first coat to thoroughly dry before the second one is applied. Another plan is to coat the paper while in large sheets, using a rather large, flat, hog-hair brush for applying the dextrine with, and, after it is quite dry, cut it up into strips the width and length required. A quicker method would be to float the large sheet of paper upon the solution of dextrine, after placing the latter into a porcelain or other suitable dish, the process being similar to that of sensitising albumenised paper. This plan is only suitable when large quantities are required. Some lantern slide manufacturers use hot glue instead of dextrine for binding their slides, in which case two or three strips of suitable width and length are first prepared, and then used as quickly as possible. It is, however, better for one only to prepare the strips with the hot glue or dextrine, and another to bind the slides, as the quicker it is used after being coated the better it will stick. Another way is—Dissolve one part (by weight) of dextrine in five parts of hot water and paste the strips with this. If too thick, add more water until of the required consistency. The addition of a little salicylic acid will make it keep better, but it would be best to make it fresh as required. It is more flexible and less brittle when dry than gum. Cut the strip, say, 14in long, put one down on the table, apply the glue, remove it to a clean part of the table, and then, with slide and cover glass applied edgeways in the middle of the strip, proceed to bind. *It adheres at once.*

316. Subjects (Various) — To Make Lantern Slide Copies of.—Engravings, pictures, book illustrations, diagrams, etc., can be made into good lantern slides with great ease. To insure success, one or two points should be noticed. First of all, to obtain the negative, the best sort of light is magnesium ribbon; eight inches give about the right exposure, burnt in two lengths, four inches on each side behind the lens, and about two feet distant from the object, using an aperture of f/12. Secondly, by far the best results are obtained by carefully avoiding over-exposure, and by stopping the development before there is any danger of the

shadows being veiled; in fact, slightly under-exposing and under-developing. Then intensify with mercury. The resulting lantern slide, if a bromide plate, is best developed with pyrogallic acid and carbonate of soda. For copying coloured plates and pictures, an isochromatic plate should be used, and the instructions given with it carefully followed. It is, however, a somewhat difficult task to photograph such subjects as bottles of specimens of objects preserved in spirit. In somewhat similar cases fairly successful results have been obtained by adding a little aniline or other colouring matter to the solution—preferably a red dye such as fuchsine—by which the solution is tinted red, but the specimens resting against the inside of the bottle remain in their original colour, and by employing ordinary (not orthochromatic) plates greatly improved results may be obtained. But of course it is not always possible or advisable to colour the preserving fluid, although after the photograph is taken it can be removed and the ordinary preservative used. If this is not practicable, care in lighting will facilitate matters, so that the light shall come from one direction only, say from one side, in order to obtain as much shadow and contrast as possible.

CHAPTER VIII.

LENSES.

(STOPS, OPTICAL QUESTIONS, ETC.)

317. Black Mirror—To Make.—The use o an optically ground black glass mirror or reflector has been strongly recommended from time to time for photographing clouds. Black glass can be obtained at several glass works, but as the demand for it is very limited, it is somewhat expensive, something like eight shillings a pound. Besides which if the photographer requires an optically-worked mirror of black glass for use in photographing clouds, he will have to get one specially made by one of our leading opticians, who devotes attention to silvered-glass Newtonian telescopes; this will make it very expensive; one suitable for a two-inch lens would cost four or five pounds. Fortunately, however, all this this may be avoided without detriment. In the first place, it is not necessary that it should be made from black glass; there seems a strange misconception about this matter. The mirror is made so as to reflect from its front surface, and it matters nothing what the colour may be; it is, however, important that no rays should be reflected from the back, and this is easily accomplished by covering it with black varnish. Next, with regard to the front or reflecting surface, it is not necessary that its surface should be an optically perfect plane. A piece of good mirror plate (of course, unsilvered) will do everything that is required; in fact, the diagonal planes of telescopes are frequently made from mirror-plate cut to the right size and shape, the best out of a dozen or so being selected by trial with a telescope. These, however, are required to stand very high magnifying powers without loss of definition, while no such perfection is necessary for photographing clouds, which have no distinct outlines or delicate details. Hence a piece of good mirror-plate, coated at the back with black varnish, will do all that is required quite as well as the most expensive optically perfect plane of black glass, the one costing as many pence as the other does pounds. It should be mounted in a frame fixed at an angle of 56° 45′ in front of the lens, and it will be a convenience in using if a finder of some sort be fixed to the camera in the proper position to allow for the change of direction caused by the reflection. The exposure varies, of course, with the light, stop, and plate used, but using a slow plate and stop f/16, about a tenth of a second would be required. There are some black glass mirrors on the market—Claude mirrors or Claude Lorraine mirrors—for artists' use, but as these have not a perfectly plane surface, they would be unsuited for cloud photography if absolute correctness is required. A mirror about four inches by three would cost about five shillings.

318. Circle of Illumination—To Calculate.—The angle (a) included by this circle is given by the equation $a = \frac{\text{tau } r}{2h}$ in which r is the radius of the front lens and h the distance between the front surface of the lens and the incident, nodal point. Now, as the position of the latter varies with the type of lens employed it is clear that the value of (a) will also vary even when the focus is the same, according as a simple (*i.e.*, one piece of glass) landscape, doublet, or portrait lens is employed. It may, however, be stated generally that the circle of good definition, *in addition to focal length*, in a single lens will depend upon—(1.) *Shape of lens*, and will be greater with a meniscus than with other forms. (2.) *Achromatism.*—It will be greater with an achromatic lens than with a non-achromatic. (3.) *Size and Position of Diaphragm.*—It will become greater as the diaphragm becomes smaller up to certain point. It will also be greater if the diaphragm is moved nearer the lens, but in this case the distortion is also greater. If a *very small* diaphragm is used, it must be placed nearer the lens than usual. (4.) *Refractive Index of Glass.*—It will be greater if the refractive index of glass is higher. With a doublet lens it will also *vary in a similar manner* with the shape of lenses, size of diaphragm, and refractive index of glass, and the circle will also be greater the nearer the lenses are together. There are several exceptions to these rules.

319. Combinations of Lenses—To Calculate the Focus of.—The rule for finding the focal length of the combination of two lenses is, "Divide the product of the two focal lengths by their sum less their distance apart," *e.g.*, say the focal length of one is 8in. and the other 6in., and their distance apart is 2in., we have

$$\frac{8\times6}{8+6-2} = \frac{48}{12} = 4\text{in.},$$

and the position of the diaphragm slot is at a distance proportional to the focal lengths. Thus in this case it will be $\frac{4}{7}\times2=\frac{8}{7}$in. from the 6in. lens, or $\frac{8}{7}=1\frac{1}{7}$in. from the 8in. lens. Of course, if the combination is to be symmetrical, two lenses of equal focal length will be used, and the diaphragm slot will be midway between them. The above is practically accurate, but theoretically the distance between the lenses should be measured from their optical centres. Now in double convex or double concave lenses, the optical centre is inside the lens. In plano-convex or plano-concave it is on the plane surface, and in a meniscus it is outside the lens,

and behind it when placed with concave surface forwards. Hence, with the meniscus an error comes in the calculation; but, as a rule, it is very trifling, and can be neglected. Again, to find the focal length of a combination of three lenses, first find the focal length of the combination of two, and then (remembering that their optical centre is where the diaphragm should be, and the distance from the other lens is to be measured from this point) consider this doublet as one lens, and find focal length of the whole combination as before. Thus, to complete the above illustration, supposing a third lens to be used of 7in. focal length, and at a distance of 1¾in. from the 6in. lens, the focal length of the whole would be obtained from

$$\frac{7 \times 4}{7 + 4 - (1\frac{3}{4} + \frac{4}{7})} = \frac{28}{9} = 3\frac{1}{9}$$

and so on with other lenses.

320. Distortion—To Correct.—Arrange negative and copying camera so that axis of lens is at right angles to plane of negative. The image is focussed to suitable size on the centre of the ground glass, and then the swing back is tilted just enough and no more than is necessary to render the vertical lines quite straight. Refocussing may now be required, and a smaller stop than might otherwise have been required must be used. It may also be cured by tilting the negatives in copying. As the vertical lines probably converge to the top, that portion of the negative will require to be tilted towards the copying camera: or, if the swing back is used, the end of the plate on which the top comes will want tilting away from the lens. If the convergence is uneven, that is, the lines vertical on one side and those on the opposite side tilting towards them, it will be found most convenient to fix the negative with the central line upright, and correct the convergence by means of the swing back.

321. Finders for Hand Camera—To Make.—These are easily made in the following manner: Get an ordinary round spectacle lens of about 2in. focus. Next make a little wooden box, in the front of which fasten the spectacle lens, and of the same length as the focus of the lens. At the back of this box fasten a piece of looking-glass at forty-five degrees with the bottom. Then cut a hole in the top over the looking-glass, and fix over this a piece of fine ground glass. If the image thrown on this ground glass is not quite sharply focussed, alter the lens till it is. Try this beside the camera, and mark the amount that will include the same angle of view as the camera. Then cut a mask out of black paper with a hole in of this size, and fasten it over the ground glass. Fasten this finder a few inches below the top of hand camera, or procure at any manufacturing optician's a bi-concave lens to give *exactly* the field of the lens, and it would not cost more than sixpence. The amount of field obtained with a bi-concave finder depends on the distance the eye is from the finder. The finder is easily adjusted by moving it nearer the eye until the view seen equals that on plate. Then mark position, and always use it there.

322. Flare Spot—To Prevent. — This arises from three causes—the edges of the diaphragm or inside of lens tube having worn bright, the diaphragm not being the correct distance from the lens, and lastly from a faulty construction of the lens itself. This last cannot be cured, as whatever is done the flare is only distributed over the surface of the plate instead of being localised. Moving the diaphragm a little nearer or further from the lens will alter the second case, but this generally causes distortion in the pictures, and in the first instance the cure is obvious. The edges of the diaphragm and inside of lens tube should be carefully blacked. The above is assuming the lens always shows flare spot. If it only occasionally gives flare, however, it arises from photographing with too bright a light opposite the lens, and in this case it is obviously a reflection of the surface of the lens on the plate. Flare spot more often occurs with a single lens than a doublet, though some portrait lenses when used for outdoor work are liable to show it. It is more in evidence in certain brightly lighted subjects than in others. When of circular form, it probably arises from a misplacement of the diaphragm slot, giving an image of the aperture of the diaphragm. Light may get in at the diaphragm slot, and cause flare. In this case covering the slot is the remedy, and an indiarubber ring the best means. Flare spot is an image of the aperture of the diaphragm reflected by the lens. The smaller the stop the more marked is the flare spot. First of all try blacking the stops and using a larger one, and probably the difficulty will vanish, because it does not follow that a lens which shows a slight flare, when a small stop is used on a trying subject, may not work well in all ordinary cases. If, however, the trouble remains, try altering the position of the stops so that the reflected light will be sufficiently diffused to do no harm. Yet the stops are placed so as to reduce distortion to a minimum, so that in moving them one evil is overcome at the expense of another. Flare spots also make themselves evident in the case of certain subjects. If there be a very bright light ahead, as, for example, may be reflected from the sky, and at the same time there be very deep shadows, so that a comparatively long exposure is necessary, the defect may be seen. It is very common in the case of single landscape lenses. The smaller the stop, the more marked is the spot. It may be cured by altering the position of the stop. There is no doubt that reflection does take place at every surface of every lens through which light passes. It is possible, however, for the maker to diffuse the reflected light to such an extent that it is so weak, in comparison with the transmitted light which forces the image on the sensitive film, that practically it has no effect.

323. Focus, Chemical.—To Obtain.—In the case of a single non-achromatic lens the blue rays, to which a plate is most sensitive, are brought to a focus at a point nearer to the lens than are the yellow rays, to which the eye is most sensitive. Hence, unless the ground-glass screen is moved nearer the lens after focussing, the picture will be blurred. This distance is about one-sixteenth the focal length of the lens used. The amount of correction may be determined by focussing a view, and then looking at the focussing screen through blue glass, again focus, measuring carefully the distance through which the focussing screen is moved, or lens, if focussed from front. Afterwards, in taking a picture, after focussing, always move the screen nearer the lens by this distance, and then the negative will be sharp. This correction will be nearly the same for near and distant objects. As, however, this is not quite exact, the distance which the focussing glass has to be moved in towards the lens depending somewhat on the varying distance of the ground glass from the lens, which varies with the distance of the object from the cameras, Mr. J. Traill Taylor recommends the following expedient for ensuring the requisite sharpness with non-achromatic lenses, when used in either a single or combined state. A weak, thin, convex lens—such as can be obtained from a spectacle maker—is obtained, its strength being such that when added to the focal length of the operating lens it will reduce the focus about two

per cent., or such other proportions found to be the correct amount of adjustment for a very distant object. As the focal length of the supplemental lens will be very great – forty-five to fifty times that of the camera lens—very little error will be caused by inserting it at the place of the stop instead of in contact with the lens. It can therefore be dropped in a slit, cut into the mount of the lens, like a Waterhouse stop, where it remains until the focus is obtained, when it is removed, and the photograph taken without it. The slit in the lens mount should be covered with a rubber or velvet band to exclude extraneous light when exposing.

324. Focus, Fixed—To Calculate.—The equivalent focus of a lens is a term applied to a compound lens. It is the focus of parallel rays entering the lens, *i.e.*, the point where the parallel rays of light entering the lens cross each other. It is termed equivalent from being compared with a single lens that would produce the same sized image at the same distance from the object. With short-focussed lenses there will always be a position at a distance beyond which everything will appear in focus. (This property of a lens of bringing near and distant objects into focus at the same time is called "depth of focus.") This distance will vary with the *size of the diaphragm*, becoming less as the diaphragm becomes less, and with the *focal length of lens* the distance becomes greater as the focal length increases. With short-focussed lenses it is practical to fix the lens at such a distance from plate or focussing screen that all objects beyond a certain distance from camera will be approximately in focus, *i.e.*, the disc of confusion will be less than $\frac{1}{100}$ of an inch. This is what is meant by "*fixed focus*," and the lens is then said to be a "*fixed focus lens*." The formula given in Wall's Dictionary is practically correct, though that given by Sir D. Salomons is more so. The point beyond which all will be in focus = f + 100 f^2 R inches where f = focus of lens in inches, and R aperture of stop in relation to focus, and allowing that if points in the object are represented in the image by circles having diameters of $\frac{1}{100}$ of an inch and less, the picture will be considered sharp. As f in comparison with $100f^2$ is very small, it may generally be disregarded, thus reducing the formula to 100 f^2 R inches, or $8\frac{1}{3}$ f^2 R feet, so that with a lens working at f/8 the distance at which all will be in focus is practically f^2 feet. For instance, the distance at which all objects will be in focus when using a 9in. lens with stop f/16 = 9 + 100 × 9 × 9 × $\frac{1}{16}$ = 43 feet (nearly). The following table will illustrate this:

Focus in inches.	f/8 ft.	f/8 in.	f/11 ft.	f/11 in.	f/16 ft.	f/16 in.	f/20 ft.	f/20 in.
4	17	0	12	5	8	8	7	0
4½	21	5	15	8	10	11	8	9
5	26	5	19	4	13	5	10	10
5½	31	11	23	4	16	2	13	0
6	38	0	27	9	19	3	15	6
6½	44	6	32	6	22	6	18	1
7	51	7	37	8	26	1	21	0
7½	59	3	43	3	29	11	24	1
8	67	4	49	2	34	0	27	4

325. Focus of Lenses—To Alter.—This is very easily done by fixing a spectacle lens of suitable focus as near the diaphragm as possible. A temporary mount for the spectacle lens can be made of two pieces of thin sole leather or of rather stout cardboard, having round holes in them of suitable size, but the holes must be less in diameter than the lens is. The leather or cardboard is glued together round the edges after the spectacle lens has been placed in position, and after it is quite dry this leather or card lens mount is cut so as to fit the interior of the lens tube tightly. For instance, a lens that is fitted in the above way, is a quarter-plate W.A. lens, of 3¾in. equivalent focus, and by using one spectacle lens its focus is increased to four inches, and by means of another to six inches, and when used with care and judgment a good cabinet of lenses giving straight lines is obtained; the original combination is, however, rectilinear. Use *concave lenses* to lengthen the focus of the lens, and *convex lenses* to reduce its focus. Perhaps the cheapest and best kind to be obtained at most opticians are those round eyeglasses, price 6d. and 1s. each, as their diameter is greater than most spectacle lenses are, which is an advantage, because a larger stop when required can be used in the lens that has been fitted with one than would otherwise be possible.

The formula for ascertaining the focus of a lens required to increase or decrease the focus of a given lens of a known focus is as follows:

$$f = \frac{a \times b}{a + b - c}$$

Where f = focus of the combination of the two lenses.
a = " " lens of known focus.
b = " " " to be added.
c = distance between the optical centres of a and b.

Suppose, for instance, it is required to increase the lens focus from eight inches to twelve inches, hence:

$$12 = \frac{8 \times b}{8 - b} = 96 - 12b = 8b$$

$$\therefore \quad 20b = 96$$

$$b = 4\frac{4}{5} \text{ inches.}$$

In the second case it is required to reduce the focus to five inches, therefore:

$$5 = \frac{8 \times b}{8 + b} = 40 + 5b = 8b$$

$$\therefore \quad 3b = 40$$

$$b = 13 \text{ inches (nearly).}$$

In these cases the value of c may be omitted. It must be remembered that concave lenses lengthen the focus of the lens, and convex lenses decrease the focus. In the first equation—b is used because it is known that b must be *concave*, that is, of *negative* focus.

326. Focus of Lenses—To Correct.—When light is refracted through media of various densities it undergoes what is called dispersion, and a spectrum is formed composed of rays of different colours and of different refrangibility. The effects of the spectrum are three in number—(1.) Luminosity. (2.) Calorific effects. (3.) Actinic or chemical effects. The first effect is chiefly produced by rays in the yellow part of the spectrum; the second by rays in the red end; and the third by rays in the violet (and ultra-violet) end. These sets of rays form foci at different distances from the medium through which they pass, if the medium be of suitable form. Thus, in the case of lenses, *their* focal length with regard to red rays is longer than with regard to violet rays, while the yellow rays are intermediate. Now the focal length of the lens with respect to yellow rays gives the *visual* focus, while that with respect to violet and ultra-violet rays gives the chemical focus. Similarly the focal length with regard to red rays gives the "burning" focus. These foci obtain, even though the lens be corrected for aberration. A rather intricate mathematical calculation will give the exact degree of alteration for correction, but practically the best method is to focus as sharply as possible, and take a negative, then move the fine adjustment screw so as to bring the objective nearer the object, until upon the

screen a degree of indistinctness is produced about equal to that of the negative. Now take another negative, when most likely an improvement will be visible; by one or two trials like this, and carefully measuring the distance through which the fine adjustment screw is moved, when absolute sharpness is obtained, this distance will always be the difference between chemical and visual foci for that particular objective, but as the difference alters with each objective, trial of each will have to be made. On paper the above method sounds rather difficult, in practice it is decidedly easy, only necessitating a little care and patience. This is for photographic lenses. Microscopic lenses are over corrected; that is to say, instead of the red falling beyond the violet, as in a non-corrected lens, it falls within. The object of this is that the eyepiece, being non-corrected, it corrects the over correction of the object glass. Another difference between the correction of a photographic and a microscopic lens is that the former is corrected so as to bring the violet and yellow end of the spectrum to the same focus, and the latter is corrected for the red and yellow end of the spectrum. The visual focus is the focus of the yellow or light rays, and the chemical focus is the focus of the violet rays Microscopic lenses are not corrected for the visual and chemical foci, but for the yellow and red, as explained above. A method of correction with a microscopic lens is to screw a biconvex lens into the place of the back spot of the object glass (thus making it a part of the optical combination), and use a fairly low power (2in. or 1½in.), which will make the two foci very nearly coincident. Unfortunately, they cannot, in the case of higher powers, be made to coincide, and it is only by trial (and failure), as with photographic lenses, that the true actinic focus can be accurately determined.

327. Focus of a Lens—To Find.—The focus of a lens, *i.e.*, the distance it is from the ground glass when the object to be photographed is in correct focus, differs with the distance at which the object photographed is from the camera. The focus, however, for the purpose of definition, is what is known as the equivalent focus, and is taken as that distance at which an object at a considerable distance off is found to be in focus. The simplest way to find the equivalent focus of a lens is to point the lens and camera to the sun, and focus the image of the latter on the ground glass. The distance, then, between the ground glass and lens, if a single one, or between the ground glass and the diaphragm aperture for a combination will be the equivalent focus of the lens. There are more exact and mathematical methods than this, but it will be found to be practically all that is desired except for purely scientific purposes. Other simple methods are: Mark scale of inches on ground glass, then focus a foot rule so that the image shall be exactly of same dimensions as the object, *i.e.*, an inch of image shall cover an inch on ground glass. Measure total distance from object to ground glass—one-fourth that distance is the true focus of the lens. If the camera will not extend to double the focus of the lens, then focus on a *distant* object, say trees on the horizon, when the focus of the lens will be *nearly* the distance to ground glass measured from the glass of a single lens, or the stop of a rectilinear or symmetrical. Another: On the ground glass of the camera draw two pencil lines about an inch from the margin at each side. Now set up the camera on a sheet of white paper on a table before a window, and focus for some distant scene about one hundred and fifty or two hundred yards distant, in which there is some distinct feature, such as a tall chimney or church spire. Make the image of this fall upon one of the pencil marks on the ground glass, and with a pencil draw a line upon the paper, using the side of the camera as a rule. Now bring the image of the spire or chimney upon the other pencil line, when draw another line upon the paper also along the side of the camera; remove the camera, and with a rule continue these lines until they cut one another and form an angle, across which draw a line, so as to form a triangle, which line must be exactly the same length as the distance between the two pencil lines on the focussing screen. Find the centre of this line accurately, and connect the junction or apex of the angular lines with the centre of the base. This line will then be the true equivalent focus of the lens.

328. Focusser Compound—To Make.—Procure a pair of biconvex lenses of 2in. focus and 1¼in. diameter. Make a pasteboard tube 1¼in. internal diameter, and an inch long, to carry the lenses, and also make four other pasteboard tubes to slide inside this, a pair of these being $\frac{1}{16}$in., and the other pair ⅛in. long. Cut a circle in pasteboard 1¼in. diameter, and in the centre of it make a circular aperture ¼in. diameter. Make another pasteboard tube 1¼in. long, and of such a diameter as to slide stiffly outside the tube carrying the lenses. Glue the tube $\frac{1}{16}$in. long to one end of the lens tube and push in one of the lenses. Push down the next tube ⅛in. long until it rests on the lens, then push in the stop, next the other tube ⅛in. long, over this the other lens, and having glued the outside of the last tube ($\frac{1}{16}$in.) push it over the upper lens, so as to keep everything in position, and push the lens tube, with its lenses, into the outer tube. Another method: Obtain two plano-convex lenses (achromatic lenses are best and most expensive), each about 3in. focus, and not less than 1in. diameter. Then get two pieces of brass tube, each 1¼in. long, one just wide enough for the above lenses, and the other to *slide easily* on the first. What is known as mandrel tube may be obtained in these sizes, and is best suited for the purpose. Then make two rings or flanges of strong brass wire. Solder the first inside the smaller brass tube ⅛in. from one end, put in one lens to rest on this, a ring or tube of blackened card ¼in. deep on the top, and then lens No. 2. The second brass flange is then soldered in, the wide tube slid on, and when polished up and lacquered may be considered complete. To adjust, set up camera and focus a well-lit view, put the open end of focusser upon the screen, and slide tubes upon each other until image is most distinctly sharp; adjust by focussing, if necessary, and make a mark upon inner tube where the two meet each other. Put a slip of paper between the two tubes if they slide too easily. It will be found cheaper to buy a focussing glass complete unless materials are at hand. One can be bought much better finished, with screw adjustment, for about 1s. 6d., or with achromatic lenses, 6s.

329. Focussing Glass—The Best.—When focussing on a clear glass centre, and with a single focussing glass, the object appears in focus when it does not so appear on the ground glass. This is due to the depth of focus of the focussing glass, and can be best avoided by using a compound focusser, as this has practically *no depth of focus*. The focusser may be adjusted by drawing pencil lines on the ground glass *before* attaching the microscopic covering glass with Canada balsam. The faint pencil lines do not then interfere at all with the focussing, but, seen in the field of the compound focusser, enable one to obtain a most accurate focus.

330. Focussing—Which Stop to Use.—In most cases it appears to be best to focus with the

stop it is intended to expose with, because if a given point is focussed with a lens having a certain stop inserted, this given point will not be in perfect focus when another stop is used. A larger stop will have the effect of making distant objects less distinct, and inversely a smaller stop will bring distance into sharpness, and if a very small stop is used the effect is that there is a general sharpness all over the picture, thereby losing all atmospheric effect and distance so necessary in every picture. It is frequently recommended to focus with one stop and then insert another when exposing a plate. There is, however, only one lens of which it is absolutely necessary to focus with a given stop, no matter what aperture it is intended to finally insert when exposing. The one referred to is Dallmeyer's rapid rectilinear. But this rule only applies to sizes above whole-plate. The instructions in catalogue are, "in all cases focus with No. 3 stop, no matter which other one it is intended to use eventually." This is presumably done to correct to a high degree some optical defect, probably spherical aberration.

331. Fog on Lens—How to Prevent.—This usually only occurs on cold days, when the heat of the hand condenses on the cold lens. Remedy: Keep the hand as far as possible from the lens. Another remedy is to wipe the lens with a piece of cloth, on which there is a trace of glycerine; there is an objection to this method, as it is liable to gather dust, but as it would be the back of lens, and consequently inside the camera, there would not be any appreciable harm.

332. Gauss Points in Lens—To Ascertain.—As these are occasionally referred to in works on optics, and it is by no means easy for a non-mathematician to understand what is meant by the term, the following remarks may be of interest: Gauss, the German scientist, in 1840, wrote a treatise on the problems connected with the passage of light through a system of lenses, in which he explained how to ascertain the Gauss points—or, as he termed them, *haupt-puncte*, or principal points. If a ray of light traverse a system of coaxial lenses—the lenses being of any thickness, of any focal length, and of any refractive indices whatever—the relations between the position of the focus of the incident and the focus of the emerged ray could formerly only be determined by an exceedingly cumbrous calculation, and it had to be repeated for each different system. Gauss showed how the solution of the problem could be made to depend upon the determination, for each system, and once for all, of certain *fixed points*, situate upon the axis of the system, *i.e.*, a straight line running through the centres of curvature of a number of spherical surfaces, and these points having been determined, the complete solution of the problem became a matter of simple algebra or geometry. There are two planes perpendicular to the axis which possess the property that any incident rays meet the first and the corresponding emergent ray meets the second in points such that the line joining them is parallel to the axis. These two planes are called the principal planes, and the points where they cut the axis principal points (Gauss points). These points are conjugate points and fixed points, whose position depends entirely on the constants of the lens, and they may therefore be used as the origins, with reference to which the position of other points may be reckoned, and they are of great importance in the discussion of the path of a ray through a thick lens, or a system of thick rays. As the formulæ for the necessary calculations for ascertaining the position of these points are rather long, it is impossible to reproduce and explain them here, but full information will be found in following works: Vol. III. "Scientific Memoirs," 1841-1843, by R. Taylor, pp. 490-498. "Pendlebury on Lenses and Systems of Lenses," treated after the manner of Gauss (G. Bell & Sons, London, 1884). "Heath's Geometrical Optics," Ch. V., Refraction Through Lenses, p. 63, etc. (Cambridge University Press, 1887).

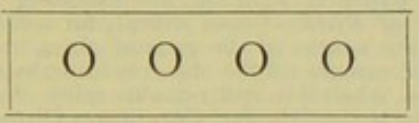
333. Heat Rays—To Cut off.—For photo-micrographic work both alum and sulphate of copper are used in the troughs. Probably the former would be best, as copper sulphate solution cannot be used for cutting off heat rays if the light is to be used for ordinary purposes, as the solution is of a deep blue colour. A solution of alum is usually used; this absorbs the heat rays effectually, and is as transparent as water. A saturated solution should be made—preferably of alum crystals, as it would probably be clearer—and is then filtered. If it is to be used as an optical lantern it should be employed in a glass trough, placed against the condenser, between it and the light. The tank should be of fairly large size—as large as can comfortably be used—as the solution will get very hot. Ordinary alum is the proper thing to use preferably, and as said above, in crystals.

334. Iridescence on Lens—To Remedy.—This means that a thin film of air exists between the two simple lenses constituting the front lens. Under normal conditions these should be in optical contract, the exceedingly thin layer of Canada balsam used to cement them preventing any reflection from the front of the back (simple) lens. As matters stand, however, a certain amount of reflection is taking place, and this must mean loss of light. It is difficult to see, however, how the definition can possibly suffer, as the excessively thin film of air cannot appreciably refract rays passing through it. It is quite conceivable that under certain conditions the ground glass and the front lens might be at a pair of conjugate focal points of the back lens, and then an image of the iridescence would be formed on the sensitive plate. It is certain, however, that when the lenses are recemented all trouble will cease, that is, of course, assuming that the iridescence is due to bad cementing, and not to any defect (exfoliation) of the glass itself. Years ago, and especially with French lenses, this iridescence used to be of fairly common occurrence, and in most almanacs instructions are given as to cleaning off the old balsam and recementing. It is an optical fact that with an object glass—and under this head a photographic lens is included—by blocking a portion of the lens, the image is not affected otherwise than in intensity, though it is otherwise with an eyepiece, generally speaking. If, however, there be a break in the cement, such as a bubble of air, possibly trouble would be caused. In this case, a new element of refraction is introduced, and this alters the refraction of the pencils of light passing through the particular portion. No doubt when the lens has been recemented, there will be no further cause for complaint. The iridescence may have been caused by the use of impure Canada balsam, by damp, or by the use of excessive pressure when the component lenses were cemented. Sometimes the outside surfaces of lenses become what is called "rusted," and this may be removed by applying putty powder and water to the lens and gently rubbing with the finger.

335. Lens, Covering Power of—To Alter.—The simplest and cheapest method that can be employed to make an 8½in. R.R. cover a 12 × 10 plate is to get some circular spectacle (eyeglass) lenses, concave for short sight, Nos. 1 to 5, and have them mounted in light collars of blackened brass, wood, or

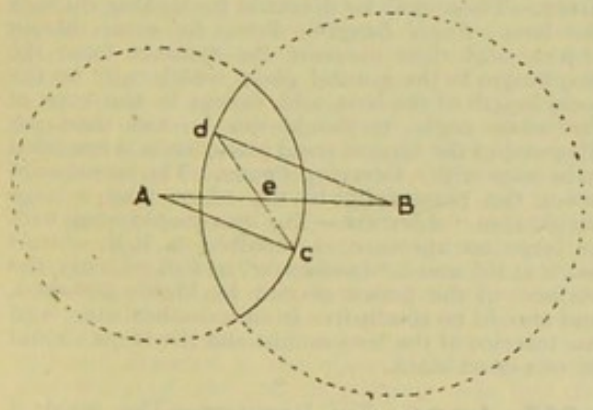
other material, to fit neatly inside the tube of the R.R. behind the diaphragm. Remove the back combination of the R.R., insert one of the spectacle lenses in its collar right up to the diaphragm slot, replace the back combination, and then focus in the camera. Measure the length of focus from the diaphragm slot to the ground glass, measure the diaphragms accurately, divide the latter by the former, and the quotient will give the new F values of your diaphragms for that particular combination. By employing other concave lenses of different powers, focal lengths may be obtained, varying from ten to eighteen inches, that will cover without much stopping down, but the F value separately must be ascertained for each measurement as above. The cost will be trifling, a few shillings at most. The R R. can be used as a wide-angle lens (without any additional glasses) by getting a new tube made into which to screw the combinations. The tube should be as short as possible so as to bring the combinations very close together, almost touching the diaphragms. The field will be rather round, so it will be necessary to stop down to f/32 at least, probably to f/45 or f/64. Another resource is to use one combination of the R.R. (Mr. Dallmeyer recommends the front one *in situ*) as a single view lens, the other having been removed. This will give a focus of about seventeen inches, and should cover with a small aperture. The F values are, of course, doubled numerically; for instance, the stop marked f/16 (probably the largest usable) becomes f/32, and will consequently require four times the exposure, and so on with the others.

Many years ago Mr. J. Traill Taylor described how he altered the focus of an R.R. lens in the following way: Four small achromatic negative lenses of different foci were mounted on a thin strip of metal, and a slot was cut in the lens mount in front of the



stop through which this strip could pass, so as to bring the additional lenses in line with the lenses proper, and between them in this way, in addition to the focus of the ordinary R.R., he obtained four other and different foci; so that by employing this method a long focus can be obtained with narrow angle lens.

336. Lens, Focal Centre of—To Find.—The focal centre of a lens depends, of course, upon



its form. In an ordinary spectacle lens it is equidistant from the surfaces. The method of finding the optical centre of a lens is as follows: From the centre of each curvature draw two parallel lines (equal to the radius) both oblique to the axis, join the points which touch the curved surfaces, and the point at which line touches the axis is the focal centre. In sketch annexed, AB is the axis, Ac and Bd the two parallel radial lines, and e the focal centre.

337. Lenses—Points to Note about.—It is always well to know one's tools, and often when the existence of a fault is known measures may be taken to avoid its influence on the resulting negative. The first point to note is whether

The hood cuts off a part of the field of view. Really, practically speaking, the hoods as generally fitted to lenses are no earthly good. The makers' idea—if they have one—seems to be that it shields the lens from stray light, but if that is the idea why not make the hood some three or four times the depth it generally is? It is a good plan to have the shutters fitted to the mount direct, after unscrewing the hood, and this is economical in more ways than one, as it saves bulk and saves money in the direction of getting smaller shutters. The hood is only used because the cap fits it. Now, to return to the subject, test if the hood interferes with the field of view. To do this, focus a somewhat distant view with open aperture. Then remove the ground glass screen, and place the eye in about the same place as before occupied by the screen and at one corner. Now look through the lens, and if the light appears a perfect circle all well and good, and the hood is all right. If, however, the appearance is not circular, but made up of two intersecting circles, the hood prevents the lens acting properly at open aperture. Insert the largest stop and examine again; if the light is not circular, insert the next smaller, and so on. Note the size of the stop which first makes the light a perfect circle. This will be the largest sized aperture at which the lens will act properly. Of course this is always supposing the hood will not unscrew. If it will, the plan is to take it off and do not use it, but have caps made to fit the mount.

The covering power of a lens should be ascertained, for many lenses sold to cover, say, 7 × 5 will not, unless much stopped down, cover a half-plate. To test covering power all that is required is to either adjust the lens to a camera having a larger focussing screen than the lens is supposed to cover, thus a 7 × 5 to a whole-plate camera; or, better still, fix the lens in a hole in the shutter of the dark room and focus on a large sheet of puttied or ground glass moved backwards and forwards for the purpose. Now observe the diameter of the circle of distinctness first with open aperture, and then with the various stops. The diameter *with open aperture* should be

5½ inches for a quarter-plate.
6½ ,, for 5 × 4
8½ ,, for half-plate.
8¾ ,, for 7 × 5
11 ,, for whole-plate.

Of course the screen must be moved to get the various parts of the circle distinct, but beyond a certain point no focus can be obtained, and it is this limit that must be observed.

Spherical aberration is a rather serious fault, as it impairs the sharpness of the image, and in some cases even gives an impression of great halation on the plate, whereas it is the lens which is in fault. To test for this is a simple matter. Focus a candle flame by means of a magnifying glass on the ground glass. Now examine the image for a sort of glow or halo all round the bright portion; also note whether the image is quite sharp. Of course this must be tried without any stop in the lens, and if the fault exists change the lens if possible. Another troublesome fault is what is called

A ghost, or false image, and this is tested in nearly the same manner as for spherical aberration. When the flame is focussed in the centre of the screen, turn the camera slowly so that the image moves to one side, and note carefully whether another image moves towards the other side. Of course it may not be in actual sharp focus, but it can be focussed if present, and appears the reverse way to the real image on the screen, *i.e.*, it is erect. It may sometimes be partially cured by the optician, but is apt to fog the plate when bright objects are on one side and dark on the other.

A flare spot is a serious fault, and unless the optician, by altering the position of the diaphragms, can cure it, the lens should be discarded. It assumes the form of a spot of light (really the reflection of the diaphragm aperture) produced on the optical axis of the lens.

Distortion is always present in single lenses, and generally in the compound meniscus form used for view lenses. This fault consists in the rendering of straight lines in the object as curved lines in the image—thus a square building will appear either barrel-shaped or dice-box shaped. With rapid rectilinears and the lenses on the same principle distortion is rarely, if ever, found.

338. Lens, Single — ADVANTAGES FOR LANDSCAPE WORK.—The single landscape lens has the advantage over the R.R.—first, in having only half the reflecting surface, and so allows more actual light to reach the plate (this gives crispness); second, the depth of focus is greater; third, *almost* perfect freedom from flare in very trying positions, and a freedom from blurring. As regards class of landscape, this is immaterial, so long as it is a landscape pure and simple, but it is found that much better results can be got with the "single" where there is a mass of trees and foliage, and also in snow scenes it is particularly marked. If the back and front lenses of a R.R. are identical in focal length, it matters not which is used, but sometimes the front has a little longer focus, and is generally used for the single lens, and makes a most admirable one. The focal length, it will be seen, is about double, and it will be found that the stop f/12 (of the combination) will give fair definition, but a much smaller one is preferable for ordinary purposes. The class of landscape in which the difference is most marked is probably in distant mountain scenery. A single lens gives a far better idea of the size of distant mountains in Swiss scenery, for instance. On the other hand, the difference is least marked where there is no far distance.

339. Lens Symmetrical — TO CONSTRUCT.—To manufacture a symmetrical lens of 5in. focus would require two lenses of 9in. focus each. To convert a 4¾in. lens into a doublet of about 5in. equivalent focus will require a lens of 18⅓in. *negative* focus mounted at the distance of seven inches. The best lens to obtain would be a deep crown meniscus of 18½ *negative* focus, that is, a diminishing lens, or one in which the concavity exceeds the convexity. The deep crown meniscus form is recommended for several reasons. In the first place it ensures rectilinearity of the image. Secondly, the actinic correction (achromatism) of the single lens will not be practically affected, so that the doublet will be practically achromatic. Thirdly, it is the form which will work at the largest aperture—a very important point in hand-camera work. In using the doublet, the 4¾in. achromatic lens must be placed at the front and the deep crown meniscus at the back nearest to the plate to get the best results in working the combination. With regard to the second point, achromatism, this *is* interfered with, but it is so slight as to be unnoticeable, and no correction is necessary.

340. Lens—TO CLEAN.—A lens sometimes acquires a brown, rusty stain on the surface which no amount of rubbing will remove. By applying a paste composed of putty powder and water to the stains, and then rubbing briskly with the point of the finger, every rust stain will be removed in a few minutes. If this does not remove the stains, the spots are probably caused by the drying or shrinking of the balsam used in cementing the lens. To remedy this unset the lens, place it in warm water, which may be further heated till the balsam softens, separate the component parts of the lens, and clean with ether, benzole, or turpentine, next place a drop of pure Canada balsam on the centre of the concave surface, and gently press the convex one down upon it until the balsam spreads and oozes out of the edges. Then apply a gentle heat until the balsam is found to have hardened. If the lens is a valuable one it is advisable to send it to an optician.

341. Lens—TO TEST ROUGHLY.—A lens may be roughly tested as follows: *Chromatic Aberration.*—Arrange a number of books on a table, slightly in advance of each other; focus for the middle one, and if on exposing a plate and developing this one comes out the sharpest, then the lens is corrected for chromatic aberration, but if not, then the lens is non-achromatic, and must be rejected. *Spherical Aberration.*—Fix up a newspaper in front of the camera, and focus sharply for some letters near to the centre of the focussing screen. If the letters nearer to the edges are blurred and indistinct, then spherical aberration is present. *Definition.*—Hang a watch up in front of the camera, and focus. The minute marks should be distinctly visible. *Flare.*—Point the camera towards a very strong light, when, if a flare spot be present, it will be seen as a circular patch of light on the focussing screen. *Flatness of Field.*—Focus sharply for some object near to the centre of the ground glass, and then rotate the camera till the object is brought close to the edges, when if it still remains quite sharp, the field of the lens will be flat. *Curvilinear Distortion.*—Point the camera at some perfectly straight upright object, such as a door-post, so as to bring it to the centre of the focussing screen. Now rotate the camera till it is brought to the edges, when if it is still upright and straight, the lens is free from curvilinear distortion, and is rectilinear. *Centring.*—Point the lens at a single gas or candle flame; several images of the flame will be seen, and if by a little manœuvring they can be brought directly behind each other, the combinations of the lens are properly centred. *Colour.*—Lay the combinations upon a flat piece of paper, when they should not colour the paper in the slightest. *Bubbles and Striæ.*—These may be detected by looking through the lens. *Focal Length.*—Focus for some distant object, and then measure the distance from the diaphragm to the ground glass, which will be the focal length of the lens, and, except in the case of the wide angle, it should not be less than the diagonal of the largest sized plate that it is intended to be used with. *Covering Power.*—The lens should cover the plate fully to the edges with a large diaphragm. *Aperture.*—The lens should work with as large an aperture as possible, a R.R. should work at f/8, and a "landscape" at f/16. Lastly, the surface of the lenses should be highly polished, and should be totally free from scratches, etc.; and the interior of the lens mount and the stops should be of a dead black.

342. Lens—TO UNSCREW.—The hood if fixed can sometimes be unscrewed by wrapping around it a piece of flannel previously soaked in boiling water, then placing it in a small vice and screwing it round, when it will unscrew quite

easily. A little oil poured round the thread of the screw and allowed to soak in will release a fixed screw; but Beck lenses on examination show that although the hood appears to screw on to the rack cell of the front lens, it is impossible to move it; although almost new lenses. If it appears that it is not meant to be removable, it is best not to try to force it off, but consult the makers about the possibility of removing the hood.

343. Rapidity of Lens—To Estimate.—The rapidity of a lens depends upon the relation the working aperture bears to the focus, the colour of the glass, and the freedom of the lens from dirt or extraneous matter. There is also some loss of rapidity due to the internal reflections of the lens surfaces. The rapidity of a lens is inversely proportional to the focal length, and directly proportional to the area of the aperture of the stop; that is, the longer the focus the slower the lens is, and the larger the aperture of the stop the quicker the lens works. The construction of lenses is based entirely on the mathematical laws of light. The rapidity of each stop is generally expressed numerically by dividing the focal length of the lens by the diameter of the stop. The values of the stops are then expressed as f/8, f/16, etc., and the relative exposures are *proportional to the squares of these numbers.* (See No. 351)

344. Sky Shade—To Make.—A simple yet effective sky shade may be thus made: Procure a piece of Honduras mahogany ¼in. thick, 6in. square. In the middle, one inch from the bottom, cut a hole just large enough to pass the lens tube (the hood being removed). Line this hole with black cloth, and also cover the edges of the wood with the same material. On the side nearest to the camera, at a distance of 1¼in. from each side, draw two pencil lines from top to bottom, and half an inch from the top one line from left to right, one inch below that another line in the same direction, and also one an inch from the bottom. Where these lines cross each other fix small wire staples, such as are used for binding papers, etc., the four at the top being placed horizontally, and the two at the bottom vertically. This completes the support for the sky shade. Having placed this on the lens tube and replaced the hood, it should stand up perfectly rigid. To make the shade get a piece of stout, thick millboard 18in. × 6in., divide this by lines into three portions each 6in. square; glue a piece of 1in. tape on the lines and cut through from the other side, forming hinges of the tape, bend into position, and apply to the wood support; then either make holes in the cardboard or fix wire staples into the edge to correspond with the staples in the wood. A piece of wire bent into the form of a square staple fixes the centre division on the top of the support, each leg of the staple going through the rows of wire staples. Another such wire fixes the side pieces or wings, the bottom being left open to allow the cap to be removed easily. Another simple form which answers well is as follows: Two light iron or brass rods are hinged to the camera front, the top portion of each being bent at right angles to the fixed part, so as to project in front of the camera and to fold flat against the front when not in use; a light rod two inches longer than the space between the two rods is bent down one inch at each end, and a hole or ring made at the end of each projecting rod for the cross rod to fit in; the whole is covered with cloth; it should be sewn to the cross rod and fastened at the other corners by hooks. For carrying the two supporting rods fold flat against the camera, and the cloth is rolled round the cross rod.

345. Spectacle Lenses for Stereoscopy—To Make Use of.—Spectacle lenses are quite suitable for stereoscopic photography. There is no distortion, and, provided a small enough stop is used with them, say f/32, they will give a sharp and brilliant image, equal to any and superior to many a compound achromatic lens. Spectacle lenses are sold by numbers to indicate the focus in inches, therefore a 5½in. focus spectacle lens would be No. 5½, but it is doubtful if they can be got ready made at fractions of an inch, though any number from five to thirty-six, and sometimes forty-eight, can be bought at any opticians at the price of about threepence apiece, and meniscus shape at fourpence and sixpence apiece. But the numbers over eighteen run only in 2in., and from forty-eight upwards in 12in.; that is, the next number over forty-eight is sixty, then seventy-two, and so on. Care should be taken to select lenses of a perfectly colourless glass, otherwise the exposure would have to be prolonged. If a good colourless lens is chosen, the exposure may be very rapid, as the lens is very thin, and for an instantaneous exposure in a good light in summer a f/32 is quite possible. But a 5½in. focus spectacle lens will never cover a quarter-plate sharp to the edges unless a great sacrifice is made in the centre and very much stopped down. To obtain this result nothing less than an 8in. focus lens will suffice, with stop f/32, and a meniscus or periscopic lens should be used with the convex side towards the plate. All spectacle lenses sold under a certain number by the same maker are of the same focus. Spectacle lenses should be used as large as possible, as they come from the makers, before they are cut down to fit into the spectacle frames, when they are nearly two inches in diameter, and admit, of course, a great quantity of light and shorten the exposure. There is no necessity for a stereoscopic photograph to be sharp to the very edges, as, as a rule, the picture is only 2¾in. × 3in. in size. The objection to the spectacle lens is that, being uncorrected, the visual and actinic focus is different by about $\frac{1}{30}$th of the focal length, so that, after focussing the image sharply on the ground glass, the screen would have to be racked in $\frac{1}{30}$th, which, in the case of a 5½in. or 6in. lens, would be nearly $\frac{3}{16}$in. In the case of a fixed-focus hand camera, the exact distance could be determined by experiment of exposing a few plates, and then there would be no further trouble. The cheap kinds of hand cameras have lenses of this character, and the focus arranged in this way.

346. Spectacle Lenses—To Employ.—Experiments go to show that, used properly, spectacle lenses give very soft and pleasing results. At the very best the definition is not equal to a corrected lens, but is infinitely superior to that obtained with a pinhole. In practice the camera must be extended about $\frac{1}{16}$ the focus of the lens beyond the distance that gives a clear image on the ground glass; if they are intended for use in a hand camera the same rule applies. For instance, a 5in. lens must be fixed 5⅜in. from the plane of the dry plate. The meniscus form or periscopic spectacle lens is to be preferred, and should be used with the convex side towards the sensitive plate. They had better be mounted for experimental use in a short cylinder made of tin or cardboard, or even of several thicknesses of stout brown paper pasted together over a suitable mould, taking care that the first layer of paper is not fastened to the model itself. In either case a stop made of tin or cardboard should be placed in front of the lens at a distance from the surface of the lens of about two-thirds of its diameter, and if convenient it will be well to actually try an exposure with this diaphragm adjustable, so that, if necessary, an alteration in this distance might be made. The centre of the diaphragm should be

in a line with the centre of the lens. It is possible that a larger aperture than the f/22 mentioned will be required to obtain the broad and soft effects referred to, and it will be well to try one of f/11, providing means for inserting a smaller stop if required. If, however, spectacle lenses of great focal length are used, it will be found that on account of the diameter of the spectacle lens being an almost constant quantity, it will not in such case be possible to use diaphragms of such large proportion to focal length.

347. Spectroscope, Simple—To Construct.—A spectroscope sufficient for the purpose of testing ruby glass can easily be improvised by the following arrangement: Make a small hole in dark-room shutter, or arrange matters so that light may only enter the room in one small hole. In the path of the light place a small glass prism (price about 1s. 6d.), and arrange a screen to receive the solar spectrum. Then when the spectrum is clear on the screen, place the piece of glass which it is wished to test on the hole where the light enters. If the glass be suitable for photographic purposes it should cut off the whole of the spectrum except the red. If the glass is to be used only for developing slow bromide plates or papers, it will be sufficient if the glass cuts off all the rays except the red and yellow. Another plan for testing ruby glass without the use of the spectroscope has been suggested by Dr. Vogel. The glass to be tested must be translucent enough to enable anyone to read in a light of seven candle-power a newspaper distinctly. Suppose that the seven candle-power light is yellow artificial light, not daylight. Then expose a plate under a negative one foot distant thirty seconds to the red light in question and develop. If only a *mere trace* of a picture is produced in this way the red glass can be considered as safe for photographic purposes. The red glass should be coloured ruby with cuprous oxide, not gold.

348. Spherical Aberration—To Test Lens for.—A lens may be tested for spherical aberration by choosing a large sheet of good print, and fixing it in a good light. Fix lens to a camera, with focussing screen at least as large as the lens is supposed to cover. Fix the camera at such a distance from print that the image may be clearly read. Having focussed centre of field, examine image carefully with a good focussing magnifier, and notice definition if sharp and distinct, etc. Then without moving camera, focus edges of screen, and again notice if any falling off in definition. It will be better to compare the lens (if possible) with a first-class *tested* lens of similar focal length. Freedom from spherical aberration depends upon the lenses being of proper curves, and a right proportion between flint and crown glass. When so proportioned there is a certain distance apart at which the lenses work best, and they are, or should be, fixed at that distance. In wide-angle lenses the combinations are deeply curved, and placed near together, in order to enable them to transmit very oblique pencils of light, and correction for spherical aberration is, to some extent, sacrificed to attain this. If, however, a wide-angle lens is used to cover a medium angle only, or used with a very small step, it should be fairly aplanatic. Another way is to place a piece of printed matter in small type, and about an inch square, in front of the lens, and at a distance equal to about ten times its focal length. Using the lens full aperture very carefully focus the image on the ground glass with a focussing glass magnifying ten diameters. Now, without altering anything, insert the smallest stop with which the lens is provided, and again examine the image. If it is as sharp as before, spherical aberration is absent; if not as sharp, spherical aberration is present. The amount of the aberration may be estimated by measuring the distance between printed matter and diaphragm slit of lens when the latter is used full aperture, and then having refocussed by moving the *camera* forward, if the back is movable, or the *lens*, if this is movable, again measuring the distance. Calling the two distances, less the equivalent focus of the lens d and d′, the equivalent focus of the lens f, and the longitudinal spherical aberration L, this latter is given by the equation $L = \frac{f^2 (d - d')}{d\,d'}$

It must be remembered, however, that measurements of this sort give no information as to the actual *photographic* value of the instrument. To determine this it is necessary to measure the extent of surface sharply covered, and the luminosity of the image, upon the product of which two things the value of a lens depends. Wide-angle lenses, made with ordinary flint and crown, are non-aplanatic, because the deep curves which it is necessary to give them, in order to make them include a large angle, render the comp ete destruction of spherical aberration impossible. Wide-angle aplanatic lenses have, however, been constructed of the new Jena glass, the curves being much shallower, owing to the peculiarity of the material employed.

349. Stereoscope—To Construct.—The original form consists of a double convex lens 3½in. diameter, cut down through the centre so as to make two semi-lenses, which are fixed in frames to separate them 2½in. from each other, and placed with their thin edges together. There is no reason why spectacle lenses of the right sort should not answer fairly, if they could be accurately paired; this, however, is almost impossible. A single spectacle lens may, however, be cut in two, and the two semi-circular (or semi-oval) lenses resulting used successfully in a small way by placing edge to edge. The chromatic aberration will be considerable, but may be reduced indefinitely with the aperture, and if the lenses be made from a double convex having the radii of curvature as 1 to 6, the spherical aberration is very small.

350. Stops—Best Position of.—The usual rule for a single lens is to place the stop one-fifth of the focal length in front of the concave, or flat side of the lens. The rule is not absolute, as at that particular distance it may give flare spot, this depending upon the curves of the lens. Another consideration is that the nearer the stop is to the lens the less distortion there will be towards the edges of the plate, and the larger the plate will be that the lens will cover, though the fixed stop or full aperture must be proportionally reduced, while the farther it is away within limits the flatter will be the field, and the better the definition. The optician usually fixes it at a distance which combines the balance of advantages. The most satisfactory means, however, of determining the distance of stops is by experiment. The following is a quotation from Mr. Traill Taylor's "Optics of Photography and Photographic Lenses," in which the above assertion is fully borne out. The book in question says: "A very sensible advantage may frequently be derived by the power of adjusting the distance between the stop and the lens in the case of a single landscape lens (objective. It is well known that with all such lenses, especially those of a plano-convex or only slight meniscus form, the farther the stop is from the surface of the lens, the wider may be the aperture in such stop. This, however, circumscribes the field of delineation. By placing the stop nearer to the lens, two advantages are secured: first, the lens will cover a much larger plate, and, secondly, the distortion that is so

common to landscape lenses becomes minimised; for, as we have shown in a previous chapter, the nearer the stop is to the optical centre of a lens, the less is the distortion: but this approximating of the diaphragm to the lens necessitates a smaller stop being employed than when a greater distance intervenes between them." It will therefore readily be seen that the distance must depend somewhat upon requirements, and that the only way of finding the best distance is by actual experiment.

351. Stops—How to Use.—Unless he has properly read up the subject, or received some instruction, the tyro's ignorance of his "stops" is sublime. Not knowing their use, he does not use them, or else, using them, knows not what allowance in exposure to make, and thus goes hopelessly and helplessly wrong. To use the stops, the principal object in the view to be taken is focussed until it is sharp. The edges of the picture, and either or both the foreground and the distance will then be seen to lack sharpness. A large stop is then inserted (or the "Iris diaphragm" somewhat closed) and the picture examined. If still not sufficiently sharp this stop is removed and a smaller inserted, or the "Iris" still more closed, until the desired effect is obtained. But the alteration of these stops makes a wonderful difference in the exposure requisite, and it is therefore highly desirable to understand the "focal value" of one's stops. They are measured according to their relation to the focal length of the lens, and if not already marked, the photographer should measure and mark them at once. In the "Iris" form of diaphragm the "focal values" are marked on a circular band with a movable indicator. First of all the focal length of the lens is ascertained. This is done by focussing sharply on some object sixty or seventy feet away, and then measuring the distance between the ground glass of the camera, and the diaphragm aperture of the lens if a combination (or the back of the lens itself, if it is a single one). Suppose this is 8in. F, or the focal length, then equals 8in. Now measure the diameter of the largest stop; this will probably be 1in. The diameter of the stop, therefore, is one-eighth of the focal length of the lens, *i.e.*, F ÷ 8, and is known for the future as f/8, or F·8. Now take stop No. 2; it is perhaps, $\frac{3}{4}$in., 8in. divided by $\frac{3}{4}$in. gives a fraction over eleven. Not to be too exact, it is called f/11. Stop No. 3 may measure $\frac{1}{2}$in. across. This, then, will be called f/16, and so on. This done, gives the focal values of each stop, which, in the case supposed, will be f/8, f/11, f/16, f/22, f/32, and f/45. Their relation to each other, as far as concerns the exposure requisite with each, is in proportion to the *squares* of the focal value numbers, thus squaring the focal numbers of the six stops set out above gives as follows:

f/8	f/11 and a fraction	f/16
64	128	256
f/22 and a fraction	f/45	f/45 and a fraction
512	1,024	2,048

Direct division of the square of the value of the largest stop into the squared figures of the others gives now their relative exposures with regard to each other. Thus dividing the above numbers each by sixty-four produces the series

f/8	f/11	f/16	f/22	6'32	f/45
1	2	4	8	16	32

Therefore when using f/16, *four* times the exposure will be required than when using f 8, and when using f/32 four times the exposure of f/16 or *sixteen* times that of f/8 will be necessary.

352. Stops—To Make.—Many advantages would be secured by having a set of central diaphragms made to a lens. One who is at all "mechanical" can easily make them at home. The full aperture of the lens will be the exact size of smallest combination. Find the *equivalent* focus of lens accurately. Here is a simple way of doing it. Set up a strip of paper on a drawing board, say a strip about half-inch wide and 5in. long, or, in any case, such a length that a full-sized image can be got on the ground glass screen; this will require a distance of about 13$\frac{1}{2}$in. between lens and focussing screen. Be sure that the image of strip of paper is exactly the same size as the actual strip of paper on drawing board. Now measure distance from drawing board to focussing screen, and divide result by four—this will give the equivalent focus. Also another equally accurate method is this: Get a full-sized image of the strip of paper and mark the exact position of the camera front; this can be done by sticking a small piece of gummed paper on the camera base. Now take camera and lens to a window, and rack in camera until a very distant object is sharp—the sun or the moon would do well, or a church—at a good distance, but be sure to obtain a perfectly sharp image. Then measure *the precise distance the camera has been racked in*, and this distance is the equivalent focus. All the above should be done with full aperture of the lens. Find the distance midway between the two combinations and cut the tube nearly half in two, then fix in two circular discs with apertures not smaller than the smallest combination. These discs must be close together, just far enough apart to allow the diaphragm to be inserted between them. Suppose the *equivalent* focus to be 8$\frac{1}{2}$in. The first diaphragm should have an aperture of 2$\frac{1}{2}$in.; this is just used to keep the light out of the diaphragm slot. According to the U.S. standard the next stop should be 5·657, and is numbered 2; that signifies that it requires twice the exposure of the previous number. The aperture will be as nearly as possible 1$\frac{7}{8}$in. in diameter. But the figures should be worked out quite accurately. The next stop would be f/8, or No. 4 of the U.S. standard, and will require an aperture of exactly 1$\frac{5}{8}$in. in diameter, and so on up to f/64. The above rough calculation is made assuming that the *equivalent* focus of lens is 8$\frac{1}{2}$in. Make discs, also diaphragms of brass, about $\frac{1}{40}$in. thick, and be sure to strike the circle of aperture so as to be central. Cut out aperture with fine fret-saw, using plenty of oil, otherwise the saws will break immediately. Black the stops chemically by immersing for five minutes in copper nitrate 20 grains, silver nitrate 20 grains, and water 1 ounce; then dry, and rub over with a little blacklead. Black lens tube with lampblack moistened with methylated spirit and a little shellac polish, just enough to make the mixture bind. The discs to hold diaphragms must be neatly soldered in, preferably with a blow-pipe.

CHAPTER IX.

MOUNTING AND FINISHING.

(ENAMELLING, TINTING, ETC.)

353. Alpha Prints—To Mount.—If it is possible to apply the mountant to the back of the print so nicely that not one spot gets on the front, there is no necessity to use black paper, but it is not easy to do this. However, when nearly drying off the glass plate to which they have been squeegeed, coat the back of the print with the mountant, and apply to the mount; use the squeegee vigorously, and when dry the glass may be stripped off, leaving the print in all its beauty upon the mount. It is best to use freshly-made starch paste, and most convenient to make it in a small evaporating dish, and then to heat gently over a Bunsen burner until it is just the right consistency, at the same time stirring it rapidly. Another very good mountant is gelatine in alcohol. With this prints can be mounted on foolscap paper, and will be as flat as though mounted on the thickest millboard. The solution is made by swelling fine gelatine shreds with the least possible quantity of water. Boil with alcohol, keeping them in agitation with a stirring rod all the time. The proportions of gelatine to alcohol are eighty grains to two ounces. When cold the solution will become gelatinous. It can be used for mounting by letting it stand in a pot of warm water. The prints can be burnished in a burnisher, but the gloss obtained by stripping off glass or ferrotype plates is much better. Another method is to use indiarubber solution as follows: Prepare a solution of indiarubber by dissolving forty grains of pure masticated rubber in four ounces benzole, and when dissolved apply the solution to the edges only of the print by means of a camel-hair brush, and transfer to the mount. The print will set quite firm on the mount, and the gloss will be retained even to the edges.

354. Aristotype Prints—To Mount.—After being squeegeed to polished glass, the print is left till it becomes surface dry. Then a sheet of stout white paper is coated with starch, and applied to the back of the print. After drying, the print is removed from the glass, and can now be mounted to the cardboard without losing its gloss. A good mountant is prepared in this way: Soak four ounces of best glue in cold water till it is quite saturated (an hour or two). Throw the water away, and melt the glue in a tin vessel standing in hot water; add three ounces of hot water, mixed with eight ounces of alcohol; the mixture must be well stirred. Add two ounces of glycerine and twenty drops of carbolic acid. This glue will keep a very long time. Before using it, place the vessel in hot water till the glue is quite fluid, and apply the latter to the white paper, backing with a stiff brush. Then mount as usual. To ensure easy stripping, it is found that waxing the glass with the following solution—pure beeswax five grains, rectified benzole one fluid ounce—is more certain than only rubbing or dusting with powdered talc, and the glass, once waxed, is always ready for squeegeeing prints. When it is required to mount the print on cardboard or in an album, brush the edges of the back with mountant to the breadth of about a quarter of an inch, and then mount the print, which will retain its gloss and flatness. Another method, dispensing with a backing, is to coat the edges of the back of the print itself while still on the glass, and slightly damp as above. Allow it to dry, strip, and when required for mounting, damp the edges where the mountant is. Another method is suggested by Mr. G. Wharton Simpson. Take eighty grains of gelatine and swell them with the least possible quantity of water, and boil in two ounces of alcohol for a short time, keeping well stirred with a piece of glass rod. When cool the solution will become gelatinous. It can be used for mounting by letting it stand in warm water. With this mountant prints may be mounted on foolscap paper, and they will be as flat as if mounted on the thickest cardboard. To preserve the gloss on mounted Aristo prints, procure some black glazed paper, white on one side, and take a piece one-sixteenth of an inch smaller all the way round than the print to be mounted, and having coated the white side with the mountant, press it on the back of the print (while it is still quite damp), which has been squeegeed to glass or vulcanite. When quite dry the print can be removed from the glass. Now paste the backing paper and mount in the usual way, putting under a weight for about an hour. Do not let any mountant get on the surface of the print.

355. Aristotype Prints—To Spot.—Aristotype, and all prints having such a high gloss, should be spotted *after* burnishing, as the heated roller would naturally disturb or melt any gum, gelatine, or albumen, used as a medium with the colours. If the tints used are rubbed up in strong gum, and carefully applied with a tiny brush merely damp, they ought to dry up with the same extent of gloss as the print operated upon. If any large surfaces have to be covered, oil colours, using gold size as a medium, give splendid results, and dry almost as quickly as the water colours, and, owing to the gloss upon all the "spotting," is quite imperceptible upon the finished prints.

356. Artistic Finish—To Give to Prints Mounted on Glass.—The most effective and

simple mode of putting an artistic finish to prints mounted on glass of larger size than the print is to gild with gold paint. Give two coats, the second to be applied when the first is dry. This should be done after the print is mounted on the glass. Morgan's gold paint is advised, and a small bottle will serve for a large number of prints. Another way would be to paste strips of white or any delicately-tinted paper round the print at the back, or lay the glass upon a piece of gilt cardboard that is a trifle larger than the mounted print, thus forming a sort of frame around. To anyone using oil colours, a pretty finish would be to paint a "Greek Key" design upon the clear glass with black, and, when dry, back it up with gold paint, or pale blue. Straight black lines of varying width, placing the broadest at edge of glass, and finest next the print, would also look well, either left upon the clear glass or backed with a tint, or gold, as in the previous suggestion.

357. Autotypes—To Mount.—There are three methods of doing this. The first is, after the print is developed, the final support squeegeed to it, and the whole partly dry, to give the back of the support a thick coat of paste, place the mount in proper position over it, and put the lot under pressure till dry. The objection to this method is that drying takes so very long on account of the water having to dry through the mount. The second method is, after pasting the support, instead of putting the mount over it, to put on instead a piece of thin cardboard or specially-prepared waterproof paper, cut a little bit smaller than the print. This, of course, dries very much quicker. When dry, it is stripped from the glass, and if the cardboard has been used it is given a coat of alcoholic mountant round the edges only, and placed in position on the mount. If the prepared paper has been used, it can be given a coat of any mountant all over the back, and mounted in the ordinary manner. The prepared paper mentioned above can be obtained from Fallowfield. The third method is to let the print and support dry in the ordinary manner and strip. A solution of indiarubber in benzene is then used for mounting, and does not injure the surface. The objection to this is that, after a time, the indiarubber "perishes," and the prints then come unmounted. Another method to maintain the gloss of the collodion is to mount with the following:

Nelson's No. 1 gelatine	8 ounces.	
Soaked and dissolved in water ...	32	,,
Add methylated alcohol	10	,,
Glycerine	2	,,

Apply as little as possible, and when mounted keep under slight pressure for a short time.

358. Bromide Enlargements — To Finish in Black and White.—Bromide enlargements can be worked up in three distinct methods, either in oil, water-colour, or crayon. The colours required are Chinese white, lamp black, or Indian ink, crimson lake, or carmine, and neutral tint. For oil painting, add megilp and turpentine, and for the water colours, gum water, while the crayon method requires a parcel of assorted stumps and a stick or charcoal. Whichever method is decided upon, the print requires to be perfectly clean, and free from greasy finger marks, etc. If a fresh made enlargement, of course it would be, but if it has been lying about, or handled at all, it is advisable to give it a brisk rub over with a fine sponge and a trifle of soap; when thoroughly dry, a thin wash of alum water will give an agreeable surface for water colour or crayon. With water colours, commence operations by rubbing up black and carmine in a little gum water, to as near as possible the tint of the picture and, with a fine brush, carefully fill in all irregularities, white spots, and retouching marks; and, in the case of portraits, strengthen faint shadows, outline eyebrows, pupils of eyes, curves of mouth, and finger nails. Trace out any patterns of trimming or lace that may have been lost in exposure, and always have a print from the original at hand for reference in working. If the general effect is too chalky and wanting in half-tones, pass a wash of the merest tint of grey over all, and either take out the high lights while damp with a clean brush, or leave until dry, and delicately rub them off with an ink eraser, which can also be used with good effect upon dark shadows. The actual "working up" is done in a series of dots or strokes, known as "stippling" and "hatching" in different shades of grey, according to the requirements of the subject, and if the worker is not already somewhat artistic, it is better to closely study the markings of a good engraving to gain an insight into the direction these stippling or hatching touches should take upon the face. The forehead is done in a series of horizontal lines, blending and softening all wrinkles, rounding it with strokes crossing each other at angles. Reduce any "crow's feet," and faintly indicate eyelids and lashes with delicate touches. The iris of the eye may require outlining, and a trifle of white upon the ball on the *lighted* side only. In inserting high lights be sparing of the white, or unpleasant hardness results, and continually consult the guide, as any deviation from the original in this particular may completely alter expression and likeness. Delicately outline nostrils, and soften shadows each side of mouth, also the one under the lower lip, which should be nicely rounded off on to the chin. High cheek bones, lumps and muscles in the throat, can all be toned down or obliterated by working over several times, and the hair can always be improved by washes, adding touches of gum-water in the deeps and shadows. The gum-water tends to give an air of "finish" to the work, when all is satisfactorily stippled up, and can be employed with advantage upon the drapery also. In oils, lights and shades have to be blended into each other with the badger softener, and, perhaps, more "showy" pictures are the result, with less labour than either water or crayon demand. In crayon there is the advantage of being able to blend with the stumps, but, unless the "hatching" is done in firm, bold strokes, with a masterly hand, an untidy and "smudgy" effect is the annoying result. With a little perseverance, however, pleasing pictures are easily obtained, and if the beginner can obtain any good work to study, or has already any knowledge of negative retouching, he will he astonished at the rapidity of his progress.

359. Bromide Enlargements — To Finish in Colour.—Oils are decidedly easier and preferable for this work. In the following general instructions, it is assumed that the subject is a portrait. Before beginning the painting, have the print mounted on stiff cardboard, and when dry rub the whole surface to be painted with megilp, to keep the colours from soaking into the paper. Begin by laying in a background, say, of light greenish grey (permanent blue, lemon chrome, crimson lake, and white), and deepen gradually towards the bottom with a little raw sienna, vandyke brown, and more of the blue. Then mix a rather purplish grey with permanent blue, vermilion, and white, but inclining more to red than to blue. With this grey go over all the shadows on the face, beginning with the deepest ones, and adding, of course, more white for the lighter shades. The shadows must be made a little lighter throughout than they appear in the

bromide print, and their general tone (or the relation of one shade with another) must be strictly adhered to. Then work in the flesh tints (light red, yellow ochre, and white), beginning with the half-tone, and working up to the highest light. For the eyeballs, keep the colour as transparent as possible, using little or no white, and do not make the light on the eye too strong, or it will result in a staring expression; be very careful to render correctly the gradation of the shades on the white of the eyes, gradually deepening to the corners. Use a little crimson lake and white on the lips, but do not make them too red. Keep the colour for the shadows in the inside of nostrils warm, using burnt sienna for this purpose. For the hair use the colours as transparent as possible, except in the lights, which will be more or less grey, according to the local colour of the hair. Then proceed to the drapery, putting in the shadows first, and leaving the highest lights till the last. Do not attempt to finish at one painting, but aim at getting a groundwork of colour, keeping rather a low tone throughout. Let the painting dry, and then proceed to finish, using the colours as transparent as possible, making all the shadows and flesh tints warmer, and the colours throughout richer, using a little crimson lake and raw sienna (with or without white) for the flesh tints, and these two colours, with the addition of a little permanent blue and a little vandyke brown, will be also useful for glazing over the shadows. The above hints will also be found of considerable service in painting a landscape or interior. For landscape painting a series of useful greens may be made with lemon chrome, raw sienna, and Prussian blue for light tints; burnt sienna, chrome yellow, and Prussian blue for darker ones, and with less blue a variety of russet tints may be obtained. A simpler method still of finishing a portrait is that of tinting with powder colours, or ordinary crayons, confining the colouring to a flesh tint only, working up hair, eyes, and drapery, with black and white. This style is known professionally as a "tinted crayon," and is one of the most charming methods of finishing. To gain this effect, commence by rubbing the print over with soft bread crumbs, to remove any possible dirt and finger marks. Next dip the forefinger into pumice powder, and slightly grind all over the surface to be tinted; this roughens it sufficiently to take the crayon without disturbing the film. With an HH retouching pencil stipple in all spots or defects, and work up with "cross hatching" lines all the delicate shadows at the roots of hair, under the eyes, round the nostrils, and the corners of the mouth; the denser shades are softened afterwards with the crayon being stumped over them. If the worker is fortunate enough to meet with a flesh-tinted chalk, the task is much simplified; if not, the print must be treated with vermilion and Naples yellow, well blended with the stump, and the high lights should be rubbed in with white. Tint the cheeks and the lower lip with a delicate pink, and blend the colour on the cheeks into the flesh tints with the stump. With a fine charcoal pencil work up hair and eyebrows, and define the nostrils; line between the lips with the pencil also, and insert misty cloud-like masses each side of the head, well shading off the edges with the ever useful stump. When all the crayon and charcoal work is completed, to give a brilliant finish, just touch the pupils and corners of the eyes with a brush merely damp with gum. The curved line between the lips can also be treated thus with good effect, but great care must be exercised in thus applying gum, for fear of disturbing the crayon work. It is hardly necessary to add that this description of finish is extremely frail, and only suitable for portraits about to be framed.

360. Bromide Prints—To Colour.—If the print is mounted while wet with starch paste (which should be well rubbed into the paper) it will not become loosened when wet through colouring. The best method to colour bromide pictures is to mount, and when thoroughly dry to apply a wash of cold water in the same way as if proceeding to colour on an ordinary piece of paper before applying the tint. If the part to be washed with colour is evenly wetted with a small sponge and clean water, there will be less difficulty. The best effects can be obtained by broad hatching work; still the main body of local colour must be washed on before other tints are hatched over them. The results of a nicely-coloured bromide print are very charming and quickly done by one who knows how to do it, but they are not the things on which to try a 'prentice hand. It is also generally necessary to *harden* the gelatine surface. This should be done by soaking the finished print in a five per cent. solution of ordinary alum; or, if the print is already mounted, the solution may be sponged over it. Without this preparation the paper is too absorbent, the colour sinking into it wherever it is touched with the brush, or the prints may be soaked in chrome alum before mounting. Then give the print a thin wash of Newman's preparation for sizing; work can be done any way on this, and the colours will not be disturbed when worked over. Perhaps it would be better not to give such a copious dose when "washing" in the broad spaces—this April shower style would cockle any board—give t just enough to hold and flow even, and if not deep enough give it another when dry; the result will be far purer than before. Also mix the "body" colours with Newman's preparation; it makes a wonderfully rich "sheen," and the surface will bear gum with ease over it. For oils, no further preparation is required; mix the colours with megilp; this will work better on the gelatine than a thick colour, and by its making the colours more transparent it will make it easier to keep to the likeness. Put the background in first—light tints or warm ones suit bromides the best. When filled in soften and blend with a badger softener, put a little dark colour where it is wanted to increase a shadow, and some white if necessary to reduce one, put it on in a dotty way, and then blend it rather vigorously with the badger. It will be noted that a little colour has crept on the hair, flesh, etc. Remove this with a tuft of cotton wool, moistened in turps. Finish the hair and then the drapery. With the flesh, commence with the forehead, a pale thin yellow "blushed" with vermilion, and work down warmer as it reaches the cheeks. Leave these rather brighter than required, and soften and blend the whole with slight cross-strokes of the badger softener. When smooth work in the shadows with a *thin* shade tint. Wipe the flesh tint that has got on the eyes off with the cotton wool, and point them in. Take as little liberty as possible with these, for very little difference here will spoil the likeness. Bear in mind to use plenty of megilp to keep the flesh colour, etc., transparent, so as to enable the likeness to be adhered to, and the colours can be made more solid as skill is acquired, and, above all, don't be in too great a hurry. Many an oil "tinting" is spoiled with doing it with a rush.

361. Bromide Prints—To Mount.—Bromide prints should be mounted dry, and in the following manner: Take the print and place it face downwards on a piece of clean glass. Brush it over with a mountant composed of

Starch powder...	1 ounce.
Oil of cloves	6 minims.
Boiling water	8 ounces.

Boil over a fire until thick enough. Take a

mount and press into contact with the print, rubbing the surface until perfectly flat; place under a weight to dry. Prints can be mounted on linen by pressing stretched linen against the print instead of the mount. The mountant recommended by Prof. Burton answers very well. Put an ounce and a half of gelatine into an earthenware jar, such as a jam-pot, and add four ounces of cold water. Let this stand till the gelatine is soft, then place the jar into a saucepan containing hot water and heat until the gelatine is melted; then add half an ounce of glycerine and stir well. Finally, add ten ounces of strong methylated spirits in two or three portions, stirring well between each addition. This mountant can be bottled in wide-mouthed bottles, and will keep for a very long time. When required for use, place the bottle in hot water until the gelatine is fully melted. To mount bromide prints, when the prints are thoroughly dry, flatten them by the method recommended by Eastman, that is, by drawing the prints face downwards on a flat surface under the edge of a flat ruler, or flatten them by pressure. If the mount has a wide margin mark on it the correct position of two diagonally opposite corners of the print. Then lay the print face downwards on a flat surface, and brush over the back with a flat camel-hair brush, lightly charged with the melted mountant. Lay the print in position on the mount, and gently pat it down with a soft cloth, being careful not to rub the surface. Then lay a piece of rubber cloth on the mounted print and squeegee it thoroughly, preferably with a roller squeegee. Then allow it to dry under pressure. With prints mounted by this method there will be no trouble from cockling edges.

362. Burnishing—To Use a Substitute for.—It is often quite impossible, from various causes, to pass a print through the burnisher, yet a gloss or burnish may be desired. This can be obtained by rubbing the surface of the mounted print with encaustic paste, which is composed as follows:

Purified beeswax	50 parts.
Oil of lavender	30 ,,
Benzole	20 ,,
Gum elemi	1 ,,

363. Enamelled Prints—To Mount.—After enamelling, as usual (for which see directions Nos. 365 and 366), allow to thoroughly dry. It is a good plan to do this in the evening, and leave the prints all night in a warm room. In the morning they can be lifted at one corner with a knife, and stripped from the glass. The collodion film adheres to the print, and leaves the glass with a very high polish. The very best way to mount them is to make a solution of pure masticated indiarubber (forty grains dissolved in four ounces of benzole). Apply this solution *to the edges of the prints only* by means of a camel-hair brush, and then transfer them carefully to the mounts. This is by far the most satisfactory way to mount prints of this class.

364. Enamelled Prints—To Spot previous to Enamelling.—Use, instead of water, a mixture of white of egg and chrome alum solution for thinning the colours. In some large establishments they take the white of an egg, place it in a bottle with about a dram of finely-powdered chrome alum, and let the whole remain in contact, with occasional shaking for a day or two. This forms the medium, and it certainly does not run. Another method is to dissolve a little sensitised carbon tissue in hot water and spot with it, let it get dry, and then expose to light for a short time. It will then stand the gelatine bath perfectly. Or mix rose madder with India ink and a little albumen to match the tone of the print, spot it then with a fine sable brush, and when dry apply a drop of strong methylated spirit; this coagulates the albumen, and makes it insoluble in the hot gelatine bath. The albumen can be purchased in a dried form, and mixed with water as required; this will be more convenient than having to break a fresh egg each time. Another way is to mix the colour with plain water, and when *quite* dry on the print protect it by putting a spot of thin enamel collodion over the parts spotted. This is an effectual protection, and does not show when the enamelling is finished. It is possible also to spot without detection *after enamelling* by mixing the colour with a solution of gum senegal; this matches the polished surface very nicely, and allows more latitude for correction.

365. Enamelling—American Method of.—The following is Brandt's method of enamelling photographic prints with a transparent glossy film, which he says may be wiped with a wet cloth, and will not crack when exposed to heat or cold. Take a piece of clear glass free from any bubbles, and apply with cotton rag a mixture of talc and alcohol (equal portions), and rub dry. Then flow the prepared side with the following solution:

Celloidine	100 grains.
Ether	10 ,,
Alcohol	6 ounces.

To which is added any colour of diamond aniline dye desired in order to give the colour required. Allow the coated glass to dry for one or more hours. The print to be enamelled is mounted on a piece of thin card about two inches larger than the glass used, having previously soaked the card and print to render it very pliable. When the prepared glass is quite dry, the following solution is made at a temperature of 212° F.: Gum arabic 2 grains, alcohol 2 grains, glutina alba (white glue) 2 ounces, soft water 4 ounces. When dissolved pour into a filtering and pouring vessel. Then pour the dissolved emulsion over the glass, and with a straight edge work the sheet down on to the surface of the glass, taking care that no air bubbles get between the print and the glass. Put upon a rack to dry, with the glass down, in a cold room. When dry the enamel may be broken from the edges of the glass, and the sheet detached and cut up. If the article is to be mounted upon a card, it may be done by placing it in any of the usual presses used for that purpose, first cooling the enamelled surface with a piece of plate glass, and then allow it to remain for about a minute. Although this process and preparations are patented in the United States, anyone is at liberty to use them in this country, no doubt.

366. Enamelling Prints—Method of.—The first step is to procure a good quality of English sheet glass, as flat as possible, and, of course, free from scratches and bubbles raised above the surface. This is for all practical purposes equal to patent plate at about one-sixth the cost. Next make a strong solution of common washing soda, and after dusting the glass, immerse one piece, then tie a piece of string round each end of another piece, and place this on the one already in the solution, and so on, the string on each alternate one; the use of the string is to separate each plate, and so allow equal action of the soda. Let them remain overnight, and swill well with clean water. Allow them to drain, and when dry clean them by rubbing with a crumpled handful of tissue paper (this is much better than with a cloth). When this is done select the best side, and make a mark on the worst side with a diamond or a file; this will render it easy to tell at once the right side. After further manipulation dust a little powdered talc

(otherwise French chalk) on the glass. Rub this over briskly with a piece of very soft muslin, and dust off with a camel-hair brush. This is to ensure the perfect stripping of the film, but if left this way it is very apt to strip itself whilst the print is drying and so spoil it. To prevent it there is nothing better than to stretch a piece of muslin over the end of the index finger, then moisten it well in the *mouth*, and draw it with fair pressure round the edges of the plate, say about one-eighth of an inch wide; this enables the collodion to adhere firmly all round. Coat the plate with enamel collodion (this is much better than "home-made"), and allow to dry. The plate so prepared will keep any length of time. Dissolve one ounce of soft gelatine in eight ounces of hot water and filter, pour it into a hot dish, and immerse the prints, take one out, allow it to drain for a moment, then place it quickly on the collodionised plate, about one-eighth inch from the edge, and so on until the plate is filled (about six half-plate prints are quite enough on one glass). It should be noted that the best result is obtained when the glasses are warmed before the prints are placed on them; then squeegee lightly with a *roller* squeegee. This is better than a rigid one, for it permits dispensing with the piece of rubber cloth that must be between the print and *flat or rigid* squeegee. When all air-bells are out put at one side until surface dry, and then back them within an eighth of an inch all round with a fine quality of ticket pasteboard about twice the thickness of stout notepaper, soak the board in hot water, and then in the gelatine used for the prints, and squeegee them lightly on the prints; allow to dry for at least twenty-four hours; it is a mistake to strip them too soon, for it spoils the gloss. When dry, run a sharp knife round the edges of the prints, and they will at once leave the glass; trim as usual, and mount with thin hot glue applied to the edge, say about ⅛in. wide. By careful work the glasses will never require anything but fresh talc each time they are used, for if stripped clean there can, of course, be no dirt or grease on them. Another method of enamelling is by means of encaustic paste, for which the following are formulæ: (1.) Dissolve four parts by weight of white wax, by placing the vessel containing it in boiling water, and add three parts of turpentine. If the smell is objectionable, add some oil of cloves. Rub over the picture with the paste and burnish.

No. 2.	
Pure virgin wax	400 parts
Gum elemi	8 ,,
Benzol	160 ,,
Oil of spike	14 ,,

Apply with camel-hair brush or a soft flannel pad until a brilliant polish is obtained. The enamel collodion may be made as follows: Ether 4½ ounces, alcohol 3½ ounces, pyroxyline 30 grains, castor oil 24 drops. The first method can only be used successfully on cards by printing on paper a little larger than the mount, and afterwards trimming both and mounting on another card, or by masking the picture and printing a border to it. By the following process an absolutely perfect surface may easily be obtained, and that either on mounted or unmounted prints. Take Nelson's photographic gelatine, Nos. 1 and 2, ½ ounce each, water 13 ounces, methylated spirit 1 ounce. After soaking, melt and filter. Collodionise a glass plate as usual. When dry, dip the print in the fluid gelatine (not too warm), and lay it flat on the plate. Any superfluous gelatine does no harm. If the print be unmounted, take a mount and damp it, then place it on the back of the print *in situ*. With a roller squeegee a sheet of indiarubber, give three or four sharp rubs to and fro to drive out the bubbles, and to reduce the layer of gelatine to the utmost thinness. In four or five hours the mounted print will leave the glass perfect. The mounts must not be made too wet, or a separation from the print may occur. If this happens, just float the inside of the mount on the gelatine before applying it. A point worth notice is that enamelled prints always look best when convex. This can easily be brought about by using a thin two or three-sheet board instead of the proper mount. When dry, turn and raise in the press, cut a thin spring of card to place in the cavity behind, and to prevent a collapse. Mount by running a thin line of glue round the inner edge, and place under suitable pressure for, say, ten minutes. If this be neatly done, there ought not to be any scratches when mounted.

367. Flesh Tint—To Mix.—The tints for dark, medium, and fair complexions may be obtained of the artists' colourmen. The proper colours to use (when not using those ready mixed) for flesh are Naples yellow, with a little madder pink, the slight opacity of the Naples yellow giving a very soft effect to the flesh. In this combination of colours, yellow ochre would be more suitable than gamboge, which should not be used in flesh tints. A little cobalt will be found extremely useful for giving coldness to the tones, while raw sienna acts beneficially with regard to pale dark complexions.

368. Gelatino-chloride Prints—To Spot.—For spotting prints upon this paper before *enamelling* use retouching pencils BB and HB for working up faces and small spots. Any large surfaces can be touched with oil colours, diluted with methylated spirit or turpentine. In spotting previous to ordinary *burnishing*, the colours can be rubbed up in strong gum or white of egg, and will not be affected unless the rollers are allowed to get too hot. Spotting upon the polished prints can also be accomplished with the colours that are rubbed up in gum-water, and should any difficulty be experienced in getting the brush to work easily, add a drop of dilute ox gall to the palette. The most useful colours for matching various toned prints will be found in ivory black, carmine, indigo, and burnt sienna. It is also needless to observe that the finest of sable brushes are required for successful spotting, and the most suitable numbers are 0, 1, 2 and 3. A good way is to rub down on the palette Indian ink and crimson lake to match the tint of the prints, and mix it with a small quantity of gum-water. Let it dry on the palette, and it will keep for any length of time. Thin the colour down with a little *weak* gum-water, which should be fresh and clean. Prints spotted with this medium can be burnished without any fear of its moving.

369. Glue (Liquid)—To Make.—There is no really satisfactory glue for strong work which is liquid at ordinary temperatures; indeed, the higher the temperature at which glue melts, the stronger it usually sets. A fairly good liquid glue, which, however, will not stand damp, can be made by dissolving one ounce of borax in one pint of water, and gradually dissolving two ounces of shellac in the boiling solution. The following are also recipes for liquid glues made without acid:

No. 1.	
White glue	16 ounces.
Dry white lead	4 ,,
Soft water	2 pints.
Alcohol	4 ounces.

Dissolve the glue with heat, stir in the white lead, and last add the alcohol. Bottle while hot. (2.) Dissolve one part of sugar in warm water, and add quarter part of slacked lime. Keep at a temperature of 145°-165° F. for a day, shaking at intervals.

Then of this solution four to five parts are used to dissolve one part of glue, the whole being gently warmed. The addition of two to three per cent. of glycerine improves the glue, and a drop or two of oil of lavender removes the peculiar odour. (3.) Common glue dissolved in nitric ether forms a liquid glue of the consistency of treacle, and of superior quality as regards tenacity. A few scraps of indiarubber may be added to impart water-resisting properties. The ether will only dissolve a certain quantity of glue, and hence the solution never becomes too thick. (4.) Chinese glue. Shellac is dissolved in methylated spirit to the proper consistency, and the solution used as glue. Its quality, however, is inferior. If ammonia be used instead of spirit, the resulting solution of shellac will stick anything, but possibly ammonia may be as objectionable as free acid.

370. Gulliver's Paste — To Make.— Photographers often find it inconvenient to prepare starch paste in small quantities, but the following mixture, invented by Mr. Thomas Gulliver, when once made, will keep for months ready for use, and will be found excellent for mounting pictures. It is as smooth as oil, easy to prepare, does not thicken, and will stick like glue; it also has the advantage of not cockling prints so much as the ordinary starch paste. Take of

Picked white gum arabic	½ ounce.
Dextrine	2½ ,,
Liquid ammonia	4 drops.
Water	8 ounces.

The gum arabic is to be pounded in a mortar, and mixed with the dextrine; then rubbed in the mortar with two ounces of the water till quite smooth; then the rest of the water added, and boiled in an enamelled saucepan for ten minutes. When cold it may be put into a wide-mouthed bottle, the ammonia added, and thus kept for use.

371. Landscape Photos—To Colour.— Brush the surface of the photo with a weak solution of gelatine (six grains to the ounce). When dry the water colours will work well. Mix a little Chinese white with all the colours used, and use pure colour for the shadows. If there is much sky, sea, and foliage, a very pretty effect may be produced by floating the print on a solution of aniline blue for a few minutes. When dry, paint foliage with a transparent yellow, such as gamboge, made very thin; this forms a pleasing green when painted over the blue paper. Clouds painted in white and shadows in Indian ink look very well. Another way of rendering the surface of silver prints fit to take colours is to moisten the face of the print all over with saliva, and allow to dry before applying the colour. But if the print, after the last washing, be soaked for a minute or so in a solution made thus — Alcohol 8 drams, water 2 drams, glycerine 6 drams, the surface will then be rendered fit for colour, and will not be covered with minute cracks, as sometimes occurs when albumenised paper is moistened with the tongue. Only transparent water-colours should be used. Of course, those colours which are heavy and do not wash well, as vermilion and ultramarine, are to be avoided. The great object is to get a clear transparent wash through which the beauty and gradation of the photo underneath may be clearly seen, and on no account attempt to produce finish by elaborate manipulation. The colours of the landscapes must be kept cool in the distances, the warmer greens, yellows, and browns being used as the landscape advances to the foreground, always working with a full pencil of colour and put in the skies first.

372. Mountant, Indiarubber — To Make.—Great care must be taken in selecting the rubber used for the purpose. What is known as "masticated indiarubber" is best, but good bottle indiarubber will answer. The ordinary commercial rubber is useless. Then be sure the liquid obtained is benzole, and not *benzoline*. Some druggists either do not know the difference, or imagine that either will answer the purpose. Those who are not chemists enough to distinguish should get the benzole from a reliable dealer. To make the mountant dissolve ten grains rubber in each ounce of benzole. It dissolves on shaking. Indiarubber solution is prepared on a large scale by masticating the rubber and heating it till it nearly melts; it is then easily soluble in benzole. To make a small quantity, cut good Para gum into shreds, put it into a bottle of pure rectified benzole, shake it at intervals for a fortnight, when enough will probably be dissolved. An addition of chloroform will take up more of the rubber. If this is too tedious an operation an extraction flask can be used; take a flask with a wide neck (at least an inch wide) with a perforated cork stopper, through which passes a long straight tube of about a quarter of an inch bore, to the end of this tube must be suspended, inside the flask, a test tube with a hole in the bottom of it, put the shreds of rubber in the test tube and benzole in the flask, then set it on the top of a vessel of warm water, the benzole will be vaporised, will condense in the upright tube and drop back on the rubber in the test tube. In order to economise benzole it is as well to let the upright tube above the flask pass through a Liebig's condenser. Of course, it is easiest to buy the solution ready made. Another method: The rubber should be cut with a wet knife into the thinnest possible slices, and these cut with scissors into finest threads. A small quantity of these shreds (about one-tenth the capacity of the bottle) is then placed in a wide-mouthed bottle, and the latter is three-quarters filled with good benzole, which should be quite free from oil. The rubber almost instantly commences to swell, and in a few days, if frequently shaken, will assume the consistency of honey. If too thin, add more rubber, and if too thick, more benzole. The secret is to cut the rubber very fine, and use good benzole. Another capital solvent for indiarubber is chloroform, which may be used as with benzole. Turpentine also dissolves it, but is objectionable in use. Another solvent is mineral naphtha in the proportion of twenty ounces to half an ounce of indiarubber. No difficulty in making the solution should be found if the rubber is cut small enough, and a slight heat applied. Many recipes contain either shellac or mastic resin, and these are added in varying proportions, but generally the same weight of resin is used as of indiarubber. Rubber in benzole is the best to use for edging purposes, etc., as benzole is easily obtained, and is considerably cheaper than chloroform.

373. Mountant—To Make.—There are a large number of formulæ, of which the following are a selection :

(1.)

Dextrine	2 ounces.
Water	6 ,,
Dissolve and add methylated spirits	2 ,,

Put prints under pressure till dry.

(2.)

One of the easiest to use is made by dissolving

Pure masticated rubber	10 grains.
in Chloroform or benzole	1 ounce.

Benzole is cheaper, but smells a little unpleasant.

(3.)

The following mountant is a good one, and does *not* cockle the prints :

Gelatine	...	...	...	...	2 ounces.
Glycerine	...	...	...	...	½ ,,
Methylated spirits	...	...	...	...	3 ,,
Water	...	...	...	...	7 ,,

First dissolve gelatine, add glycerine, and finally the spirit.

(4.) Soak half a pound of best glue in cold water till soft. Melt the glue in kettle or earthern jar standing in a saucepan. When quite thin, pour in gradually methylated spirits, stirring well between each addition until quite clear. Strain through coarse muslin into bottle. Well cork, and keep for use. When wanted, stand bottle in hot water till glue is melted. This is especially good for *thin* mounts.

(5.) The following mountant will not cockle either the prints or the paper: Into a wide-mouthed bottle put one ounce of photographic gelatine and ten ounces of cold water. Allow it to remain until the gelatine is softened, then place the bottle into a saucepan of warm water, and the saucepan on the fire. When the gelatine has dissolved, add, in successive small quantities, five ounces of methylated spirits, stirring after each addition of spirit until the cloudiness caused by the addition of spirit disappears. The temperature of the solution of gelatine must be maintained until all the spirit has been added. When nearly cold it should be poured into small wide-mouthed bottles for convenience when required for use. The bottle should be placed in hot water until the mountant liquefies. It should then be well rubbed into the back of the print (which has been previously damped), leaving as little as possible on the surface, then immediately placed in position and gently pressed until dry.

(6.) An excellent non-cockling mountant can be made by dissolving white or unbleached shellac in methylated spirit to saturation. This is applied to the *dry* print with a brush, but care must be taken not to let any of it on the *front* of the print, as in such a case it could only be removed with spirit, and this would leave an ugly patch owing to the shellac dissolving and penetrating through the paper. This mountant has been used scores of times and with uniform success. By its means prints can be mounted on writing paper without cockling.

(7.) To mount without cockling, the print should be mounted dry, and either quite flat or with the face side curling outwards. This may be effected by rubbing the back of each photo with a paper-knife or very smooth ruler, with the print face downwards and lying on some soft material; half-a-dozen folds of flannel on a deal board answers well. Mark on the mount with slight pinholes the four corners that the print will occupy, and placing the print on a slab of glass brush quickly and evenly over it the following mountant: Good light coloured glue 4 ounces, glycerine ½ ounce, sugar ½ ounce, water 7 ounces. A little alcohol improves this. Now place the print in position and rub it down.

374. Mountant (Paste)—To Preserve.—Either alum dissolved in the water used for mixing the paste, or a few drops of carbolic acid, will preserve it for a great length of time, but if it is to be utilised for photographs of any description it is a mistake to desire the solution to "keep," as most prints, and those on silver in particular, cannot be mounted with too fresh a medium, and every batch ought to have paste especially made for it. Any of the pastes used for photographic purposes, such as starch paste, flour paste, and arrowroot, can also be preserved for any length of time by incorporating a small quantity of oil of cloves to preserve its sweetness, with a small quantity of glycerine and spirits of wine, the spirit to be added occasionally as it evaporates. The glycerine and oil of cloves must be added while hot, the spirit stirred in well when cold.

375. Mounts—To Cut out.—First mark out the shape required with straight-edge and T square for square shapes, and by the well-known method of sticking two pins in the board, tying some string very loosely round these for ovals. Stretch tight with a pencil, and, keeping the string tight all the time, draw the oval. The position of pins and length of string will be learned by experience, and vary according to size to be marked. Then procure a mount-cutter's knife, or an excellent knife is made by grinding an oyster knife V shape at the end. See that this is perfectly sharpened, and, holding in same manner as a dagger, make an oblique cut firmly and steadily on the lines marked out. If necessary, use a steel straight edge for the straight lines. If the board is cut through (a thick board may require two cuts), knock the centre out and trim the corners. For cutting out mounts a sharp knife is wanted. For rectangular shapes nothing is better than an old razor, not a hollow ground one, and a hard steel or glass bevelled straight edge. After a little practice it is not very difficult to cut fairly true, but attention must be paid to keeping the slope of the knife always the same. Oval mounts are much more difficult. A narrower knife is wanted, which can be mounted on a block to keep the bevel true, but with practice this can be dispensed with.

376. Mounts—To Gild.—The best way of gilding mount bevels is to use the transfer gold leaf, which is gold leaf pressed on to waxed paper as a temporary support. This may be cut into strips, and upon applying the gold to the portion of the mount previously sized, it leaves the paper. Or it can be done by having gilt paper cut into narrow strips, then gummed, and applied carefully and neatly. Strips ready cut and gummed may be had of the dealers as well as all other materials for framing and mounting. In using gold leaf it is advisable to gild several mounts at once, by placing them in a press, or they may be done singly by applying with a brush a mixture of four parts of Armenian bole, one part of sugar-candy ground up with whites of eggs, to make sufficiently fluid; the gold leaf is then laid on, and when dry burnished. This gives a good red gold, but the whole, or part, of the bole may be omitted if desired. Another method of using gilt paper—Take a sheet of gold paper and cover the back of it with thin French glue, being careful no dust or grit is in it, and hang up the sheet to dry. When dry, with the straight edge cut the sheet up into strips about the eighth of an inch broad. Next pass over the tongue four strips, or enough of the gold paper for the mount, when the contact of the glue with the tongue will have moistened it, and it will be sticky and pliable. Now take the mount and lay it down on the board in front, and with a strip of gold in the left hand, commence at the right-hand corner of the mount, and lay the strip close up, letting the edge of it be just covering the turn of the bevel; when about an inch is laid by the left hand, a clean duster once round the first finger of the right-hand passed over the short piece laid in its place will secure it, and in like manner till the end of the bevel is reached, when a small pair of scissors is used to cut the strip exactly to fit the corner. It will now be found that one half of the gold strip is secured to the mount, and the other half is sticking to the board; carefully disengage the paper from the board by raising the mount, and pass the tongue quickly over the glue again, and with the finger of the right hand, as before, rub it down carefully over the

right edge of the mount, and rub it down at the back. The other three sides must then be covered in the same way.

377. Names on Prints—To Write.—To print the name on the photograph several methods may be adopted. The simplest is to write the title of the subject on a slip of paper with aniline copying ink, or with ordinary copying ink mixed with gamboge or vermilion. Then slightly dampen the surface of the negative near the bottom corner in as unobtrusive and unimportant a portion of the picture as possible. Press down the paper with the writing upon it, leave for a few minutes, and then remove the paper, when the writing will be found to have adhered to the negative. When printed, the name will print out white. Another way is to write backwards on the negative, whilst a still better plan is to write the name with Indian ink on the surface of the paper before it is printed on. The ink will wash off in the after operations and leave the name in white where the surface of the paper has been protected by the ink. A good ink for writing on the dark portion of a photograph is as follows:

Potassium iodide	160 grains.
Distilled water	1 ounce.
Iodine	16 grains.
Gum arabic	16 ,,

This discharges the colour. Or a white ink may be made by mixing barium sulphate (precipitated) with thin gum arabic solution.

378. Opalines—To Make Composition for.—What the composition consists of is only known by those firms who make a speciality of them. A coating of Aspinall's white enamel applied to the edges will form a perfect substitute; or a composition may be used consisting of a mixture of barium sulphate and gelatine. A thick solution of gelatine should be used, and the barium sulphate stirred in to about the consistency of thick paint; apply warm with a brush. Another—Mix plain colourless collodion, such as is used for enamelling, with sufficient sulphate of baryta to give it a good body of colour. The trimmed prints being mounted on the opaline glasses, the margins are thoroughly cleaned, and a thin coating of the above preparation poured over the back, in the same way as varnishing a negative. When quite dry, a piece of paper should be pasted over the back to prevent the coating from chipping off.

379. Opals—To Colour.—The necessary articles for this work are an easel or retouching desk, a palette of porcelain (or a piece of opal glass is equally as effective, and cheaper); three round watercolour sable brushes, with hairs ½in., ¾in., and 1in. long respectively (one should be kept solely for dark colours); a dabber (amongst professional tinters the top of the third finger of the right hand is usually used), a short pointed stick covered at the point with cotton-wool and a piece of fine wash-leather will do as well; some megilp, or Robinson's medium, and some mastic varnish. The following colours, and the ordinary collapsible tubes of oil colours (which are the best) as sold by most artists' colourmen, are equally as good as those specially made for the purpose: Prussian blue, French ultramarine, indigo, Antwerp blue, verdigris, Italian pink, yellow lake, gamboge, burnt sienna, burnt umber, Caledonian brown, asphaltum, crimson lake, madder lake, rose madder, ivory black, lampblack, blue black. All tinting must be done by daylight. Robinson's medium is used to thin the oil colours for dabbing, and mastic varnish for brush work. The slides and opals should not be varnished if made by gelatine process. Every possible shade of colour may be made by admixture of the above. Where the photographic image is very dark, as bright a colour as possible must be used, so as to show any tint at all. Crimson lake is the most useful flesh tint. Prussian blue with one of the yellows gives good green foliage, for brighter tint use verdigris and Italian lake. Burnt umber, Prussian blue, and gamboge give good tree-trunk colours. The red of bricks (houses, tiles, etc.), best made by crimson lake and burnt umber. Prussian blue for skies. The followimg directions also apply to water colours: The colours chiefly wanted in portraiture are for the face, Naples yellow, pink madder, cobalt, brown madder, sepia, Indian red, burnt sienna, and vermilion. Indian yellow for jewellery, and a tube of Chinese white. Cakes of colour can be obtained for fair, medium, or dark complexion, also for various shades of hair, which would help the novice in colours. Commence by washing over the retiring shadows of the eyes, mouth, and forehead with a wash of cobalt and Naples yellow, the blue or green predominating as the complexion is dark or fair; then give a wash on the flesh of Naples yellow and pink madder (or the ready-prepared complexion colours before mentioned), then wash the hair with a suitable tint, remembering to keep it *en masse* (warm coloured hair will require cold high lights); then with a careful touch go over the eyebrows and eyelashes, and put in the pupil of the eye with sepia; the iris may be put in with sepia and cobalt for blue or grey eyes, and burnt sienna for dark eyes. Then hatch or stipple over the shadows from nostrils and mouth with brown and pink madder mixed. The lips are then to be touched with vermilion and pink madder, remembering always to keep the upper lip in shadow (the lips of children require more vermilion than adults). Next go over the shadows of the face with a mixture of Indian red, cobalt, pink madder and Naples yellow, taking care not to use the colour too heavy. Then the general flesh tints may be heightened by hatching, using the colour thin, and following the lines of the face. The colour on the cheeks may then be heightened with vermilion and pink madder, and the light on the pupil of the eye carefully put in with Chinese white. Touch the corners of the eye next the nose with just a faint touch of pink madder, and the edge of the upper eyelid with Indian red, and finally put in the white of the eye with Chinese white with a faint trace of cobalt. Jewellery may be touched up with Indian yellow, with Naples yellow for the high lights, lace, etc., Chinese white on high lights, and a faint wash of neutral tint in the shadows.

380. Optical Contact—To Mount Prints in.—The most simple and best method of mounting gelatine prints in optical contact with glass is the following: The glass is first thoroughly cleaned in the usual manner. The well washed prints are then taken, one at a time, from their last washing water, drained slightly, and then placed in their proper position on the glass, film, or picture, side downwards. Then put several thicknesses of dry, white blotting paper over the back of the print, and then a piece of American leather cloth, or sheet indiarubber, like or similar to that used for overcoats, and pass a squeegee over the whole several times, increasing the pressure each time. After the first few strokes the blotting paper (now wet) is removed, and the cloth or rubber placed over the back of the print, and the above squeegeeing process repeated, until all air bubbles or bells are removed. It is then stood up in a warm room or cupboard until quite dry, and is then mounted in the usual way. Either solio or P.O.P. prints can be made to adhere to glass very easily. The prints have only to be soaked in a weak aqueous

solution of gelatine, and then squeegeed down to the glass so as to avoid air bubbles. It is generally advised that to do this the best plan is to bring the glass and print in contact underneath the surface of the gelatine solution, but it is more convenient to proceed as follows: Remove the print from the gelatine solution, and lay it face downwards upon the glass plate. Then slide the print nearly off the glass, and gradually draw it back over the edge. Repeat the operation on the small portion of the other end of the print which was not previously acted upon. Then place the print in the position desired upon the glass, hold it firmly there with a finger and thumb, and then squeegee it well down to ensure good contact. In order to ensure the prints sticking well they should be dried slowly at the ordinary temperature of the air. Quick drying at an elevated temperature is apt to cause them to come off. The proper strength of gelatine solution is as follows:

Nelson No. 1 gelatine... ... ... 1 ounce.
Water ... ... 40 ,,

To prevent the gilt edges from peeling off, after cleaning the glasses, have them quite dry; now contact the prints from the gelatine bath on to the dry glass. For this kind of work it is best to use the plain bevelled-edged glass, and print a quarter-inch border all round the prints; it is more artistic. If it is found that the prints mounted with gelatine have a tendency to strip off, try the following: All that is required is a paste composed of pure wheaten starch. Rub some of the paste on to the face of print either with fingers or a *soft* brush, such as camel-hair, also rub some on to the glass plate Then lay print on the glass, and gently press out all *air bubbles*, preferably using a soft india-rubber squeegee Gelatine has been tried in a weak solution instead of starch, but found to be of no use whatever. It is desirable that all prints which are to be mounted as above should have a bath of alum and water, a somewhat strong one, and it will harden them and also remove last traces of hypo, thus serving a two-fold purpose. Of course it will be understood that the prints must be *thoroughly* washed between fixing and alum baths. Or another method: First clean the glass with whiting and water, rubbing well all over with a circular motion, allow to dry, wipe off with a clean cloth, and finally polish with a silk handkerchief and a little French chalk or ground talc. The success depends on having perfectly clean glasses. Now prepare a paste by taking three-quarters of an ounce of Brown and Polson's corn flour, rub to a smooth paste with a little water to remove lumps, pour on half gill of boiling water, stirring well, then place in a small brass pan, and allow to boil for half a minute, still stirring. Finally pour into a jar to cool, then smear the surface of the glass on which the print is to be mounted evenly, and go over it with the tip of the finger to get rid of any lumps. The photo, if dry, is immersed in water till thoroughly moistened, then taken out and the face drawn over a clean linen cloth to remove excess of water, when it is placed on the glass, and a piece of wet parchment placed on top of it to prevent damage. Then the squeegee is applied firmly and carefully to remove all excess of starch. A blunt piece of wood about 5in. × 1in., with a smooth chisel end, is found to be the best squeegee, always working from the centre of the print to the edge—in fact, for convex and concave glasses this is the only method to be employed.

381. "Papier Minerale"—How to Employ.—This is a strong, thin, and almost grainless paper; it can be obtained of most photographic material dealers. It is used by retouchers for working up thin high lights, the lights on drapery, etc., etc. It is used by pasting it on the back of the negative, and is then worked upon with a pencil or a stump and crayon, it having a splendid surface for this purpose. It is also used for a substitute for ground glass, but is hardly suitable for being used on the film side of a negative for the actual retouching.

382. Parlour Paste—To Make.—(1.) Four parts by weight of glue are allowed to soften in fifteen parts of water for some hours, and then moderately heated until the solution becomes quite clear. Sixty-five parts of boiling water are now added, with constant stirring. In another vessel thirty parts of starch are stirred into twenty of cold water, so that a thin milky fluid is obtained without lumps. Into this the boiling solution of glue is poured, with constant stirring, and the whole kept boiling a few minutes. After cooling, ten drops of carbolic acid are added to the paste. This paste is of extraordinary adhesive power, and if kept in closed bottles to prevent evaporation will keep good for years. (2.) Another is—Take a teacupful of best white flour, stir it up with cold water to a smooth rather thin cream, place the whole in an enamelled saucepan, and gently warm it over a fire, stirring constantly until thick. Remove it from the fire, and, when cold, add half-an-ounce of chloralum (obtainable from any druggist) and ten grains of crystallised carbolic acid, stirring well to incorporate the ingredients. This will keep fresh for years. (3.) Paste especially for photographs. Mix thoroughly 630 grains of Bermuda arrowroot with 375 grains of cold water by means of a spoon, then add ten and a half ounces of water and sixty grains of gelatine. When soaked, heat to boiling until clear, and when cold stir in well 375 grains of alcohol and five or six drops of pure carbolic acid. Keep in well-closed vessels and work up before use with a brush. (4.) Allison's mountant: Powdered gum tragacanth 60 grains, powdered gum acacia (or dextrine) 60 grains, alcohol 3 drams. Mix the spirit with the powdered gums in a cup, and add gradually, and with constant stirring, sufficient cold water to form a paste of suitable consistency.

383. Pastel Painting—To Colour Photographs by.—The materials employed in this process, which is a favourite one for colouring enlargements, are soft crayons or chalks of various shades and colours, and the work is entirely done, or ought to be done, with the fingers and the palms of the hands. The crayons should not be cut or pointed, excepting when some little finishing touches are desired to be given to the features and hair, but should be gently rubbed on the paper, one colour over another, and blended into form with the fingers, always commencing to work from the top, by which means a marvellous delicacy and softness can be produced. The shading is done by what is termed cross-hatching. Some pastel painters employ a stump, either of paper or leather, but it will be found that results of a far more satisfactory nature are obtained by working the entire picture with the fingers alone, and by a careful manipulation of the colour an effect is obtained almost equalling in strength and beauty that of oil colours, combined with that delicacy and transparency which is an essential quality in the highest portrait painting. For all large surfaces, such as backgrounds, etc., the palm of the hand should be used in manipulating the colours, after laying them on the paper. It will be found that when working with the crayons they are apt to break of themselves, and the sharp edges thus acquired will be of appreciable benefit in helping the student to produce the form he seeks to achieve. It is important that great care should be exercised in laying on the colours, so as to avoid too frequent

coatings, which tend towards opaqueness. The chief aim to be sought in pastel painting should be transparency combined with freshness of colour. Paper of a yellowish hue is considered the best for pastels. Should it be found necessary to efface any colour from the work, recourse must be had to a sable or hog-hair brush, with which the offending colour is easily dusted off. Pastel paintings are usually covered with glass in order to protect them.

384. Pinholes—To Take out.—With a fine camel-hair pencil the pinholes may be filled in with the following:

Flexible collodion	4 drams.
Ether	3 ,,
Rectified spirit	1 ,,

Rose aniline sufficient to colour the mixture a deep ruby colour.

This dries rapidly, and if carefully applied to the film effectually prevents the pinholes showing in the print. It is sometimes difficult to absolutely remove the pinholes, but the photographer may much improve the negative by placing on a retouching desk (or, at a pinch, in a printing-frame with the back removed and placed at a convenient angle above a piece of looking glass laid on the table), and with a fine-pointed camel-hair brush stopping out the holes with Indian ink. Indian ink is better than red colour, which is often used, because it approximates more nearly to the colour of the negative, and so is easier to judge of the required density. This will very likely produce light spots on the print, but they are easily spotted out with water colour. Another method—Procure a small bottle retouching medium and a HH retouching pencil. Sharpen this latter to a fine, long, tapering point, finishing off the pointing on a piece of the finest sandpaper. Put a drop of the retouching medium upon the negative and rub it round and round with the finger tip until dry. This is to enable the gelatine to *bite* the pencil. Now, with the negative propped up against a window, just touch a pinhole with the point of the pencil. If one touch is not sufficient, give another, and so on until the transparent spot is filled in. Use the pencil with the least possible pressure, and be sure to have it very finely pointed. In this way with a little perseverance all the spots will be eradicated. Another way is to fill them in with a fine brush and black varnish.

385. Portraits—To Colour in Oils.—The instructions given for tinting in water colours apply almost exactly for oils, with the exception, of course, that oil colours are used instead of water, and also a different medium. The medium found to be the best by one who has painted thousands of photos in oil colours is known as "japanners' *quick* gold size," and the photograph is either given a coat of this, and then the colours painted on that when dry, or else—and this is the way most used—it is mixed with the colours and used directly upon the photograph. If the print is on plain or even albumenised paper, it must be sized with a transparent size, to be obtained from any picture-frame gilder; if this is omitted the colours will sink, and the paper will yellow frightfully from absorption of the oil. In case of bromide prints this does not apply; when dry, paint in the background with good solid tints, and stub it over with the badger softener to blend and stipple the tints.

For tinting pictures in oil the following colours will be required: White, Naples yellow, yellow ochre, raw sienna, burnt sienna, mars orange, light red, vermilion, pink madder, crimson lake, Indian red, raw umber, burnt umber, terra verte, emerald green, ultramarine, Prussian blue, ivory black, and whatever other colours the particular draperies and background may require. Payne's grey is also useful. Use sufficient megilp to render the colours thin and transparent, and lay the colour on with as little disturbance as possible to secure their purity. Commence by carrying a warm tint of light red and burnt umber over the darkest shadows; use white, terra verte, and Indian red for the lighter shadows, white and terra verte for blending the high lights. The following are the best combinations for various complexions: White, Naples yellow, and vermilion; the same, with an addition of light red, white and pink madder, with a little vermilion for the tint on cheek. If these colours are mixed in small quantities those most suitable for the model can be easily selected. The shadows may be glazed over with a mixture of white, light red, and emerald green, or white, Indian red, ultramarine, and raw umber, the complexion of the person indicating the choice. The high lights should be touched in with white and Naples yellow graduating into the local colour. Strengthen the nostrils and the lines of the eyelids, and that separating the lips with Indian red. Carry a line of brown or indigo as may be required round the iris of the eye, put in the local tint, the reflected light and the pupil, remembering the part of the eye called white is really greyish, more or less light, according to the position of the eyes and length of eyelashes. The eyebrows and hair should be glazed with a suitable brown, keeping the former soft, transparent, and hairlike, and the divisions of the hair well, but not too strongly, defined, and the hair transparent where it meets the brow. The high lights of the hair will be bluish, being colder by contrast as the hair is dark or fair. Use Payne's grey mixed with shadow tints to blend the hair and face. Black dresses or coats should be glazed with a warm transparent black, into which strengthen the lights with tints of black and white mixed, and deepen the shadows with vandyke brown and a little lake. Should the hands require painting, they should be done with the same tint as face, with the addition of a rosy tinge on the knuckles and tips of fingers, and the divisions strengthened with a warm shadow tint. All draperies may be done, as in case of black, with such colours as the fabric may require, remembering always where the lights are cold the shadows must be warm. For lace or linen use white and blue black, white, black, and burnt umber, with white for the lights. For gold ornaments use yellow ochre or Naples yellow, yellow ochre and raw umber, and burnt sienna and raw umber.

386. Portraits—To Colour in Water Colours.—The best colours for the purpose are those known as "moist," which may be obtained of any of the best artists' colourmen. Newman's preparation is an excellent medium prepared. Oxgall is also a good medium. The face may be hatched or stippled. To commence, wash the face and parts it is desired to tint over with the medium, and then proceed to give the retiring shadows of the face a wash composed of Naples yellow and cobalt, the green or blue tint prevailing as the complexion is dark or fair. Then give the flesh a wash composed of Naples yellow and pink madder, keeping the tint pure, and not too heavy. Then give the hair a wash; if for brown hair, sepia is a good local colour; for fair hair, use Roman ochre, the shadows frequently having a greenish hue. In some photographs, it is necessary to use a little body colour for the high lights. The eyebrows and eyelashes should be lightly touched with brown, the pupil put in with sepia, and the iris with cobalt and sepia if a grey or blue eye, or, for a dark eye, with burnt sienna. The lips should be

coloured with vermilion and pink madder, remembering to always keep the upper lip in shadow. The lips of children require more vermilion than adults. The shadows about the mouth and nostrils should be hatched or stippled with brown or pink madder. The principal shadows of the face should be gone over with a mixture of Indian red, cobalt, pink madder, and Indian yellow, or cobalt and Naples yellow, the complexion of the model indicating which to use. Now heighten the general flesh tint by hatching or stippling, using the colour thin, and following the form of the face. In dark complexions, the carnations may be strengthened with Indian red; the cheeks should be hatched with vermilion and pink madder. A small quantity of gum may be used in the shadows of the hair and the line which separates the lips. The colours actually required are vermilion, rose madder, burnt sienna, raw sienna, indigo, cobalt, sepia, vandyke brown, ivory black, Naples yellow, burnt carmine, light red, yellow ochre, sap green, Chinese white, Indian yellow, and neutral tint. The colours should be mixed with gum water or they dry too flat, and seem out of place on an albumenised print. Use sable brushes Nos. 0, 1, 2, 4.

387. Prints (Bromide), Scratched—To Renovate.—Soak them first, and then squeegee them, whilst very wet, upon glass of good surface which has been washed in soapy water, wiped dry, polished, and rubbed with French chalk. Leave the glass on the kitchen mantelpiece, or other dry place, for twelve hours, if the prints upon it be unbacked. If paper has been pasted upon them they must be left for twenty-four hours, or longer. When thoroughly dry they are ready to be stripped off. It will be found that those with no deep scratches are fit to put aside as not requiring further treatment. The others will require touching up with water colours where necessary, and sizing with weak, almost cold, gelatine solution. This should be allowed to dry; and when dry the print should be placed for a short time in alum solution, and be well washed afterwards. A squeegeeing upon glass, as before, should now make these prints as good as the others. Another method—If they have been lying about, accumulating dust and finger-marks, the first step towards their restoration must be the removal of all such blemishes by briskly rubbing them over with soft bread-crumbs, and any stains that will not disappear under this treatment may be slightly sponged with a trifle of soap. When all are thoroughly clean, the prints can be sorted into three classes; those which are badly scratched can be set aside for finishing in chalks or crayons; the discoloured and yellow ones may be improved with oil colours, leaving the best and cleanest in the collection to be tinted in water colours. Taking the crayon process first, as a speedy and effectual mode of finishing, or in this case, repairing, a bromide print, commence by dusting the picture over with pumice powder and rubbing down with the tip of the finger all scratches upon the film until a certain degree of evenness is obtained, and an agreeable surface gained for the crayons. If the print is too yellow to be treated for a "black-and-white," apply flesh-tinted chalk in broad, free masses, and blend in all brighter tints for the cheeks, and deeper ones for the shadows, with the paper stump or finger, and keep continually dusting off the superfluous powders with a soft badger. The retouching pencil will be found most useful in all fine lines, and to accentuate the eyebrows, pupils, curves of the mouth, etc. Simple "clouding" each side of the head may be gained by blending pale blue and grey crayon, putting in the high lights by scratching off the film with the ever useful pumice powder. The prints to be renovated by the aid of oil colours must be previously carefully sized with strong gum arabic to prevent the tints from penetrating the film (this precaution is not necessary when treating a fresh print). Spot well with water colours, and sharpen all little details such as eyes, brows, lips, also outline of the dress or collar. These little preliminaries, applied in *water* colour, simplify the oil process immensely, and admit of the picture being completed in the first painting, as there are no blemishes left to conceal. To finish bromides with water colours requires a somewhat practised hand, as, unless the first wash is quickly applied and of the correct tint, the colour sinks into the film, sometimes beyond recall, therefore it is always advisable to apply the first tint rather paler than desired, as when dry more colour may be added by stippling or cross-hatching over the shadows.

388. Prints — Method of Mounting and Displaying.—One of the best methods of displaying prints is by means of a screen. These may be made three-fold or four-fold at discretion. A magnificent photo screen was made in Paris by an amateur photographer a few years ago, which was very effective, as follows: A frame of 5ft. × 1ft. 8in. was made of 2in. washable gold moulding, and was fitted for a glass as for a picture. Inside this was fitted a stretched canvas, upon which the photos were mounted thus: the canvas was first coated with a wash made of prepared chalk and water, to which was added a little size and a trace of ultramarine blue, just enough blue to give the faintest tinge of colour. When quite dry a second coat of the same wash was laid on and allowed to dry. The photos being selected and carefully trimmed were now taken, and a piece of thin cardboard cut for each, the cardboards being ¾in. wider and longer than the photos. These cardboards were then fixed by drawing pins in the positions the photos would eventually occupy on the canvas. The space between the cardboards was then carefully painted over with the chalk wash coloured with a deep Venetian red; when dry the cardboards were removed and replaced by the photographs. When finished each photo had a white border ¾in. wide (produced by the extra size of the cardboards), which, with the deep red background, showed them up splendidly. The finished canvas was then placed in the dead-gold frame, and fastened by small tacks. The back of the panel was covered with pleated pale blue silk. The whole screen consisted of three such panels joined by hinges. For *storing* prints nothing is better than a large sheet of stout cartridge paper in which are made four incisions with a sharp penknife, to take the four corners of the print. If the sheet is large enough a dozen prints may be fixed to it in this manner, and they will lie perfectly straight. They may then be rolled up very loosely and placed aside until required. The advantage of this way is that the prints are not fixtures, and any can be taken out and fresh ones inserted. Another method is to employ Zaehusdorff's self-binding mounts, which can be had in various tints. Albums are now made with each page containing four incisions, so that photos may be placed in and kept perfectly flat and removed and exchanged at pleasure.

389. Print (Mounted)—To Remove.—This is a rather ticklish process. Cut out a piece of waterproof paper the size of the page of the album, and cut out a hole in the part of it which will register just over the print to be removed, but a *shade smaller* than the print. Gum or paste it, at the very edge of this hole, down on to the print, so as not to soil the page itself, for which it is intended to form a protection. Now damp the surface of the print with warm water, and the

gelatine emulsion will soon dissolve off and leave the paper support clear. Patient damping of this with a warm sponge will gradually loosen it, but be careful not to try and tear it away until the whole of it is saturated with water. A small slit may then be made in the middle, and it will be found to come away easily in strips right up to the safe edge formed by the waterproof paper. Probably when this has been done the waterproof paper will also come away clear on account of the moisture which has worked under it. If not, as much of it as possible can be torn off, and the remainder worked over with water in a small brush until the page is clear. It is almost impossible to remove by any method of soaking or steaming a print properly mounted with starch. Such a print may be thrown into water and left until the card is almost a pulp, and still the top surface of the card will adhere to the paper of the photographs held and protected by the horny film of starch paste between them. The best way is, therefore, to split away the top layer of the card with, of course, the print also, and then paste a piece of paper, previously damped in the place of what has been taken away. The paper may with advantage be a little larger than the card it is to cover, because the work will look so much better trimmed at the edges after drying than if the trimming be done beforehand. If the edges of the album have been gilded, a different plan may be adopted. The card should be cut through its upper layer only by four lines made with a sharp knife just outside the print. The upper layer from the rectangle within the lines may now, without great difficulty, be lifted up and removed. A piece of paper should be trimmed so that it will just fill the space when damp, and after being damped should be pasted there. Should the joint show at all objectionably, an India paper tint pasted so as to cover it will make matters better than at first. Bookbinders frequently make a small engraving suitable for binding in a large book by inlaying it in a similar manner in a piece of thick plate paper from which the central portion has been removed for half its thickness. They will even inlay a plate in paper of its own thickness by deftly splitting a margin from the former and pasting it half thickness to half thickness to an inner margin cut in the latter to receive it. Another method would be to thoroughly soak some sheets of white blotting-paper in clean water, drain from the superfluous moisture, and place the page of album between them, protecting the other leaves by inserting the damped portion in two sheets of oiled paper (such as used in copying books). Put under pressure for a few hours, when the cardboard will be found sufficiently damp to allow of the print being removed. Sponge off the remains of the old mounting medium, and lay dry blotting paper each side of page, putting away under pressure until all moisture is absorbed, and the leaf presents its original smooth appearance. By thus thoroughly damping *each* side of the page no subsequent warping will ensue, as would undoubtedly be the case were it only moistened in the vicinity of the print.

390. Prints on P.O.P.—To Colour.—Prints on any of the gelatine printing-out papers may be tinted with colours. but solio seems to lend itself better than any other, the film being slightly tougher and harder than the others. The colours used are the ordinary moist water colours, those in the tubes being preferred, as they keep cleaner and softer much longer. The simplest way to begin is to give the prints a matt surface, then there is no trouble whatever. All that is necessary is to take care and not let the print get too wet, or else the colours will run and spoil the effect. The colours are best mixed with gum water and water megilp, which can be procured from any artists' colourman. The colours should be put on as dry as possible, but not too thick. If the ordinary surface is to be retained on the prints, a somewhat different mode of treatment is necessary. Wet the face of the print with a sponge and clean water, then dry with clean blotting-paper, and, having pinned the print on to a board, proceed to lay on the colours as thin and dry as possible, beginning at the sky or top and working down, and always have a clean piece of blotting-paper handy to dry up any superfluous moisture, for if the print gets too wet the colours will all run, and the whole thing will be spoiled. If the colours are kept pretty thick with the addition of the megilp, then very little of the gloss on the paper will be spoiled. If there is any difficulty in procuring the water megilp or gum water, they can be got direct from the makers, who also supply the colours, and also now supply special paints for colouring photographs. For oils the ordinary oil colours, such as can be bought at an artists' colourman, in tubes, satisfactorily answer the purpose. They are not expensive, only costing from about 2d. to 6d. per tube, according to colour, and the surface of solio, or, in fact, any of the gelatino-chloride papers, "takes" these oil colours admirably —the gelatine film protecting the paper perfectly, and the most beautiful effects can be obtained with a minimum of trouble—the oil colours giving a gloss identical with the gloss on the print, so that it is impossible to see, by reflected light, where the colour has been applied, which is usually the drawback with water-colours and stains. The best medium is "megilp," which is also obtainable in similar tubes. It is a quick drier, and is useful in thinning out the colours to the tint required, although any of the usual driers employed in oil painting, such as picture copal, light drying oil, etc., may be used The best colours for the purpose are those which are transparent or nearly so, although a little body colour considerably heightens the effect, if added judiciously, to lace, draperies, the eyes, or to the reflections on metal, etc., especially in the case of a print from an over-exposed negative. The colours most useful for all ordinary work are raw sienna, yellow ochre, crimson lake, light red, Prussian blue, indigo, cobalt, burnt sienna, vandyke brown, brown pink, and ivory black. From these, of course, an almost endless combination of colours can be obtained, such as greens from Prussian blue and one of the yellows, purple from blue and crimson lake, etc., etc. Although, if great purity of tone is required, it is better to buy the colour wanted direct. To give body to any of these colours, it is only necessary to add a little flake white, although it would not be unwise to get a few body colours such as vermilion, cadmium, emerald green, etc., for little brilliant touches of colours here and there add to the effect. The most suitable colour for flesh is generally found to be light red thinned out to the proper tint, and touched up after with a little crimson lake for colour and indigo for the shadows. Two or three fairly large round sable brushes are used to apply the colours, although camel-hair will answer as well, using turpentine to rinse them in. The colours should be washed on after the fashion of water colours, and not in dabs of solid pigment as in oil painting, and in the case of a very large surface to be tinted with a uniform colour, such as a sky or a background, it is best to dab the colour on with the top of the finger (the second finger on the right hand), working it about with a smearing kind of touch until the desired tone and effect is obtained. For painting photographs of flowers or fruit for Christmas cards, etc., these oil colours give beautiful results if used properly, making the picture look almost like a photo in natural colours.

391. Print—To Render Transparent.—Immerse it in some pure white wax melted in a dish, and then remove the excess by a hot iron applied to the print, placed between two pieces of blotting paper. To remove the wax it is only necessary to place the print in a dish of warm benzole. Oiling the silver print will, however, spoil it for many purposes, but will enable it to be printed from. In that case, oil vaseline, as used by the Eastman Co., is best, and will not damage the print, but if it is desired to remove the oil afterwards, and restore the print to its original condition, oil vaseline will not do, though it might probably be removed by benzole; but castor oil can be removed by methylated spirit, and will answer. In using castor oil, it must be soaked, say, forty-eight hours. If transparency such as is required in a lantern slide be desired, there is no way but to remove the paper altogether. The albumen film will in that case require a fresh support, for which purpose a sheet of glass will probably be most suitable. If the print be smoothly pasted on the glass face downwards the paper backing may be removed with fine glass paper, as in the crystoleum process; or if before pasting on the glass, the print is enamelled with collodion, it may be damped with water and rubbed up with the finger. In either case, a final application of vaseline, castor oil, wax, or the like, will be advisable for the attainment of all possible transparency.

392. Quick Drying Medium for Oil Painting—To Make.—Megilp could be used, and so-called drying varnishes can be purchased at any colour dealer's, but they are apt to spoil the picture by causing it to crack. Turpentine and methylated spirits are both sometimes used. By putting the pictures in some quiet room, and only going in when necessary, they will not be affected by dust. A mode of making drying medium is as follows: Take half-a-pound of litharge and place it in a bottle with a pint of linseed oil; place the bottle in the oven or other very warm place for two or three hours, occasionally shaking it up. When cold allow it to settle down, and pour off the clear portion. This, when used with a little turpentine, forms a good quick-drying medium for oil colours. Or another, which is useful, as it is quick-drying and pleasant to use: One part copal varnish, one part linseed oil (dark drying), and one part turpentine. Some colours, however, especially dark and transparent ones, require forcing, and this can be effected by adding ground sugar of lead or goldsize. In skies, or other light-toned masses, drying oils must be avoided, and it is generally found that tones, having a good foundation of flake white, dry fairly well without any medium. Mem.—Always turn the painting to the wall on a shelf, etc., when not working.

393. Retouching Dodge—To Apply.—When it is required to retouch a harsh negative with dense high-lights and empty shadows, a good dodge is to affix a sheet of *papier minérale* on to the glass side of the negative. This serves a double purpose. First, work out the dense lights with a dabber charged with vaseline or Canada balsam (thinned, perhaps, with benzole). This renders the *papier*, on the lights where applied, transparent, while the shadows remain protected by the ungreased portions of the *papier*. Secondly, the detail in these dark shadows may be further helped by working with stump and blacklead, or a soft lead pencil. If the negative be of opposite character—viz., weak and flat, and lacking contrast—the *modus operandi* is reversed. Here pick out the shadows with the vaseline, and strengthen the high-lights by means of the blacklead.

394. Retouching, "Line of Light"—How to Treat.—If care be taken to submit each head to the style of lighting best suited to the character of it, the line of light down the nose may safely be left to take care of itself, and should require no more retouching than any other part of the head in a successful negative. Unfortunately, it is too often the practice of retouchers to run the stereotyped line down the side, ending in a dot without any particular regard to its decided shape or character, and the falsity of it is glaringly apparent in the case of life-size enlargements from cabinet or carte heads. A practised retoucher says he works up a great many carbons in the course of the year, and invariably finds the light in question to require very careful attention to obtain the distinctive characteristics indispensable in preserving the likeness, and the utmost care should be taken by the retoucher, not only in keeping its shape, but in not overdoing it, as it produces a metallic shine never under any circumstances seen in nature.

395. Retouching Medium—To Make.—For unvarnished negatives nothing answers as well as the following: Slightly moisten the finger with turpentine and rub lightly over film, and it will give as good a "tooth" to the pencil as can be desired. Or, if preferred, use the following:

Sandarac	1 ounce.
Castor oil	80 grains.
Methylated spirit	6 ounces.

Or any of the following formulæ may be taken as reliable: (1.) Best orange shellac 2 ounces, ammonia carbonate 4 ounces (in crystals), soft water 32 ounces. Raise the water to nearly boiling point, add the carbonate, and when dissolved add the lac, stir well until all is dissolved; when cool, filter and apply to negative by pouring on and off a few times, and dry thoroughly. (2.) Monckhoven's retouching varnish is similar to the above, only that after the shellac has been placed for twenty-four hours in a saturated solution of carbonate of ammonia, the solution is poured off, and replaced by an equal quantity of water and boiled, the proportion between shellac and water being one to eight: Shellac 1 ounce, sandarac 6 ounces, mastic 6 ounces, ether 10 ounces. After solution is complete, add benzole (pure) 10 ounces.

(3.) Collodion Retouching Medium.

Celloidine	80 grains.
Ether	9 ounces.
Alcohol...	7 ,,
Castor oil	32 minims.

To be flowed over the negative after being thoroughly dried.

(4.) Fritz Luchardt's Retouching Varnish.

Alcohol	300 parts.
Sandarac	50 ,,
Camphor	5 ,,
Castor oil	10 ,,
Venice turps	5 ,,

(5.) W. T. Wilkinson's Water Varnish.

Shellac (in thin flakes)	4 ounces.
Water	1 pint.

Raise to boiling point, and add a few drops of saturated solution of borax, stir vigorously, adding more borax until the lac is just dissolved, or stop short of complete solution, as too much borax is injurious. Filter through charcoal, and the varnish is ready. This is applied to the negative when washed and still wet. Another method is as follows: The negative to be retouched should be varnished well with any good negative varnish, and allowed to dry thoroughly; then on those places where retouching is required should be dusted a little very finely powdered cuttle-fish, and, using the fingers as a pad, rub the powder up and down, or in a circular manner, till

on examining the film through a magnifying glass it is seen to be quite rough; now dust the superfluous powder off, and it is ready for work. Instead of the cuttle-fish, any of the following matt varnishes may be used: (1.) Dissolve amber resin 10 grains in benzole 1 ounce, and allow to subside for twenty-four hours before use. (2.) Gum dammar 10 grains, Canada balsam 5 grains, turpentine 1 ounce. (3.) Dissolve sandarac 6 grains, shellac 36 grains, mastic 36 grains, in ether 12 drams; when dissolved, add benzole 2 drams. (4.) Resin 360 grains, gum dammar 70 grains, spirits of turpentine 4 ounces. The last-mentioned formula (4) is quoted from PHOTOGRAPHY ANNUAL for 1895 (p. 107), in which appears a long illustrated article on retouching by Mr. S. Herbert Fry, and a number of formulæ for portrait and landscape work.

396. Spotting—HOW TO PERFORM.—This is better done after burnishing. Burnt sienna mixed with a little ultramarine or Prussian blue, or rose madder, according to the tone of the print being used. The paints should be mixed with a little gum water to give them a glossy surface when dry, but should they show as dull spots a little encaustic cerate should be rubbed over them. Spotting in the shadows should be done with a brush fully charged with colour, but in the high lights with a brush nearly dry, and in every case with a slipping action. Others say it should always be done before burnishing, for two reasons—First, the surface of the print being rougher before burnishing than after, it will take the colour better; second, when burnished, it will gloss the colours as well as the picture, thus rendering it *impossible* to see where the colour has been applied. As to colours, the most useful would be crimson lake, burnt sienna, vandyke brown, and sepia. Lick the surface of the print with the tongue, as it makes the colours "take." This does not seem a very elegant way, but it is a very handy one. The very best colours for the purpose are those manufactured by Liesegang. The prints should be spotted *before* burnishing in the following way: Into a bottle put three ounces of distilled water, and the white of one fresh egg, shake the bottle to thoroughly mix, and add five or six drops of ammonia liquor, mix the colour on the palette in the usual way, and then dip the brush into the liquid just mentioned; before taking up the colour spot carefully, and when this has had time to dry, rub each one with a piece of flannel on which is a small quantity of the following mixture: Powdered Castile soap 1 ounce, pure alcohol 1 ounce; place in a wide-mouthed bottle *tightly corked*, and then in warm water. Allow the water to gently simmer, when the soap and spirit will form, on cooling, a smooth paste (do not use an excess of the soap, or it will give a smearing result after burnishing); then put away the prints for two or three hours, and proceed to burnish in the usual way. Other methods generally adopted are as follow—Colours: Debenham's neutral tint for silver prints, ivory black for bromides and platinotypes; medium, mixture of white of egg and chrome alum or water only, the latter when spotting is done after finishing. Mode: Apply with fine brush. If *carefully* done with colours *the same tint* as part touched, it will not show on finished result. Another method is to use carbon tissue, dissolved in a little hot water, to spot with. In this case the spotting can be done before burnishing, the prints having been, previous to the burnishing, left in a strong light for a few minutes to harden the spotting. The foregoing method is the only reliable one for spotting before burnishing. Several other methods have been tried, but none can be depended on. If spotting after burnishing be resorted to, there are several ready-made spotting mediums in the market. Marion's supply one, amongst others; the most usual method, however, is to mix the colours with gum-water. The colours used are Indian ink, sepia, Prussian blue, crimson lake, and madder brown; with these any photographic tone can be imitated. The lake should be very sparingly used, owing to its lack of permanence. Mix the colour on a slab of white china, with strong gum-water; let it dry, and use it by moistening the brush in mouth. The brush, which should be sable, should be just moist enough to form a good point. Many professionals insist upon all spotting being done *after* burnishing, and it takes a practised hand indeed to so neatly stipple in waists, tone down cheek bones, knuckles, and so on, that it cannot be observed when the print is regarded "sideways" (a favourite test amongst retouchers). To attain this proficiency the palette must be "dressed" with gum of such thickness that the colours will just grind up in it, and no more—allowing them to quite dry before using. The brushes should only be damp enough to take up a little colour upon the extreme tip, and this particular degree of moisture is generally "professionally" obtained by putting the brush in the mouth; if that is objected to, keep a wet sponge handy; on no account dip into water or the palette will be spoilt, and work consequently appear dull at once. If the cold roller is used it is best to work upon the rough print, but when the hot press is preferred it is much safer to spot afterwards, as any elaborate working up, such as copies often require, has been sometimes known to disappear in burnishing.

397. Spotting Medium—TO MAKE.—Monckhoven recommends the following formula for a spotting medium: Rouge and ivory black (in proportions suited to the tone of the print) 10 parts, saturated solution of gum arabic 2 parts, white honey 2 parts, and sugar-candy 1 part. This is applied by means of a fine sable brush held in a vertical position, as in stippling, and after the print is mounted and burnished. Water colour of the same tint as the print will answer equally well, though sometimes there is a difficulty in getting the colour to flow. To obviate this, either use prepared oxgall, or—far simpler and equally effective—apply the tongue to the surface of the print and let the print dry; then apply the colour. The usual colours necessary will be ivory black, indigo, vandyke brown, and crimson lake, and with these almost any tint can be obtained.

398. Stereographs—TO MOUNT.—No pictures should ever be mounted so as to exceed three inches apart, but, if possible, a quarter of an inch less should invariably be preferred; and no picture should have so much subject shown on the left-hand margin of the left-hand picture as displayed on the left hand of the picture on the right, and *vice versâ* with respect to the right hand. That on the right-hand side of the mount should show less subject, laterally, than on the left-side picture. The proper mode of mounting stereographs is first to separate the pair of pictures and trim the edges of each print. It is necessary to separate the pictures and reverse them; if this were not done the picture from the left station would be presented to the right eye in the stereoscope, and conversely, which would produce a pseudoscopic effect. Then trim them three inches high and two and a half inches wide, and mount them so that the central points of the pictures are two and a half inches apart, and consequently exactly opposite to the centres of the twin lenses of the stereoscope. By this method when the lenses of the stereoscope are of the same focal length as those of the camera, the true natural effect of size and distance is perceived on looking

at the prints through the stereoscope. This plan involves the necessity of reducing the breadth of the prints, and therefore of cutting out some of the objects. This cannot be helped, but if it is of importance to retain them, then lenses of shorter focus must be used, both in the camera and in the stereoscope. Stereographs upon thin albumenised paper may be mounted so as to be viewed by transmitted light; and then by applying colour to the back of the print where it is required, and laying a piece of tinted tissue paper on the back, very pleasing effects may be produced.

399. Tinting Photographs—To Use Aniline Dyes for.—These will answer perfectly. The quantity to be added to the gelatine in enamelling will depend upon the colours used, etc., and can only be learnt by experiment. Employed mixed with the gelatine the print will not become stained to any perceptible degree, particularly if the gelatine solution be used when nearly cold. The best way to apply them for tinting enamelled photographs is by colouring the *collodion* before use as deep as taste dictates. Apply to any large chemist for the colours required, stating they are wanted to be soluble in spirit. When the collodion is coloured proceed in the usual way, and the print, having a layer of gelatine between the aniline dye and itself, is insulated from any injury by contact with an acid colour. The collodion film may also be stained whilst it is on the enamelling glass by simple immersion in an aqueous solution of Judson's dyes until deep enough for the purpose, the collodion taking the dye quite evenly and readily. It can then be dried or enamelled at once as may be desired, but *do not* stain the gelatine.

400. Transparencies—To Colour.—For this work use the best water-colours, the most useful tints of which are gamboge, Italian pink, burnt sienna, raw sienna, Prussian blue, crimson lake and red madder. The above colours are perfectly transparent, and can be used without fear. There will also be required a desk or support for the transparency whilst painting it, a "dabber" (a piece of cotton wool wrapped up in a piece of white kid—an old glove will do), and three brushes—a small, medium, and large size. For an example, suppose the transparency to consist of a landscape, a few hills in the distance, and a background of sky. Place it in the desk—a printing frame of the right size will do—and go over the sky with a brush charged with Prussian blue, taking care not to go over the same place twice. When the colour is nearly dry give it a few light touches with the "dabber" if required, to give an even tint. Next go over the distant hills. Lay the colour on thinly, making it warmer as the foreground is approached. The various tints of the landscape must now be painted in, taking care not to have the brush too wet. As soon as the colours are thoroughly dry, give the transparency a coat of varnish, consisting of equal parts of white, hard varnish and methylated spirit. When the varnish is dry paint it all over again, keeping the brush well charged with colour. Let the colours dry, and then add strength to the foreground by judiciously touching it up with Indian ink. A coat of varnish now completes the process. It will be found that the glass will repel the colour. To prevent this mix the paint with oxgall instead of water.

401. Transparency—To Back.—Thin transparent positives make excellent pictures, provided they are not too dense, when backed up with a coloured medium, but great care must be taken, a very much under-exposed transparency giving the best effect. If something out of the way is wanted make a very thin positive, preferably gelatino-bromide, or experiment with a spare plate. After having developed and got a passable picture on a paper background in contact, get some Aspinall's white enamel, and when the plate is quite dry give a good thick coat of this on the gelatine side of positive, and the result will be highly pleasing. This brings out all the details very beautifully, and surpasses many bad attempts at this class of work. Of course, by backing up with paper instead of enamel any amount of retouching can be done upon the paper, and it is then difficult to tell where photography ends and hand work begins.

CHAPTER X.

NEGATIVES AND THEIR TREATMENT.

(INTENSIFICATION, REDUCING, ETC.)

402. Belitzki's Reducer—To Make.—This is one solution, will keep in the dark indefinitely, can be used over and over again, and when inactive and exhausted the colour changes—

Potassium ferric oxalate 22 grains or 10 grains.
Sodium sulphite ... 18 ,, 8 ,,
Water ... ... 1 ounce or 200 c.m.

When dissolved add

Oxalic acid ... ... 3 grains or 2½ grains

And shake till the blood-red solution turns green. Decant from any undissolved acid, then add

Sodium hyposulphite 120 grains or 50 grains.
Dissolved in water ... ½ ounce or 100 c.m.

This can be applied immediately after fixing, or to a previously dried negative, and causes no stain.

403. Broken Negative—To Repair.—Get a piece of perfectly clean glass, same size as negative, and cement latter to this, film out, with Canada balsam. To use the latter, warm it till melted, spread on plain glass, and press pieces of negative in contact, removing whatever exudes at edges with a little turpentine. It will not be necessary to cement the broken edges together, but get them into as close contact as possible. When all the pieces are in position, bake the whole in a warm oven for a couple of hours. Another good way of mending a broken negative is the following: First procure a clean piece of flat glass, as free from defect as possible, exactly the same size as the negative was before being broken. Place this upon a piece of perfectly flat board, about an inch larger each way than the glass is, now get four strips of wood, about half an inch wide, and very nearly, or quite, as thick as the combined thickness of the piece of glass above mentioned and the glass of the broken negative. Having cut these strips of wood to suitable lengths, screw three of them to the board in such a manner that the piece of glass is held tightly between them; the fourth piece is fitted, but is not fixed now. It will be a good plan to cover the piece of glass with damp notepaper, *i.e.*, paste it on by its edges only to it with gum or starch, and when quite dry proceed as directed. Now take the largest piece of the negative, and warm its edges, also the piece that fits into it, then moisten the edges with a camel-hair brush dipped into a bottle of Diamond cement, the bottle containing it having been previously placed in a vessel of hot water in order to liquefy it. Both the edges are again warmed by a fire or lamp, and pressed into close contact with each other; they are then placed upon the piece of glass, which has been fixed as above directed, paper side uppermost. All the broken pieces of the negative are treated in exactly the same manner, and stuck to the two pieces already fastened together. When all the pieces have been put together place the fourth strip of wood into position and fasten it. The object of the temporary frame, which is formed by the four strips of wood, is to prevent all possibility of the pieces of the negative from shifting or parting when they have been once placed in position. And the use of the paper covering to the glass on which the negative is put together is to enable the whole to be removed from the glass easily by simply slipping a thin sharp knife between the negative and the glass; this must be very carefully and slowly done. All the cement that has been forced out of the cracks is carefully cleaned off both the film side and the back of the negative, also the pieces of paper which are sure to stick to it. The film side is cleaned previous to removing the negative from the temporary frame. All the paper is now cleaned off the piece of glass on which the negative has been placed, and is made perfectly clean, clear, and bright, or another suitable piece is used instead. *The mended* negative is now placed upon this glass, to which it is bound, film side upwards, just like a lantern slide is, and when it is quite dry and again cleaned, if required, which it most likely will, it will be ready for enlarging. Any pieces of the film must be fixed into their proper places with gum, or with the above or other cement, and any places from which pieces have been lost must be touched out with opaque water colour. If it is a gelatine negative, the mending business will not be so easy as if it were a collodion negative, because the film may be torn in the former case, and not broken only just where the glass holding it is, as in the latter case. If a transparency is taken from the above mended negative by contact, and this, after being properly worked up, is used to make an enlarged negative, and this also carefully worked up, a good enlargement should be obtained, or, indeed, as many as are wanted.

404. Broken Negative—To Transfer.—First of all glue the glass side of the cracked negative to a stout piece of cardboard, *or* cement it with Canada balsam to a second piece of glass. When the glue or balsam, as the case may be, is quite dry immerse the whole in a solution of hydrofluoric acid (half teaspoonful to half pint of water). Shortly the film will be seen to frill at the edges, and gradually to become liberated from the glass. Have at hand a dish of water, in which is a sheet of glass at least twice the area of the negative. Take up the negative glass with a film floating on it, and, after carefully tilting a little on one side to drain off superfluous acid, transfer the whole to the dish of water, and remove the cracked glass. The film will be seen to expand wonderfully, but to check this and reduce it to its original size, after the film has been washed a little in the water, catch it on

the glass already in the water, and transfer to a bath of equal parts of methylated spirit and water. The film will now return to its original size, and if trouble is found add a little more methylated spirit, *but on no account use undiluted spirit*, as it curls up the film, and renders it unmanageable. Now carefully catch the film on the glass to which it is intended to transfer it, and gradually bring glass and film together to the surface. If it inclines to cockle at any point gently blow on that point, and it will then lie flat. Take a glass of the same size as the original glass, and measure each way for distortion. If the film is the same size, remove it on the glass with plenty of liquid, and leave it in a level position for the liquid to gradually evaporate. When dry round the edges, it may be turned up on end, but do not be in a hurry to do this, as it sometimes sags in the middle. When quite dry it may be washed in water like an ordinary plate to get rid of any remaining acid. If, when the film is measured, it is found to be still larger than before, add more spirit until it resumes its original size. Of course care is to be exercised in handling it, but it is astonishing how tough gelatine is. A bottle of Cresco-fylma renders it unnecessary to procure or make other hydrofluoric acid. Again, if the negative was originally developed with pyro of ammonia, it will be better to treat it first with a bath of acetate of soda sixty grains to the ounce of water before applying the hydrofluoric acid. Weak hydrochloric acid will also remove films, but not so easily and surely as the hydrofluoric. N.B.—Be sure the negative does not get reversed during the process, unless, indeed, this is wanted. The following is another plan for successfully transferring the negative film: Take the negative, which must be unvarnished, and coat it with a solution of india-rubber in benzene, containing about two grains of indiarubber to the ounce of benzene. Allow it to dry, and then flow over the following collodion:

Ether ·730	...	...	5	ounces.
Alcohol ·805	...	...	10	,,
Castor oil ...	...	...	½	,,
Pyroxyline	...	...	½	,,

After the application of this collodion the film must be allowed to become thoroughly dry, and is then placed in a dish of cold water containing a little acetic acid. In this bath the film soon becomes loose, and can be floated off into a dish of clean water in which it is washed for a short time, when a clean glass plate is placed underneath the film, and the latter secured to the plate by means of a soft squeegee. The plate with its film is then set aside to dry, and has only to be varnished to be ready for use again.

Another way: Make a solution of gelatine (twenty grains to the ounce), flow this as thinly as possible over the film. When dry, it is advisable to carefully cut round the film about $\frac{1}{16}$in. from the edge, as if the film is inclined to refuse to leave the glass it is always at the extreme edges. The plate must then be soaked for twenty-four hours in the following solution: 120 grains chrome alum, 30 grains citric acid, water 1 pint. After this, soak the plate several hours in several changes of water, to thoroughly remove the alum. It will then be found that if one corner of the film is loosened, raised, and turned back, it can be slowly and without difficulty removed from the glass. Then float the film on to a clean piece of glass, avoiding air bubbles, lift slowly from the water, drain and dry. If done with care, this method will work well. The usual plan for removing negative films from glass is to use a dilute hydrofluoric acid bath, but the following procedure, which was originated, to a certain extent, by Professor Burton, is an improvement. It is as well, when possible, to avoid the use of hydrofluoric acid, and as sulphuric acid or hydrochloric acid will answer equally well, it is employed here. Soak two ounces of hard gelatine in ten ounces of water, and when swelled, heat and filter. If the negative has been varnished, the varnish must be removed with warm methylated spirit, and the film placed in an alum hardening bath (if this was not done originally). When dry, warm the negative and apply a coating of the gelatine, say half an ounce for a half-plate, level, and let it set. Then place it for five minutes in a saturated solution of chrome alum, neutralised if necessary with ammonia, and wash to remove the blue colour due to the alum. The plate must now be soaked for thirty minutes in methylated spirits, then blot off the surface moisture, and place in a dilute sulphuric acid bath (two and a half per cent.) until the greasiness caused by the alcohol disappears (about half-an-hour, as a rule), when the film will come off quite easily, care being taken in removing the broken glass. Then put the film directly into a bath composed of ammonia one ounce, glycerine (to give flexibility) one ounce, water two pints, to remove the acid from the film. The film should be kept moving in this bath for about ten minutes; it is now ready to be transferred to a new glass, or if preferred it may be squeegeed on to talced glass, dried and stripped, and used as a film negative.

405. Copper Bromide Intensifier— To Use.—The bromide of copper intensifier was first introduced—or was it re-introduced?—by Captain Abney, about fifteen years ago, and he became a warm advocate of it. It is prepared as follows: To a saturated solution of sulphate of copper add sufficient potassium bromide to convert nearly all the sulphate of copper into bromide of potassium. An ounce of water will dissolve 120 grains of copper sulphate, so that it will be necessary to add about 125 grains of bromide of potassium (dissolved in a small quantity of water) to effect total decomposition—the *exact* amount is immaterial, but the bromide should not be spared—and the solution is then filtered. The developed and fixed plate is then flooded with this solution, and it is allowed to act until the metallic silver turns to a white colour. It must be then well washed under the tap until perfectly free from the solution, and the addition of ammonia to the wash waters ceases to give a distinct blue colour. The plate is then immersed in a solution of silver nitrate (one hundred grains to the ounce), when an intense black colour is obtained. If still greater density be desired, the plate so treated may be again submitted to the alkaline developer, when absolute opacity may be obtained. This intensifier is practically only used for the reproduction of engravings, for photolithography, and relief work. Captain Abney says as regards the permanence of this intensfication there is no question. The action is purely chemical, and consists of the formation of an image composed of bromide and sub-bromide of silver in combination, the metal of the sub-salt being obtained from the silver solution with which the bromised image is treated. With cadmium the procedure is the same, except that cadmium bromide is to be had ready made, and the first bath consists of thirty grains to the ounce of water. The following bromide of copper intensifier is the formula given by Mr. S. R. Bottone. In all cases where a medium intensification which does not block up the fine lines is required it is a desideratum.

A.

Bromide of potassium	...	...	1	part.
Water	...	...	25	,,

B.

Powdered sulphate of copper	...	...	1	part.
Water	...	...	25	,,

Dissolve each salt in its allotted quantity of water. Mix the two solutions, and allow the sediment

which forms to fall to the bottom. Decant or filter off the clear solution. To use this intensifier, the negative, if just fixed, is carefully washed to remove the hypo, and then immersed into, or, better still, flooded, with the above solution, precisely as in developing, a dish, of course, being used. The colour of the image rapidly changes, and, after the lapse of a few seconds, it acquires a beautifully pearly white tint, the shadows remaining remarkably clear and free from stains or fogginess. If the negative has been *dried*, it should be immersed for five to ten minutes in water, to soften the film, previous to being treated with the bromide of copper solution. If it has been varnished, the varnish must be removed by soaking in clean methylated spirits, followed by copious washings in water. A tuft of cotton wool, carefully and frequently passed over the film during the foregoing operations, will help the removal of the varnish, etc. The bleached negative is now well washed in water until all trace of copper has disappeared, and then immersed in a dilute solution of ammonia, consisting of

Strongest liquid ammonia	1 part.
Water	12 ,,

The negative rapidly acquires a warm chocolate tone, which will be found very non-actinic. This intensifier seems to increase the contrasts much more than those in general use. Probably denser negatives could be obtained if desired if A and B were made double the strength given, also by leaving them in the ammonia solution for a longer time than is necessary with the weaker solutions given.

406. Cracked Negative — To Print from.—Negatives often get cracked, unfortunately. If the film itself is not broken, a print can be taken from it without showing the crack by placing the printing frame at the bottom of a deep box, with tissue paper stretched over the top, and suspending this beneath a roasting-jack, by which it can be kept constantly rotating. The printing will, of course, take much longer than in the usual way. If the broken edges of the glass are cemented together first with a solution of Canada balsam in benzole it will help in the desired end, as well as prevent further breakage of the glass, and possible fracture of the film. The following is a narration of a personal experience on this subject: "Having the misfortune to crack a half-plate negative of a group, and being anxious to obtain good copies somehow, the following plan was adopted with good results: First, paint on the plain glass side with black varnish a thin line covering the crack, then take a transparency from the negative. The crack will be defined as a plain white line; then carefully retouch out the line, and from this retouched transparency take a negative by contact. This negative will produce prints equal to the uncracked original. A pyro and potash developer was used in each case."

407. Daguerreotype—To Intensify.—If the intensification of a daguerreotype is not effected by the usual means for restoring, the proper thing to use is hyposulphite of gold, and the means that are taken are as follow: After the fixation of the plate by sodium thio-sulphate, it is thoroughly washed, and the hyposulphite of gold prepared as follows:

Solution 1.

Gold chloride	1 part.
Water	500 ,,

Solution 2.

Sodium thio-sulphate (hypo) ...	4 parts.
Water	500 ,,

These two solutions are well mixed together, and after flowing them on to the plate, a spirit lamp is moved beneath the surface in order to start the action of the intensifier. The more rapidly the action takes place, the more satisfactory the result will be. After the gold has deposited, the plate is rinsed with distilled water, and dried at a gentle heat.

408. Damaged Negative—To Restore.—The best thing to do is to spot each clear place carefully, both on negative and print. A professional retoucher would probably be able to do this in such a way that little or no spotting would be required on the print. To remove ink impression apply a solution of muriatic acid, oxalic acid, or salt of sorrel (binoxalate of potash). After the stains disappear wash thoroughly and dry. Printing ink can be removed from the film with a tuft of cotton wool, moistened with a little clean turpentine; spike oil of lavender will also answer the purpose. If the negative has been developed in this state the result is that on those parts of the film covered with ink the developer has not acted, and consequently they will be clear spots on the ink being removed. Ordinary brown paper is by far the best material to pack exposed plates in.

409. Dense Negatives—To Obtain, of Line Subjects.—The best way is to employ the collodion process with the following modification. Have and keep the silver bath acid and of full strength. Use a ripe collodion, and give a full exposure, but do not over-expose. The developer given below gives dense negatives from diagrams and line subjects. Into a large jar put 3½ pounds of copperas, and 2½ ounces sulphate of copper, pour on two quarts of boiling water, stir up well when cool, filter, and keep in clean bottles. This is the stock solution of iron sulphate. To make the developer take

Stock solution	4 ounces.
Acetic acid (not glacial) ...	2½ ,,
Water	40 ,,
Methylated spirit	½ ,,

After exposure flow over the developer and keep the plate rocking, when the whole of the details are developed, and before the lines show any signs of becoming filled up, wash the plate thoroughly to get rid of the iron, then flow over a solution of

Pyrogallic acid	60 grains.
Citric acid	20 ,,
Water	1 ounce.

Return this to an egg-cup, and add a few drops of a twenty-grain solution of silver nitrate. Pour this on and keep the plate in motion till sufficiently dense, then well wash and fix in

Potassium cyanide	2 ounces.
Water	10 ,,

Be very careful with this; it is deadly poison, and should be kept in safety, labelled "poison." Remember not to over-expose, and also to wash off the developer as soon as the lines show the slightest signs of clogging, then there is no reason why negatives suitable for process work should not be got. The following collodion is specially recommended for photo-process work:

Pyroxyline	260 grains.	N.B.—The strontium salt gives an extraordinary increase of density to the negative.
Ether	21 ounces.	
Alcohol	25½ ,,	
Cadmium bromide	120 grains.	
Strontium iodide ..	72 ,,	
Calcium chloride...	25 ,,	

The nitrate bath should be about fifty grains to the ounce, with a grain or two of iodine; this of itself renders the bath acid far better than adding iodide and nitric acid. The exposure should be on the short side, and the developer either the ordinary iron (water 1 ounce, ferrous sulphate 24 grains, acetic acid 24 grains, alcohol 24 minims) or the following: Water 7 ounces, ferrous sulphate

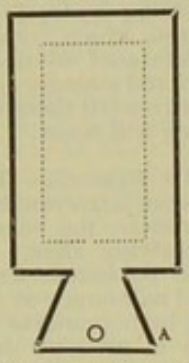
90 grains, sulphuric acid 3 minims, alcohol 70 minims; in both cases, of course, using silver nitrate when developing. Fix in hypo. When the negative is washed bleach in a solution of bichloride of mercury, twenty-four grains to the ounce, *in strong daylight*, wash well and darken in ten per cent. ammonia. When dark, wash and coat with gum water, and when quite dry varnish as usual. Dr. Liesegang recommends intensifying the negative in the usual way with pyro and silver, to fix, wash, and treat alternately with bichromate and with permanganate of potash until the colour is a strong orange-yellow. Wash, dry, and varnish with a negative varnish tinted with alcoholic solution of aniline blue. This gives a deep black to the ground of the negative, while the lines appear blue, and this is sure to give the required result in the transfer print. In the case of a coloured subject a light canary screen might be of service, though it would considerably prolong the exposure.

410. Eikonogen Developed Plates—To Intensify.—The uranium intensifier is recommended for this purpose, having been repeatedly used with complete success. It is made and applied as follows: Dissolve twelve grains of uranyl nitrate (so-called nitrate of uranium) in four ounces of water. Soak the well-washed plate in this for fifteen minutes. Meanwhile, weigh out three grains of potassium ferricyanide (red prussiate of potash); place it in an ounce measure, fill up with water, let stand a minute and decant off the water. Repeat this treatment a second time, the object being to wash away the potassium ferrocyanide with which the ferricyanide is almost invariably coated. Finally, dissolve the clean ferricyanide in an ounce of cold water. The uranyl nitrate having thoroughly wetted the negative, remove the latter, mix the ferricyanide with the uranium, and place the negative in the mixture in which it is to remain until sufficiently intensified. Finally, wash in running water for not more than half-an-hour. Another writer strongly recommends for these plates Mr. Wellington's silver intensifier. It is not pretended that it is a *cheap* intensifier, but it has one manifest advantage over most others—the image when intensified is silver, and nothing but silver. It is, moreover, what may be called a *cumulative* intensifier, and suits all plates, however developed. Another has found no difficulty in intensifying such negatives with the usual corrosive sublimate and ammonia formula. It is important not to neglect one of the essentials for perfect intensification. These are, fix thoroughly, and wash until all *hypo* is removed. Use a clean and strong solution of corrosive sublimate; some people have an idea that this solution lasts for ever when used for intensification, but as a matter of fact, it gets weaker with every plate treated, and when intensification is unsatisfactory it should be thrown away, and a fresh solution made. Let the plate remain in this solution until completely bleached, then again wash thoroughly, and treat with ten per cent. ammonia; wash once more, and dry.

411. Films from Waste Plates—To Remove.—Spoilt negatives can be used in various ways. They can be cut up to form the cover glass of lantern slides. If large enough, they can be used to make forcing frames, or repair the greenhouse; they will be found useful in the printing frame when films are used, or, if free from blemishes, prints can be mounted in optical contact upon them. The simplest way to remove the film is to place the glasses in strong soda and hot water. If the water be boiling, or nearly so, the gelatine will be melted off, and a little application of "elbow grease," and a dry clean duster, will finish them off completely. Films can also be stripped by soaking the plates in dilute acid.

412. Films—Spoilt Celluloid—To Utilise.—Spoilt celluloid films may be used for an endless variety of purposes, and a few are enumerated below: (1.) Clean the celluloid thoroughly, and then sensitise with bromide opal emulsion (for formula see No. 509), and use exactly as an opal. Charming effect. When finished, the prints may be backed with glass. (2.) Albumenise, sensitise with silver nitrate, and use like ordinary silver paper. Splendid results. (3.) Capital thing for painting on in oils. (4.) Make splendid focussing screens; may be attached to glass for protection if thought necessary. (5.) Splendid transparencies may be produced by coating with transparency emulsion, giving the effect of an ordinary transparency backed with ground glass. It may also be used for backing ordinary transparencies instead of ground glass. (6.) Very good imitation stained glass may be made by coating the films (cleaned, of course) with coloured gelatine, made by mixing various dyes with gelatine solution. When dried the films may be cut into small pieces, which are stuck on the glass. Moistening the gelatine will generally make them adhere, but if not a little starch paste may be used. Cut narrow strips of dark grey paper and paste it over the joins; if well done the effect is very good. Artistically inclined friends are glad to do this after preparing the films; it is just the sort of thing they will delight in. These can be utilised also for producing a very durable enamelled print. Proceed by soaking the films in warm water to remove the emulsion, then soak one ounce of gelatine in ten ounces of water, and when soft, heat until dissolved; filter and immerse the print, apply to the celluloid film, and squeeze all air bubbles out. When about surface dry apply a little of the gelatine to the back of the paper and mount on cardboard; they then look very similar to "opalines," and are superior, in respect of being unbreakable. They may also be used as a support for carbon prints, and when mounted on a cream board look very much like ivory. If it is wished to make them useful as frames, procure a few of the *embossed* brass photo (carte and cabinet) frames, remove the back and glass, and rub lard well over the outside; when covered thinly *all* over, place in a rough cardboard frame, say a plate box, and pour in fine modelling plaster of Paris; when set hard remove from the box, trim the edges and separate—this will take place easily if properly greased; allow the plaster to get quite dry, now place the celluloid film on the brass and place the "plaster" over it and put in a warm oven with about a 4lbs. weight on it; this will gradually force the celluloid into the pattern, and when "down" allow to cool and it will set to pattern, paint the *back* with any enamel colour to taste, cream for ivory effect, etc., or pick it out in colours as desired, mount with glue on cardboard, and cut out the opening with a sharp knife; this process will be found very interesting and effective. Charming albumen-silver pictures of a browny pink tint can also be produced on them, and to make them, dissolve four drams of strontium chloride in four drams of water, and add to the albumen of one egg, beat well, and filter through cotton wool (pour a few drams of methylated spirit through the cotton first, or it will repel the albumen), coat the film by floating or pouring on and off, as if varnishing, and allow to dry. These will keep for twelve months in a dry place. To sensitise, float from three to four minutes on a bath of silver nitrate 1 ounce, sodium nitrate ½ ounce, and distilled water 12 ounces; allow to dry, and print similarly to ordinary paper, but much

deeper; tone with the acetate bath, and fix in hypo two ounces to the pint, and one dram of ·880 ammonia added, for fifteen minutes; the after-washing does not require near so long as paper prints do; finally, paint the back with cream enamel, and the appearance of ivory is given. If the print is a portrait, perhaps a pale pink would be admired, or they can be used as a window transparency. The following is a description of the mode in which they can be utilised for window decorations: If the gelatine on the film is perfect, and is not fractured, the silver must be cleared out in a strong solution of potassium ferricyanide, and the film then thoroughly washed in water, care being taken that the gelatine coating is intact. Having prepared a number of films of this sort, a window which it is wished to decorate may be found in the house, or it may be desirable to work a design on a sheet of glass to hang up after having finished it. To design the picture any picture may be taken, but many of our magazines provide a lot in the way of form, and, as for colour, taste must be consulted in the matter. After having decided on the picture, and armed with a piece of clear white glass the same size, and having it perfectly clean, take a brush—not too large—and some Brunswick black, and carefully outline in black about one-eighth to a quarter of an inch the principal figures and subjects of the picture. This ought to be done carefully, and too much detail in this line work will spoil the after effect of the work. Conventional work looks best, but pretty results may be obtained from other subjects if carefully chosen. If the waste films are large, good broad effects may be secured, but if they are small the after use which will be mentioned may be of some good. Now supposing a design has been mapped in with the black lines, any shadows may be put with fine hatching, and features of the figures put carefully in. After this has been done, consider next the colouring, and this is where the films are of use; take the films and a goodly number of dishes to colour with. Aniline dyes are brought into requisition to stain the films, and the depth of colour will be given to the film according to the length of immersion. The long list of dyes on the market give almost any colour required, and a little experimenting is almost necessary to get well used to the different colours. After having obtained the colours, solutions should be made up, and the films placed in these different solutions until the colour has been imparted to the film; when this has been done, place the film on one side to dry; when quite dry the different coloured films may be used to fill in the spaces between the black lines. By placing a piece of film over the space it may be marked round with a needle set into a piece of wood, and afterwards cut with a pair of embroidery scissors to just overlap the black lines, but to only lap over half-way across, as the corresponding colour will come up to it. The coloured films are fixed at one side with a touch of cement or glue, and not more. After the whole of the glass has been covered in this way, a large piece of glass is placed over the whole, and finally bound up with strong paper, lantern-slide fashion, after which it may be put into a frame and hung where it can be seen. Only the aniline colours, which are fast, should be used. Messrs. Spiller & Co., Atlas Works, Hackney Wick, London, E., make a variety for dyeing, and many of them, besides being rich in colour, suffer little from being exposed to light, if not too strong. For films that have the gelatine surface removed, a curious little novelty may be made, and, perhaps, can be greatly modified—when once the idea has been given, and the idea was originated from a competition that was recently on in one of the art journals, and this is the adaptation. The old Hornbook used by our great grandfathers and grandmothers, though a thing of the past, has a quaint feeling of novelty hanging to it, and to make some of these things, one must bring into requisition some pieces of wood this shape, with a small hole in the handle at A;



the size of this piece of wood need not be large, but can be made to suit requirements. After having cut out the wooden shape (cigar box wood does very well), cut out a square of paper as shown by the dotted line. But in the Hornbook, the ABC used to be printed thereon, and sometimes finish with the Lord's Prayer; and over this used to be nailed a thin piece of horn to protect the letters and paper, hence the name of "Hornbook." But instead of the alphabet, a view or photograph, or even the words "A Merry 'Xmas," might be substituted, and finally, instead of the horn, a sheet of celluloid film may be carefully nailed, and form an interesting little souvenir of the days that are past and gone. Maps mounted on celluloid are very convenient for cyclists, etc. Cut up into pieces a little smaller than the film, and squeegeed with the face to the film, just as an opaline is squeegeed to its glass, two such portions have only to be cemented together to make a flexible and almost indestructible pocket map, and a selection of several such maps will set the cyclist up for a tour. A celluloid film is useful in a pocket-book. The rough side can be written on with pencil, and tabulations made by permanent columns ruled on the paper underneath. Waste films after being cleaned of emulsion may be used for a number of purposes. (1.) Take equal parts of alcohol and ether, in which dissolve celluloid film to saturation. This can be diluted in equal parts of alcohol and ether to make an excellent varnish for negatives or lantern slides. (2.) Dissolve to saturation in acetate of amyl. This makes an excellent coating for wooden dishes, being impervious to water. (3.) These celluloid films may also be used for vignetting as follows. Lay the film over the negative, and with a lead pencil draw on the matt side a line around the image that it is wished to vignette. Then with Prussian blue work a broad wavy line over the pencil mark. From the edge of this line to the edges of the film paint heavily with Gihon's opaque This gives an opening through a translucent medium that should softly vignette a weak negative. However, if the edge be not soft enough, take the brush heavily charged with Prussian blue, and paint saw teeth a half inch long from the edge around the inside of the circle. This will do the work, and will be very useful. Lastly, to light a fire quickly, use plenty of films. Cut up in strips for spills—not, however, for pipe-lighting.

413. Films—To Prevent Stretching.—After the film has been stripped and expanded, soak it in alcohol until it contracts to its original size, which will soon occur. Another plan: Soak a film of plain gelatine in dilute hydrofluoric acid one to sixty, and lay on negative, when the film may be detached without stretching. This plan is

proposed by Mr. Pumphrey, and answers well. Or soak the film before stripping in solution of potassium bichromate, then expose to light, which will render gelatine perfectly insoluble, and after stripping and transferring, wash well, if necessary, with water containing hydrochloric acid to remove all yellowness, which would affect printing qualities. Or if a saturated solution of chrome alum be employed, rendered strongly acid with sulphuric acid, and the negatives left therein for an hour, not a trace of stretching will occur.

414. Fog—To Reduce.—There is nothing better than potassium ferricyanide and hypo; this will, of course, reduce the image as well, and will require intensifying after. Proceed by dissolving half-ounce potassium ferricyanide in two ounces water; add half-ounce of this to ten ounces of the hypo fixing bath, immerse the negative, and keep the solution in motion; this will clear the negative slowly, but equally, and it must be examined at short intervals, and, when sufficiently cleared, wash well. The image will no doubt now be a mere ghost. but the intensifier will soon alter that, and the following is recommended:

No. 1.

Potassium bromide	10 grains.
Mercury bichloride	10 ,,
Water	1 ounce.

No. 2.

Pure potassium cyanide ...	10 grains.
Silver nitrate	10 ,,
Water	1 ounce.

Put the negative in No. 1 until it is quite white, then rinse, and place in No. 2; wash well, and it will produce a *very* much improved negative, but not a *perfect* one.

415. Intensification, Partial—Method of.—By diluting indiarubber solution with benzene it can be brought to a consistency which enables it to be applied with great accuracy with a camel-hair paintbrush, and with the high lights thus waterproofed, the whole negative can be immersed in the intensifier until the darker portions are brought up to sufficient density. When dry, the indiarubber has only to be rubbed off with the finger.

416. Intensification—To Reduce after.—Immerse negative (after soaking in running water half an hour) in

Copper sulphate	1 ounce.
Common salt	1 ,,
Water	1 pint.
Hydrochloric acid	½ ounce.

till whitened thoroughly. Then wash well in running water, say, ten minutes, and immerse in fixing bath two or three minutes, rinse, and immerse in alum bath ten minutes, and wash. The chemistry of above process is as follows: The intensified image consists of mercury and silver, either metal or oxide. This is changed by the copper solution into cupric, mercuric, and argentic chlorides, and on immersing in hypo the silver dissolves, leaving a red image of mercury sulphide and copper chloride. Very quick printing. Stains usually disappear at the same time. If stained by intensification the following, from "Wheeler's Tables," is very useful: "Soak the plate in water for five minutes, then dissolve half a dram of cyanide of potassium in one ounce of water, and gently rub the stains with a tuft of cotton wool until they are removed." This solution should not be made too strong, or else fresh stains may appear. Rinse the plate well after treatment under a tap, and dry as usual. Great caution should be observed with cyanide of potassium, as it is very deadly poison. It is also possible to reconvert the deposit into chloride of silver by bleaching the negative in a saturated solution of bichloride of mercury, rendered acid by the addition of a little hydrochloric acid (say, half a dram to twenty ounces), washing well, and then immersing in a ten per cent. solution of sodium sulphite until sufficiently dense; or, instead of using mercuric bichloride, the following bleaching agent may be employed:

A.

Potassium bromide...	½ ounce.
Water	12 ,,

B.

Sulphate of copper	½ ounce.
Water	12 ,,

Mix A and B, and allow to settle, and filter off the clear liquid. The treatment is the same as with mercury. Instead of bleaching the image thoroughly and then darkening or redeveloping it, the above reducer may be allowed to act for a short time, and the plate then fixed in a solution of hyposulphite of sodium, the disadvantage of this process being that it is impossible to tell with any exactness the amount of reduction which has taken place until after the fixing operation. However, solutions which effect both the conversion and removal of the silver at the same time have been made, of which Eder's formula is a good specimen—

A.

Ferric chloride	1 part.
Water	8 ,,

B.

Potassium oxalate	1 part.
Water	4 ,,

Mix equal parts of A and B together, and add a small quantity to a strong solution of sodium hyposulphite. Immerse the plate in this, and the image will rapidly weaken, the reducer converting the silver of the image into silver oxalate, which is immediately dissolved out by the sodium hyposulphite. Another plan is to immerse negative in a bath of sulphite of soda for a short time, and, on taking it out, a reduction of its acquired density will be found to have taken place. The strength of the bath may be that of a saturated solution. This is a simple way, and will probably succeed.

417.—Intensifier, Monckhoven's, is perhaps the best means of strengthening a negative, and it has the advantage of adding silver to the image, thus favouring its permanency. It is said that our greatest photographic scientist frequently develops merely a ghost of an image on the plate, and builds up this image to printing density by means of a silver intensifier. To use this intensifier, two solutions are made thus:

A.

Bromide of potassium	10 grains.
Bichloride of mercury	10 ,,
Distilled water...	1 ounce.

B.

Pure cyanide of potassium (crystals)	10 grains.
Nitrate of silver	10 ,,
Distilled water...	1 ounce.

The silver nitrate is dissolved in half an ounce of water, and the cyanide in the other half ounce, and the latter is then poured into the former, and should clear up all precipitate. The well-washed plate is first placed in A until bleached quite white, then rinsed and transferred to B, until it gains the requisite density, then it is well washed, and the process repeated if necessary.

418. Isochromatic Plates—To Intensify.—Bleach with mercury as usual, and darken with saturated solution sodium sulphite, or bleach with acid potassium bichromate, and redevelop with ferrous oxalate or old quinol developer, or try the Platinotype Company's intensifier. A writer says: "The intensifier which succeeds best is the mercury bichloride, followed after a thorough

washing by a developer. The bichloride should be nearly saturated solution, and should be made strongly acid with a few spots of hydrochloric acid. The acid is very important. In the first place it destroys any trace of hypo in the film, and also prevents the mercury salt from hardening the film, which it does if neutral, and making it difficult to wash completely out. The developer depends upon the amount of intensity required by the negative. If only a little is required hydroquinone is used. But if it is a rather thin flat negative, where plenty of intensification is desirable, the Ilford pyro-soda developer is preferable. By means of it a negative that would give a wretched print, or even bromide, is converted into a splendid negative, fit for printing in P.O.P. or albumen. The difference in the amount of intensity given by quinol and pyro is very great, and can only be appreciated by trial. The difference is only noticeable in printing, and is not so much optically."

419. Local Reduction—To Effect.—To be any good for local reduction a reducer should work in one solution. The two which are most easily prepared are the ferricyanide and hypo and the ferric oxalate and hypo. To use the first, dilute some fresh fixing solution with an equal bulk of water, and add a few spots of a saturated solution of potassium ferricyanide. It is fit to use as long as it remains yellow. If through standing it has become blue or deposited sulphur it is useless. If the parts to be reduced are fairly extensive use a little piece of cotton wool as a brush for applying the above reducer, or else simply use a weak solution of ferricyanide and treat the plate with it as soon as it comes out of the fixing bath, the hypo in the film being sufficient to dissolve away the oxidised silver. It is always desirable to touch up lantern slides from drawings in this way, and a great advantage will be found in doing so. If the parts to be reduced are small, such as the delicate windows of a cathedral, it is a good plan to thicken the mixed reducer by diluting it with gum solution instead of water. It is then less easy to reduce the main portions of the negatives. The ferric oxalate reducer is made as follows, and the remarks as to the use of the ferricyanide and hypo apply to it with equal truth:

Potassium ferric oxalate	1-10 grains.
(According to rapidity desired.)	
Ordinary hypo fixer	1 ounce.

The potassium ferric oxalate is the green salt which crystallises out on allowing old ferrous oxalate developers to evaporate in the air.

420. Negative—To Harden—Take

Chrome-alum	¾ ounce.
Soda sulphite (powdered)	1 ,,
Water	8 ,,

Dissolve and pour into

Hypo	½ lb.
Water	12 ounces.

Let the negative remain in bath some ten or more minutes after having become apparently fixed. This renders the gelatine film insoluble, and permits shorter washing by the use of warm water. It can, if for any purpose desirable, be flushed freely at once with either warm, hot, or scalding water, without any slipping or softening of the film. It also prevents frilling. It should be remarked that before employing this, it is well to be sure that the negative is of the right strength, not needing reduction, as it responds with difficulty to any subsequent treatment.

421. Negative—To Improve Printing of.—Negatives with too much contrast may be greatly improved by pasting tracing-paper over the back, and applying oil with a fine brush to the dense parts. On the contrary: A very simple way of increasing the density of any portion of a negative is to mix some of Judson's yellow or orange dyes with half an ounce of gum senegal, and apply thinly with a camel-hair brush moistened with saliva. It adds enough density to parts of the negative required without shutting out the detail.

422. Negative—To Intensify.—A negative which is full of detail, but which has insufficient printing density, may be much improved by intensification. This is best done before the negative is dried, but if it has been dried it must be soaked in water for half an hour, and then placed in a saturated solution of bichloride of mercury (corrosive sublimate), and allowed to remain until the image is thoroughly whitened, both back and front, and all traces of yellowness have disappeared. Then wash in running water for an hour. Now, if a considerable increase of density is desired place in a solution made up of half an ounce of strong ammonia to ten ounces of water, and allow it to remain until uniformly black throughout. Then again thoroughly wash. If only a slight intensification is desired, in place of the ammonia make up a ferrous oxalate developer by *adding* to one ounce of a saturated solution of potassium oxalate, quarter of an ounce of a saturated solution of sulphate of iron, and three minims of a ten per cent. solution of ammonium bromide. Place the bleached negative in this till all action has ceased, and if further density is then desired, repeat the whole operation, bleaching in the mercury bath, washing, and redeveloping with ferrous oxalate as before. The following methods of intensification are arranged in the order of the amount of density obtainable, the *least first:* (1) Bichloride of mercury and sulphite of soda; (2) bichloride of mercury and ammonia; (3) silver intensification; (4) uranium intensification. The processes are as follow: *Mercury with Sulphite of Soda.*—Wash the negative thoroughly free from hypo, immerse in a saturated solution of bichloride of mercury till bleached, wash well, and immerse in a saturated solution of sulphite of soda till blackened, and give a thorough final washing. The mercury solution should be slightly acid. Some operators add bromide of potassium to the mercury solution, which is an improvement. *Mercury with Ammonia.*—Proceed as above, but use a solution of ammonia in place of the sulphite of soda solution; the strength of the solution can be varied from two or three drops per ounce to a twenty per cent. solution, a strong solution giving greater density than a weak one. Thorough washing at every stage is necessary to secure permanence and freedom from stains. *Silver Intensification.*—Wash thoroughly and soak for half an hour in a solution of peroxide of hydrogen (one dram of a twenty-volume solution to five ounces water), wash again, then apply the following: Ferrous sulphate 5 grains, citric acid 10 grains, water 1 ounce; to this add one or two drops of a twenty-grain solution of silver nitrate. This must be kept in motion over the surface till sufficient density is obtained. Wash, immerse in a solution of common salt, then into hypo again, wash and dry; great density can be obtained by this method if desired. *Uranium Intensifier.*—Wash thoroughly free from hypo, and immerse in uranium nitrate 15 grains, potassium ferricyanide 15 grains, water 4 ounces. The intensification is gradual, commencing in the shadows. Great density can be obtained, and the colour of the image is very non-actinic, so care must be taken to stop in time. The peroxide of hydrogen solution may be used with advantage, whichever way it is intended to intensify. The mercury intensifiers are *fairly* permanent if care is taken especially in the washing;

the silver and the uranium intensifiers are permanent. The Platinotype Co. have a good platinum and mercury intensifier, which is permanent and simple, but the formula is a secret. The various methods of intensification, with full particulars, will be found under separate headings.

423. Negative—To Make from a Negative.—Expose, say, an Ilford ordinary plate under a perfect but "thinnish" negative at about six inches from a No. 3 Bray burner gas flame for about forty-five minutes. Develop with

Pyrogallol	4 grains.
Ammonium hydrate	1 to 2 minims.
Water	1 ounce.

Bromide may be added if desired or required. It will be difficult to see the progress of the high-lights through the slight fog, so it is advisable to use a slow developer, though a normal one—pyro or iron—will give good results. The resulting negative will, of course, be "reversed." (See No. 433.)

424. Negative—To Modify.—Prepare the following solution:

Water	100 parts.
Dextrine	4 ,,
Sugar	5 ,,
Bichromate of potash	3 ,,

And a few drops of ammonia until the odour is perceptible in the liquid. This mixture is used to cover the back of the negative. Drain and dry the plate horizontally, at a temperature of 140° F. While still warm place it in the printing frame, the image against the glass; expose to daylight until the coating has become insoluble in the shadows. A photometer may be used. The plate is again heated to 140° F., and in artificial light. Then apply with a soft brush very finely powdered graphite, which adheres only to those portions which have not been acted upon by the light. When the retouching is sufficient coat with collodion and expose the whole to a strong light, and wash until the yellow tint disappears.

425. Negatives—To Reduce.—There is nothing better than Farmer's solution, made by mixing a little potassium ferricyanide (red prussiate of potash) with hypo, say, in the proportions of ten ounces of the ordinary negative fixing bath to five grains of the ferricyanide. Be quite sure the negatives are not greasy. It must be remembered that contact with the hand renders gelatine more or less repellent to moisture, and with such a negative no reducer will work properly. If the negative is an old one, begin by rubbing it over with a piece of rag moistened with benzole, then put it into methylated spirit for ten minutes, and finally apply the reducer, when matters will progress all right. Another reducer is recommended by Mr. Pringle, which is useful for "all-round work," whether clearing or reducing.

Half a handful of alum.
,, , citric acid.
,, ,, ferrous sulphate.
Twenty ounces of water.
Exactly 120 minims hydrochloric acid.

This can be used again and again. Another mode of using Farmer's is by adding two or three drops to the ounce of fixing solution of a saturated solution of potassium ferricyanide (*red* prussiate of potash). The negative is immersed in this; reduction at once commences, and proceeds rapidly. When the required amount of reduction is obtained, it is taken out and well washed. But for simplicity and ease in working many strongly recommend perchloride of iron as a reducer. The formula is iron perchloride about 20 grains, citric acid ½ dram, water 10 ounces. Place negative in this for two minutes, then wash, and dip the plate in and out of hypo fixing bath, repeating as often as required to produce the proper density. The reduction must be watched very closely, as it is very rapid, and should be stopped a little before the required density is reached. A weak solution will reduce the high lights in a harsh negative, and a strong solution will improve a flat negative by attacking the shadows. Therefore it gives at one time the command of the density and increase and decrease of contrast. What reducer can do more? For a general iron reducer the following formula can hardly be beaten:

Perchloride of iron (cryst.) ...	120 grains.
Citric acid	240 ,,
Water	32 to 50 ounces.

(according to strength required)

In warm weather add two grains of chrome alum to prevent frilling. After fixing and washing, place the plate in the iron solution and keep it moving to secure even treatment until sufficiently reduced, then wash and pass plate through hypo solution (ordinary strength) for a few seconds. If it is desired to reduce the high lights without affecting the final details of the shadows, use a weak solution of perchloride of iron—

Perchloride of iron	30 grains.
Citric acid	60 ,,
Water	20 ounces.

Place the plate in this for a minute or two, wash, and just pass it through hypo bath, and repeat as often as necessary until the exact degree of reduction is obtained. If a strong solution of iron be used the shadows will suffer, whereas if a weak solution is employed the high lights are first attacked. So that this reducer, judiciously used, may be made to improve the flatness of a badly-developed negative, if used strong giving it more brilliance by making greater contrast between the lights and shadows, and if used weak it lessens the contrast. Or try a reducer recommended by Monckhoven. Potassio-ferric oxalate 10 parts, dissolved in as little water as possible, and add 100 parts of ordinary hypo solution. Reduction takes place slowly and evenly. This reducer has the advantage that no washing is required after fixing, and it does not discolour the plate. For local reduction apply any of the solutions to the parts of the plate requiring reduction by means of a cotton rag or brush, washing between each application; or methylated spirits applied on a piece of cotton wool or rag would effect local reduction. The strongest reducer known is, however, the cyanide of potassium and iodine, especially for wet plates, and it is of the utmost importance to have the proper proportions of each, otherwise the image will be entirely dissolved, should it be too strong in iodine. It was much used years ago, especially for the ferrotype process on wet plates. Its use was to reduce more or less the image upon an over-exposed or over-developed picture; by this simple means many otherwise useless pictures were saved. Its strength should be such that it acts slowly, *i.e.*, causes slight reduction when it has been upon the wet plate for from, say, half to one minute, after which it is well and quickly washed, and if not reduced enough, repeat the operation again and again until the desired reduction has taken place. The proportions to be used are as follow:

Cyanide of potassium	200 grains.
Distilled or clean rain-water ...	20 ounces.
Pure iodine in crystals	4 to 5 grains.

It will soon be seen if it is the proper strength or not by trying it upon a waste plate. If it does not reduce quick enough, increase the quantity of iodine carefully, not adding more than one grain at a time before trying the solution again. If it acts too quickly reduce the quantity of iodine a grain

or two and try it again. When the exact strength is found that suits requirements, make a note of the formula in a pocket book for future reference. Do not, on any account, increase the quantity of the cyanide of potassium, or it will yield a solution that acts with such speed as to be quite beyond proper control. The quantity of the iodine must be increased or decreased, as previously directed; a very small quantity only is required. No iodide of potassium is really necessary, as the pure iodine alone dissolves easily in the cyanide solution. The chemical action of the above reducer is this: The iodine in it converts a portion of the metallic silver, forming the image, into iodide of silver, and this being extremely soluble in a solution of cyanide of potassium, it is almost instantly dissolved, which, of course, reduces the thickness of the silver deposit forming the image, and its density is reduced in consequence. See also Belitzki's reducer (No. 402).

426. Negative—To Reverse.—This can be accomplished by either the "stripping" or "dusting on" processes, or a simpler method still is to expose a plate under the negative to be reversed, and thus reduce the possibility of any stretching of film. Mr. Bolas advises the soaking of a plate in a solution of potass. bichromate (four per cent.) for a few minutes, transfer it to a bath of methylated spirit and water, drain off upon blotting paper, and leave it to dry. N.B.—These operations are, of course, to be carried out in the dark room. Expose the plate when dry under the negative, in a printing frame, if in sunlight about four minutes, or fifteen or so in the shade; when removed from frame a faint image will be observed. Rinse well under tap, and develop as usual, well wash, and fix as for ordinary work. The film could also be easily reversed by coating the plate with collodion. When quite set, immerse in a bath of hydrofluoric acid (one part to twenty parts water). The film will gradually loosen and slip off the glass, and can be turned over in the water, floating it back to its original support, or, if preferred, to a fresh glass that has been previously coated with thin gelatine. "Cresco-fylma," which is admirable either for reversing negatives or for enlarging, may be used, but the developer has something to do with the success of it, as negatives developed with pyro-ammonia or pyro soda curl up in the solution, and make it rather difficult in floating it on to the glass again. As it is only required to reverse negative, use one part of the prepared solution to eight parts of water. Full directions for use are given with each bottle. The developers which give the best results are hydroquinone, amidol, rodinal, eikonogen, and ferrous oxalate. See also directions for stripping negatives (No. 404), in addition to which a bath is recommended containing potassium fluoride 1 dram, sulphuric acid 2 drams, methylated spirit 3 ounces, water 12 ounces. Either bath must be kept in a gutta-percha bottle. The negative is placed in either of these baths, and left there until the edges of the film commence to leave the glass. It is then gently detached, placed in a bath of clean water containing a clean glass plate, which has been given a coating of weak gelatine solution which has been allowed to set. The reverse side of the film is laid on this plate whilst it is under water, the two removed together, a soft squeegee passed over the surface to expel the moisture between the two surfaces, and the plate set aside to dry. A coating of enamel collodion can be given before stripping in place of the glycerine and gelatine. It serves the same purpose of preventing expansion of the film. Reversed negatives are sometimes obtained direct by the use of a prism or mirror, or the negative is taken through the glass. A right-angled prism, as pointed out by Zentmayer, is far less effective for purposes of inverting than an obtuse prism, the obtuse angle being in the Zentmayer form, 125° 30′, and the angles at the base each 27° 15′. The methods of using a mirror in the exposing apparatus, as well as that utilising a prism, of whatever form it be, are open to serious objections, such as loss of sharpness, distortion, and difficulty in focussing. As regards the three methods of making reversed negatives in the camera mentioned, there are advantages and disadvantages in each case. In the case of taking the negative through the glass, its advantages are that the ordinary camera can be used, simpleness of operation, and cheapness. Its disadvantages: The glass must be absolutely flat, and free from spots and specks, and perfectly clean; and the difficulty in focussing, necessitating the use of a small stop, which for many subjects is impracticable. As regards a prism its advantages are: It is less liable to injury to its surface than a mirror (whose silvered surface is easily scratched and quickly tarnished), and for small sizes its small cost. Disadvantages: If the prism is large, light is lost by absorption, which necessitates longer exposures, and on account of the difficulty of obtaining glass of large size in perfect condition, and of working the surfaces optically true, prisms are very expensive. Advantages of mirrors: Small cost, small amount of light absorbed (if the mirror is well silvered and perfectly polished), it is more easily and cheaply replaced than a prism. Disadvantages: Liability to injury. This can be minimised by placing the mirror behind instead of in front of the lens (which will then be placed in the side of the camera), thus protecting it better from the atmosphere and dust, etc., and one lens may be substituted for another without touching the mirror, which would be impossible if it were in front of lens. Another disadvantage is great care is required in keeping and polishing a mirror, but if this be attended to properly a mirror will keep in good condition for a year or more without requiring to be resilvered. Taking all things into consideration, it appears that a well-silvered and polished mirror is to be preferred for large negatives, though for smaller work other processes than the above are also much used.

427. Paper Cloud Negatives—To Make.—These can either be made by painting on fine white paper with vermilion, or if desired to make them by photographic means, a good way is as follows: Take suitable negatives of clouds on ordinary dry plates taking care to give a very short exposure, and then take positives from them on albumenised paper. These should be printed deeply, and fixed without toning. After well washing and drying, prints may be taken off these positives, which, of course, will give the required paper negatives. They should be rendered transparent with vaseline, and put between blotting paper till quite dry. Or they can be made as follows: Make a transparency on an ordinary plate, and from that make by contact any number of cloud negatives on any negative paper. In developing endeavour to obtain as much contrast as possible, but stop development before shadows are obscured. Paper cloud negatives may be made on Eastman's stripping films, or Morgan & Kidd's negative paper, rendered more translucent after development, etc., by means of vaseline or wax. The former, of course, can be stripped and put on a glass plate Take a piece of the paper of the size required, and place it in a film carrier, or it may be kept in position in the slide by a waste plate. The camera should be directed to the point of sight, *i.e.*, horizontally, and not tilted upwards. Give a drop-shutter or rapid

hand exposure, and develop with any suitable developer, such as ferrous oxalate, hydroquinone, or eikonogen. Probably the best time for taking cloud negatives is in spring, when the weather is somewhat unsettled, and clouds assume definite forms. The majority of cloud negatives which are sold are of very little use, though effective in appearance. The reason of this is, that they are generally lit from behind, showing the edges of their "silver linings." As it is rarely that landscapes are taken with the sun directly in front of the lens, they are obviously of small use. Above all, in choosing a cloud negative, see that the lighting of the clouds is from the same point as that of the landscape, and in character with it. Cloud negatives on paper have the great advantage that they can be printed from either side, thus virtually being equal to two negatives, one lighted from each side.

428. Paper Negatives — To Make.— Bromide paper may be used successfully for the production of negatives. It has several advantages, especially in the larger sizes, arising from its lightness, its cheapness, its freedom from halation, and the facility with which retouching can be done on the reverse side of the paper. These more than balance the disadvantages caused by the difficulty of securing the paper perfectly flat in the ordinary dark slide, the liability to unequal development, and the existence of more or less of the appearance of the grain of the negative paper in the finished print. A great number of pieces of bromide paper may be taken in the space occupied by a glass plate, and with a very considerable saving in weight as well, while if the paper be purchased in the larger sizes or in a continuous roll it will be found less than half the price of plates. The smooth rapid bromide paper should be procured and used just as a glass plate would be, giving about the same exposure as to a negative plate of ordinary rapidity, and modifying succeeding exposures by the experience thus gained. According to Mr. Ferrero, the rapidity of Ilford rapid bromide paper is from two and a half to three and a third times that of an ordinary plate, so that the above exposure will be "full." In using bromide paper for negatives, the dull surface of the gelatine film and the non-transparent character of its support removes the principal cause of the spreading of the action of the light known as halation. Retouching may be performed for the removal of accidental defects by working with the pencil on the plain side of the paper before waxing, while clouds may be inserted by the same means or with Indian ink and a camel-hair brush. The lead pencil, however, has an advantage in the ready removal, or the alteration, of this after work. For small sizes —less than whole-plate—and where the apparatus has not to be carried a great distance, it will be sufficient to insert the paper in the rebate of the dark slide, backing it up with a piece of glass, say a spoiled plate, to keep it in position. For larger sizes it will be better to prepare a skeleton frame of light wood almost thick enough to fill up the space usually taken by the two plates in the double dark slide, pasting a sheet of opaque paper on each side of the frame. The sensitive paper is then clamped to this frame by pieces of tin three-eighths of an inch wide bent into the shape of ⊏. Two of these clamps at each end have been found sufficient for sheets 12×10in. The face of the rebate should be recessed to accommodate the clamps and allow the sensitive surfaces to lie firmly against the wood in the same way that a glass plate would. For touring purposes, the space occupied by the frame just described may be entirely filled with bromide paper cut to proper size. Two pieces of blackened tin perfectly flat should be placed between the pieces of paper ready for exposure and the store of inside pieces. When exposures have been made, the exposed sheets may be marked in pencil near the margin with a distinguishing number or letter corresponding with that in the book of exposure notes, and placed inside the pieces of tin, while two fresh sheets might be withdrawn from the store and placed ready for exposure. As an additional precaution against the inadvertent exposure of a piece the second time an eighth of an inch may be torn off one of the corners of each exposed sheet. It is difficult to keep large pieces of paper perfectly flat, and as the depth of focus with lenses suiting such pieces is mostly very little, a stop as small as can be used is generally to be advised in case part of the surface of the paper should have bulged outwards at the middle, and so prevented it coinciding with the position of the surface of the focussing screen. If a roll-holder be used, and suitable strips of the continuous bromide paper carefully placed on an emptied roller, the paper can be strained tightly in the proper position, enabling as large an aperture to be used as with glass to produce equal results. In developing, care must be taken to allow the paper to expand in the preliminary soaking as much as it will, and the solution must be kept in motion or wavy lines, coinciding with the places where the paper has touched or rested on the developing tray, will make their appearance. Hydroquinone appears to be the most suitable developer, while of the newer agents, amidol has been found to produce very good results. Neither of these seem to have the accommodating nature of pyro development, but they are cleaner in use. The iron developer is very good when the correct exposure has been accurately estimated. In any case, development should be carried beyond that of a bromide print. After development, fixing and clearing with a dilute acid solution; if necessary, it should be washed and dried like a bromide print, and is itself ready for furnishing a print after any retouching that may be required. Put it in the printing frame upon a piece of clear glass, and if the print from it shows that the negative is satisfactory, it may be coated with vaseline to hasten the printing of further copies. This will also obliterate the grain of the paper. The vaseline should be allowed to soak into the paper, giving it plenty of time. If heat be employed to quicken its action, it will sometimes exhibit marks of drying out which are not easily removed.

429. Paper Negatives — To Render Transparent.—The use of paper negatives has often been advocated in recent years, both on account of advantages in weight, storage, and cheapness; and in the old days of calotype and waxed paper processes, special papers were made —such as Turner papers—such papers being smoother and polished and free from grain. What is wanted is a paper in which the fibres are well knit together, and having little tendency to swell when wet. As regards the method of and materials for rendering the paper negative more or less transparent opinions differ, some saying that they prefer to use the paper just as it is, although taking a longer time to print than if rendered translucent. One of the best ways is to take a piece or pieces of paraffin wax and melt it in a water bath in a dish a little larger than the paper to be treated, having a layer of, say, half an inch. When quite melted, immerse the paper negative in it carefully so as to avoid air bubbles, and when fully immersed, gently go over the surface back and front, then draw out and draw off as much wax as possible. It will soon harden, and should then be placed between two sheets of stout

bibulous paper, and a warm iron passed over it to remove superfluous wax. If a more transparent paper is required, the following may be used: Mix together one part of Canada balsam and four parts of spirits of turpentine, and apply this with a brush or flannel to both sides of the negative; probably three applications will be necessary to obtain the necessary transparency — letting the paper dry between each application. A negative treated in this way is, however, more likely to go yellow than one treated with paraffin wax. Another way is as follows: The dry negative is pinned down to a clean flat surface (such as a drawing board, covered with a sheet of paper), face down, and a coat of castor oil applied with a rag. It is then pressed with a hot iron until it shows an even dark colour. If the iron is too hot it will dry out the oil, and it will be necessary to treat with the rag again. On the other hand, if the iron is not hot enough it will fail to cause the oil to penetrate the paper sufficiently. When an even colour is obtained, wipe off the excess of oil with a soft cloth, and the negative is ready to print. No oil should be allowed to get on the front of the negative; should it do so, it may be removed with a cloth and a few drops of alcohol. Captain Abney finds that paper negatives may be made transparent by waxing instead of oiling as described above. The process, which is very efficient, is conducted very simply as follows: A flat iron, previously well cleaned by rubbing on emery cloth and blotting paper, is warmed and placed on the back of the dry paper negative. A small cake of pure white wax is then brought into contact with its point on the back of the negative. The heat melts a certain amount of the wax, which, by moving the iron, can be spread over the whole picture. Blotting paper is then placed over the negative, and the hot iron passed over the surface of the blotting paper till all superfluous wax is removed. The negative is then fit for printing purposes. The object of immersing the negative after fixation in dilute hydrochloric acid is to remove the sizing from the paper. Of course, copious washing is required immediately after fixation; otherwise, decompositions of the hypo will be set up by the acid, with consequent irritability of the print. Other methods are—(1.) The following, which is not messy: Gum benzoin 60 grains, gum mastic 30 grains, Canada balsam 1 dram, sandarac 60 grains, essential oil of camphor 2 ounces. Mix the gums and balsam, and heat in a water bath; add the oil of camphor; stir frequently till dissolved; apply with a tuft of cotton wool whilst warm, and when cold polish off the superfluous solution with clean wool, and hang up in a warm room to dry, or pass a hot iron over it between sheets of blotting paper. (2.) The best way of making the paper transparent is a mixture of ether and castor oil (pure); one part of ether to four parts of castor oil. (3.) As good as any is—White wax 1 ounce, turpentine 5 ounces. Dissolve with heat on a water bath. To facilitate solution the wax should be shredded finely. Apply warm with a flat brush, and hold the negative before the fire to melt it well into the pores of the paper.

430. Pinholes—To Remedy.—These holes are caused by dust being on the plate at the time of exposure. The remedy is obvious. The following is from the formula given with Fry's plates: "Dust the plates with a flat camel-hair brush before using, and for further precaution apply a thin coating of dilute glycerine to the frames of the slides." They are also caused by a scum of oxidised pyro which forms on the surface of the developer, especially in hot weather. If this scum forms before flowing the developer over the plate it is liable to become attached to the film in spots, preventing development in the same way as air bubbles. This can be prevented by soaking the plate in water before developing. After they are formed, the holes, where high lights occur, could be stopped with blacklead scraped from a soft pencil, and rubbed in with the ball of the finger, and the negative be subsequently varnished, or block out the sky and other parts affected with a lead pencil, carefully touching each hole.

431. Potash Permanganate Intensifier—To Use.—Permanganate of potash has been used for intensifying for many years, notably in the wet-plate process. Simply immerse the fixed and washed plate in a ten-grain solution until it attains a brown non-actinic colour. Another way: One dram of ten per cent. solution of potash permanganate is diluted to two ounces with water, and the plate (developed with pyro and sulphite, and previously soaked in water) immersed therein for fifteen minutes, then four drams saturated solution of potash oxalate, and one dram saturated solution of ferrous sulphate are mixed and added. Intensification commences at once, and proceeds rapidly. When sufficiently dense remove and wash. The high lights are slightly stained yellow, but the intensification is very even, and the resulting colour a blue black.

432. Rain Marks on Negative—To Remove.—These marks can be removed by half an hour's soaking in plain water. Or it might be desirable to try a weak perchloride of iron bath. Perchloride of iron 4 grains, citric acid 4 grains, chrome alum 2 grains, water 1 to 2 ounces. Immerse negative in this bath for a minute or two, keep in constant motion, but do not allow the film to get bleached. Then well wash and intensify with gallic acid and silver solution. (A.) Pure gallic acid 80 grains, alcohol 1 ounce. (B.) Nitrate of silver 30 grains, distilled water 1 ounce. Take 1 dram of A, 1 dram of B, and 1 ounce of water, and pour this over the negative in a clean glass dish, and keep rocking until film is sufficiently dense. Then wash plate well, and dip in weak hypo solution and wash again. The light part might also be treated with the brush to minimise the contrast. Another method is by retouching. Rain marks, in addition to the clear spot, generally cause a dark semicircle round it, the removal of which could not be successfully done except by a skilled retoucher. Or try soaking for half an hour in a saturated solution of chrome alum, and then washing them in *warm* water, gradually increasing the temperature until the sunken portions rise about level with the other, and then allow to drain and dry. Do not hurry and force the operation, but do it slowly and carefully, and success will result.

433. Reversal of Negative Image—To Secure.—There are several methods by which the image may be converted into a positive instead of a negative image. This is called "reversal of the negative," and it is perhaps unfortunate that there should be some chance of confusion owing to similarity of name with that of "reversed negative." The latter, of course, means a negative reversed as to sides, and is obtained by various means, such as stripping and reversing. If, however, a negative is obtained by contact from a negative as in the former process, it is also "reversed," hence this process may be made use of for carbon printing. Equally, of course, a positive may be obtained from a positive. Ordinary gelatine plates, if very much over-exposed, will yield a positive instead of a negative. (See No. 423.) Colonel Waterhouse finds that the addition of thio-sinnamine or phenyl-thio-carbamide to the eikonogen developer used in

the development of gelatine plates correctly exposed will produce *reversal*, that is, yield a positive image. His formula is as follows:

A.

Eikonogen	5 parts.
Sodium sulphite	10 ,,
Water	100 ,,

B.

Sodium carbonate (cryst.)	4 parts.
Water	100 ,,

C.

Phenyl-thio-carbamide	1 part.
Water	2,000 ,,

The developer is formed by taking one part of A, two parts of B, and one part of C, to which is added one part of a ten per cent. solution of potassium bromide, and, if the contrasts are too strong, a few drops of ammonia. Colonel Waterhouse also recommends the tetra-thio-carbamide ammonium bromide compound salt as being more soluble, and yielding better results.

434. Silver Intensifier—To Make.—When Mr. Kennett introduced his "Gelatine Pellicle," he recommended the following intensifier, which collodion workers will recognise as being very like an old acquaintance:

Pyrogallic acid	3 grains.
Acetic acid	6 drops.
Citric acid	1 grain.
Water	1 ounce.

To this two or three drops of a twenty-grain solution of silver nitrate were to be added at the time of using. Mr. Kennett remarked that any degree of density might be obtained, and gave a warning against intensifying too much, as the colour of the film becomes very non-actinic. The solution was not to remain on the plate if it became discoloured, or a stained film would result. The operation concluded with thorough washing and spontaneous drying. It is sometimes found that the acid in the formula causes frilling, though this is hardly likely to occur with the harder films of modern commercial plates. The following modification of it enjoys a good reputation: (A.) Hydroquinone 5 grains, citric acid 6 grains, water 1 ounce. (B.) Silver nitrate 30 grains, water 1 ounce. Mix three parts of A with one of B, and pour the mixture over the negative in the dark room. When the requisite density is obtained, wash the plate well and dry it slowly. Any of the following formulæ are very permanent: (1.) This intensifier works well, and at the same time possesses the quality of being absolutely stable. (a.) A stock solution of iron sulphate is made as follows: Iron sulphate 15 grains, citric acid 15 grains, water 1 ounce. (b.) A second solution is made as follows: Water 1 ounce, silver nitrate 10 grains, acetic acid 10 minims. To intensify, take enough of A solution to cover the plate, and add thereto from six to ten drops of B solution; flood the plate, and intensification will take place in a clear, gradual, and satisfactory manner. The greater the quantity of silver solution added, the greater the intensity produced in the negative. Wash thoroughly after intensification. (2.) Another is Mr. Farmer's intensifier, which is valuable, as the plates need not be absolutely free from hypo. It is as follows:

Solution 1.

Silver nitrate	480 grains.
Distilled water	12 ounces.

Solution 2.

Potassium bromide...	360 grains.
Distilled water	2 ounces.

Add No. 2 to No. 1, collect the precipitate, wash thoroughly, and mix in the following:

Sodium hyposulphite	960 grains.
Distilled water	6 ounces.

The mixture is thoroughly stirred, allowed to stand for a few hours, and filtered, and sufficient distilled water added to make the solution measure sixteen ounces. The plate is soaked in this solution for five minutes, drained, and a ferrous-oxalate developer applied; washed and dried, or the following may be used:

Pyro	4 grains.
Distilled water	2 ounces.
Silver solution	60 minims.

Add immediately before use eighty minims of a ten per cent. solution of liquid ammonia ·880. Monckhoven's also is a great favourite among photographers (for which see No. 417), but for fine effects many prefer Mr. Wellington's intensifier, which has the advantage of depositing the silver in exactly the same state of division as is present on the plate. This briefly is—(A.) Silver nitrate ½ ounce, water 6 ounces. (B.) Ammonia sulphocyanide 1 ounce, water 3 ounces. (C.) Hypo 1 ounce, water 3 ounces. Take equal parts of each, and add the sulphocyanide to the silver until it just dissolves the precipitate. To each ounce add three grains of pyro (with sulphite, *i.e.*, thirty minims of sulpho pyro) and six minims of ammonia. More NH_3 must be added if more density is required. There are, however, one or two precautions, and these are—(1.) Keep the solutions separate until wanted, as the sulphocyanide and hypo, if mixed, decompose. (2.) Harden the film well with chrome alum, as the sulphocyanide is a great softener of gelatine. (3.) Thorough fixation and a slight washing, two or three changes of water being sufficient. (4.) A *very*, *very* clean dish, or the silver will be left on the dish. (5.) If the negative has been dried, a good and prolonged soaking is necessary for regular intensification.

435. Stained Negatives—To Clear.—The best way to remove the yellow stain from pyro-developed negatives is to bathe them in sulphurous acid water, or in a ten per cent. solution of sulphite of soda to which a few drops of sulphuric acid has been added. Either of the following clearing solutions may remove the stain:

Eau de Javelle.

Dry chloride of lime (hypochlorite of calcium)	2 ounces.
Carbonate of potash...	4 ,,
Water	40 ,,

Mix the chloride of lime with thirty ounces of water, dissolve the carbonate of potash in the remainder. Mix, boil, and filter.

Labarraque's Solution.

Chloride of lime (as above) ...	2 ounces.
Carbonate of soda	4 ,,
Water	40 ,,

Mix in exactly the same manner as the eau de javelle solution. Either of the above must be very carefully used, as they soften the film greatly. If the clearing solution will not clear the negatives it might be best to stain them over with a weak *blue* stain, which can be made with aniline dye, and is best done by immersing the negative in the dye. The effect of the blue on the yellow is to give the whole a greenish tint, and though they will still print somewhat slowly; they will be better than with the yellow stain. If there is any doubt about the success of the above, try an experiment with one negative by staining the glass side only, and then making a print from it; then, if an improvement (as it surely will be), the same remedy may be applied to the lot, or the stain can be easily rubbed off the glass. If the negative is stained blue (from contact with ferro-prussiate paper) proceed as follows: First soak the negative in dilute ammonia (ten minims of ·880 in one ounce of water), wash very thoroughly after this, then give it a bath of dilute hydrochloric

acid, same strength as the ammonia, and again wash. The ammonia decomposes the blue stain, changing it into a brownish-red one of ferric hydrate, which the hydrochloric acid dissolves. Wash well after the ammonia, or the blue stain will be precipitated again. Or a saturated solution of oxalate of potash, such as is used in oxalate development, will remove the stain without injury to the film or to itself. Immerse the negative until the stains disappear, wash it well in several changes of water, and set it aside to dry. If the stains are silver the following method will remove them: Soak the plate for five minutes in clean water; meanwhile make a solution of iodide of potassium 20 grains to an ounce of water; put the plate in this solution, and let it stay for ten minutes. If the stain is very old, keep it in for half an hour. Now dissolve half a dram of cyanide of potassium in one ounce of water. Put the plate into this, and gently rub the stains with a tuft of cotton wool, free from grit, until they are quite gone. If the stains are very old, make the solutions stronger, and soak for a longer time.

436. Transparencies—To Make Negatives from.—If required to make negative by contact, it is advised to use a quick plate, for the reason that it has the finest grain, and is, therefore, most suitable for reproduction. As to make of plate, there are so many good plates now in the market that almost any make will answer. For developer, the ordinary pyro formula answers well, but use the developer that is given with the plates. This is only fair to the plate maker, and will prove more satisfactory to the worker. Expose to the light of gas flame or paraffin for fifteen to thirty seconds, at a distance of two or three feet. Printing can be done by daylight, but the exposure must be so short that there is great danger of over-exposure. It is found a good plan to use the developer half strength, and then when all the details are up to add more pyro or hydroquinone as the case may be, and so build the negative up to the required density. Be sure to have the dry plate close up to the positive in order to obtain a sharp image. Use the ordinary printing press, which answers better than the dark slide, the springs being, as a rule, too weak. In order to make the press safe, cover the back and ends with a dark cloth. If the transparency is flat, and hence there is but little contrast, a plate containing a proportion of iodide would be suitable; such, for instance, as Morgan and Kidd's Special Instantaneous, which are of moderate rapidity, and give negatives with strong contrast. If the negative is to be by contact, say, from an unmounted lantern slide, there is no better method than to use a lantern plate, say Thomas's, for the negative. Expose to one inch of magnesium ribbon at three feet, and develop with pyro and ammonia. In fact, if the negative is to be by contact, a Thomas's transparency plate of the same size as the transparency will give capital results. Of course it is necessary to arrange matters so that the films of the transparency and negative look towards each other, otherwise there will result a reversed negative. Also well clean the back of the transparency, and diffuse the light with ground glass.

437. Uranium Intensifier—To Make.—The following is Dr. Eder's formula for this:

Uranium nitrate	12 grains.
Potass. ferridcyanide	15 ,,
Water	4 f. ounces.

Before using this the plate must be well washed and alumed, as traces of hypo produce fog. The plate is immersed in the solution, and allowed to remain till proper density is reached. This method of intensification is perfectly permanent, and is much recommended by Captain Abney for that reason. It is also much better than mercuric chloride and ammonia for the same reason. The results are quite permanent, and its advantage lies in that fact, also that fine detail is not blocked out, as is the case with most other intensifiers. There are two ways of using the uranium salt. First is the one solution as above, another formula for which is given by E. Vogel, jun. Dissolve

Uranium nitrate	1 gramme.
Potassium ferridcyanide	1 ,,
Glacial acetic acid	20 ,,
Water	200 ,,

The negative must be well washed before using this intensifier, which is fairly powerful, and when sufficiently intensified must be washed for fifteen minutes, not more, as the deposit gradually washes away. This method of intensifying is very useful when local intensification has to be effected. If too great density is obtained, it can be removed locally or generally by dilute liquor ammonia. Second, the two solution method, for which the following formula is an excellent one. One very great advantage is that with uranium intensification over-density can be corrected by giving a longer wash in water, but the negative must be continually moved, or the reduction will be unequal. Formula:

1.—Uranium nitrate	9 grains.
Acetic acid	2½ drams.
Water	8 ounces.
2.—Potassium ferricyanide ...	9 grains.
Acetic acid	2½ drams.
Water	8 ounces.

Take equal parts for use at time of using. Remember the *mixed* solution will not keep. Do not over-intensify, as the colour is very non-actinic. It is quite immaterial what the plates were developed with. But one point is most essential, and that is, the film must be *perfectly free from hyposulphite of soda* before attempting to intensify with uranium or any other substance used for a similar purpose. The following is also a good formula:

Nitrate uranium	50 grains.
Distilled water	1 ounce.

Soak plate for ten minutes in this solution, drain and soak again in a solution of the same strength of potassium ferridcyanide till sufficient density is obtained. Negatives that are dry should first of all be well soaked in distilled water, as the action is more even, while those which are varnished must be soaked in methylated spirit, and the varnish removed with a tuft of cotton wool. Another way is—Make two separate solutions by dissolving in two ounces of water fifteen grains of uranium nitrate and fifteen grains of potassium ferricyanide. Mix these solutions only when to be used immediately. The negative must be thoroughly washed, and it is therefore best to let it wash all night, thus ensuring the perfect absence of any hypo. Immerse the plate in the mixed solution, and allow the action to proceed. The details in the shadows are first affected, then the half-tones, and finally the high lights. According to Dr. Eder, a negative that will not acquire sufficient intensity with uranium will not acquire it with any intensifier. If the negatives have been developed with eikonogen or amidol they will intensify equally well. Those that have been under intensified may be put into a second bath of the mixed intensifier, or, better, soak them in a solution of carbonate of soda or liquor ammonia, and after well washing start the process afresh. Two hints are important: Rinse the ferricyanide crystals with distilled water before dissolving them, and also use distilled water for both solutions. Do not perform the operation of intensification in the sunlight.

438. Uranium Intensification — RED STAIN, TO AVOID.—Immerse the negatives in question in dilute ammonia solution ten per cent., and the red stain will speedily disappear, and the negatives (after washing) will be left in the condition they were before intensification. The trouble arises from one of the two following causes: (*a.*) Insufficient washing after fixing. If the hypo is not perfectly removed a red stain in the shadows of the negatives will surely be produced. (*b.*) The negatives were *fogged* before intensification commenced. In that case the shadows will, of course, receive a deposit of the ferrocyanide of uranium. In fact, the deposit forms first on the shadows, then on the half-tones, and finally on the high lights. If this is the case the negatives must first be reduced until the shadows are partly clear glass, until, in fact, the *shadows* are as they should be in a perfect negative. The following reducer will be best—

Hypo (five per cent. solution) ... 2 ounces.
Ferricyanide of potassium (five per cent.) ... ... 30 minims.

Put this in a dish, and put the negative in this until reduced sufficiently, then wash immediately and thoroughly, and intensify as before, or rather allow the negative to remain in the uranium solution for one to five minutes (about) until the deposit appears to be *rather less than that actually required*; it becomes rather more dense on drying. The deposit is of a red brown (burnt sienna) colour, and *is very non-actinic*. This is rather deceptive, acting much more energetically than would be expected. The uranium nitrate and potassium ferricyanide are best kept in separate solutions (four grains to the ounce of each), and mix them shortly before use. Where only a slight intensification is needed, uranium should not be used, as it is about twice as strong as the mercury ammonia process.

439. Veiled Negatives—TO CLEAR.—The following process has been recommended for clearing *veiled negatives*: Prepare a mixture of glycerine and water, equal parts, which is added to a cold saturated solution of hyposulphite of soda (40—50 to 100). This mixture is spread with a brush over the yellow negative, then the plate is left on a plane surface protected from heat and dust. According to the intensity of the colouration of the negative, the yellow tint invariably disappears in a longer or shorter time, which may vary from one to twenty-four hours. The negative is afterwards washed in the ordinary manner. It is here the *nascent sulphurous* acid which acts on account of the oxidation of the hyposulphite coming in contact with the air. By this process negatives have been cleared that were so yellow that it was hardly possible to see the image, and which had been dry for more than two years.

CHAPTER XI.

PAPERS.

440. Albumenised Paper—To Prepare.—The following is the process: Crack a dozen eggs separately, and carefully remove the yolks without breaking them. Weigh the whites, which should weigh about twelve ounces, and add 120 grains of chloride of ammonium dissolved in half an ounce of spirits of wine and four ounces of water to the albumen. Now beat up this mixture with an egg whisk into a thick white froth in a large jar. It must now be allowed to settle, and should then be filtered through a piece of cotton wool into a flat dish, a little larger than the sheets of paper to be coated. Great care should be taken in placing the paper on the surface of the albumen, so as to avoid air bubbles. Take hold of opposite corners of the sheet, and bring the hands together so that the paper is curved inwards. Then gently lower the hands until the middle of the paper touches the albumen, when the hands should be gently separated until the sheet lies on the albumen. In a few seconds raise the sheet half up at one end to see if there are any air bubbles; if so, remove them with a fine camel-hair brush dipped in the albumen. Replace the paper, and examine the other half in the same way. If the salted albumen is well beaten up in the first instance and carefully strained, there should be no difficulty from frothing in the subsequent operations.

441. Albumenised Paper—To Prevent Cockling.—First place the paper in a damp cellar for a few hours previous to floating it upon the silver nitrate. This will prevent it from curling up. As regards cockling after sensitising, hang the paper over a thick cord or wooden rod to dry, with two corners hanging down, the line running diagonally under the sheet, sensitised side upwards. To prevent it from rolling up when on the sensitising bath, the paper should be slightly damped by leaving in a damp cellar, or in a box containing an open pan full of warm water for an hour or two before floating. Another way would be to lay it between damped sheets of *chemically pure* blotting paper for the same time. Another way to prevent it curling is to breathe gently on the back as soon as it commences to roll, also laying the sheets of paper when half dry between sheets of blotting paper that have been dipped in a solution of carbonate of soda, and then thoroughly dried, is a very good dodge. When the paper (after sensitising) is bone-dry store away in the following manner: Roll tightly, face outwards, on a clean wooden roller, a round ruler will do, as tight as possible without tearing the paper, then well wrap round with red blotting paper that has been soaked in a ten per cent. solution of sodium carbonate. This will entirely prevent all cockling, and paper stored this way will keep almost indefinitely.

442. Albumenised Paper—To Convert into Bromide Paper.—Take ordinary albumenised paper (not sensitised), and wash to remove sodium chloride. Then float on solution of sodium bromide (forty grains to one ounce of water) for two minutes, dry and sensitise by flotation on silver nitrate (sixty grains to ounce) for one minute, wash in distilled water for several minutes, and dry. Of course, all the sensitising and drying operations must be performed in the dark room. Develop with hydroquinone. Or albumenised paper may be converted into bromide paper by sensitising in the ordinary way to produce albumenised-sensitised paper, and, when this is dry, floating on a ten per cent. solution of bromide of potassium for two minutes. It is ready for use when dry. Paper thus prepared requires an exposure about four or five times as long as ordinary bromide paper, but after development with ferrous oxalate produces prints almost indistinguishable from ordinary bromides.

443. Albumenised Paper, when Acid—To Treat.—Papers of this class are generally acid owing to the addition of sulphurous acid, sulphites, etc., to improve the keeping qualities. A slight acidity is of no consequence in sensitising, but if very acid the following treatment is advised: Pass paper, after first two washings before toning, through a bath of washing soda half an ounce, water twenty ounces, allowing it to soak two or three minutes in this, and again well wash before toning. Another method would be to fume the paper, before printing, with ammonia. It consists simply of exposing the dried and sensitised paper to action of ammonia. Any arrangement will suit that will prevent light getting at the paper, and allow the ammonia to act evenly. A box or cupboard that will allow the sheets of paper to be hung up separately will do. The sheets are hung up, and a saucer containing a little strong ammonia is placed some distance below. The time of fuming varies with the weather, and also with the brand of paper, but may be from three to twenty minutes. The fuming should only be done just before printing. Add solution of washing soda to the sensitising bath till a distinct precipitate is produced each time after sensitising; shake well up, and place in the sun in a colourless glass bottle when not in use. Always keep the fixing bath slightly alkaline by adding ammonia to it drop by drop, till it just smells, and do not use it stronger than three ounces to the pint. Wash the prints well before toning.

444. Alpha Paper—To Make.—The formula for the preparation of the emulsion for this paper is a trade secret, and is likely to remain so. The following citrate emulsion has been recommended for yielding tones going from a light red to a purple, with a short exposure:

A.

Chloride of sodium	60 grains.
Citrate of potash	60 ,,
Distilled water	1½ ounces.

B.

Gelatine (half hard and half soft)	240 grains.
Distilled water	5 ounces.

C.

Nitrate of silver	230 grains.
Distilled water	1½ ounces.

Develop with ferrous oxalate, and tone in a sulphocyanide and gold bath, and fix in a ten per cent. solution of hyposulphite of soda. Mr. J. B. Wellington also recommends the following formula for the preparation of Alpha paper:

Solution A.

Nitrate of silver	10 parts.
Citric acid	10 ,,
Distilled water	144 ,,

Solution B.

Chloride of sodium	2 parts.
Bromide of potassium	4 ,,
Citric acid	10 ,,
Gelatine	4 ,,
Distilled water	144 ,,

Both solutions must be heated to 60°C., and solution A poured into B, shaking violently, and then twenty parts of gelatine, previously swollen in water, melted and heated to 66°C., should be added thereto, and the whole well shaken. Now pour the solution into a dish to set, where it should remain for twenty-four hours, and then broken up and washed. Remelt the emulsion and coat the paper in the usual manner. Note.—All operations should be carried on in a ruby or orange light.

445. Aniline Black Paper—To Prepare.—The paper intended for use in this process should be well sized with an aqueous solution of gelatine in the proportion of one to fifty. The sensitising solution consists of:

Chloride of sodium	48 grammes.
Bichromate of potash	48 ,,
Vanadiate of soda	0 gr. 10.
Distilled water	960 c.c.

Another solution is made of

Sulphuric acid	96 c.c.
Water	480 ,,

When this is cold, it is added to the first solution; the paper is floated upon the mixture, and allowed to dry in a dark place. The paper, when dry, or while slightly damp, is then exposed under a printing frame for about seven minutes to the action of light, after which it is kept in the dark until it is desired to develop the image. It is then exposed for one minute to a mixture of vapours of water and aniline; next it is placed in an atmosphere of vapour of water kept at a temperature of from 24° C. to 30° C. The image is thus developed in black lines upon a green ground. To remove the green colour, it suffices to soak the paper in a one to six solution of ammonia. The print has then to be dried and pressed.

446. Aristotype Paper—To Make.—The term "Aristotype" was originally applied by Liesegang to a collodio-chloride paper, for which he gives the following formula: (A.) Silver nitrate 124 grains, water 100 minims, dissolved by heat, and added to a collodion containing pyroxyline 124 grains, ether 6 ounces, alcohol 4½ ounces. (B.) Alcohol 1½ ounces, lithium chloride 15 grains, tartaric acid 15 grains. Emulsify B into A, shake well, and spread thickly over sized paper. It has since been given to gelatino-chloride papers, for which formulæ will be found under that heading. Abney gives the following:

No. 1.

Sodium chloride	40 grains.
Potassium citrate	40 ,,
Water	1 ounce.

No. 2.

Silver nitrate	150 grains.
Water	1 ounce.

No. 3.

Autotype gelatine	320 grains.
Water	3½ ounces.

Mix Nos. 2 and 3 together, and add No. 1 in the ordinary way. As soon as set, squeeze it through canvas into cold water; there let it remain for about a quarter of an hour. Add the following to the emulsion when taken out of the water:

Alcohol	3 drams.
Chrome alum	2 grains.
Water	2 ounces.

If the emulsion appears grainy, boil it for about ten minutes. Plates or paper are coated in the usual manner. The following formula of Mr. Barker gives good results:

Gelatine (Nelson's No. 1 and Coignet's, equal parts)	175 grains.
Chloride ammonium	18 ,,
Potassic-tartrate of soda (Rochelle salts)	50 ,,
Nitrate silver	75 ,,
Methylated alcohol	¼ ounce.
Water	5 ,,

To mix. Procure an orange glass hock bottle (and then the operations may be performed in an ordinary room), pour in the water, add the salts and the gelatine, and allow to soak for a quarter of an hour, then put the bottle in a saucepan of hot water and apply heat until the gelatine is dissolved. When the temperature is about 100° F., add the nitrate of silver in crystals and all at once, put the cork in the bottle, and shake gently for some minutes until all the silver is dissolved. The emulsion is very thin and transparent, and must be kept at a temperature of 100° F. for about ten minutes, then add the alcohol, shake, and let stand for a few minutes; the emulsion is now much thicker and can be poured out to set, or can be used upon the paper at once without washing. If it must be washed, squeeze it through coarse canvas, and soak for a short time in two or three changes of water, and then when it is remelted add a little more alcohol. Now to coat the paper: Take good Rives, wet it well with warm water, and squeegee on to a piece of plate glass; pour on the emulsion (three drams will coat 8 × 5), and it will flow well over the wet paper, put upon a level place to set, and remove from the glass and pin up to dry. It will probably curl up a bit as it dries, to remedy which roll it face outwards upon a moderate sized roller. Print somewhat deeper than required, then tone in same manner as a gelatine lantern slide, *i.e.*, sulpho-cyanide first, and then ordinary acetate or borax bath; fix for fifteen minutes in hypo one to water sixteen.

447. Baryta Paper—To Prepare.—This paper, known also as *kreide-papier*, is paper coated with an emulsion of sulphate of barium and chrome alum, which is used as a support for gelatino-chloride printing-out emulsion and also in collotype printing. Prepare—

No. 1.

Gelatine, Heinrich's	90 grains.
Barium chloride	30 ,,
Distilled water	5 ounces.

No. 2.

Ammonium sulphate	15 grains.
Distilled water	2½ ounces.

Soak the gelatine in the water till soft, add the barium, and dissolve by heat; then add No. 2 solution in small quantities at a time, shaking

between each addition. Allow the emulsion to set; then break into small pieces and wash thoroughly; afterwards add seven and a half grains of chrome alum previously dissolved in a little hot water.

448. Bitumen Papers—To Make.—Printing with bitumen on paper is never done nowadays, the process being quite unsuitable for printing on paper. The reason of this is that the surface of the bitumen is first rendered insoluble by light, and in case of a print in half-tones a soluble layer is left between that and the paper; consequently, on development, parts of the image are liable to be washed off. Of course this objection does not apply in line work for photo-mechanical printing, as the extremely thin film used is rendered insoluble right through, except where protected from the light. The following particulars are from W. K. Burton's "Photographic Printing": "Preparation of the bitumen varnish. The bitumen is reduced to coarse powder, and is dissolved in rectified turpentine. By allowing sufficient time, in three days, if frequently stirred, it dissolves one-third its own weight. When the turps is thoroughly saturated, ether is poured into the solution. The ether at first has the effect merely of thinning it, but when about two parts of ether have been poured into one part of the solution, a doughy precipitate begins to fall. To discover if all the bitumen not soluble in ether has been precipitated, a little ether is placed in a test tube, and a few drops of the supernatant solution is poured into it. If a precipitate is formed, more ether is added to the solution till on trying this test no precipitate forms. The whole is allowed to stand for twenty-four hours, when the supernatant liquid is poured off. The precipitate which remains amounts to about half the bitumen. Fresh ether is poured over the precipitate, which is stirred up occasionally during two or three days. The precipitate is removed with a bent strip of zinc from the vessel in which it was thrown down. It is placed in a porcelain dish, and is allowed to remain in a warm place for several days, with occasional stirring to completely remove the ether, when there remains a hard, brittle, glittering black mass, easily reduced to powder by hand. The prepared bitumen is powdered, and is dissolved in benzole, the solution being of such strength that it will flow like collodion, and to each hundred parts are added one and a half parts of turpentine. The paper is coated with this, and laid on one side in the dark for twelve hours for the film to harden, and just before exposure it is dusted with French chalk to remove any trace of tackiness. The exposure, if the negative be quite clear, and the varnish prepared as described, will be about 15m. to the brightest sunshine. To develop the print a mixture of benzole and turps is used. Benzole alone cannot be used, as it is so energetic that it would dissolve even that which had been acted upon by light. Turpentine, on the other hand, acts too slowly. It is well, however, to begin with turpentine, and gradually to add benzole as appears necessary. The print is flooded with the mixture as in developing a plate. At the end it may be necessary to assist the action by gently rubbing with a tuft of cotton wool, but the greatest care must be taken or the image will be injured. When development is complete it must be passed through three or four baths of clean turps and benzole to completely remove the bitumen, neglect of which causes the prints to be yellowy.

449. Black Line Process—To Prepare Paper for.—Many methods, more or less satisfactory, have been published for getting black lines on a white ground. In 1880 Riegel published in *La Technologiste* a method of doing this by exposing a sensitive layer of iron salts and gelatine to light, and developing with gallic acid. He took the following:

Ferrous sulphate	10 grammes.
Ferric chloride	102 ,,
Gelatine	10 ,,
Tartaric acid	10 ,,
Water	300 c.cs.

The paper was coated with this mixture, and the image developed with a two per cent. solution of gallic acid, to which a little alcohol was added. The prints were washed with water and dried. In 1884 a patent was brought out for the same purpose. The formula is quoted by Dr. Eder as follows:

Gelatine	1,500 grammes.
Ferrous sulphate	600 ,,
Sodium chloride	940 ,,
Tartaric acid	188 ,,
Ferric chloride	1,500 ,,
Water	11 litres.

The paper, which has been coated with this mixture and dried, is touched over with powdered gallic and tannic acid. After exposure the image is developed to a brilliant black with water and a sponge. Another method for the same thing was published by Fisch:

1.—50 parts gum arabic, 500 parts of water.
2.—50 ,, tartaric acid, 200 ,, ,,
3.—30 ,, ferrous sulphate, 200 parts of water.
4.—100 ,, of ferric chloride solution, of 45° B.

Solutions 2 and 3 are mixed together, poured into No. 1, and then No. 4 added. Well sized thin paper is coated with the mixture, and dried quickly at a rather elevated temperature, about 50° C. It keeps about fourteen days. The printing from a drawing occupies about ten to twelve minutes in sunlight. The highest lights should lose their yellow colour. As soon as the ground is thus perfectly white, the development is proceeded with. It is advisable to test the extent of the printing by exposing at the same time a test print which is tested with solution of potassium sulphocyanide, as to whether it produces a deep red image on a white ground. If this is the case the reduction of the iron salt by light has been completed. The print is then removed from the frame and allowed to float (image side down), without wetting the back, for a minute in a solution of two to three grains of gallic or tannic acids, with $\frac{1}{10}$th grain oxalic acid in a litre of water. It is then washed with plenty of water. By all these processes a positive print of black lines on a white ground is obtained direct from a drawing, but it is very difficult to keep the ground pure white. The process has been simplified, and the following method is advised—prepare the solutions:

A.

Ferrous sulphate	154 grains	(22 grains : 1 ounce).	
Tartaric acid ...	154 ,,	(22 ,,	1 ,,).
Ferric chloride	308 ,,	(44 ,,	1 ,,).
Distilled water	7 ounces.		

B.

Gelatine ...	154 grains (38 grains : 1 ounce).
Distilled water (warm)	4 ounces.

Mix 1 and 2 and filter through flannel whilst warm. Sensitise suitable paper by lamplight with the mixture, and use as soon as possible. Expose to direct sunlight under a drawing until the black lines are visible as yellow on the sensitised paper. Then immerse the print in the following bath:

Gallic acid	108 grains.
Oxalic acid	15 ,,
Water...	35 ounces.

The lines should develop a deep black, and if the ground is tinted over, the print is under-exposed; over-exposure is shown by disappearance of fine lines. After development rinse the print well in clean water, remove the surplus moisture with

absorbent paper, and dry. The above processes give a positive from a positive; to obtain a positive from a negative, the following is recommended. In the first place, procure a piece of well sized paper, and sensitise it with the following preparation:

Gelatine	1 part.
Perchloride of iron	2 ,,
Tartaric acid	1 ,,
Persulphate of iron	1 ,,
Water	30 ,,

Place a piece of the sensitised paper in contact with a negative in a printing frame, when the result will be, when printed and developed, another negative print. Next procure a transparency, treating this in a similar manner to the negative, the result being a fine positive print; but everything is reversed. The more the copy is printed, the fainter will be the impression; therefore, to obtain good results, correct exposure must be given. Development is effected in the following manner:

Gallic acid	1 part.
Water	160 ,,

When dissolved, immerse the print, and let it remain in developing solution, until all detail is out, then wash in clean water for a few minutes, and finally hang up to dry, or dry between blotting paper.

450. Blue Prints Transparent—To Make.—For blue prints, especially if made with the object of subsequently making them transparent, fine unsized Rives paper should be used, or a thin stiff paper having no grain. The sizing may be removed by immersing the paper in dilute hydrochloric acid, then well washing and drying. Attach the dried paper to a drawing board with a few drawing pins, so that it shall remain flat. Have ready the following solution:

Ferricyanide of potassium	60 grains.
Warm. boiled, or distilled water	1½ ounces.

Filter this, then in the dark room add ninety grains of ferric ammonia citrate, shake up well and set aside for a little while. The solution should now be applied to the paper by means of a sponge or flat camel-hair brush, brushing it first across the paper and then lengthwise, but too much solution should not be taken up on the sponge at a time, or uneven coating will ensue. The paper should now be hung up to dry, when it may be rolled up, and if kept from light and damp it will keep for a month or two. The paper should be exposed fully until the print assumes a metallic bronzed colour in the shadows. After printing, wash in water to which a very little hydrochloric acid has been added. This tends to keep the whites clear. Then wash thoroughly, but not too long, in ordinary water, blot off and dry. No toning is necessary. To render the paper transparent, various oils, etc., may be used; perhaps one of the best is cold-drawn linseed oil (not boiled), in which the paper is soaked until thoroughly permeated. Vaseline, or a mixture of Canada balsam and varnish, may also be used. M. Rossel says beautiful blue transparencies may be produced by printing on commercial cyanotype paper until the image is intensely visible, when the print is thoroughly washed, and placed for fifteen minutes in

Bichromate of potash	1 ounce.
Water	10 ,,

After the print has been again well washed, it is allowed to dry, and then rendered transparent by placing it on a warm glass plate and treating it carefully with paraffin. The print can then be framed between two glass plates.

451. Bromide Papers, Characters of—How to Work according to.—As a rule, all bromide papers are much alike. For a thin negative, use Eastman or Ilford *slow*; for a fairly dense negative use Fry's or Marion or Ilford fast. The fact is just this—Eastman and Ilford slow are very slow papers, and Ilford fast. Fry's and Marion are very fast bromide papers, as much as fifteen to twenty times as fast as the others, and so each have their advantages, but by altering the exposures, and also the developer, according to the kind of negative, any of the above papers will give good results, and results that can hardly be told from each other. The general rule for contact printing is prolonged exposure and distance from the light in the case of weak negatives (for instance, with a thin negative of an architectural subject, and using a tissue-paper screen on the printing-frame, sixty seconds at twelve feet from a Bray No. 5). With a vigorous negative and tissue paper screen, thirty seconds at two feet from the light is not too much. The rapid paper is best for enlarging purposes, while the slow paper gives good results with contact prints. The hydroquinone developer is convenient, in that the prints can be developed as far as one chooses, and after a rinse put at once into the hypo, while with the iron development a certain amount of developing continues in the acetic acid bath, sometimes just enough to spoil the print. It should be noted that light varies inversely as the square of the distance, thus one second at one foot from the light is four times as much exposure as one second at two feet, and so on.

452. Bromide Paper, Lack of Density in—To Remedy.—A lack of density in a bromide emulsion paper may be due to over-exposure. A rapid emulsion usually gives a feebler image than a slow one. Capt. Abney, in his book on "Emulsions," says that the addition of a chloride emulsion materially aids the production of density. If a proportion of one-fifth of an emulsion, as follows, be added to an emulsion lacking in density-giving qualities, it will be secured without detriment to sensitiveness, the range of sensitiveness being slightly altered. The presence of iodide in the film is desirable, and the coating should not be too thin or density will be impossible. The following is the chloride emulsion formulæ referred to:

No. 1.

Sodium chloride	80 grains.
Nelson's No. 1 gelatine	30 ,,
Silver nitrate	200 ,,

No 2.

Nelson's No. 1 gelatine	80 grains.
Coignet's gelatine	80 ,,

453. Bromide Paper—To Extemporise.—If bromide paper is unexpectedly required and none at hand, try the following: Float a sheet of ordinary sensitised paper for two minutes on a bath composed of—

Bromide of potassium	1 ounce.
Water	1 quart.

Dry in the dark, and manipulate precisely the same as with bromide paper.

454. Bromide Paper—To Make.—*Paper.*—Pirie & Sons, of Aberdeen, genuine wove vellum, or Whatman's medium hot-pressed, may be employed, the former of which is cheaper, and possesses besides the advantage of having a slight cream tone, which tends to soften the otherwise (generally) somewhat hard high lights. *Substratum.*—Nelson's No. 1 gelatine 60 grains, chrome alum 10 grains, water 4 ounces. Dissolve the alum in an ounce of the water, and the gelatine in the remainder (hot), mix solutions, add five drops glacial acetic acid, and filter. Spread this on the paper with a brush, and hang up to dry.

Emulsion.—Water 10 ounces, ammonium bromide 150 grains, ammonium iodide 20 grains, ammonium chloride 50 grains. Put all into a thirty-ounce flask, dissolve, add sufficient hydrochloric acid to just acidify, soak 100 grains Nelson's No. 1 gelatine in mixture and when swelled dissolve by heat. Bring flask into dark room, and add in small quantities at a time 450 grains silver nitrate in crystals, shaking well after each addition. This done, place the flask in boiling water for half-an-hour. Meanwhile, soak 400 grains Heinrich's hard emulsion gelatine in five ounces of water for an hour, and add this (water included) to the emulsion. When all gelatine has dissolved, squeeze through canvas, and wash. Next drain as dry as possible, re-melt, add an ounce pure alcohol, and filter. *Coating the Paper.*—Thoroughly wet each sheet, carefully squeegee it prepared side uppermost on a levelled sheet of plate glass, turn up edges a little, so as to form a dish, pour on emulsion, using pneumatic holder to hold glass, return excess to flask, put back the glass plate in original position, and when emulsion has set, pin up by one corner to dry. Do not aim at getting a thick coating, as this is positively detrimental. With care about two drams should suffice for a 12 x 10 sheet. The following directions are also given for a paper emulsion. A slow emulsion is requisite, and to obtain *perfectly clear whites* a strong fixing bath is required, which is six ounces of hypo to the pint of water, and the emulsion must be toughened to stand this, so first mix three grains of *chrome* alum in one ounce of water, and add ten drops of this to each ounce of emulsion; this will give rich, crisp images. As to coating the paper, of course the machine takes the palm, for the paper wrinkles so very much when the wet emulsion is poured on by hand, and then spread to obviate this, and so keep the paper tight, that an even coat can be given. An appliance may be made similar to a box without a lid, say 24 × 18. This will do for 20 × 16 prints (when trimmed), or, of course, any smaller size; for larger make a larger box. Screw across the top at one end a piece of hard wood 1½in. broad, and glue a piece of rubber about ⅛in. thick along its length; now make a duplicate, and attach with thumbscrews. This is to put the edge of the paper in, and pinch it tight with the thumbscrews on to the rubber pads. Next saw a circular rod of wood, say 24in. long and 1¼in. thick, in two halves; line these with rubber, and pinch the other end of the paper in them with thumbscrews. Cut notches along the upper edges of the box to correspond with the length of paper it is intended to coat, drop the rod into a convenient notch, grasp the rod in the left hand, and give a twist to tighten the paper, pour the emulsion in a pool in the centre of the paper, and rub it over quickly from right and left with a piece of "swansdown" (from any draper) stretched over a small squeegee. As the paper stretches and wrinkles with the moisture, it can be kept taut by turning the roller, and so coat very evenly. If there is danger of allowing the emulsion to chill, place a large tin of boiling water in the box (of course, covered with a piece of tin to keep the steam in), and the warmth from this will allow time to work with leisure.

The emulsion is made of

Potassium bromide	84 grains.
Potassium iodide	5 ,,
Nelson's No. 1 gelatine	10 ,,
Nitrate of silver	120 ,,

Call this No. 1. No. 2 is

Nelson's gelatine	100 grains.
Heinrich's or Coignet's	60 ,,

Dissolve the bromide and iodide in one ounce of hot water, the ten grains of gelatine in one ounce of water, and the silver in half an ounce of water. Mix in the dark room whilst hot, adding the bromide and iodide rather slowly, and shake well, boil for ten minutes, and lay aside to cool; in the meantime dissolve the gelatine of No. 2 in as much water as it takes up whilst soaking for an hour, and mix with No. 1 at a temperature of 90°, and shake it well; let it ripen for twenty-four hours, squeeze it through canvas, and wash in a large bowl, drain well, and add three drams of pure alcohol, and make up when melted to seven ounces of warm water; shake again, filter, and coat away. *This emulsion can be exposed and developed whilst still wet*, but, of course, set. There are a great variety of other formulæ, one of which, given by Mr. T. C. Lapworth, is as follows:

Ammonium bromide	120 grains.
Ammonium iodide	4 ,,
Soft gelatine	30 ,,
Water	4 ounces.

Apply sufficient heat to melt the gelatine, and stir occasionally till perfectly liquid. Now add three drops of diluted hydrochloric acid (one part acid to ten of water):

Silver nitrate	200 grains.
Distilled water	3 ounces.

Mix slowly in the usual way, and then boil for an hour or a little longer, shaking well at intervals of half-an-hour. When it has cooled to 100° Fahr. add 270 grains of hard gelatine, and keep the mixture at a temperature of 90° till all is dissolved. Another: For bromide paper, suitable for contact and enlarging, Dr. Eder recommends the following. Make two solutions:

A.

Ammonium bromide	18 parts.
Potassium iodide	2-4 ,,
Gelatine	50-80 ,,
Water	400 ,,

B.

Silver nitrate	30 parts.
Water	400 ,,

Mix the solutions in the dark at a temperature of 60° Centigrade, heat the mixture in boiling water for about thirty minutes, and then pour out into a shallow dish somewhat larger than the sheet to be coated. The emulsion must be about a quarter of an inch in depth in the dish, and should be kept at a temperature of about 130°. The paper to be coated is turned up for about a quarter of an inch at one end, and the sheet rolled up into a coil, the coil being towards the turned up end. This end is then placed on the emulsion, and the coil allowed to unroll itself until the whole surface, except the turned-up end, rests upon the emulsion. After resting a minute the end is raised and hung up to dry in a cupboard free from dust. Perhaps the method advised by Prof. W. K. Burton is as simple and reliable as any for a landscape gelatino-bromide emulsion. He has made the process as simple as possible, and reduced the chances of failure to a minimum. Take

1.—Silver nitrate	200 grains.
Distilled water	3 ounces.
2.—Potassium bromide	160 grains.
,, iodide	10 ,,
Nelson's No. 1 gelatine ...	40 ,,
Hydrochloric acid	2½ minims.
3.—Hard gelatine	150 grains.
4.—Hard gelatine	150 grains.

Allow the gelatine of No. 2 to soften. At the same time pour water over the lots of gelatine Nos. 3 and 4 (keeping them separate) and let them swell. Nos. 1 and 2 are now heated to 120° F., and No. 1 is slowly poured into No. 2 with vigorous stirring. The emulsion thus formed is allowed to stand for ten minutes, with occasional stirring. Meanwhile, squeeze as much as possible of the water out of No. 3 gelatine. After ten minutes pour the gelatine emulsion over No. 3, heat being

applied if necessary to melt the gelatine. When they are thoroughly mixed the jar containing them is set aside, and the whole allowed to set into a stiff jelly. In warm weather it will be necessary to stand the jar in water containing a lump or two of ice. Once set, the emulsion is squeezed through coarse canvas, and after thoroughly draining it is mixed with gelatine No. 4. The whole is melted up, one and a half ounces of pure alcohol added, when it is ready for coating.

455. Carbon Tissue—To Make.—Proceed as follows. Take

Gelatine	5 ounces.
Isinglass	½ ,,
Water	70 ,,
Lampblack	¾ ,,
English red (peroxide of iron) ...	1 ,,
Glycerine	1½ ,,

The gelatine should be neither too soft nor too cold, and the quantity of glycerine added should be about equal to the volume of the colouring matter added. The black colour is rubbed down on a stone slab, then the glycerine is added and the rubbing continued. Sufficient water is then poured on to obtain the required consistency, and the desired degree of fineness having been attained, the colour is collected with a horn spatula. The red colour is rubbed down with water only. The two colours are then mixed together on the slab. During the time occupied in preparing the colours, the isinglass, cut into small pieces, is allowed to soak in about four ounces of water. It is then boiled, stirring all the time, until but fine skins are floating in the somewhat muddy solution. When the whole is strained through linen this solution is then poured into the gelatine, previously dissolved in lukewarm water. The colouring matter is now placed in a large porcelain dish, and the warm gelatine and isinglass solution added in small quantities, stirring all the time with a pestle, until an even homogeneous mixture has been produced. The whole is at once strained through muslin or moistened flannel, and the mixture is ready to coat the paper with. This will answer well if carefully prepared, but the tissue can be had ready made, either sensitised or unsensitised, in the following colours: Standard black, engraving black, sepia, red chalk, purple, warm black, portrait brown, portrait purple, and special purple. Another formula is—Prepare the following solution:

Nelson's No. 2 flake gelatine ...	100 parts.
Brown sugar	10 ,,
Glycerine	20 ,,
Honey soap	10 ,,
Water	400 ,,

Soak the gelatine in water for about half an hour, melt with gentle heat, and then add the other ingredients, and keep warm until all are dissolved. Pigment of the required colour, and of a permanent nature is now finely ground and incorporated in a mortar with a little thin gelatine and glycerine solution, and then mixed with the above. Aniline dyes are apt to render the film insoluble, and so are some kinds of pigments, and the particular pigments used are obviously not revealed to all the world by the Autotype Company. However, paper is now to be coated with this pigmented gelatine solution. The paper is placed on a carefully-levelled glass plate, after having been soaked in warm water, and the excess of water blotted off. The proper quantity of the warm gelatine solution is poured on it, and distributed evenly over the surface by means of a glass rod. In cold weather the gelatine will set almost at once. In warm weather iced water is used in contact with the glass plate to cause rapid setting; as both rapid setting and drying are essential to sensitiveness. Another method of coating is as follows: A porcelain dish is placed on a hot water tin under which is a lamp or Bunsen burner. Above the dish is a level table, at one end of which is a roller, the upper edge of which is on a level with a glass plate on the table. The paper is floated on the warm gelatine solution contained in the dish, drawn through it, seized and drawn over the roller on to the glass plate and allowed to remain till the gelatine is well set, after which it is hung up to dry. Of course, by this method, the dish has to be moved each time the paper is floated, and the paper itself must be suitable, *i.e.*, not oversized, and rather porous. The following points also require attention: Temperature of gelatine solution, freedom from air bubbles, and freedom from grease on the paper. Much practice is required to give an even coating. The tissue, when dry, is improved by rolling in a copper-plate press, though this is not essential if sufficient glycerine has been added to cause it to remain somewhat limp. Once coating is generally sufficient, though if the white of the paper show through, it will be necessary to give a second coating in the same way as before. If a sensitive tissue is required, forty parts of potassium bichromate should be added to the above solution. Otherwise it can be sensitised afterwards on a solution of bichromate of potassium 50 parts, water 1,000 parts. The solution should not contain free acid, and the tissue should be floated for about three minutes. The drying in all cases should be rapid and even, and should be conducted in a room having a constant current of dry air circulating through it.

456. Chromated Gelatine—To Make.—This is a mixture of gelatine and a soluble salt of chromium, preferably an alkaline bichromate, in varying proportions, used for most of the photo-mechanical printing processes which are based upon the fact that when light acts upon such a mixture the gelatine becomes less capable of absorbing water than when not acted upon, and also swells up to a less extent, and becomes insoluble. The formula for it varies for each process for which it is used.

For carbon printing—

Nelson's No. 2 flake gelatine ...	100 grammes.
Brown sugar	10 ,,
Honey soap...	10 ,,
Glycerine	20 c. c.
Water	490 c. c.

Which is sensitised on—

Potassium bichromate	50 grammes.
Water	1 litre.

For photo-lithography—

Potassium bichromate	44 grammes.
Gelatine	44 to 66 ,,
Glycerine	2 c. c.
Water	1 litre.

457. Cyanotype Paper—To Prepare.—This process is based on two facts: First that the *per* salts of iron (or ferric salts) react with certain substances in a different manner to what *proto* salts (or ferrous salts) do. The second fact is that ferric salts are reduced by the action of light to ferrous salts in the presence of organic matter, such as the size of the paper. The processes connected with this subject are of two kinds—first, prints by development, and second prints by simple washing after exposure—and it is the second process that is described here. To begin with, prepare the paper as follows: Take Rives plain paper and give it a coating of arrowroot (prepared just like starch for mounting, *i.e.*, rubbing with a little cold water, and then pouring boiling water on it till it clears) and let it dry. Now for the chemicals. These are what the druggists know as double citrate of iron and ammonia, and ferricyanide of

potassium, commonly called red prussiate of potash. Now for formulæ:

No. 1.—A.

Ferric ammonio-citrate	... ...	1 ounce.
Water	...	3½ ,,

B.

Ferricyanide of potassium	...	1 ounce.
Water	...	6 ,,

Take equal parts of A and B, filter, and apply with a broad brush. Dry quickly.

No. 2.—C.

Ferric ammonio-citrate	... ...	1 ounce.
Water	...	2½ ,,

D.

Ferricyanide of potassium	...	1 ounce.
Water	...	8 ,,

Take one of C to two of D, and proceed as above.

No. 3.—E.

Ferric ammonio-citrate	... ...	1 ounce.
Water	...	4 ,,

F.

Potassium ferricyanide	... ...	1½ ounces.
Water	...	8 ,,

Take equal parts of E and F.

No. 4.—G.

Ferric ammonio-citrate	... ...	64 grains.
Water	...	1 ounce.

H.

Potassium ferricyanide	... ...	48 grains.
Water	...	1 ounce.

Take equal parts of G and H. There are many other formulæ, but the above should suffice. The point is when the negative is intense increase the ferric salt. Now take the paper, and apply the sensitising solution with a broad camel-hair brush in the dark room. When dry it is ready to expose under the negative, than which the paper should be somewhat larger, so as to judge of the printing. The paper assumes the following tints: First it is yellow-green, then greenish, then greenish-blue, then a deep bluish-grey, then a light grey, and, lastly, an olive with metallic reflections. Be careful not to stop the exposure at the deep bluish-grey, but proceed to the light grey or olive. The print is then simply washed in clean water, with or without the addition of a little citric acid. Change the water until the necessary tone and detail are obtained, then dry by placing between blotting paper and then suspending. Prolonged washing only lessens the intensity of the blue. This process with drawings of course gives white lines on a blue ground; if blue lines on a white ground are required, print a negative (blue ground and white lines) as above, only much darker; dry and print a positive from this negative. Ordinary albumenised (but not sensitised) paper can be used, if it be first immersed in boiling water to dissolve out the chloride and to coagulate the albumen. Then, with a pad of flannel, apply the sensitised solution, and dry quickly. This method gives very brilliant prints. What are known as moonlight effects are well rendered by this blue process. Next are directions how to make the ammonio citrate of iron. Take a measured quantity of saturated solution of ferrous sulphate (the older prepared the better), add a few drops of nitric acid to the ounce, and boil until the solution becomes a darkish yellow, when all the ferrous will have been turned into ferric sulphate. When cool, add liquor ammonia until the red precipitate ceases to come down; filter, and wash the red ferric oxide with warm water to get rid of all soluble salts; transfer the washed oxide to a glass vessel, and gradually add to it from a measure glass a solution of citric acid, and warm. When a small quantity of the ferric oxide remains undissolved, stop adding citric acid, and note how much of the solution has been added. This gives the ferric citrate; for the ammonium citrate, take the same quantity of citric acid solution as was used for the iron, and carefully neutralise it with ammonia, testing with litmus paper. Then mix the two solutions, and evaporate until when sufficiently concentrated the crystals of the double salt separate out. Dry them in blotting paper, and they are ready to use for the formulæ. Note also that the paper prints best when fresh, and that the double oxalate is prepared in exactly the same way as the citrate, and may be used instead of it, but gives better prints when developed after exposure. The paper will not keep, nor will the solution, unless a preservative is added, for the "salts" quickly part with oxygen, and so allow the blue precipitate to take place. *Without* light this degrades the whites of the print, and makes the solution practically inert. *The preservative* is potassium bichromate, and this added in a powder to the mixed solution, in the proportion of about five grains to the ounce, will keep both paper and solution for a long time, as the potassium bichromate gives up its oxygen readily to replace that which is lost by spontaneous decomposition, or from the use of old or impure chemicals, for ferric salts are converted into ferrous by any de-oxidising agent, as sulphuretted hydrogen, etc., etc., but are quickly made into the *ferric* salts by an oxidising agent, and potassium bichromate is a very powerful one. In this process ferric salts are required, and ferrous are enemies; potassium bichromate will defeat them. If desirable the blue colour of the print can be altered to green, brown, lilac, or black as follows: For green tones print rather lightly, and immerse the print in

Sulphuric acid ...	... ...	1 dram.
Water	... ...	10 ounces.

For brown and black tones immerse in a twenty per cent. solution of caustic potash until the print assumes a yellowish tint; wash, and place in

Tannic acid ...	... ...	2 drams.
Water	... ...	8 ounces.

until dark enough. For lilac hues (which by-the-way, are not permanent) immerse in a ten per cent. solution of ammonia ·880 until the desired colour is obtained. Many other formulæ are given, varying only in proportions somewhat. The following are simple directions how to obtain the best results in this process. It is best to size the paper before sensitising with the solutions mentioned below. To do this, procure some sheets of plain stout Saxe paper and float one of them in the following solution: One hundred and fifty-four grains of arrowroot rubbed up with a little cold water, to which are added twenty-three ounces of boiling water, and, when cold, six ounces of alcohol are poured in. Float on this for two or three minutes, and suspend by the end which left the solution last. A method claimed to be even superior to this in brilliancy is proposed by Mr. J. Traill Taylor, who takes a sheet of salted albumenised paper, and, after allowing a jet of steam to play on it for half a minute, immerses it in boiling water to coagulate the albumen and dissolve out the chloride in the albumenised paper. Whichever way be adopted, the sensitising of the paper is the same in method and preparation. Prepare the following:

A.

Ammonio ferric citrate	... ...	1 ounce.
Water (distilled or boiled)	... ...	4 ,,

B.

Potassium ferricyanide	... ...	¾ ounce.
Water (distilled or boiled)	... ...	4 ,,

Take equal parts of A and B, filter, and coat the paper in the following manner: Lay the prepared paper (dry) on a clean glass plate, clipping the same at the four corners. Apply solution with clean sponge, squeezing it fairly dry before applying. Go over paper in one direction, and again damp the sponge and go over in direction at right angles

to former. Streaks occur when sponge is too wet. Dry in the dark. Print till shadows are quite bronzed, then wash till high lights are white.

The following method will give black tones: Float the print for a short time on a weak nitrate of silver bath until it almost disappears. Remove the print, wash out all the free nitrate, and then heat it in a bath of ferrous oxalate. The result will be a black picture on a white ground. The above processes give *white lines on a blue ground*, and are hence sometimes called negative cyanotype. The positive cyanotype, or Pellet's process, gives blue lines on a white ground from a plan or tracing, because where the light acts no image is formed, whilst in those parts where the light does not act blue lines are formed upon development with ferrocyanide of potassium. Pellet's formula was as follows:

Oxalic acid	5 parts.
Ferric chloride	10 ,,
Water	100 ,,
Gum arabic	9·5 ,,

The paper was coated with this solution, and, after printing, developed with

Potassium ferrocyanide	20 parts.
Water	100 ,,

Which should be spread upon the print with a broad brush, care being taken not to touch the back, or stains will be produced. As soon as the print appears of a deep blue colour, the print should be well washed and then laid in dilute hydrochloric acid 1 : 10 till the ground appears white; the print should be then well washed and dried.

Pizzighelli gave good working formulæ for this process:

A.

Gum arabic	20 parts.
Water	100 ,,

B.

Ammonio-citrate of iron	50 parts.
Water	100 ,,

C.

Ferric chloride	50 parts.
Water	100 ,,

The solutions are mixed in the following proportions *and order:* Take of A twenty parts; B, eight parts; C, five parts. As soon as mixed this solution is thin, then becomes thick and cloudy, and then clear and liquid again, when it is ready for use. Well-sized paper is evenly coated with a broad brush and quickly dried. When printed the image is yellow on a darker ground. Develop as above.

458. Drying Box for Paper—To Make.—Make a box, say 24in. × 24in. × 36in. of any hard wood, and run a series of shelves across it. At the bottom connect a coil of ½in. leaden piping, inside which can be placed the glass chimney of an ordinary (lighted) paraffin lamp, leading away the hot air by a hole in the top. Through the door, which must, of course, fit accurately so as to force the air current to travel over the shelves, lead in a thermometer so that its bulb is inside the box, the stem being outside. After a little practice it is easy with a box of this kind to get a temperature of from 100° to 200° Fahr., not varying more than 20°. If a temperature is wanted which will vary to a smaller degree use a gas jet provided with a self-regulating tap to heat up the coil of piping. Another way is to fix a 2in. gas pipe with an elbow joint in the centre of the top, and insert a small gas burner in the joint; when lit this will cause the draught. If preferred, anhydrous chloride of calcium may be put in the bottom of the cupboard to assist the drying. Fit up the interior with stout wire to hang the paper on, and allow an inch or two of space between each sheet. It is not even necessary to have a special box for this purpose, as by sensitising the papers overnight and utilising the kitchen oven after the fire is raked out to thoroughly dry the paper, the purpose will be efficiently served. However, if a box for the purpose is necessary its dimensions should be—supposing it is desired to sensitise paper of the usual 17 × 22 size -24 × 18 × 7. Make the bottom of tin plate, or, still better, block tin, and give it three or four coats of Aspinall's white bath enamel inside. About one inch from this metal bottom fix a frame, over which coarse canvas—such as ladies use for woolwork—is stretched, and on which the paper can be laid. At the top of the box which should for convenience have a hinged lid) attach three thicknesses of yellow muslin or two of yellow fabric as used in the dark room; for if the top of the box is wood, the moisture cannot escape, unless, indeed, it is intended to use some desiccating agent within the box. Through one side, 4in. up, bore a hole, and fit it with a cork; perforate the cork to take the thermometer. So far for the box, now for the means of heating it. This can be done most simply by placing the box on a lidless, handleless saucepan (in fact, the more broken down affair the better, provided it is water-tight), which is supported over the oil stove, Bunsen burner, etc., on an iron tripod or retort stand. Another method is to have a flat tin utensil made, like those used for foot-warmers, say, 23 × 17 × 1 inches, and provided with a screw cap. This can be half filled with water and used instead of the saucepan on which to rest the box. No elaborate light-tight arrangements will be necessary, as the paper will quickly dry, and, of course, the operations will be conducted indoors.

459. Emulsion—To Coat Paper with.—Paper may be successfully coated with emulsion by rolling it up loosely, and allowing to unroll on the surface of the solution, breathing on the back to prevent it curling away from it. The emulsion should be placed in a deep developing dish, used only for this purpose, and kept in a warm room whilst coating the paper. Whatman's hot-rolled "Double Elephant" rough surface is a good paper for enlarging purposes, and takes the emulsion well. Price, size 40in. × 27in., 12s. per quire. Another way is to make a double bath, the lower one containing hot water kept at an even temperature, the upper one holding the emulsion. Place two sheets of paper face outwards, and gum them together about one eighth of an inch from the top. Now insert a stiff silver wire, to prevent the ends from falling down. Hold the sheets by two fingers of the left hand in the centre of the wire, and draw them through the emulsion, keeping them under, if necessary, with a glass triangle held in the right hand. If any air bells form on the paper remove them with the little finger, which should be dipped in the emulsion. Another way to coat paper with emulsion is to damp it and squeegee on glass, turn up edges so as to form a dish, pour like collodion, and assist spreading with a large camel-hair brush. Put back the excess, set, and hang up to dry. A very pure and good paper is made by Pirie & Sons, Aberdeen, named genuine vellum wove. Also Whatman's paper would answer in any of the three grades — rough, medium, or hot-pressed. To prepare the paper, add to every dram of gelatine five to ten grains of chrome alum and four ounces of water (the alum thickens the gelatine after a little); liquefy with acetic acid, and coat as described. Another method: Get a trough 21in. square, run the gelatine in, and keep warm over a water bath, small stove, or other contrivance. Roll the paper up, and start by laying the free end on the surface of the liquid. Gradually unroll the paper, so that it pushes the free end forward, and when it reaches

the end of the trough have an assistant ready to grasp it, and carry it forward. Gradually unroll till all the paper has passed over the surface of the liquid, when hang up to dry. The quicker it is dragged over the thinner will be the coat, and *vice versâ*. The difficulty of coating as above is caused by the irregular expansion of the paper. This is entirely obviated by using a cold emulsion in the following manner: In the centre of a long table place a zinc reservoir, with two projecting openings on each side, which are used for filling the reservoir with boiling water, and also act as guides to the paper. Place the paper to be coated on the table, the right-hand side of the reservoir, and with a stiff hog-hair brush, like a small whitewash brush, work the "set" emulsion well over the paper with a vigorous action until it looks free from lumps; now, taking the paper by the corners, draw it steadily over the reservoir, when the heat of the water will flow it into an even coating, much more uniform than by coating with fluid emulsion. Now place it on other end of table, when it will set almost immediately, then hang in a cool draught to dry. Do not let the paper stop for an instant on the reservoir, or it will cause wavy lines.

460. Gelatino-chloride Paper—To MAKE.—The following gelatino-chloride emulsion for coating paper was published by Abney:

No. 1.—A.

Sodium chloride	4 parts.
Potassium citrate	4 ,,
Water, distilled	48 ,,

B.

Gelatine	16 parts.
Water	160 ,,

C.

Silver nitrate	15 parts.
Water	48 ,,

B must be heated until the gelatine is dissolved, then C added; when thoroughly mixed add A, constantly shaking. The emulsion is allowed to set, pressed through canvas, and washed for half-an-hour, allowed to drain, and remelted. Now add 180 parts of alcohol and two parts chrome alum dissolved in 180 parts of water. The emulsion is now ready for coating the paper. Ashman's formula is as follows:

No. 2.—A.

Citric acid	20 parts.
Water	480 ,,

and as much ammonia as will render the solution faintly alkaline.

B.

Silver nitrate	45 parts.
Distilled water	480 ,,

C.

Gelatine	45 parts.
Ammonium chloride	6·5 ,,
Distilled water	480 ,,

D.

Silver nitrate	40 parts.
Distilled water	180 ,,

The gelatine is soaked in the water in which the chloride has been dissolved, and melted with a gentle heat, and D is added to it, and well shaken. A is next added gradually, and finally B in the same manner; the emulsion allowed to set, then broken into small pieces, and washed thoroughly. Again melt, and pour the emulsion into a dish, so the paper can be drawn over the surface; sufficient adheres to give a strong image.

No. 3.—Abney's Citro-chloride.

A.

Chloride of sodium	3·7 grammes or 57 grains.
Citrate of potash	1·8 ,, 28 ,,
Water (distilled)	30 c.cm. or 1 ounce.

B.

Silver nitrate	11 grammes or 170 grains.
Water (distilled)	50 c.cm. or 1¾ ounces.

C.

Gelatine	15 grammes or 231½ grains.
Water (distilled)	175 c.cm. or 6 ounces.

After the gelatine has swollen and been dissolved by a little gentle heat, B and C are mixed together and added with agitation, little by little, to A. When set, wash for a quarter of an hour in cold water, drain, melt, and add fifteen c.cm. of alcohol.

No. 4.—Starnes's Acetate.

A.

Gelatine	40 grammes or 617 grains.
Acetate of soda	8 ,, 123½ ,,
Water (distilled)	960 c.cm. or 34 ounces.

B.

Silver nitrate	28 grammes or 432 grains.
Water (distilled)	480 c.cm. or 17 ounces.

C.

Chloride of sodium	4 grammes or 6½ grains.
Acetate of sodium	6 ,, 92½ ,,
Water (distilled)	480 c.cm. or 17 ounces.

B is mixed in the usual way with A, and then C is gradually added, and finally

Gelatine ... ... 160 grammes or 2,468 grains.

swollen and dissolved in water is added, and the total bulk of the emulsion made up to 2,280 c.cm., or 101½ ounces with water. No washing is required. There are innumerable other formulæ, varying in slight details, but one of the simplest is by the Rev. H. J. Palmer. To make three ounces of emulsion take

Gelatine	75 grains.
Sodium chloride	70 ,,
Water	2 ounces.

Allow the gelatine to soak for two or three hours and then melt it with heat, and pour into a large warmed bottle; to this is added, in the dark room, little by little and with agitation, a warm solution of

Silver nitrate	90 grains.
Water	1 ounce.

Then the bottle (preferably of stone, like an ink bottle) is corked, and a piece of red flannel tied safely over the cork, and taken to the kitchen fender, and left there to cook for twelve hours. The temperature, however, must not exceed 100°, as this means red fog. The bottle must be shaken at intervals during the day. When cooked take the bottle, and holding it in a horizontal position under the tap, roll it round, and in a few minutes the gelatine will have set in a fairly thin film around the inside of the bottle. When this is so take it into the dark room, remove the cork, and fill it with cold water, allow it to soak and the soluble salts to dissolve, and change the water thus three or four times during about six hours. Then drain the emulsion by turning the bottle mouth down in the sink of the dark room until ready to coat. When this is the case take Rives paper if it is intended to print from half-plate or under, or, if for large sizes, and a rough surface is wanted, Saxe, Whatman, Creswick, and any good tough paper. Place the sheet on a slab of plate glass and wet it with a sponge all over, until it is quite limp and lies flat. Then having placed the bottle of emulsion in water at about 100° until the contents are melted, filter through flannel into the coating cup (having a good lip), and pour the emulsion in a pool on to the centre of the damp paper, and flow it over the paper as if coating a plate. Do not drain too much, and place the plate glass on a levelling slab until the emulsion is set, and then pin up the paper to dry, as usual. Exposure will be about two seconds to diffused daylight, with negative of medium density. Develop with Edwards's or Cowan's developers.

Another formula to be used in a similar way is as follows, and is by A. Cowan:

A.

Silver nitrate	1 ounce.
Water	10 ,,

B.

Gelatine (hard)	1 ounce.
Sodium chloride	½ ,,
Water	10 ,,

Let the gelatine soak and dissolve with heat (about 110° F.) and warm the silver to same temperature, and proceed just as before. The point about these emulsions is that they must "cook" in the presence of excess of silver, and this excess may be taken up afterwards by adding more chloride, or may be washed away. The following is still another formula for gelatino-chloride emulsion paper, which gives similar tones to albumenised paper. Make three solutions as follows:

A.

Gelatine	35 grains.
Hot water	1 ounce.

B.

Sodium chloride	25 grains.
Calcium chloride	20 ,,
Water	1 ounce.

C.

Nitrate silver (tri. crystal)	135 grains.
Water (distilled)	2 ounces.
Citric acid	25 grains.

Place the solutions in a water bath heated to 100° F., and leave here till all the gelatine has melted. Now mix solutions A and B, and then add two drops of a twenty per cent. solution of hydrochloric acid. Keep the two solutions at a heat of ninety degrees for half an hour, and then, by aid of either yellow or red light, pour solution C into A and B combined, drop by drop, stirring well all the time. Now put two drams of rect. alcohol into the vessel which contained the silver solution, and add to the emulsion. The pot containing it must now be placed in the water bath at a heat of 120° F. for one hour, and then taken out and left to set for two or three days. Now filter out any dust or insoluble precipitates not wanted in the emulsion. First warm gently until it has perfectly liquefied, and then strain three or four times through a linen bag, and all will be ready for coating. Pour the emulsion into a dish, and take hold of a sheet of paper by the ends and lower gently into the bath, allowing the middle to touch the surface first, and gradually lower the edges till it floats on the emulsion. Leave it here for three minutes, and hang up by clips to dry.

461. Heliochromic Process—To Work.—This process, given in the "Photocopie" of A. Fisch, and no doubt originally introduced by Poitevin, is as follows: A paper, very strong, well sized and non-porous, is selected and sensitised by means of a large sponge or brush, with the following solution. The sensitising must be very equal, and applied in three smooth coats. Sensitising solution:

Dissolve separately

A.—Gum arabic	13 drams.
Water	17 ounces.
B.—Tartaric acid	13 drams.
Water	6¾ ounces.
C.—Persulphate of iron	8 drams.
Water	6¾ ounces.

C is poured into B, well shaken up, and then the mixture added to A, with constant stirring. When completely mixed, add slowly, with constant stirring, three and a third ounces of liquid acid perchloride of iron at 45° Baume. Filter and keep in the dark. It keeps well for a long time. Having sensitised the paper, dry as rapidly as possible with heat up to but not exceeding 55° C. (equivalent to 131° F.) in the dark, and the paper should be kept away from damp or light, but it does not keep well beyond at most a fortnight. The paper dries a yellow colour. The printing is conducted as usual, and the parts acted on by light should become quite white. The progress of the printing is watched as usual with print-out papers. The general time of exposure is about ten to fourteen minutes in the sun. When printed the paper should show a yellow drawing on a white ground. If there be any difficulty in judging this a dram or so (sixty to eighty-five minims) of a concentrated solution of ammonium sulphocyanide added to the sensitising solution will give a red colouration both to solution and to sensitised paper, but this also when printed gives a white ground, while the drawing is red and easily judged. The paper, if prepared with sulphocyanide, soon loses the red tint even in the dark, so must be used quickly. After the prints are sufficiently exposed, they are floated face down for one minute on gallic acid (or tannin) 31 (46) grains, oxalic acid 1½ grains, water 34 ounces. Care should be taken to avoid air bubbles when floating. In this bath the drawing is converted into gallate or tannate of iron, and this is *ink*, and consequently permanent. The print is then plunged into ordinary water, well rinsed, dried, and then finished. The violet black lines become darker in drying, but the ground often also acquires a light violet tint. It may be observed that by this process the reproduction is similar to the original, and to obviate reversal the original should be placed face down on the glass of the printing frame, and the prepared paper face down *on the back* of the original. This process—the title of which is a misnomer, as it is *not* in natural colours—must not be confounded with the true heliochromic printing (see No. 272) or process for reproducing the colours of nature. The above, though published under a misleading name, is really a ferrogallic process (see No. 449).

462. Iron Printing Processes—To Make Paper for.—Under this heading there are two distinct processes, the cyanotype blue or ferro-prussiate process, and the ferro-tannate or ferro-gallic process. In either case it is necessary for best results that the paper used—Rives or Saxe—should be well sized, so that the iron salts may not sink into the paper; gelatine (rendered insoluble) or arrowroot may be used, preferably the latter. First as to ferro-prussiate—white lines on a blue ground. The preparation of the paper is simplicity itself. Select a good photographic paper, such as are sold in sheets 17 × 22 inches. For large plans, drawing paper may be used, or paper specially prepared for blue printing, which can be obtained from any large stationer. The great point to be sure upon is that the paper is well sized and does not allow the image to sink into it. A sensitising solution which gives very satisfactory results is made as follows: (1.) Red prussiate of potash 60 grains, distilled water 6 drams. (2.) Citrate of iron and ammonia 60 grains, distilled water 6 drams. Prepare these two solutions separately, mix them in the dark, and keep the bottle containing the mixture in a tin or other case to exclude the light. If this is done, the sensitising bath will keep indefinitely, and is always ready for use. As much as is required at a time should be filtered through paper into a clean wide cup or beaker. Filtration is necessary to avoid spots. The paper is very easily coated by pinning it to a clean board and brushing over the sensitising solution with a clean tuft of cotton wool or a fine sponge. The strokes of the sponge should be made first one way of the paper, and then in a direction at right angles to this, so as to ensure

obtaining an even coating. Wash the sponge before it sees the light, and you will avoid blue stains in subsequent use. Pin the paper up to dry, which it will do in a few hours. Drying must take place in the dark, and if thorough precautions are taken as to this, the sensitive paper will keep for a considerable time—a month at least. After exposure the print is washed with water, which may be applied with a sponge, until the washings are free from yellow colour. A white line in a ferro-prussiate print cannot be removed, since it is due to the background of paper. It may be judiciously coloured with Prussian blue, so as to match the rest of the ground. A white line is best put in by drawing on the surface of the print with a fine brush, dipped in a solution of dilute ammonia. This will not produce a pure white, but it is the best means of attaining the end in view. For other formulæ see Cyanotype (No. 457). Next as to the ferro-gallic process, known as the black line process, black lines on a white ground. The sensitising solution is prepared as follows: Four solutions are made — (1.) Gum arabic 50 parts, water 500 parts. (2.) Tartaric acid 50 parts, water 200 parts. (3.) Persulphate of iron (ferric sulphate) 30 parts, water 200 parts. (4.) Ferric chloride solution (density 45° by Baumé's hydrometer) 100 parts. Mix Nos. 2 and 3, pour the mixture into No. 1, and then add No. 4. Well sized paper is floated on the sensitising bath for a minute or two, and dried quickly at a temperature not below 55° Cent. It will keep about a fortnight. The exposure is made under the tracing in the usual manner, the time being about ten or twelve minutes in sunlight in summer. Fully printed proofs lose their yellow colour where most light has acted, so that as soon as the ground is white the proof is ready for development. It is preferable, however, to expose a small test piece by the side of the tracing, and to test this either by floating it on the developer or by sponging it with potassium sulphocyanide solution, which, if the exposure has been sufficient, should produce a blood-red image on a white ground. The printing proof is developed by floating for about a minute on a solution containing two or three parts of gallic or tannic acid, with ·1 part of oxalic acid in a thousand parts of water. It is then washed in a copious supply of water. A second bath, used for the purpose of preventing staining of the ground, contains either sulphuric or oxalic acid in dilute solution. The ferro-gallic process is scarcely touched upon in the English text books, and the following references may be useful: *Photography* (C.N. process), 1893, p. 251; Eder's "Handbuch der Photographie," part iv., pp. 235-238. For further information see No. 449.

463. Kallitype Paper — To Make.— The kallitype process was invented by Dr. J. Nicholl, the principle of which is that ferric salts are reduced by light to ferrous, and in this condition are capable of reducing a soluble silver salt to the metallic state. The paper is first sized, then coated with either of the following solutions, the first of which is

Sodio-citrate of iron solution	...	20 per cent.
Neutral potassium oxalate	...	5 ,, ,,

The sodium salt can be replaced by the ammonium or potassium salts, or by the tartrate salt, or by mixtures of these compounds. The paper is printed in the same way as platinotype, and developed for bluish tones on a solution containing

Potassium oxalate	...	20 per cent.
Silver nitrate	...	1·5 ,, ,,

to which sufficient ammonia is added to dissolve the precipitate first found. For neutral black tones a solution containing

Potassium oxalate	...	10 per cent.
Silver nitrate	...	1·5 ,, ,,

With ammonia, is used.

For sepia tones—

Borax	...	7 per cent.
Silver nitrate	...	1·5 ,, ,,

With ammonia as above.

The second sensitising solution is—

Ferric oxalate	...	5 per cent.
Ferric tartrate	...	5 ,, ,,
Oxalic or tartaric acid	...	1 ,, ,,

This may be developed with

Potassium citrate	...	15 per cent.
Sodium acetate	...	10 ,, ,,
Silver nitrate	...	1·5 ,, ,,

With ammonia as above.

A modification of the process has lately been introduced, in which the silver nitrate is added to the sensitising solution, and the prints developed with Rochelle salts, borax, and water.

464. Plain Salted Paper—To Prepare. —Either of the following formulæ answers well, the latter being more suitable for extra heavy papers: (1.) Ammonium chloride (pure) 80 grains, sodium citrate (dry) 100 grains, sodium chloride 30 grains, Nelson's No. 1 gelatine 10 grains, water 10 ounces. (2.) Ammonium chloride (pure) 100 grains, sodium citrate (dry) 100 grains, Nelson's No. 1 gelatine 20 grains, water 10 ounces. Be sure to employ the pure white crystalline variety of ammonium chloride—not the rough, crude preparation met with in fibrous masses, which always contains iron—and leave the sodium citrate for an hour or so in a warm oven before weighing it. Soak the gelatine in the water until swelled, dissolve by placing the mixture in boiling water, add the salts, and when dissolved filter. Float the paper for fifteen minutes, dry it, and sensitise in an eight per cent. (practically forty grains to the ounce) solution of silver nitrate, to which sufficient ammonia has been added to *just* redissolve the precipitate first formed. Printing and toning are carried out in the usual way. The following method gives good results in the hands of the careful. Prepare a salting and sizing solution in the following proportions: Ammonium chloride 6 grains, gelatine 3 grains, water 1 ounce. Pour the solution into a flat dish, and float the paper for one minute. Hang up to dry, and it will keep good in this state for a long time. To sensitise, float for two minutes on a bath made as follows: Dissolve fifty grains nitrate of silver in one ounce distilled water, and add strong ammonia, drop by drop, constantly shaking. When the dark brown precipitate is *nearly* dissolved and the liquid *almost* clear, the bath is ready. This bath, though not suited so well for albumenised paper, answers perfectly with matt paper, prepared as above, or with resinised paper (see No. 470). After the paper is dry, expose and tone and fix as usual, or perform both operations in one by using the following toning and fixing bath. When the printing has continued so far that the image is nearly veiled over, wash, and immerse in water 4 ounces, hypo 1 ounce, ammonium sulphocyanide 50 grains, soda phosphate 30 grains. When dissolved, add chloride of gold two grains, previously dissolved in two drams of water. Allow the prints to remain until they have acquired a rich black tone, and then wash thoroughly. The following are other formulæ for the plain salted paper process. Any good paper is suitable for sensitising, if not sized too heavily, but the most reliable papers to use are Saxe, Whatman's hand-made drawing paper, not pressed, for large pictures, and Whatman's hot-pressed paper for pictures requiring a smooth surface. To salt the paper take either

Water	10 ounces.
Arrowroot	80 grains.
Chloride of ammonium	80 ,,

Or

Water	10 ounces.
Gelatine	80 grains.
Chloride of ammonium	80 ,,

The arrowroot must be made into a paste with a little cold water, and then the rest made up with hot water; or if gelatine is used the gelatine must first be soaked, and then dissolved. Using this solution warm, *float* the paper on it for three minutes, and hang up to dry. This may be kept any length of time. When ready for sensitising make up a solution of silver nitrate 60 grains, citric acid 25 grains, water 1 ounce. Float the paper on this for two or three minutes, dry, and it is ready for printing. It may be kept between sheets of paper, impregnated with solution of washing soda, but soon spoils by keeping, and should be used at once. This is toned and fixed like albumenised paper. Porous papers require from ten to twelve grains of gelatine to the ounce, and hot-pressed papers six to eight grains. If the printing is to be done from hard negatives, use less ammonium chloride, if from soft negatives use more.

465. Platinotype Paper—Hot and Cold Processes for Working.—This is one of the simplest and most fascinating processes in photography. The results are most artistic and absolutely permanent. Until lately a licence was required to use it, but now it is not necessary. The hot process is briefly as follows: The platinotype paper is printed until it is about half done, as compared with a silver print; it is then developed by floating it on a solution of oxalate of potash at a temperature of 150° to 170° Fahrenheit. The print is then transferred to a dish containing a solution (1 : 60) of hydrochloric acid, and the acid bath changed two or three times until it is no longer discoloured. The print is then washed and dried; this completes the process, and the result may be mounted in the usual manner. The cold process differs, inasmuch that the platinum salt is used in the developer instead of being in the paper, and the ingredients for the developer are made especially by the Platinotype Company. It is a recent modification of the platinotype, and for ease of working and beauty of results is quite equal to the older process. The paper is sold in cut pieces and in sheets. There are also platinotype muslin and platinotype sateen made by the company. The *rationale* of the "platinotype" process is that *platinous* chloride, which is itself scarcely acted on by light, is reduced to the metallic condition by *ferrous oxalate*, which in its turn is formed by the reducing action of light upon *ferric* oxalate. In the hot process both platinous chloride and ferric oxalate are present together on the paper; when subjected to light the ferric oxalate is reduced to ferrous oxalate, which being insoluble in water, has no action upon the platinous chloride. Upon the paper, however, being floated upon a *hot* solution of potassic oxalate (hence the name of the process), the ferrous oxalate immediately dissolves, and thereupon attacks the platinous chloride, which is reduced to the metallic state, forming a black deposit whose permanence is unquestionable. The cold process differs from the hot in that the paper is coated with ferric oxalate only, to which is added a minute quantity of mercuric chloride; upon exposure to light the same reduction takes place, and development is effected in a *cold* bath containing potassic oxalate and potassium chloroplatinite; the ferrous oxalate, being soluble in this, reduces the platinum, which deposits where the light has acted. In both processes, after development the print is plunged into an acid clearing bath to dissolve away all iron. In the hot bath process the paper has been kept without any sign of deterioration for twelve months, but all depends upon the care exercised in keeping same free from damp of any kind. Good results may often be obtained when the paper is old and discoloured by improper keeping by developing on the following bath:

Carbonate of soda	1 ounce.
Distilled water	4 ,,
Alum	12 grains.

Dissolve the soda in half the water, and the alum in the remainder, mix and shake thoroughly; do not filter, but float exposed prints face downwards on cold solution for ten or fifteen seconds, and then raise, and watch progress of development; as soon as dense enough, plunge instantly into usual acid bath. On the other hand, the paper for the cold process *may* be exposed under the negative, in a damp state (although in this case the detail is less visible than when dry), while in the hot process the paper *must* be dry during exposure. It renders the development by the cold bath process much more manageable to mix about one-third of glycerine with the oxalate of potash solution. The development proceeds slowly, but if any parts show signs of under-exposure, the glycerine (in which the platinum salts are quite insoluble) may be displaced by painting the strong solution of oxalate with a brush. Or the paper may be first wetted with glycerine, and this gradually displaced by a brush dipped in oxalate. By this means skies may be fetched out in developing whilst the landscape is kept back, or a picture may be vignetted by judicious use of the brush.

466. Platinotype Paper, Print-out—To Make.—There are several processes published, one of which is Wischeropp's method. It is essential to use a chemically pure ferric salt, and to dry the solution quickly after its application, in order that it may not penetrate into the paper. For this purpose a dry box should be kept at a temperature of 56° C. (133° F.); so that it may dry the prepared paper placed in it within two minutes. The following are the solutions:

Solution A.

Sodium oxalate solution (3 : 100) ...	100 c.cm.
Sodium ferric oxalate	40 grammes.
Potassium chlorate	0·1 ,,

Solution B.

Potassic chloroplatinite	10 grammes.
Distilled water	60 c.cm.

Solution B keeps indefinitely, whilst solution A should be renewed from time to time. To sensitise one sheet of arrowroot paper, eight c.cm. of solution A and five c.cm. of solution B are required. The sheets of paper are fastened with drawing pins to two wooden strips, one of which projects sufficiently to enable the sheet to be placed on the edges of the dry box. The solution is quickly applied to the paper with a bristle brush, spread with a round badger-hair brush, and then the sheet is quickly hung therein. The paper should, in order to get brilliant prints, be kept some time previously in the dark room, after drying. In the printing frame it should be covered all over with indiarubber cloth. After the desired tone is reached, fix it in a solution of hydrochloric acid (1 : 80). The fresher the paper and the more quickly it is worked the more beautiful will be the tones. For this reason it is better to print in direct sunlight, but it is a good plan to breathe on the paper before putting in frame in order to give it the requisite moisture. Another is by Pizzighelli, who has experimented as much as anyone in this direction, and the following are the particulars of his recently improved method. Unsized Rives or Saxe paper should first be coated

with a solution of arrowroot thirty grains in four ounces of water. If brilliant results are required the paper may be coated by double immersion in a one per cent. alcoholic solution of dammar, colophony, or benzoin. For sensitising prepare the following solutions :

No. 1.

Potassium chloroplatinite	150 grains.
Distilled water	2 ounces.

No. 2.

Ammonium ferric oxalate	1¼ ounces.
Potassium oxalate (five per cent. solution)	3½ ,,
Glycerine	50 minims.

No. 3.

Iron solution (No. 2)	3½ ounces.
Potassium chlorate (five per cent. solution)	½ ,,

To prepare No. 2, heat the potassium oxalate solution to about 100° F., and dissolve the ammonium ferric-oxalate in it. Upon cooling, some ammonium oxalate will be precipitated ; filter the clear solution, and keep in the dark, after adding a drop of carbolic acid. For sensitising a sheet (demy size), when black tones are required, and if negatives of medium density are used, take of No. 1 100 minims, No. 2 120 minims, and No. 3 35 minims, and apply to the paper, placed flat on a board or piece of glass, by means of a cotton wool pad. For harder negatives the quantity of No. 3 should be diminished or quite omitted, and No. 2 increased to the same extent, and in the case of softer negatives the reverse should be adopted. Preserve the paper when dry in a calcium tube. Print until the prints show the intensity they should have when finished. Then pass through two baths of hydrochloric acid 1 part, water 80 parts, until the yellow colour has disappeared. Then wash for a quarter of an hour in several changes of water to remove the acid. If in drying, the prints appear to have lost detail in the shadows, prepare the following :

Gelatine	4 ounces.
Water	35 ,,
Powdered alum	4 ,,

Dissolve the gelatine in the water first, heat up to boiling point, remove from the fire, then add the alum and stir. Before use, take gelatine solution one part, water one to two parts, warm in water bath, and immerse dry prints for a few minutes. Then place for a short time in a dish of cold water, and finally dry. Prints treated in this way are more brilliant than if finished in the ordinary way. Another, and more recent way : For plain paper the sensitiser is

A.

Pot. chloroplatinite	10 grammes.
Distilled water	60 c.c.

B.

Ammonium ferric-oxalate ...	40 grammes.
Gum arabic (powdered)	40 ,,
Pot. oxalate solution (five per cent.)	100 c.c.
Glycerine	3 ,,

C.

Iron and gum solution B ...	100 c.c.
Pot. chlorate solution (1 : 20) ...	8 ,,

D

Mercuric chloride solution (five per cent.)	20 c.c.
Pot. oxalate solution (five per cent.)	40 ,,
Gum arabic (powdered)	24 grammes.
Glycerine	2 c.c.

Solutions C and D, being sensitive to light, must be kept in the dark. Solution B is prepared by heating the potassium oxalate solution to about from 40° to 50° C., and dissolving the ferric salt and glycerine. The warm solution is then gradually added, with stirring to the gum arabic, in a mortar. The further procedure is the same as in the older process. The thick solution is muddy, and of a greenish colour. It is also sensitive to light, and subject to the formation of mould. For black images and negatives of medium density, the paper (ordinary size) is prepared with the following solution :

Platinum solution A	5 c.c.
Iron and gum solution B	6 ,,
Gum and chlorate solution C	2 ,,

For sepia prints—

Solution A	5 c.c.
,, C	4 ,,
,, D	4 ,,

The preparation of the paper is the same as described in the original instructions. The numerous small air bubbles formed during the application completely disappear when coating is smoothed with a badger softener. Drying is done in the usual manner, the dry papers showing a slight gloss, caused by the gum layer. After drying, the papers are preserved in a chloride of calcium box.

467. Platinotype Papers—To Sensitise.—The way to proceed is to take a sheet of sized paper, size side uppermost, lay it down on a sheet of glass which is about an inch larger than the paper each way, and fasten each corner by means of American clips. Now mix up iron solutions—one dram of A, seven drams of B ; to this mixture add sixty grains of platinum salt, and stir it well with a glass rod till the salt is dissolved. This solution will be sufficient for sensitising four sheets of about twenty-four by twenty inches. The solution should be used as soon as it is mixed, as it does not keep longer than twenty minutes. Take two drams of the mixture, and pour it on to the centre of the paper which is on the glass, and spread it by means of a pad of cotton wool evenly and gently. When this is done, hang it up; take a fresh sheet and proceed in the same way with it, and so on till the four sheets are finished. Now take down the first sheet, and hold it before a bright fire till it is thoroughly dry, then the rest in their order. When the four sheets of paper are all dry, they must be kept in a tin tube containing chloride of calcium. It is now ready to use for printing. The developing solution for the paper is as follows :

Oxalate of potash	130 grains.
Water	1 ounce.

This solution can be used several times. When developing, the solution is put into an enamelled iron dish, and heated to about 160° to 180° Fahr. When the developer is ready to use, take out the print which is in the frame, and pass it face downwards through the developer for about two or three seconds, and put it at once in a bath containing one ounce of hydrochloric acid to sixty ounces of water ; allow to remain for ten minutes, empty the acid out, and put the fresh acid in for the same time. Repeat this operation three times, and after that give a final washing.

468. Print-out Bromide Paper—To Make.—Bromide paper can certainly be made to print out, but as a printing process the results are scarcely satisfactory. Make up a solution of potassium nitrite, forty grains to each ounce of water. Then soak the bromide paper in this solution in the dark room for about five minutes and dry. The paper will now print out, and in a strong light darkens very rapidly. Mr. C. J. Leaper also recommends the following plan : Place one ounce of potassium metabisulphite in twelve ounces of cold water, and set aside for three or four days with occasional vigorous agitation. At the end of that time filter off the saturated solution, soak the

bromide paper in it for three minutes, and hang up to dry. When dry store in a calcium tin. Paper prepared in this manner is even more rapid than the other. Printing-out bromide of silver paper is specially manufactured for use in photometers and actinometers, and the following is given by Capt. Abney: Take some sheets of plain photographic paper, and soak for ten minutes in a solution of potassium bromide (forty grains to the ounce). Dry and float on a fifty-grain nitrate of silver bath. Then wash and pass it through a second potassium bromide bath—this time five grains to the ounce, wash thoroughly, and finally soak for five minutes in a bath of tannin, one grain to the ounce. This paper will keep, and discolours fairly well in the light. For converting ordinary bromide paper into a printing-out paper for a similar purpose, Mr. Leaper recommends immersing a sheet of bromide in a clear saturated solution of metabisulphite of potassium for three minutes, then hang up to dry in the dark room or cupboard, and store in a calcium tube or between the leaves of a book. Paper thus prepared is said to keep better, and is more sensitive than that treated for five minutes in a twenty or forty grain solution of potassium nitrite, which is usually recommended.

469. Print-out Paper—To Make.—For an emulsion similar to aristotype the following formula answers well:

Silver nitrate	6 grains.
Distilled water	6 drams.
Gelatine	230 grains.

Soak the gelatine in water and dissolve by the aid of heat and add the silver. Dissolve

Lithium chloride	1 grain.
Tartaric acid	1 ,,
Distilled water	1 dram.

and add gradually to the silver solution. The following formula is taken from "The American Annual":

A.	
Alcohol	100 c.cm.
Silver nitrate	8 grammes.
B.	
Alcohol	100 c.cm.
Strontium chloride	2 grammes.
C.	
Water	100 c.cm.
Citric acid	5 grammes.
D.	
Alcohol	100 c.cm.
Ether	100 ,,
Gun cotton	4 grammes.

To one hundred c.cm. of collodion D add first by constant agitation ten c.cm. of B and ten c.cm. of C; finally add five c.cm. of A, vigorously shaking the mixture. The resulting emulsion is allowed to settle for twenty-four hours, and is then used for coating the paper. Another, given below, comes from the Edinburgh Photo Society: Gelatine ¼ ounce, ammonium chloride 20 grains, potassic citrate 40 grains, and water 5 ounces, are put into a twenty-ounce bottle, and allowed to soak until the gelatine is thoroughly swollen, then well shaken up and a quarter of an ounce of silver nitrate added in crystals, and shaken again until all the silver nitrate is dissolved. Keep it then at a temperature of 100° F. for an hour, and then let it cool to between 80° and 90°. Now add twelve ounces of methylated spirit and shake well. The emulsion is deposited as a pasty mass. Let it stand for an hour (keeping it dark), and pour off the fluid. Add three or four ounces more of spirit, and shake well to extract the water; pour off the remaining spirit as much as possible, and the emulsion is washed. Now add five ounces of water, let soak and dissolve. Filter through chamois leather, and coat the paper, plates, etc., rather thickly. Then proceed to dry, print, wash, tone, and fix as aristotype paper. The following method is given by Mr. C. T. Frankland:

No. 1.	
Gelatine, Nelson's No. 1	60 grains.
Chloride sodium	36 ,,
Stock A	12 drams.
Carb. ammonia	12 grains.
Albumen	24 minims.
Water	6½ ounces.
No. 2.	
Silver	240 grains.
Water, distilled	3½ ounces.
No. 3.	
Best Russian isinglass	300 grains.
Stock A.	
Lump sugar	24 grains.
Citric acid	9 ,,
Tartaric acid	3 ,,
Bromide potass.	1½ ,,
Water	4 ounces.
Stock B.	
Carb. (not bi) soda	20 grains.
Water	1 ounce.

Dissolve No. 1 at 50° Fahr., and add No. 2 cold (emulsify at as low a temperature as possible), and keep to 60° Fahr. for twenty minutes, after which add No. 3 dry, dissolve at same temperature, and put by till next day. In fact, this is better for keeping three days, and when wanted for coating add half-ounce absolute alcohol, filter, and the emulsion is ready. This will give red images, and if prepared in a weak yellow light (candlelight does not harm, but do not use gas) will give perfect whites. Toning can be performed either before or after fixation; if before, use an *old* acetate bath. If fixing be done first, hypo 3 ounces, water 20 ounces, time five minutes, wash well, and tone in bichloride platinum 1 grain, water 10 ounces. Another is given by Burton. Two separate emulsions are made in the following manner:

(1.) Chloride of silver emulsion. For this are taken—

A.	
Ammonium chloride	53 grains.
Gelatine	420 ,,
Water	20 ounces.
B.	
Silver nitrate	150 grains.
Water	½ ounce.

(2.) Citrate of silver emulsion—

A.	
Citrate of sodium	30 grains.
Gelatine	100 ,,
Water	3½ ounces.
B.	
Nitrate of silver	45 grains.
Citric acid	80 ,,
Water	½ ounce.

The gelatine in A of the chloride emulsion should be about one-third soft (say Nelson's No. 1) and two-thirds hard (say Heinrich's). The gelatine in the citrate emulsion A is to be all hard. The solution A for the citrate emulsion is to be prepared as follows: The gelatine is dissolved by soaking in three ounces of the water and warming. The citrate of soda is then dissolved in the half-ounce of water remaining, the solution is warmed, and is gradually added with stirring to gelatine solution. The chloride emulsion is completed as follows: The gelatine solution A is melted by soaking and warming. The ammonium chloride is added, and when it is dissolved, the solution B, slightly warmed, is added drop by drop with continued stirring. The emulsion is put aside until quite stiff, when it is ready to be washed by passing it through mosquito netting or very coarse canvas, and allowing it to remain for five minutes in each of three or four

changes of water. It now requires only to be drained when it is ready for use. The citrate emulsion is mixed in precisely the same manner, care been taken not to raise the temperature of the solution higher than is necessary to secure thorough emulsification. It is washed first as described for chloride emulsion, and then fifteen grains of citric acid are added. The two emulsions are now re-melted and mixed, and are ready for coating paper. The following formula also gives good results when used on paper:

Nelson's soft gelatine	9 grammes.
Heinrich's hard	19 ,,
Ammonium chloride (pure) ...	35 ,,
Distilled water	360 c.c.

Allow to soak for half-an-hour, and dissolve by the aid of a water bath, and add gradually almost drop by drop, with constant stirring, the following at about 90° F.:

Silver nitrate	10 grammes.
Water distilled	20 c.c.

Allow the emulsion to set hard, pass through canvas, wash in four changes of water five minutes each, and drain well. Now prepare the following:

Heinrich's gelatine	6·5 grammes.
Distilled water	90 c.c.

Soak for half-an-hour and dissolve, and add the following at a temperature of 90° F., with constant stirring:

Sodium citrate (neutral)	2 grammes.
Distilled water	10 c c.

Dissolve

Silver nitrate	3 grammes.
Citric acid	5 ,,
Distilled water	10 c.c.

Add to the citrate and gelatine very gradually and constantly stirring; set quickly and wash in five changes of water for five minutes each; drain well. Add to the chloride emulsion as above, and add

Citric acid	1 gramme.
Distilled water	7 c.c.

And filter. If the emulsion is to be kept, add to the finished emulsion:

Thymol	·3 grammes.
Alcohol	3 c.c.

Allow the emulsion to stand for an hour in a fluid state, occasionally stirring; it is then ready for coating, but works and prints better in three days' time. Will keep in mass a week; longer it tends to coagulate. For coating glass or opal the following gives better results. Soak

Soft gelatine	10 grammes.
Heinrich's hard gelatine... ...	30 ,,
in Distilled water	400 c.c.

for one hour, and dissolve by the aid of heat, adding at the last

Calcium chloride (anhydrous) ...	14 grammes.
Distilled water	100 c.c.

Add three-quarters only of the calcium solution to the gelatine, and then add

Silver nitrate	22 grammes.
Distilled water	100 c.c.

and test the emulsion for free silver nitrate by adding to a drop of the liquid emulsion a drop of a two per cent. solution of bichromate of potash. If the characteristic red colour is produced, add the remainder of the haloid solution till the emulsion no longer contains free silver. Set rapidly, and wash very slightly in one water. Then melt and add

Citric acid	6 grammes.
Distilled water	60 c.c.

and, lastly,

Thymol	5 grammes.
Alcohol	30 c.c.

Keep the temperature as low as possible all through the operations, and be careful that no free silver is present, only a very slight excess of haloid. The coating on the opal or glass should be as thin as possible. The whole of the operations may be conducted by gaslight or by daylight, filtered through golden fabric or canary medium. For print-out paper Barker's emulsion is widely known, and in the opinion of many is, perhaps, the best.

Gelatine (Nelson's No. 1 and Coignet's, equal parts)	175 grains.
Ammonium chloride	18 ,,
Rochelle salt	50 ,,
Silver nitrate	75 ,,
Alcohol	4 drams.
Water	5 ounces.

The following points should be noted: The heat of emulsion should never be greater than 120° F., and when coating the lower the temperature consistent with fluidity the better, hence about 90° F. would work out right. To coat the paper get a flat shallow dish, a size larger than the paper to be coated, filter the emulsion into a jar, and carefully skim it to remove scum; then empty into the dish without producing bubbles; if any appear, draw a strip of blotting-paper across the surface. Then drop the paper on to the surface in the usual diagonal way, and allow it to float a few seconds; raise one corner and see if that half of the paper is free from bubbles, and then do ditto with the opposite corner. Touch out spots or bubbles with a small camel-hair brush dipped in the emulsion. Allow the paper to float quietly for, say, twenty seconds after this before removing it and allowing it to drain, and then place it on a levelled sheet of glass till thoroughly set. No preservative is required, but when thoroughly dry keep it under heavy pressure, wrapped up in non-actinic paper. Remember that for floating the emulsion should be pretty thick, hence quite a quarter of the water in the formula can be omitted. A capital plan, though somewhat more difficult, is to coat two sheets at once, thus: Place two pieces of paper back to back, and with the finger and thumb at two adjacent corners draw the two pieces (pulling them taut all the time) rapidly under and through the emulsion together; no emulsion will run between. If bubbles appear, hold the tops by one hand and touch with a camel-hair brush. Take care how the paper is dried. It should first be laid on sheets of glass in a cool room until quite set, and then transferred to a room heated to about 80° F. until dry. As regards papers, the one most generally used is called Baryta paper, or Kreide paper, and can be obtained from collotype dealers. The advantage is that the baryta or chalk keeps the emulsion from sinking into the pores of the paper. Other papers are Rives, Saxe's, and Arnold's; the last is very pure, and sold by Messrs. Reeves. Beware also of metallic particles on the paper due to the rollers, as these will be certain to deposit silver. If the emulsion is too hot, it will give thousands of tiny bubbles, or the paper will dry dull.

470. Resinised Paper—To Prepare.—The same process as for plain salted paper succeeds well with resinised paper, and the following is Mr. H. Cooper's formula, approved of by Capt. Abney: Frankincense 1 gramme, mastic ·8 gramme, calcium chloride ·5 to 1 gramme, alcohol 45 c.c. The paper, which should be fairly thin, is immersed in this solution for half a minute, and when dry is ready for floating on a moderately strong sensitising bath, such as the one given in No. 471. As the above formula may be more intelligible to many in English measures, it is here translated:

Frankincense...	60 grains.
Mastic	48 ,,
Calcium chloride	30 : 60 ,,
Alcohol	5½ ounces.

471. Salted Paper—To Sensitise.—The strength of bath should be about the same as for albumenised paper; use about fifty grains silver nitrate to the ounce. The time of floating cannot be stated, but the following is a simple and good method to find out: Make a solution of a few grains chromate of potash to an ounce of water. Take a small bit of the paper and brush a drop of this solution on the back, then float. The stain produced by the chromate will at first be pale yellow, but as the paper is floated it will gradually turn to an orange colour, and when this has taken place it has been floated long enough. The time can be observed, and this time will always be right under the same conditions.

Captain Abney gives the following strength:

Silver nitrate, 5 grammes = 77 grs. abt. } or 44 grs.
Dist. water, 50 c.c. = 850 ms. abt. } to the oz.

and the paper is to be floated for three minutes.

Monckhoven gives:

Silver nitrate 4 oz. } *i.e.*, a 20 per cent. bath.
Dist. water 20 oz. }

and the paper to be floated for three or four minutes. A drawback is that the paper keeps for only two or three days after being sensitised. A still better bath, however, is prepared as follows: Dissolve fifty grains of nitrate of silver in one ounce of water. Then add ammonia drop by drop until the dirty brown precipitate begins to clear. Now shake the bottle, and if not clear, add more ammonia, shaking or stirring after each drop until the solution is *almost* clear. Filter and float paper for two minutes. The paper prepared by the last method does not keep very well, but deep bluish black tones can be obtained with the greatest ease; really it is easier to obtain these tones than a warm brown. With a combined gold and uranium toning bath, and deep printing, it is extremely difficult to tell the difference between prints by this method and bromide prints.

472. Sensitised Paper (Albumen) Preservative for—To Make.—This is generally supposed to be a trade secret, but many formulæ have been suggested, some of which are: (1.) Silver nitrate 40 grains, citric acid 20 grains, water 1 ounce. (2.) Silver nitrate 40 grains, pure perchloric acid 20 minims, water 1 ounce. (3.) Silver nitrate 2 ounces, pure dry sodium carbonate 60 grains, citric acid 150 grains, water 20 ounces. Another formula is—Nitrate of silver 60 grains, citric acid 25 grains, water 1 ounce. The paper will keep for months. Another: Add to the silver bath citric or tartaric acid in the proportion of five grains to the fluid ounce. Should a cloudiness form, add nitric acid *drop by drop* until it disappears. Be careful to avoid an excess of nitric acid. Another method advocated by W. E. Debenham is to add ten drops *pure perchloric acid* to each fluid ounce of silver bath. The following formula is suggested by Captain Abney:

Silver nitrate	50 grains,
Citric acid	20 ,,
Water	1 ounce.

When citric or tartaric acid is added to the silver bath it is advisable to *fume* the paper with ammonia before printing, or toning is difficult. Or the paper may be sensitised as usual, and afterwards treated as follows: Float the paper for three and a half minutes on a bath of fifty grains to the ounce, draw over a glass rod and blot the surfaces dry between blotting paper, and then float, albumen side downwards, for a few seconds only, on a bath composed as follows:

Citric acid	1½ ounces.
Picked gum arabic	2½ ,,
Distilled water	30 ,,

Simply take the paper off the bath and hang up to dry in a moderately warm room. Paper prepared in this way will keep well, besides yielding good prints and toning readily. Another way is to float on a sixty-grain bath of silver nitrate, "blot off" and float (its back) on Ashman's solution: Water 100 ounces, gum arabic 3 ounces, hydrochloric acid 2 ounces, citric acid 2 ounces, tartaric acid 2 ounces. Take care that none touches the face of the paper. When dry, not bone dry, place between sheets of blotting paper that have been soaked in a solution of carbonate of soda 30 grains, water 1 ounce. Allow the sheets to be thoroughly dry before using; this will "keep" either paper prepared as above or the ready sensitised for *months*. If a little pressure is used so much the better. Captain Abney gives the following methods of preparing paper that will keep: (1.) Float albumenised paper on a forty-grain bath as usual, dry till nearly all the moisture is gone, place the sheets between blotting-paper previously impregnated with sodium carbonate solution (thirty grains to one ounce water), and allow to desiccate. Place the pile of papers under pressure, and withdraw the sheets as required. (2.) Immerse thoroughly washed paper (that is, paper, sensitised as usual, is passed through, *not soaked in*, face downwards, two or three changes of water, and hung up to dry) in a weak solution of potassium nitrite or potassium sulphite; it will keep well, and the resulting prints will be vigorous. (3.) Mr. W. Bedford prepares sensitive paper in a neutral bath, and then floats the face, whilst still damp, for one minute in a solution of citric acid 30 grains, silver nitrate 30 grains, water 1 ounce. (4.) Other workers prepare paper by floating the *back* on citric acid solution after sensitising.

473. Sensitised Paper (Albumenised)—To Prepare.—Mr. Ashman gives the following as one of the best methods: Silver nitrate solution sixty grains to the ounce, to this add ten drops of a saturated solution of citric acid, drop by drop, until the slight precipitate of citrate of silver formed is redissolved. Float the albumenised paper for, say, four minutes, then place between sheets of clean blotting paper to remove superfluous solution. As soon as the surface is dry, float the back of the sheets on either of the following solutions, previously filtered:

No. 1.

Picked gum arabic	3 ounces.
Rochelle salt	5 ,,
Water	80 ,,

No. 2.

Picked gum arabic	3 ounces.
Tartaric acid	5 ,,
Water	80 ,,

If the paper be now thoroughly dried, and put under pressure so that neither daylight nor atmospheric influences can attack it, the whiteness may be preserved for a long time. No. 1 of the above formulæ will keep the paper good for two or three weeks, No. 2 for several months. Another writer says—First as to the articles required: A flat dish of glass or porcelain, a number of American or spring clips, several sheets of chemically pure blotting paper, a funnel and filter papers, a small quantity of kaolin, nitrate of silver, an argentometer and tube, a pair of horn forceps, and a book of test papers. The strength of the silver bath depends on the proportion of salt used in the salting. In the absence of definite instructions given by the makers, it will be found advisable to employ a solution containing at least fifty-sixty grains to the ounce. Cut the paper to a convenient size, which should be a multiple of the size eventually required, to avoid waste. Make two solutions in the following proportions:

A.

Nitrate of silver	50 to 60 grains.
Distilled water	1 ounce.

B.

Nitrate of silver	100 to 120 grains.
Distilled water	1 ounce.

Operations should be conducted in a yellow light. Gas or candle light will do. The paper works better slightly damp. A sheet of damp blotting paper should be laid on the back of the paper, while a dry sheet is placed under the albumenised surface. Apply pressure for two or three minutes, and then hang up for five minutes. Take of A solution sufficient to cover the bottom of the dish to the depth of a quarter of an inch. Then take a piece of the paper with the albumenised surface downwards, by opposite corners, so as to form it into a curve, and lower it gently on to the solution, so as to prevent air bubbles forming on the coated surface, or any of the solution flowing over the back. In a minute or so the paper should be taken by one corner with a pair of horn forceps, raised and examined, to see if it is uniformly wetted and free from air bubbles. If the latter occur they should be broken with the end of a glass rod. After remaining in the bath for about three minutes the paper should be raised and drawn over the edge of the dish, in order to remove the superfluous solution. Then, fixing a spring clip to one corner, the paper should be hung up to dry. A cord may be stretched across the dark room to hang the papers on. A small piece of blotting paper should be brought in contact with the lower corner. Capillary attraction will cause it to stick to the paper and absorb the drippings. The silver may afterwards be recovered from such pieces; or the sheets as they come from the bath may be placed, face downwards, one by one, on sheets of chemically pure blotting paper, and pressure applied by means of a board and weight. Then repeat operations. Naturally the sensitising of each sheet of paper weakens the bath. To maintain the normal strength of the bath, add two drams of B solution (double the strength of A) after the removal of each sheet. After the day's work the bath should be tested with the argentometer, and any error in strength corrected. The solution should then be filtered through a layer of kaolin. This will remove any organic or other impurities incurred in the sensitising process, and the bath will again be ready for use. Should the bath become acid, a few drops of a solution of carbonate of soda should be added until it produces a permanent but slight precipitate of carbonate of silver. Then filter. Paper thus prepared will, under ordinary circumstances, keep about a week. The time of keeping may be prolonged to about three weeks in the following manner: Take some pieces of blotting paper about one inch larger all round than the sensitised paper, and soak them in a solution of carbonate of soda (one in twenty), and when dry lay them and the sensitised sheets alternately in a box—as far as possible light, dust, and air-tight—and apply pressure. The paper may be fumed with ammonia. It is claimed that this renders the prints more brilliant, and that the paper prints more quickly. Having cut the paper to the required size pin it by the four corners to the lid of an empty plate box. Place a piece of blotting paper on the bottom of the box, and drop ten or fifteen drops of liquor ammoniæ ·880 on it. Put on the lid with the paper in it, and leave it for ten or fifteen minutes according to the temperature, requiring less time in hot weather than cold. Fumed paper does not keep well. Another formula is—Prepare a solution of nitrate of silver 5 ounces, water 36 ounces. Dissolve, add just sufficient of a strong solution of washing soda to cause a slight permanent precipitate, then filter the solution into a clean porcelain dish, float the albumenised paper on this for three minutes, remove, and put the sheet between clean sheets of blotting paper, then hang up to dry in a warm room. By preparing paper on such a bath, keeping the silver up to normal strength, and floating for a sufficient length of time, no blistering need be feared, and the very best results will be obtained; but such paper will not keep more than three or four days. The best bath to use if the paper must keep for, say, a fortnight, is to make a solution of nitrate of silver as above, add to this sufficient of a solution of citric acid to cause a slight precipitate, then add sufficient nitric acid to redissolve this precipitate, then filter and float the paper upon it. The cause of blisters is imperfect coagulation of the albumen. Keep up the strength of the nitrate of silver, and float for a sufficient length of time, and no blisters will be produced. If it is required to prepare the paper from the beginning—that is, to albumenise it—the following directions are given: Procure some new-laid eggs—and let them be fairly new laid, as eggs a month old still go by that name at some shops—break them carefully, and separate the albumen from the yolks; and to each ounce of white thus separated add eight grains of common salt finely powdered, and whisk until the albumen is all a stiff, white froth. Set this aside for about twelve hours, by which time most of it will have settled into a clear liquid, which is to be carefully decanted into a flat porcelain tray of the size required. The paper—which may be Rives or Towgood's, or for large work, Saxe, and which should be marked with pencil on the wrong side—is cut slightly smaller than the tray, and held by two opposite corners, marked side upwards. The hands are brought close together, so as to bend the paper, and the curved surface along the diagonal is first brought gently into contact with the albumen; the hands are then separated and lowered, and the air is thus expelled gradually between the paper and albumen until the former lies flat on the albumen. A good plan is to slightly damp the paper before floating. One corner is now raised to examine for air bubbles (which may be removed with a small brush or card), and the sheet raised about half, the other half being similarly examined by raising the opposite corner. The paper should be allowed to float for about a minute. It is then slowly removed from the albumen, so as to drain it as it is being removed, and is suspended by clips on a string to dry. When surface dry it is generally rolled to finish the drying and keep it flatter, and it is then stored away ready for use between flat boards, etc. Another albumenising formula given by Captain Abney is as follows:

Ammonium chloride	10 parts.
Spirits of wine	15 ,,
Water	135 ,,
Albumen	450 ,,

The first three are thoroughly mixed, and the albumen gradually added. The whole solution is then put into a bottle which will hold twice as much, and a fair quantity of roughly powdered glass is introduced, and the whole well shaken. The solution is then filtered through sponge or cotton wool for use. To sensitise the paper thus prepared, make a solution of silver nitrate (sixty grains) in distilled water (one ounce), or any necessary multiple of this. Pour it into a flat porcelain dish, and float the paper as before for about two or three minutes in hot weather, to five to six minutes in cold weather, gently remove so as to drain, and hang up by one corner, absorbing the drops from the opposite corner with a piece of bibulous paper. The paper when dry

is ready to print, and will keep for about twenty-four to thirty-six hours. Still another method—To make up, say, ten ounces, take nine eggs, and give each a sharp tap on the edge of a cup and separate the whites from the yolks—none of the latter must be present. Having obtained the albumen, the next process is to add some chloride, preferably ammonium chloride (sal ammoniac). Dissolve one hundred grains of ammonium chloride in one ounce of water, and add to the albumen. The mixture must be beaten up until it forms a froth; the best means is with an American egg-beater. When settled, filter through a sponge placed in a funnel (a tundish), or through two or three thicknesses of flannel. Now pour the solution into two large dishes. Take the piece of paper by the two opposite corners, and gradually float it on the solution. Keep a sharp look out for bubbles, which can be broken by a glass rod. Repeat the operation with the solution in the second dish. Remove the paper from the dish, and allow it to drain for a few seconds. Then allow the paper to dry spontaneously. The temperature of the room in which the operation is performed should be 80° F. The hotter the atmosphere, the more glossy will be the paper. The sensitising bath consists of a solution of silver nitrate, generally about sixty grains of silver nitrate to one ounce of water. In very dry weather it is advantageous to add a quantity of sodium nitrate equal to the silver nitrate used. To make a bath of one pint, sixty grains to the ounce, 1,200 grains of silver nitrate are required. Place the nitrate in a clean bottle, add one pint of *distilled* water, and shake till it dissolves. This sensitising solution is placed in a dish larger than the paper to be sensitised, and the paper floated on it in a similar manner to that described in coating it with albumen. The paper should be floated for about two and a half minutes, and any bubbles at once broken with a glass rod. Remove the paper slowly from the bath, allow to drain a short time, and then hang up by a clip to dry; a small piece of blotting paper should be attached to the bottom corner.

474. Sensitised Paper—Best Method of Sending to Foreign Countries.—The best way to send the paper is book post. The size is limited to 18in. in length by 9in. in circumference. The paper should be cut into the required size or half-sheets, and rolled on a cardboard roller two or three inches longer than the paper, as this prevents the edges getting discoloured, as it has to be sent with open ends; if sent in full-sized sheets (17in. wide) the edges are likely to get spoilt. Pack it in waxed paper (this keeps out the damp), then orange-coloured tissue, and over this brown paper. The weight of twelve sheets packed in this manner is between twelve and fourteen ounces. The postal rate is one halfpenny per ounce.

475. Sensitised Paper—To Keep.—The simplest and one of the most efficient ways to do this is to make a small press for the purpose. This consists merely of two flat pieces of wood about 2in. longer than the size of the paper and 1in. broader; at the centre of each end is fitted a screw and bush, by which the boards can be clamped tight together. The paper is placed between two pieces of blotting paper, and the whole placed between the two boards and clamped tight, and the press put into any convenient drawer with a piece of brown paper round it. The air is thus kept from the paper, and it has been found to keep well for months like this.

476. Sepiatype Paper—The Use of.—The tones obtained by this paper are all, as the name implies, sepia tones, and somewhat resemble the sepia tones with platinotype. The paper requires printing in a strong light until the detail appears in the shadows. It must be slightly damp in order to make the picture appear directly during the printing, and in its general treatment the paper greatly resembles the Pizzighelli platina paper. It must be kept dry, and for this purpose it is best preserved in chloride of calcium tins. The only dodging required is with different negatives—thus, with a thin negative the prints are placed direct into a bath of hypo (one to one hundred of water); with an intense negative the print should be thoroughly damped before fixing. Pictures not sufficiently printed will darken if kept in a damp place for about twelve hours, while over-printed proofs may be reduced by placing in a five per cent. bath of hypo. After fixing for five minutes, the prints are washed in running water for ten minutes to a quarter of an hour. They are supposed to be permanent, and the whites are pure without any clearing solution being required.

477. Transferotype Paper—To Work.—Get a packet of double transfer paper from the Autotype Company, and with a piece of cotton wool coat it with

Yellow wax	12 grains.
Yellow resin	36 ,,
Ether	2 ounces.

Melt the wax, add the resin, and then the ether. Immerse the paper in water until limp, then bring the print in contact with the waxed side of the paper under water. Take it out and squeegee, and place under a blotter with a weight on it for about thirty minutes. Then with hot water strip the paper off the back of the transferotype, and clean the surface with cotton wool. Prepare the surface it is to be placed on by coating with a solution of

Gelatine	30 grains.
Chrome alum	18 ,,
Water	1½ ounce.

When this has dried, immerse it in water, bring the transfer paper bearing the transferotype into contact with it (under water), take it out and *well* squeegee, and dry under pressure. When dry strip the transfer paper, leaving the transferotype on its support.

478. Transfer Paper for Wet Plates—To Make.—Some twenty years ago, many photographers made collodion transfers—in fact, until the introduction of argentic bromide paper, and the paper in use then cannot well be beaten at the present day. A special transfer paper was used, but as this was very readily made at home, and seemed to keep without change for months, it presented no difficulty whatever. The kind of paper suitable for preparation was a thin smooth-surfaced cream-wove foolscap. The sheets measured before folding about 17 × 13½ inches. These were coated with a solution of gelatine prepared as follows: Dissolve half an ounce of Nelson's (or any other suitable photographic) gelatine in from twenty to thirty ounces of water, and, keeping the solution warmed, filter carefully. Now with a brush or a sponge coat one side of the paper, avoiding streaks or brush marks as much as possible, and hang up and allow to dry, when it may be readily stored until required. If smaller pieces are prepared, or if appliances permit, the paper may be coated by floating on the warm solution, drawing off with care and drying. After the collodion film is fixed and washed the transfer paper is cut to the size of the plate and soaked for a short time in cold water to soften the gelatine. It should now be laid coated side downwards upon the wet collodion film, taking care that the curved paper, as it hangs from the hands, touches

the film in the centre first. If now the hands are steadily lowered the films of water on the paper and on the plate, uniting, will bring the two surfaces into contact without introducing air bubbles. A cloth-covered roller or a squeegee should now be used to expel all superfluous water. The whole should be allowed to become perfectly dry, when upon lifting a corner with a penknife the paper will leave the glass, carrying with it the film. It should be said that this will only happen (excepting small sizes) when the glass has been coated with a substratum of beeswax in ether before coating with collodion. Five grains of pure sun-bleached white wax for the ounce of ether have been recommended as the strength of the solution. A little of this is poured on the middle of the plate and spread rapidly, on account of the readiness with which the solvent evaporates, to entirely cover the plate, and to do this a piece of linen cloth having no loose fibres should be used. The surface of the plate is now polished until no trace of the wax remains. A sufficient quantity of the wax, however, is left to effect its object—that of permitting the film to leave the glass. With regard to exposure and development, it may be mentioned that pyro restrained with *citric* acid gives an image of a bluish black, very satisfactory when finished, while the same developer restrained with *acetic* acid gives brown tones. Iron development gives warm greys, but the image is readily toned with a plain gold solution—strength one to one and a half grains to the ounce of distilled water—poured on and off. This gold toning gives warm browns to black. The smaller sized plates do not require waxing, so that when a lantern slide after fixing appears hopelessly thin the film may be transferred to a piece of the prepared paper, forming a good positive print. It may be quickly done and the film saved, while the glass may be cleaned and used again at once. In some cases negative films, too much under-exposed for printing from, can be, without drying, bleached to a pearly white with mercury, and transferred to *black* transfer paper. Films are sometimes required to be transferred to a *transparent* support in order to obtain a reversed negative. Sheet gelatine may be used for small sizes. The gelatine is soaked until soft and "squeegeed" on to the wet film in the manner directed for paper, but when set to dry the edges must be kept from curling upwards by narrow strips of wood held down by spring clips. For larger sizes, the plate is levelled and a warm solution of gelatine in water, strength about one to twenty, poured on the plate and allowed to set. When thoroughly dry a penknife is passed round the edge, cutting through the film into the glass. The film will now, if the glass has been waxed before coating, come off readily. If the gelatine solution be required to be kept any length of time, half the amount of water used should be replaced by methylated spirit.

479. Whatman's Paper—To Sensitise.—Tones resembling platinum paper may be obtained in the following way. Cut Whatman's drawing paper into suitable sizes and float on the following warm bath: Gelatine 40 grains, chloride of sodium 50 grains, water 10 ounces. When dry sensitise with a sixty-grain nitrate of silver bath to which ammonia has been added drop by drop until after first becoming muddy the solution becomes clear again. If too much ammonia is added by mistake, add a little more nitrate of silver solution. To sensitise the paper it should be attached to a board and brushed over with the above solution by means of a Buckle brush (a tuft of cotton wool drawn partly through a piece of glass tubing by means of a thread or silver wire). The board should then be set up to dry on a piece of blotting paper. The proofs should be considerably over-printed on account of the after loss in toning and fixing, and the toning bath should be a somewhat weak one, neutralised with carbonate or bicarbonate of soda. The toning should be carried rather far, and the fixing bath should be alkaline. It will be found that good tones can be got with this treatment. Of course, it is unsuitable for small work, but with broad masses of light and shade fine effects can be obtained. Another authority, however, says that English papers, such as Whatman's, do not require, as a rule, the use of gelatine in the salting bath, as it exists already in the sizing, which in this respect differs from that of papers of French make. Whatman's paper may be used with success by *immersing* in the salting bath, which does not require the addition of citrate of soda unless brown tones are sought to be obtained. The sensitising should be, as usual, by floating; and the toning, by an ordinary acetate of soda bath, will proceed rapidly. Gelatine renders toning more difficult, and is only really useful when a starch sized paper is employed. The fixing and toning baths are exactly as for ordinary albumenised paper. With this paper it is strongly recommended to use Lyonel Clarke's toning formula, which is much simpler than those generally in use. Wash print well, and then tone in

Water (distilled)	1 ounce.
Chloroplatinite of potassium ...	2 grains.
Nitric acid	1 drop.

When thoroughly toned, wash in water rendered distinctly alkaline, and fix in hypo bath of trength one in five, also alkaline.

CHAPTER XII.

PLATES AND FILMS.

(EMULSIONS, ETC.)

480. Ambrotypes—To Make.—The name given by Mr. James A. Cutting to the positive photograph on glass, put up with two glasses and hermetically sealed with balsam of fir. Now applied in general to all styles of positives on glass. Any of the positive processes on glass giving good results may be used. The manipulations in this process are the same as for positives on glass (see No. 500).

481. Backing for Plates—To Make.—The following is handy to use: Dissolve a quarter of an ounce of glycerine, half an ounce of gelatine in two ounces hot water. Add enough Indian ink to make a deep black, coat with this mixture tough black paper, and squeegee down on to talc or glass to set. Cut this prepared paper to required size, and when wanted it can be rubbed with the palm of the hand into contact with the back of the plate. Another perfectly efficient backing is provided by procuring a piece of black carbon tissue. Cut out a piece slightly smaller than the size of the plate to be used, moisten the tissue with water; allow it to become as nearly dry as is compatible with its remaining quite limp; then again moisten the black surface, but this time with glycerine. Allow all that will to drain off, and press the tissue against the back of the glass. It will adhere, and may be removed just before development. The following is also a splendid backing medium, it is easily applied with a brush, and is as easily removed:

Burnt sienna, ground in water ...	12 ounces.
Water	12 ,,
Methylated alcohol	8 ,,
Ordinary liquid gum (1 to 3 is strong enough)	3 ,,
Glycerine	1 ,,
Carbolic acid	1 dram.

At a meeting of the Photographic Club a simple, speedy, and efficient way of backing plates was shown by Mr. Carter. The backing was composed of burnt sienna, mixed with water and sufficient dextrine added to form a thickish creamy consistence. A glass plate is taken and some of the colour distributed over it, then a roller—a composition one like a printer's ink roller—is passed over the mixture and applied to the back of the gelatine plate once or twice, when a perfectly even coating results, and by this method two or three dozen plates may be backed in a few minutes without any mess. If the mixture is required to dry very quickly, methylated spirit can be substituted for most of the water. As for the roller, an ordinary roller squeegee will answer admirably. Another quick and efficient method of backing is to use a collodion stained deeply with rose aniline or turmeric, etc. A plain collodion made as follows answers well:

Pyroxyline (ordinary)	1 ounce.
Methylated spirit	10 ,,
Ether (ordinary methylated)... ...	30 ,,

and to this is added the dye. The backs of the plates are simply coated with this, and the surplus drained off and allowed to dry. After exposure the collodion film easily comes off, when the plate is soaked in developer or water. Some people recommend the addition of matt varnish to the above collodion; the difficulty, however, of removing the backing easily and speedily makes this addition a somewhat doubtful advantage. About the simplest method after all is to cut pieces of yellow paper—such as plates are packed in—the size of the plates, moisten them with glycerine and water in equal parts, and squeegee on to the plate. The disadvantage of this, however, is the introduction of damp into the dark slide, and this is more noxious if the plates are kept in the slide for a day or two before using. In one class of plates, however, no backing is required, and this is where the emulsion is coated on the plain side of ground glass, a very useful plate for interior work, where there are plain glass windows, etc. Another good backing consists in taking a piece of thin black silk or silesia (not shiny), and painting it well with

Ivory black	1 dram.
Glycerine	2 ,,
Gum arabic	2 ,,
Water	2½ ounces.

Dissolve the gum arabic in hot water, then add the ivory black and glycerine, stirring all the time. The advantage of this is that the silk can be used any number of times, and is removed in an instant by simply sliding it off, leaving the plate perfectly clean.

Captain Abney advises the following:

Powdered burnt sienna	1 ounce.
Gum arabic (powdered)	1 ,,
Glycerine	2 ,,
Water	10 ,,

To be well brushed over the back of the plate with a broad soft brush. An improvement on the above would be the squeegeeing of a piece of black paper to the plate that has been coated, although the Captain is silent on this point. Another excellent method consists in coating the back of plate with

White wax	1 ounce.
Ether (specific gravity ·720) ...	4 ,,

and placing a piece of red blotting paper between the plates. Plates backed this way will keep right for months, and it is easily removed with a damp cloth before developing—two great advantages. The following has also been often recommended:

Plain collodion	4 ounces.
Rouge (or powdered burnt sienna)	1½ ,,

Agitate until well mixed. Flow over the backs of plates, and remove before developing with a rag damped with alcohol or methylated spirit. If the

plates are of considerable size, say 10 x 8 or over, obtain a piece of matt surface black American leather and well moisten it with gum-water and glycerine, squeegee to plate, and pull it off before development. This is effectual and economical, for the leather can be used any number of times, only it should be the thinnest obtainable. Another recommendation is back plates with caramel, as there is no doubt it forms the most effectual backing, thanks to the exertions of Mr. J. S. Teape. The following formulæ will be found useful:

(1.) Gelatine (Heinrich or similar) thirty grains, soaked, squeeged, and dissolved with heat; then caramel one ounce is added. This is a fine backing, but slow drying.

(2.) Caramel ... ... 1 ounce.
Gum mucilage ... ... 1 ,,
Sienna (in powder) ... ... 1 ,,

Work them up in a mortar, and if there are air bubbles, let it rest, and they will dissipate. To make caramel (for though it can be bought, that home-made is more effectual and dries quicker), take one pound of loaf sugar (this will make about ten ounces of caramel), put it in a large saucepan—preferably of copper—and place over the fire and watch it carefully. After it has dissolved it will start to boil, and then look out! Keep it on and off the fire, stirring with a stick vigorously; let it burn thus for half-an-hour and set aside to get cool, and then add about one-third of its bulk of hot water and stir it well in. The resulting liquid should be about as thick as treacle. But great care is required when it is boiling, as it easily boils over. But perhaps the simplest plan of all is to procure sheets of stout dull-surface black paper rather smaller than the plate. When about to use the backing, very lightly smear one side of each sheet with glycerine, and squeegee it to the back of the plate. Of course, in squeegeeing down the paper, care must be taken that no glycerine gets on the film side of the plate, a mishap easily avoided by putting each plate film downwards on a clean sheet of white blotting paper whilst applying the backing. This method can be recommended as being very simple and efficient. At a push, water would do instead of glycerine, but not so well owing to its refractive index differing from that of glass, but in any case the backing must be in absolute contact with the glass, a result difficult to obtain without using a squeegee.

482. Bronze Positives—To Make.—Coat glass plates with the following preparation:

Distilled water ... ... 3½ ounces.
Gum-arabic (powdered) ... ... 75 grains.
Glucose (sat. sol.) ... ... 1 dram.
Bichromate of ammonia (sat. sol.)... 3 ,,

When dry, expose for, say, five minutes in strong sunlight. Then breathe upon the plate to give it moisture, and dust it lightly with a tuft of cotton wool charged with bronze powder. Then, with a second tuft, use considerable pressure to impart brilliancy to the bronze. Flow with collodion; when dry, wash in water, and dry by gentle heat.

483. Collodion Emulsion (Unwashed)—To Make.—This emulsion is very slow, not half as quick as wet collodion, but the following is an easy method of making it:

Soluble cotton ... ... 20 grains.
Cadmium bromide ... ... 16 ,,
Ammonium bromide ... ... 12 ,,
Ammonium iodide ... ... 5 ,,

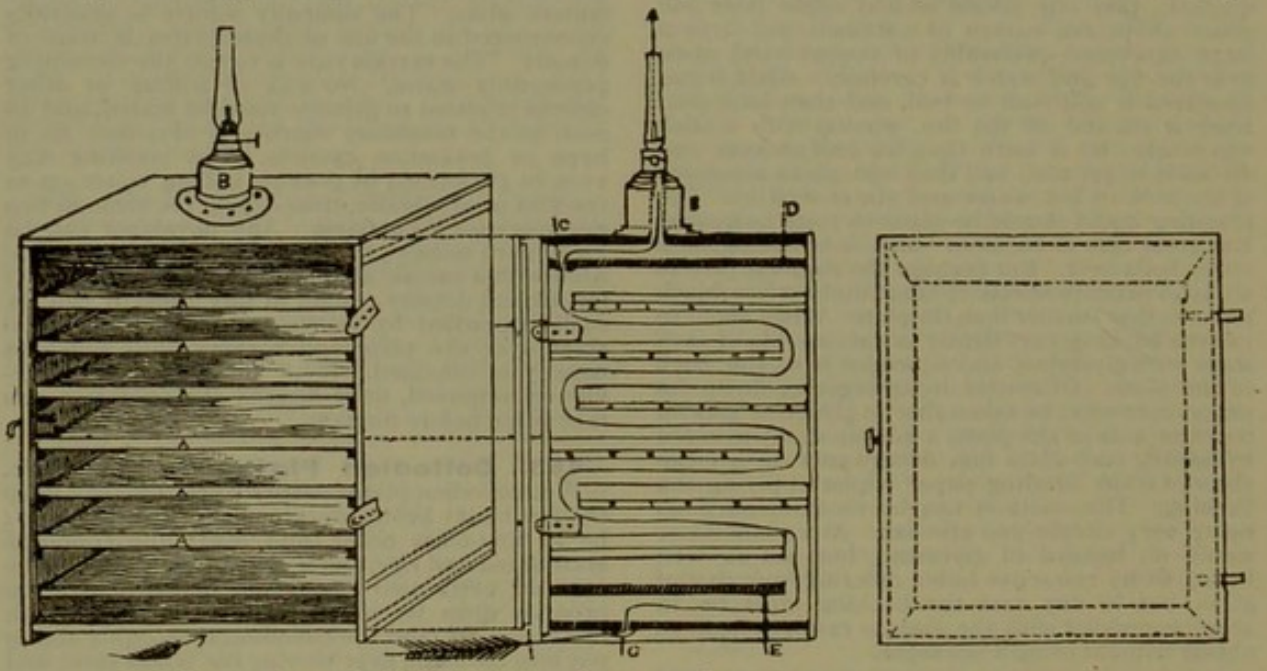
Dissolve in alcohol two ounces, and ether two ounces. Then add finely-powdered nitrate of silver twenty-four grains, and shake well, and allow to stand a few hours when dissolved, and then filter through cotton. Coat the plates as usual, and when set place in a flat dish of water, and coat another, and so on. When, say, a dozen are completed, place the first in another flat dish containing the preserver—twenty grains of tannin to each ounce of distilled water. Allow it to remain for about twenty seconds, then drain and dry. These will keep for certainty five months. Develop with a three-grain solution of pyrogallic acid, made slightly alkaline with a solution of carbonate of ammonia or liquor ammonia very much diluted. Pour this on the plate, and the details quickly come out. If it fogs from over-exposure add a few drops of a solution of ten grains to one ounce of bromide of potassium. No trouble to obtain great density. Fix in sodium hyposulphite five ounces to the pint.

484. Collodion (Hill Norris) Dry Plates—To Work. The Watkins speed number of the medium rapidity is five, so that the plates require seven times the exposure of Ilford ordinary. The number of the transparency plate is eight, that is to say, four times as rapid as Thomas's lantern plate. The difficulty which is generally encountered in the use of these plates is want of density. The certain cure is to use the developer perceptibly warm. No risk of frilling or other defects inherent to gelatine need be feared, and as soon as the necessary density is obtained, fix in hypo or potassium cyanide. The washing may even be performed by pouring boiling water on to the film from a kettle, then drying the same in two minutes over a gas flame. Any developer can be used; pyro soda, pyro ammonia, and hydroquinone used with a caustic alkali all give good results. If insufficient density results at any time, it can be easily remedied by pouring the acid silver intensifier over the plate and rocking until sufficient density is obtained. Hypo must have been previously removed, or if desired the operation can take place before fixation.

485. Collodion Plates—To Keep Wet.—Wet collodion plates properly prepared will keep for ten hours before development; the bath must be in first-class order, and acid; the collodion *must be old and ripe*, and if commercial collodion be used an extra two grains per ounce of calcium bromide must be added. The plate coated with the collodion (and the collodion thoroughly set) is put into the bath, kept moving the whole time, and *directly* greasiness disappears the plate is drained and put into the dark slide, the lower edge resting upon clean dry blotting paper; a backing of either wet red blotting paper or of yellow calico is put against the plate, and it will keep in good condition for at least ten hours. An additional precaution against drying is to put a wet cloth, black, in camera during the exposure. Collodion plates, after sensitising and washing, may be coated with Bass's beer and dried; after exposure (say a hundred times more than a gelatine plate), may be developed with pyro and soda. All methods of applying organifiers or viscous solutions to wet collodion plates with the view of preserving the film in a moist condition are more or less failures. A method recommended when exposures of two or three hours have to be given is as follows: The collodion used should be of a dark straw colour, which is attained by allowing it to stand for a sufficient time after iodising. One grain of cadmium bromide must be added to each ounce of collodion. After the immersion of collodionised plate in the bath it should be kept in rather violent motion, until all greasiness has disappeared (this will take about two minutes). It should then be taken out very slowly, so as to drain completely. Damp blotting paper should be placed at its back, and the droppings absorbed in the slide by a strip

placed at the lower edge. The rationale of this process is as follows: The plate is kept in the bath long enough to change the iodides into iodide of silver, whilst the bromide of silver is only partly formed. The fine nitrate of silver left on the plates is absorbed by the bromides to complete the change. This prevents the crystallisation of silver nitrate on the film. The nitrates of cadmium, etc., formed being very deliquescent, retain sufficient moisture to prevent the film drying, even in the space of two or three hours. In cool weather collodion plates may be preserved with tolerable certainty for a few hours by simply applying honey to them in the state in which they are taken from nitrate of silver bath. The best virgin honey should be obtained, since if the honey is of inferior quality or adulterated the process may not succeed. Sufficient water should be added to make the preserving solution pass slowly through filtering paper. After the plate is removed from the nitrate bath, it is to be drained and wiped on the back in the usual way. The honey is then poured along the edge in such a manner as to form a broad wave, which forces the nitrate of silver solution before it, and covers the film. Next drain the plate into a measure, and pour on a second portion of honey as before. Lastly, stand the glass on blotting paper in a dark place for about a quarter of an hour and wipe the lower edge before putting it into the dark slide. The exposure will probably be about four or five times as long as that for new and sensitive collodion, or twice as long as the exposure required for old and brown collodion. Before applying the developer, immerse the plate in bath of distilled water for five minutes to soften the honey. This treatment will be sufficient for plates required to be kept for four hours, but beyond that time it is not safe, since the honey exercises a slow reducing action on the nitrate of silver. The use of pure honey, free from mouldiness and fermentation, will in cool weather almost certainly ensure success.

486. Drying Box—To Make.—The following are particulars of a drying box. This consists of a box of sufficient capacity to take the requisite number of plates, having a false bottom and false top, which exclude light but permit passage of air. A series of thin trays, sliding like drawers, are arranged at intervals horizontally in the body of the box, the trays being the full width of interior of box, but about two inches less in length than the space between back and front of box, so that the end of one tray may press against the box back, and the opposite end of the next tray against the box front. The reason for this arrangement is that the air in passing from bottom of box to top has to pass over the surface of each tray in turn. It has been suggested that a very good form of tray for small plates would be ordinary school slates: two or three of these might have the external edges of their wooden frames squared up with a plane on a shooting board, and then the slates be joined together (two or three forming one tray) by narrow laths. The current which dries the plates is induced by a Defrie's lamp, having a central passage up through reservoir; the lamp being placed on top of box immediately over a hole cut in the top.



Door. Arrow indicates course of current of air.
A.—Trays.
B.—A Defrie's lamp, with central passage through reservoir.
C.C.—Air passages covered with thin porous black fabric to filter dust.
D.—False top.
E.—False bottom.

When the lamp is lighted the air is drawn in from the bottom of box upwards, and passes over all plates before reaching the flame. If the box is well put together, it might safely be left in daylight (after being filled) until plates are conjectured to be dry.

The following are also particulars of another drying box which answers its purpose admirably. The box is 3ft. square and 2ft. deep, and is made of 1in. floor boarding. The door is hinged, forming one of the square sides, and has a fillet of wood round its margin fitting inside the box, and thus preventing the access of light when the door is closed. Before putting the box together, a 6in. circular hole is cut in the centre of top and bottom for the air to enter and escape. In the top of the box hooks are screwed by which to suspend the racks for holding the plates. These racks are triangular, and consist of three bars of wood parallel to each other, and fastened together at top and bottom so as to form a triangle in section. Into two of these bars small nails are inserted

opposite to each other, and about 1in. apart. On these nails the foot of the inclined plate rests, while the back of the plate rests against the third bar. Of course, the size of these racks, as also their number, will depend upon the size of plates to be made; but it will be found that a greater number of plates can be dried on racks than if the plates were laid on horizontal shelves, and dried with a greater freedom from dust troubles. It will be found needful to suspend a piece of wood (a little larger than the opening) over the bottom opening, and about 2in. from it, in order to diffuse the air as it comes in, and thus prevent it from passing through the box. The same contrivance may be applied with advantage to the opening in the top of box. And now to consider the question of draught, which is the most important of all. The easiest way to create a draught is to connect the top hole in the box with a chimney by means of a 6in. tin or iron tube, with a square bend in it, in order to prevent access of light; the bottom hole is also connected with a short bent pipe to prevent access of light. If a chimney is not handy, then a Bunsen burner may be placed in the top tube, which in this case should be four or five feet long in order to create a sufficient draught. If the air is at all damp it may be made capable of taking up moisture by heating the inlet tube in the room where the box is placed, thus warming the air, and at the same time without any chance of burnt air (which is deleterious) entering the box. It is as well to place a large muslin bag over the inlet aperture to prevent admission of dust. In this box, with a moderately dry atmosphere, the plates should dry in about twelve to eighteen hours. Or the following arrangement will be found satisfactory: Cut a circular hole 4in. in diameter in the bottom of drying box, then fix in a circular iron pipe (stove piping), about 18in. long and 4in. diameter. (Put a plate over end of this in drying oven, so fixed as to admit air and not light.) Inside the stove pipe fix an iron pipe 15in. long and 1½in. diameter, with a T piece with open ends projecting through sides of stove pipe 3in. from drying box. Inside this inner pipe light a small Bunsen burner or lamp. This warms the inner pipe, which in its turn will warm air current entering the drying box. There will, of course, be outlets at top of box. Or a closed tin box filled with *a hot saturated solution of sodium acetate* may be placed in the bottom of the drying box, so that the air entering passes over it. This will give out heat for a long time, and warm the in-coming current of air. Heat it up again in oven when cold.

487. Emulsion, Beechey—To Make.—The formula for Beechey's emulsion is as follows:

No. 1.

Cadmium bromide	20 grains.
Methylated alcohol	4 drams.

Dissolve and add

Hydrochloric acid (pure)	4 minims.

Add

Methylated ether (·725)	9 drams.
Pyroxyline	12 grains.

Shake, and let stand if the cotton is at all cloudy and full of fibres. In fact, the main secret of good emulsion is to get a good cotton.

No. 2.

Dissolve by the aid of gentle heat

Silver nitrate...	40 grains.
in Methylated alcohol...	8 drams.

Add No. 2 to No. 1 little by little, shaking vigorously between each addition. Keep for twenty-four hours to ripen, when the emulsion will have become thick and creamy. The plates are to be carefully cleaned, and either coated with a substratum, or, what is quicker and quite as efficacious, edged with indiarubber in benzole for about ⅛in. all round. They are then coated—the emulsion having been shaken about half an hour before to allow the bubbles to subside—and when set are immersed in a dish of distilled water until all greasiness has disappeared. Then drain slightly and immerse in a bath of

Pyrogallol	1 grain.
Beer (flat but not sour)	1 ounce.

and dry as usual. The exposure should be about three times that of a wet plate. Develop with alkaline pyro. For instance, the following has given warm tones:

Pyro	3 grains	to 1 ounce with water.
Pot. carb.	9 „	
Pot. brom. ...	1½ to 2 „	

Fix in weak cyanide, say twenty grains to an ounce

488. Emulsion, Collodio-bromide—To Make.—The first requisites to success are cleanliness and accuracy. Then the following materials are wanted: Pyroxyline, high temperature (Thomas', Rouch's, Hopkin & Williams, or any other standard cotton, *but* this is the difficulty, viz., to get good pyroxyline), methylated spirit (not finish, but Hopkin & Williams, of Cross Street, Hatton Garden, sell a good sample), methylated ether specific gravity ·725 (get this as fresh as possible, as by itself it will not keep), nitrate of silver (pure recrystallised), bromide of ammonium (this must be *quite freshly made*, so apply to manufacturing chemists for it), and bottles. Now to make the emulsion. Weigh out sixty grains of pyroxyline, and into a fifteen-ounce bottle (or larger) measure out three ounces of alcohol, insert the pyroxyline, and when soaked pour in two and a half ounces of ether and shake. All the cotton should dissolve, yielding a limpid collodion. If there is any appearance of cloudiness, leave the collodion for a few days and it will settle, then decant the clear liquid. Having done this, proceed to bromise it by adding to it

Ammonium bromide...	65 grains	Dissolved with heat in a test tube.
Water	90 minims	

and then add alcohol one ounce, the whole to be added to the collodion and well shaken up. Now prepare the silver solution by dissolving with heat in a test tube

Silver nitrate	100 grains
in Distilled water	1 dram.

Now in the dark room add the silver to the collodion as follows: Pour in a drop or two, cork and shake. Then a few drops more, and more shaking, and so on until all the silver has been added. Wash out the test tube with a little alcohol, and add this to the emulsion. Then shake vigorously for about five minutes. Pour a drop or two of the creamy looking emulsion on to a clean glass plate, put away the emulsion in a dark box (a one pound tobacco tin makes a capital store box for the bottle), and examine the drop or two on the glass plate by gaslight. It should, if all be right, be a fine orange or ruby colour. Leave the emulsion to ripen for twenty-four hours, giving it an occasional shake. Then evaporate it in the dark room in a flat dish until it becomes the consistency of a blanc mange, break it up into small pieces, and proceed to wash it thus: Place the pieces in an old handkerchief, and immerse in water for a quarter of an hour. Take out and squeeze all water out, and immerse in a fresh lot of water. Leave it for half an hour or so, and then squeeze out again. Do this five or six times in the course of six hours, and then test a drop of the liquid squeezed out with bichromate of potash, if no red colouration is produced, the emulsion is washed. Now it has to be dried, or rather freed from water, by placing it in a jar and covering with methylated alcohol for half an hour, then squeeze out and place it again

in more alcohol, another squeeze, and half an hour more alcohol, and it is ready for redissolving. Place it in a twenty-ounce bottle, and pour over it four ounces of methylated alcohol and four ounces of ether, and shake for five minutes, then wrap it up in two or three coatings of brown paper, and carry it about, or give it a shake every now and then for about two or three hours. Then proceed to filter it into its final bottle, a ten-ounce one. Get a piece of stiff paper (thick note does well), twist it into a sugar-loaf shape, and pin it near the broad end. In the cone thus made insert a piece of cotton-wool, moisten it with alcohol to get rid of loose fibres, and then pour in the emulsion after a good shake. It will run through quite quickly, and the emulsion is finished and ready for use. The following is another well-tried formula for a *washed* emulsion:

Ether specific gravity ·720 ...	4 fluid ounces.
Alcohol specific gravity ·820	2¾ ,,
Pyroxyline	40 grains.
Castile soap dissolved in alcohol	30 ,,
Bromide of ammonium and cadmium	84 ,,

Sensitise with one hundred grains of nitrate of silver dissolved in one ounce of boiling alcohol, and after standing ten days add twenty grains more of silver dissolved in two drams of alcohol. For greater rapidity use quarter of an ounce more alcohol, and add at first only fifty-four grains of the double bromide of ammonium and cadmium, sensitise with 125 grains of nitrate of silver, dissolved as before in one ounce of boiling alcohol. In twelve hours time add thirty grains more of the double bromide of ammonium and cadmium dissolved in half an ounce of alcohol. The emulsion, after being allowed to ripen for the time stated, should be poured into a dish and allowed to become thoroughly dry. The mass of dry emulsion is then washed to remove all the soluble salts, and is then again dried and redissolved in equal parts of ether and alcohol, at the rate of from twenty to twenty-four grains to the ounce of solvents. Such an emulsion can be kept in bottles for years, and when required, it is only necessary to melt it by placing the bottle in hot water, and then to coat the plates and dry them. For an *unwashed* emulsion the following formula is recommended by Abney. Make a plain collodion as follows:

Alcohol	2½ ounces.
Ether	5 ,,
Gun cotton	75 grains.

Two hundred grains of zinc bromide are now dissolved in the smallest quantity possible of alcohol, and four or five drops of strong nitric acid added. This is then added to half the collodion. Crush on a clear glass plate with a glass stopper 330 grains of silver nitrate, place in a large test tube, and add two drams of warm water. In another test tube boil one and a half ounces of alcohol (·805), and pour on to the dissolved silver. Mix by pouring one solution into the other and back again till accomplished. This is added to the other half of collodion. Into this *silver* collodion the *bromised* collodion is added drop by drop, with constant shaking. By transmitted light the emulsion should now be nearly of a deep orange colour. The emulsion is then poured into a twenty-ounce bottle, and made up with ether (·720) and alcohol (·805) in equal parts to fifteen ounces, and shaken for ten minutes. After being set aside for sixteen or twenty-four hours it is ready for coating. The plates must be prepared with a substratum, or edged, and the collodion poured on, and after setting immersed in a dish of distilled water till all greasiness has disappeared, and then flooded with a preservative made by adding one grain of pyro to an ounce of beer. Drying is the next step to take, which may be done in the usual manner, after which it is ready for exposure. Plates prepared as the above keep for about a week. The alkaline developer should be used. The ferrous oxalate developer is also suitable. For a substratum make up the following:

White of one egg.	
Water	50 to 100 ounces.
Ammonia	5 drops.

The albumen and water should be well shaken together, and then filtered, the ammonia added, and the plates coated and allowed to dry spontaneously.

489. Emulsion, Collodio-bromide — To Keep.—After mixing the constituents of the emulsion it improves on keeping up to a certain point. It should be kept from sixteen to twenty-four hours, when it acquires the "creamy" condition, and is *at its best*, and the plates should *then* be coated. From this time it steadily deteriorates, and in a few days afterwards the silver bromide will precipitate to the bottom of the bottle. It may be revived up to a certain stage by the addition of *one-tenth* the quantity of cadmium bromide first used, and the *same* proportion of silver nitrate, both dissolved in alcohol previous to addition. It will therefore be better to prepare only enough emulsion to coat the plates in hand, and use at once. As regards Canon Beechey's formulæ, the emulsion will not keep for any length of time. Canon Beechey himself says that only sufficient emulsion should be made at one time to coat the plates required; and secondly, Capt. Abney states that after about twenty-four hours the bromide is precipitated. The emulsion when first prepared is smooth, thick, and transparent, but after keeping a day it becomes creamy and of an orange shade when coated on glass and viewed by transmitted light. This is the right condition for use, and shows that the bromide of silver is in a minute state of division. After the creamy state is reached it gradually becomes thin, and the bromide of silver rapidly precipitates. The keeping quality of the emulsion may vary, however, according to the formula, as Canon Beechey published several containing respectively an equivalent, a slight excess, and a greater excess of silver than bromide. Col. Stuart Wortley recommended the use of nitrate of uranium in the emulsion, as giving it greater keeping qualities.

490. Emulsion for Transparencies (Collodion)—To Make.—The following are collodion emulsions specially suited for transparencies: Dissolve in a four-ounce accurately stoppered bottle thirty grains of Schering's celloidin in an ounce of absolute alcohol, mixed with the same quantity of absolute ether. Now prepare the following solutions: (A) Ammonium bromide 13 grains, absolute alcohol 1½ drams, distilled water 20 minims. (B) Silver nitrate 20 grains, distilled water 12 minims. These are best made in clean test tubes, and in making (A) the bromide should be first dissolved by boiling the distilled water with it, and the alcohol added when the mixture is quite cold. The collodion in the four-ounce bottle, and (A) and (B) are now brought into the dark room, and (A) added to the collodion in small quantities at a time, shaking well after each addition, and (B) is then added in the same way. The emulsion is then put aside for twenty-four hours to ripen, then poured out into a dish, and, when alcohol and ether have evaporated, the pellicle is well washed with distilled water, dried, and redissolved in a mixture, six drams each of absolute alcohol and ether, to which two grains iodine have been added. The plates are coated in the usual manner, dried, exposed, and developed with the following developer: (A) Pyro 15 grains,

sodium sulphite 60 grains, citric acid 2 grains, water 15 ounces. (B) Ammonia 15 minims, potassium bromide 30 grains, water 15 ounces. To develop take equal volumes of each. Fix in hypo. If a black tone is required, tone in weak solution of chloro-platinic acid, acidified with nitric acid.

Another: None but a washed emulsion will keep for eight months, and to make it prepare a plain collodion of five grains *powdery* pyroxyline to the ounce of mixed alcohol and ether, allow to settle for a *week*, decant, and add to each ounce seven grains bromide ammonium, finely ground in a little alcohol, well shake at intervals for two hours; then add for each ounce fourteen grains nitrate of silver, ground as usual in a little water and hot alcohol, agitate well for about two hours, and filter into a dish, set quite level, allow the emulsion to remain until it is thoroughly set. It will be capable of bearing a moderate pressure of the finger without breaking. When in this condition break it up with strips of glass (broad), and wash slightly with distilled water, transfer the film into a wide-mouthed bottle, and well wash with ordinary water, smashing up the film into small pieces, to ensure all the soluble salts being removed; when this is accomplished the water comes off quite clear, drain off all the water possible, wash again in three or four changes of alcohol. The last should be absolute, to counteract any water that may be left in the film. Finally, dissolve in equal parts of ether and alcohol. Ten ounces of plain collodion, treated as above, will yield twelve ounces of emulsion. Don't throw the alcohol away after washing—it will do again. Back the plates with burnt sienna ground in water, and thinned with a little alcohol *only*. Very much better results are obtained by backing, and it does not take ten seconds for a lantern plate. This emulsion will keep twelve months.

The following is condensed from "Photography with Emulsions," by Captain Abney. A plain collodion has first to be made as follows: Alcohol (·820) 10 ounces, ether (·730) (methylated ·717 will do for this) 20 ounces, pyroxyline (ordinary) 400 grains. Seven and a half ounces of the above are taken, one hundred grains of zinc bromide are taken, and dissolved in the smallest possible quantity of alcohol, and four or five drops of nitric acid (strong) are added, and the whole poured into the seven and a half ounces collodion. Three hundred and thirty grains of powdered silver nitrate are placed in a large test tube with five drams of water and boiled; ten drops of nitric acid are now added to it. In another test tube one and a half ounces of alcohol (·820 to ·830) are boiled, and the two fluids mixed by pouring from one test tube to the other. The bromised collodion is now poured into a glass jar, and three-quarters of the silver solution are added drop by drop with constant stirring. Another hundred grains of zinc bromide are dissolved as before, but ten drops of nitric acid are added this time, the whole poured slowly into the collodion, and the remainder of the silver solution added as before. The silver nitrate remaining in the tube is washed out with a little water, and half-ounce of alcohol added. The emulsion, which should now be of an orange colour by transmitted light when a spot is placed on a strip of glass and examined, is then poured into a twenty-ounce bottle, and shaken for ten minutes. It should then be put on one side to ripen for from sixteen to twenty-four hours. It is then poured into a flat dish in the dark room. The above operations can be performed in diffused daylight, the nitric acid preventing the formation of silver sub-bromide, and allowed to evaporate. It should be stirred up with a glass rod every half-hour. When of a stiff jelly-like consistency it is broken up into small lumps and washed for half-an-hour in running water, or two to three hours in standing water, changed every half-hour. The pellicle should now be squeezed as dry as possible, and either laid on blotting-paper till thoroughly desiccated or placed in a water oven, the temperature of which must not exceed 150° F. When dry the pellicle is dissolved in the proper proportion of solvents, which are five grains of pyroxyline to every ounce of the two when mixed. The emulsion should be well shaken and filtered each time before use.

491. Emulsion (Gelatino-bromide)—Effect of adding Potassium Dichromate to.—(1.) The chemical effects of washing bromide emulsion in a solution of dichromate of potassium are two-fold: First, all the excess of silver nitrate is converted into (red) chromate of silver, and next the gelatine itself becomes hardened to a considerable extent, more especially after the exposure of the plate to light, thus rendering the resulting negative more dense. (2.) As regards the beneficial effect of chromate of silver in the film, W. K. Burton claims the following advantages for a sensitive film containing argentic chromate: (*a*) The prevention of halation owing to the intense ruby colour of the chromate; (*b*) diminution of exposure owing to the light absorbent powers of chromate of silver (and especially for the rays at the red end of the spectrum); (*c*) the camera itself will be less filled with diffused light; (*d*) the use of a weaker developer, owing to the chromate being a much looser compound than either of the haloid salts of silver. Eder also recommends it, but states that the general sensitiveness is decreased. He gives the following specific formula:

Potassium bichromate	1 gramme.
Hydrochloric acid	3 ,,
Water	100 to 150 ,,

The emulsion, after having been pressed through canvas, is allowed to soak in the mixture for ten or fifteen minutes, and thoroughly washed. He also states that the original sensitiveness may be restored by adding a few drops of ammonia. Abney recommends stirring the emulsion in a ten-grain solution of bichromate of potassium and an equal quantity of soluble bromide, and thorough washing after an hour's soaking. This appears, however, to interfere with the sensitiveness of the emulsion, so that this method is only recommended for slow plates. The use of bichromate for restoring the sensitiveness of exposed plates has been known for some time, and may be utilised for plates accidentally exposed to light either by Eder's or Abney's method, the plates being thoroughly washed, and note being made of the decrease of sensitiveness.

492. Emulsion (Gelatino-bromide), Quick Drying.—To Make.—This purpose might be effected by substituting hard gelatine for soft, as a film of hard gelatine dries much quicker than a soft one. However, if a rapid-drying emulsion is required, the following modification of Burton's may be satisfactory:

A.

Gelatine	30-50 grains.
KBr	300 ,,
Water	20 ounces.

Soak the gelatine till swollen, and dissolve by gentle heat.

B.

Silver nitrate	1 ounce.
Nitric acid	1 minim.
Water	1½ ounces.

Dissolve.

C.

Potassium iodide	15 grains.
Water	1 dram.

Dissolve.

First add A to B drop by drop with shaking, until a permanent milkiness is produced, then cease the addition. Now raise A to boiling point, then add B in the usual manner, and thoroughly mix, and then add the remainder of C, and cook as usual, or add ammonia to gain sensitiveness. When the sensitive precipitate has subsided (*i e*, if emulsion is made in the evening, it will be ready next morning), wash in three changes of water. Then add two hundred grains of hard gelatine (Heinrich's), previously swelled in distilled water, and make up the bulk to 10—12 ounces. Dissolve the gelatine with heat, and as it dissolves shake the flask vigorously, and if, as is often the case, there is granularity, raise the heat to near boiling- or even to boiling—point, and keep it there until the necessary fineness is obtained. Now add to the cooled (90° F.) emulsion four ounces of albumen (prepared by beating whites of four eggs, *without the help of water*, acetic acid, etc., into a stiff froth and strained after reliquefaction), and thoroughly mix; make up the bulk to twenty ounces, filter, and coat the plates. The emulsion sets rather slower than usual owing to the small quantity of gelatine, but *dries rapidly* to a hard glassy film, which some prefer. They look thinner and more transparent than ordinary ones, but there is no deficiency in the matter of density. By using Heinrich's or Autotype gelatine in larger proportions, and keeping the soft gelatine down, any emulsion formula may be used, and the plates will dry quicker.

493. Emulsion (Gelatino-bromide) Rapid — To Make.—There are innumerable formulæ published for making a rapid emulsion, so that failure to obtain a rapid emulsion must be assigned not to the formula, but to the worker. The rapidity or sensitiveness of an emulsion does not depend so much upon the formula as upon the process employed in the treatment, and the higher the sensitiveness sought, the more risk there is of obtaining a foggy useless plate. In the boiling method it is advisable that the silver solutions should be neutral, and the bromised gelatine neutral, inclining slightly to acid, certainly not alkaline. Great care must be taken in the boiling, and no definite time can be stated. Frequent tests of a sample drop withdrawn and inspected by transmitted light is the best test, although for a very rapid emulsion it may be "boiled" for a considerable time after reaching the blue stage. Probably, the most sensitive emulsions are made by the ammonia process. J. Barden, who has experimented considerably in gelatine emulsion work, gives the following for a very rapid emulsion giving plenty of density: Take one ounce distilled water, and add ten drops of ammonia ·880, then add twelve grains Nelson's X gelatine, and let stand for some hours, when the gelatine should be dissolved by heat. Then dissolve eighty-four grains of ammonium bromide in one ounce water, and 120 grains nitrate silver in same quantity of water, and when dissolved add ammonia drop by drop until the precipitate is just dissolved, stirring well all the time. In the dark room warm all the solution to 120° F., and pour the silver solution into the gelatine, and afterwards pour the bromide solution into the silver gelatine, stirring all the time. After standing for a few minutes add 120 grains Heinrich's gelatine, dry, and stir until dissolved—say about fifteen minutes. Now let the emulsion stand for ten minutes, keeping the temperature at 120° F. Now let the emulsion set in a cool place—this should take three or four hours, then wash as usual. If made carefully these plates will be very sensitive and work well at once, but will be more sensitive and work clearer when six months old. The following is a condensed description of the Paget prize emulsion: To make a pint of emulsion, select a narrow-mouth stoppered bottle with a thin bottom, and make it perfectly clean. Make a stock solution of hydrochloric acid (pure) 1 fluid dram, distilled water 12½ ounces. Put into the bottle 20 minims of the above dilute acid, 3 fluid ounces distilled water, 210 grains ammonium bromide (255 grains potassium bromide is recommended now instead), 80 grains Nelson's No. 1 photo gelatine. Let the gelatine swell for fifteen minutes. If the bromide and gelatine be both neutral the acid is best omitted, so that the addition of the acid must be made *intelligently*. In a clean glass vessel dissolve 330 grains recrystallised silver nitrate in three ounces distilled water, and add a few drops of carbonate of soda solution till a slight permanent precipitate is formed. Pour out about two drams of this solution into a clean vessel, and add an equal quantity of water. Take the twenty-ounce bottle and the two silver solutions into the dark room, which must be lighted with deep ruby. Have ready the water bath with three or four inches of boiling water. Turn out the gas of the heater, and plunge the bottle into the water three or four times, so as to avoid cracking the bottle, then leave it in till the gelatine has completely dissolved. *Do not leave it in longer than necessary*. Take it out, shake up, remove the stopper, and pour in all at once the dilute silver solution, shake up well for half a minute, and add the rest of the strong solution half-ounce at a time, shaking up after each addition, and a final shaking for two minutes. Now put the bottle into the water and boil up as quickly as possible, then keep boiling for *fifty-five minutes*. After this it should be cooled as quickly as possible without cracking the bottle, taking out the stopper first, or it will not be removed afterwards, to 90°. In a large glass beaker put one ounce "No. 1 photo," or "X opaque" gelatine, and pour over it ten ounces of water. When it has absorbed four ounces pour off the six ounces and melt, and pour into the bottle, shake up well and pour all into the beaker, draining the bottle; leave it to set, and stand for twenty-four hours; wash, melt, filter, make up to twenty ounces with two ounces of alcohol, remainder water, and coat. Another writer says: "Either of the following formulæ will, if intelligently worked, give plates ranging from twenty to twenty-four Warnerke: *Boiling Process.*—(A.) Potassium bromide 120 grains, distilled water 10 ounces. (B.) Silver nitrate 180 grains, distilled water 10 ounces, pure glycerine ½ ounce, strong nitric acid 4 drops. (C.) Nelson's special dry plate gelatine 180 grains. In the dark room add A to B *drop by drop*. Let precipitated silver bromide subside, wash by decantation with distilled water until the liquid no longer gives the faintest precipitate with silver nitrate, and drain the precipitate as dry as possible. Soak twenty grains of the gelatine in six ounces of distilled water. and when swelled dissolve by heat, and add the solution to the precipitated silver bromide, shake well, and boil until blue. Let the whole cool, pour it over the remaining gelatine, let stand for an hour, remelt, shake well, filter, add half ounce of alcohol, and coat. *Ammonia Process.*—(A.) Silver nitrate 120 grains, distilled water 2 ounces. (B.) Potass. bromide 120 grains, Nelson's special dry plate gelatine 20 grains, distilled water 3 ounces. (C.) Nelson's gelatine, as before, 160 grains. Pour into A *drop by drop* dilute ammonia until the precipitate first formed is just, but not quite, redissolved, filter, and make up to three ounces. When gelatine in B is soft, dissolve gelatine by heat, let solution cool to 70° C., and in dark room add A to it in small quantities at a time, and shaking well after each

addition. Finally boil until blue. Let liquid cool, pour it over C, let them remain in contact for an hour, remelt, let the whole set, squeeze through canvas, wash, remelt, filter, add half-ounce of alcohol, and coat in the usual way." The general test for sensitiveness when making an emulsion is the colour of a drop of emulsion viewed by transmitted light, and this colour varies from a deep orange red in emulsion just made to blue in emulsion boiled sufficiently. Another reliable formula was given originally by Professor Burton, and the emulsion will stand prolonged boiling to obtain the necessary change of colour:

No. 1.

Silver nitrate	200 grains.
Distilled water	3 ounces.

This must be strictly neutral, and rendered so (if acid) by weak solution of ammonia.

No. 2.

Nelson's No. 1 gelatine	30 grains.
Bromide of potassium	165 ,,
Distilled water	2½ ounces.

This should be *just* acid, slowly turning blue litmus paper red. This is a most important point.

No. 3.

Iodide of potassium...	6 grains.
Distilled water	½ ounce.

No. 4.

Heinrich's hard gelatine	250 grains.
Water...	Several ounces.

Nos. 2 and 4 are allowed to stand until the gelatine is quite soft, and then all water poured away from 4 and the gelatine is squeezed. Nos. 1 and 2 are heated to about 160° F., and a little of 1 added to 2, and the whole shaken, and the process repeated until all 1 has been so added. No. 3 is then added, and the emulsion thoroughly shaken. If a drop of the emulsion be now viewed by transmitted light it should show ruby or orange red. It is next boiled —no definite time can be given—until a drop shows the complete change from red to blue. It will now have attained a high degree of sensitiveness. The time required to effect the change of colour varies from about three-quarters of an hour to even three hours. Then 4 is added, and the whole stirred. The emulsion is then allowed to set, is washed for half an hour, drained for half an hour, remelted and filtered. Half an ounce of alcohol is added, and it is ready for coating the plates. The plates should show about twenty-five on the sensitometer.

494. Emulsion (Gelatino-bromide), Slow—To Make.—The following is a slow emulsion, suitable for landscape work: *Preparations.*—Perfectly clean jar for mixing emulsion, beakers for dissolving gelatine, etc., scales, saucepan, porcelain dish, and coarse canvas. Take thirty grains Nelson's No. 1 gelatine, and 120 grains each of both hard gelatine and No. 1 gelatine; cover them with water, shake for a few seconds and pour off. Dissolve five grains potassium iodide in one dram of water, and 135 grains potassium bromide in one and a half ounce of water. To solution of bromide add one minum of strong hydrochloric acid. Swell the thirty grains of gelatine for ten minutes in one ounce of water, and then dissolve by heat. Dissolve 175 grains silver nitrate in half-ounce of water, and heat. Now, in dark room, add the silver solution to the thirty grains gelatine, and shake up well in bottle. Then slowly add the bromide solution, then the iodide. The bottle is now placed in a saucepan and boiled for forty-five minutes, with constant shaking. While boiling place in a pot the 240 grains of gelatine with two ounces cold water, and allow to swell. Then dissolve by boiling, and add to emulsion in bottle after that and also gelatine have cooled down to 80° F. Shake up well, allow froth to subside, and pour emulsion into flat porcelain dish and allow to rest. When set, scrape out with a piece of clean glass, and transfer to a piece of coarse canvas. Squeeze into a ball, and by gentle pressure force the emulsion through the canvas into some water; repeat the operation, and then spread emulsion on canvas over mouth of jar and repeatedly douse with water. Allow to drain a couple of hours. Place in clean jam-pot, put this in boiling water, and heat till all gelatine is thoroughly dissolved. Then filter through swansdown calico previously well boiled. Pour some emulsion into a warmed beaker, and coat plates, taking care to avoid all bubbles; pour from one corner to another, as in varnishing, and finally quietly rock until an even coating is secured. It is then allowed to set and finally dried. Another method is given by Liesegang. Into a wide-mouthed flask, placed in a water bath heated to 114° F., is poured this solution:

Bromide of ammonium	10 grammes.
Gelatine	12 ,,
Water	150 c.cm.

After complete solution, to this is added—

Nitrate of silver	16 grammes.
Water	150 c.cm.

The latter should be added all at once, and the flask strongly shaken. The bromide of silver thus produced builds up an emulsion. The shaking should be kept up for at least a minute. There should be a slight excess of bromide of ammonium present during the formation of the bromide of silver, or otherwise fog is likely to occur. Now to this is added gelatine twelve grammes. The gelatine should be previously soaked in water, as a quick solution is aided thus. The temperature of the water bath is now raised to boiling point, and kept there for fifteen or thirty minutes. It is then allowed to cool down again to 114°, and once more is added gelatine twelve grammes. The emulsion is continually shaken until entire solution. Ten drops of a saturated solution of bichromate of potash are now added, well mixed; the solution strained through muslin into a flask, and kept in a water bath at a uniform temperature 114°. The plates may then be coated; the operation is easy. A level horizontal support should first be provided, such as a drawing board, supported on three small levelling screws, and by the help of a spirit level made perfectly horizontal. In winter the well-cleaned glass plates should be slightly warmed, as the emulsion will otherwise stiffen before it is evenly spread upon the plate. The emulsion may be poured upon the plate, and the surplus returned to the jar; or it may be spread with the aid of a glass rod. A rather thick film gives the best results. As soon as the plate is coated it is laid on the level board, the emulsion soon stiffens; the plates are then taken from the board and laid in a washing tray, which is filled with water. Up to this the work has been carried on in ordinary daylight, not too strong; but hereafter all actinic light must be excluded. The plates are then washed from three to five hours in running or often changed water. This is for the purpose of freeing the emulsion film from the bichromate and other soluble salts which would interfere with their sensitiveness. After washing, the plates are covered with common alcohol sufficient to cover them, and in this they must remain for eight days. The tray should be air and light tight. They are then dried. The following will also yield excellent slow dry plates, though an amateur is not recommended to make a practice of making his own plates, as it is next to impossible for him to prepare plates equal to the commercial articles. Mix each of the following solutions in a glass beaker:

A.

Silver nitrate	400 grains.
Distilled water	6 ounces.

B.

Nelson's No. 1 gelatine	80 grains.
Potassium bromide	300 ,,
A one per cent. mixture of hydrochloric acid water	400 minims.
Distilled water	5 ounces.

C.

Potassium iodide	25 grains.
Distilled water	1 ounce.

D.

Heinrich's gelatine	600 grains.
Distilled water	*quant. suff.*

Allow solutions B and D to stand until the gelatine is quite soft; then pour off all the water from D, and squeeze as much of it as possible from the gelatine. Now place the beakers containing solutions A and B in hot water, till the solutions reach a temperature of 160° Fahr., when B should be poured into a yellow glass bottle—a hock bottle answers the purpose admirably. All the remaining operations must be conducted in a feeble ruby light. Add the solution A in small quantities at a time to the solution already in the bottle, shaking thoroughly after each addition, and giving a very thorough agitation at the end. C is now added, and the emulsion thus formed must be again shaken. The emulsion should now be poured into a stoneware vessel. This is placed in a saucepan half-full of water, the lid is placed on the saucepan, and the water brought as quickly as possible to the boiling point. A cover of some sort should be placed over the vessel while in the pan to prevent condensed water from dropping off the lid of the saucepan into the emulsion. The emulsion should be allowed to remain in the boiling water for about twenty minutes, at the end of which time the gelatine (D) should be mixed with it, and the whole well stirred up. The pot is then placed in a cool, dark place to allow the emulsion to set, which will be accomplished in about two hours' time. When thoroughly set, break up the emulsion into small pieces with a china spoon, and pour it into a large piece of coarse canvas, through which it is squeezed into a basin of distilled water. While in the water it should be kept constantly agitated by means of a glass rod, and the water also should be changed very frequently. After about ten minutes the water should be poured off, and the emulsion drained on a piece of chamois leather. Then repeat the washing and draining two or three times, and collect the emulsion and give a thorough final draining. The emulsion should now be remelted and filtered through several folds of fine cotton, after which add one ounce of alcohol, and the emulsion is finished and is ready to be used for coating the plates. Give the plates a good thick coating of emulsion—the precise amount requisite for each plate will soon be ascertained, two drams being about sufficient for a half-plate. When the films have "set," they should be transferred to the drying box.

495. Emulsion (Gelatino-bromide), Temperature of—To Regulate.—An emulsion by the ammonia process may be prepared in two ways. First, by adding the ammonia to the emulsion *before* boiling, or rather cooking, and secondly, by adding the ammonia *after cooking*. Now, in the first process, the temperature must not exceed 104° F. (Abney says 105°), or London's famous product – fog – will be produced; but in the second method the temperature may be much higher, so that 140° F. would be correct in this case, but then the emulsion must be allowed to cool, and the ammonia being added, it can be heated up to 104°, but not beyond, to increase the sensitiveness of the emulsion. Abney recommends for a very sensitive emulsion that it should be heated (*without* ammonia) for half an hour at 140° F. or higher, and when the emulsion is cool, say 70° F., add the ammonia, and digest at 90° to 100° for half an hour or an hour, but never let the temperature rise above 105° F. It is perhaps unnecessary to mention that only some emulsions will bear these high temperatures, and for a certain time. With others, failure would result even at lower temperatures. As a general rule, however, one ought not to fog an emulsion by simply heating it to 140° F. (60° C.), as it is certain that 140° F. is not an excessive temperature. Although the ammonia method is strongly recommended, a wonderful effect, as regards increase of sensitiveness, is produced by adding about eight drops of ammonia to the twenty ounces of emulsion (prepared according to Burton's formula for boiling), and keeping, say, for a week. There is an increase of at least two hundred per cent. in the sensitiveness.

496. Emulsion, Gelatino-bromide—To Make.—The following is a very simple and excellent emulsion:

Nitrate of silver	75 grains.
Distilled water	1 ounce.
(Dissolve this by itself.)	
Bromide of potassium	60 grains.
Iodide of potassium	½ ,,
Gelatine (Heinrich's)	1 ,,
Distilled water...	1 ounce.

Dissolve with heat to boiling point, and keep stirring with a glass rod for half an hour, then mix with the silver solution by filtering through a filter drawn to a fine point, then add, while still stirring the solution, one and a half ounces of water and sixty-seven grains of gelatine; it is now poured into a basin, and allowed to cool. After a few hours cut it into small pieces with a silver spoon, and place it on a piece of thick muslin, and gather it into a thick lump, tying the muslin tightly above it, and holding it under the running tap, bruise it into a pulp with the thumb and finger. It is again melted over a Bunsen burner, and is ready for coating the plates. Another way to prepare a good, cheap, and fast emulsion for dry plates. Place in a four-ounce bottle thirty-six grains of gelatine (Nelson's), and add two ounces of warm water; after two or three hours pour off the water as closely as possible, place the bottle in a dish of warm water, and add half an ounce of distilled water and thirty-six grains of potassium bromide. While the gelatine and bromide salts are coming in solution dissolve fifty grains of silver nitrate in six drams of distilled water, and place it in the dish to become slightly heated, then in non-actinic light add the silver in four portions to the bromised gelatine, shaking well after each addition; then place the bottle in a light-tight box in a warm place, and leave overnight. Add then sufficient distilled water to make up two ounces, heat it if necessary in a hot water bath to render it perfectly fluid, and digest for a few hours. At the expiration of the time above mentioned filter well, and it is in a condition to coat the plates, or it may be set aside for a few days. This quantity is sufficient to coat about eight or ten quarter-plates. When coating, the plate must first be warmed, then pour on the emulsion in a pool in the centre and guide it all over the plate, the surplus being poured off at a corner. Place it on a horizontal surface, and it will soon set. Another: To make five ounces of good emulsion, take

Potassium bromide	25 grains.
Ammonia	55 ,,
Nelson's No. 1 gelatine	10 ,,
Water	3½ ounces.

Place a jar containing this in a vessel of cold water, and raise the water to boiling point, when

immediately remove the jar, having ready weighed out

Silver nitrate ... ... 100 grains in crystals.
Potassium iodide ... 3 grains.

dissolved in fifteen minims of water. In the dark room add the nitrate of silver to the bromised gelatine, and proceed to beat up vigorously for about five minutes with a horn spoon, then pour the iodide solution in and again beat up. Now proceed to acidify with hydrochloric acid, and test with litmus paper, until there is an acid reaction, the paper turning clearly red. Next replace the now sensitised emulsion in its jar in the vessel of boiling water, there to remain boiling for one hour, or longer if greater sensitiveness is required. In the meantime weigh out

Nelson's No. 1 gelatine ... ... 30 grains.
Heinrich's gelatine ... ... 60 ,,

and in a second jar soak this for about three-quarters of an hour in cold water as much as the jar will hold, then reverse the jar with a piece of muslin over the top, and drain thoroughly. When the emulsion has boiled for the specified time, remove it from the boiling water, and replace it with the jar containing the soaked gelatine. Plunge the jar of emulsion into cold water, and keep it there until the gelatine in the second jar is thoroughly liquefied. The vessel of boiling water having been removed from the fire before the jar of gelatine was placed in it, the temperature of both will now be found to be just suitable for mixing. This must, of course, be done in the dark room, pouring the emulsion into the gelatine, so as to leave behind any coarse precipitate which may have been formed. The process of thorough mixing must now be repeated, and the emulsion finished by adding about a dram of strong ammonia, with constant stirring, when it may be put aside to cool and ripen for a few days. The whole operations from the addition of the silver nitrate must be conducted away from actinic light. The washing may be done by placing in a cone-shaped lamp glass, the broad end of which is covered with a piece of calico, and the other end placed under tap. For storing, nothing serves the purpose better than an old stone ink bottle, of course thoroughly cleansed, and in this the emulsion is remelted for coating over an ordinary fire as in boiling. A glossy appearance after coating is often caused by drying the plate at too high a temperature, sometimes also by using too hard gelatine. A mixture of four parts of Nelson's with five parts of Heinrich's gelatine gives a dead surface. The reason for plates varying is caused by different qualities of gelatine. The longer an emulsion is cooked, the more matt-like its surface. The following combined formulæ give a splendid matt surface:

No. 1.

Gelatine ... ... 3 drams.
Bromide of potassium ... ... 25 grains.
Iodide of potassium ... ... 1½ ,,
Water... ... ... 2 ounces.

No. 2.

Nitrate of silver combined with ammonium nitrate ... ... 38 grains.
Water... ... ... 20 ounces.

When part one is thoroughly in solution add part two, stirring well all the time, and cook for one and a half hours at 100° F.

Second formula.—No. 1.

Nelson's No. 1 gelatine ... ... 15 grains.
Bromide of potassium ... ... 80 ,,
Iodide of potassium ... ... 5 ,,
Water ... ... 2½ ounces.

No. 2.

Nitrate of silver ... ... 100 grains.
Water ... ... 2½ ounces

When part one is nearly boiling add part two, stirring well, boil for one hour, and when cooled to about 100° F., add 150 grains of hard gelatine, which has previously been soaked in cold water. When the gelatine has nearly all dissolved, add thirty minims of ammonia, and cook for two hours at 100° F., afterwards add batch made from formula No. 1, and cook for another two hours at the same temperature. These plates are rapid enough for slow drop-shutter views, and are capable of producing fine negatives.

497. Emulsion, Gelatino-chloride— To Make.—The following are formulæ for the best known chloride emulsions:

No. 1.—Abney's Citro-chloride.

A.

Chloride of sodium...	3·7 grammes	:	57 grains.
Citrate of potash ...	1·8 ,,	:	28 ,,
Water...	30 c.cm.	:	1 ounce.

B.

Silver nitrate ...	11 grammes	:	170 grains.
Water...	50 c.cm.	:	1¾ ounces.

C.

Gelatine	15 grammes	:	231½ grains.
Water...	175 c.cm.	:	6 ounces.

B and C (after the gelatine has swollen and been dissolved by gentle heat) are mixed together, and added with agitation, little by little, to A. When set, wash slightly for a quarter of an hour in cold water, drain, melt, and add fifteen c.cm. of alcohol.

No. 2.—Ashman and Offord's Citro-chloride.

This is a double emulsion, afterwards blended:

i. Chloride Emulsion.

A.

Gelatine	3 grammes	:	46 grains.
Ammonium chloride	0·64 ,,	:	10 ,,
Water...	33 c.cm.	:	1 ounce.

B.

Silver nitrate ...	2 grammes	:	31 grains.
Water...	10 c.cm.	:	3 drams.

This emulsion when mixed thoroughly should be tested for excess of nitrate of silver (with neutral chromate of potash giving orange red colour to it), and if in excess, a few drops of solution of ammonium chloride must be added to remove the same.

ii. Citrate Emulsion (with excess of silver nitrate).

A.

Gelatine	3 grammes	:	46 grains.
Water	30 c.cm.	:	1 ounce.

B.

Citric acid	2 grammes	:	31 grains.
Water	10 c.cm.	:	3 drams.
Ammonia	*quant. suff.* to neutralise.		

C.

Silver nitrate ...	2 grammes	:	31 grains.
Water	5 c.cm.	:	75 minims.

When emulsified i. and ii. are blended in the proportions of three, four, or five parts of i. to one part of ii. The more of ii. the redder the tone before, and browner after, toning; for deep purple tones, four or five of i. to one of ii. is the best proportion. The mixed emulsions are, if granular, heated to 80° C. for about five minutes, then set, squeezed through canvas, and twice washed for five minutes, drained and remelted.

No. 3.—Ashman's Improved Formula.

A.

Citric acid	20 grammes	:	308 grains.
Water	100 c.cm.	:	3½ ounces.
Ammonia	*quant. suff.* until *only slightly acid.*		

B.

Silver nitrate ...	45 grammes	:	694½ grains.
Distilled water ...	480 c.cm.	:	17 ounces.

C.

Gelatine	45 grammes	:	694½ grains.
Ammonium chloride	6·5 ,,	:	100 ,,
Water...	480 c.cm.	:	17 ounces.

D.

Silver nitrate ...	46 grammes :	710 grains.
Water	180 c.cm. :	6½ ounces.

D is slowly added to C, then A, and lastly B, washing as before in No. 2.

No. 4.—Starnes' Acetate.

A.

Gelatine	40 grammes :	617 grains.
Acetate of soda ...	8 ,, :	123½ ,,
Water...	960 c.cm. :	34 ounces.

B.

Silver nitrate ...	28 grammes :	432 grains.
Water	480 c.cm. :	17 ounces.

C.

Chloride of sodium...	4 grammes :	6½ grains.
Acetate	6 ,, :	92½ ,,
Water	480 c.cm. :	17 ounces.

B is mixed in the usual way with A, and then C gradually added, and finally

Gelatine ... ... 160 grammes.

swollen and dissolved in water is added, and the total bulk of the emulsion made up to 2.280 c.cm., 101½ ounces with water. No washing is required.

No. 5.—Barker's Tartrate.

Gelatine	175 grammes :	2,700 grains.
Chloride of ammonium	18 ,, :	277½ ,,
Rochelle salts ...	50 ,, :	771½ ,,
Silver nitrate ...	75 ,, :	1,157½ ,,
Alcohol	120 ,, :	4¼ ounces.
Water	2·5 litres :	88 ,,

The salts are dissolved in the water, the gelatine added and soaked for an hour or two, then melted and the silver added, and the emulsion kept at 100° C. for ten minutes. Set, and wash or not, *ad lib.*

No. 6.—Woodbury's Modified Barker's.

A.

Silver nitrate	½ ounce	Dissolve.
Citric acid	1 dram	
Distilled water	1 ounce	

B.

Gelatine	1 ounce	Swell and dissolve by gentle heat.
Water...	6 ,,	

C.

Alum	50 grains	Dissolve.
Rochelle salts	20 ,,	
Ammonium chloride ...	10 ,,	
Water...	1 ounce	

B and C are mixed, and the temperature is never allowed to exceed 120° F. The silver solution A is put into a dropping bottle, and added with continual stirring drop by drop. Then the emulsion is heated to 120° F., and filtered through fine muslin, etc., and requires no washing.

498. Emulsion (Henderson's) — To Make.—In his demonstration at the London and Provincial Society, Mr. Henderson laid great stress upon the necessity for the use of pure distilled water, uncontaminated by contact with red-rubber tubing or other impure surface. "It was essential," he said, "for the avoidance of green or red fog that the gelatine should not come in contact with free nitrate of silver." This is brought about as follows: 120 grains of silver nitrate are dissolved in three ounces of water. Sixty to ninety grains of dry potassium carbonate are also dissolved in three ounces of water. The potassium solution is added to the silver solution. A precipitate of carbonate of silver formed, which is permitted to subside. Part of the clear liquid is poured off, and the remainder, with the sediment, is poured into a solution containing 240 grains of gelatine and ninety grains of potassium bromide. The gelatine has previously been well washed, and melted with as little adherent water as possible. The solutions are mixed at a temperature of 150° Fahr., and when the bromide of silver is formed, one per cent. of potassium iodide is added. For subjects of great contrasts a larger percentage is necessary, also more gelatine. When set it is broken up and washed in the usual way, and, on melting, there results about fifteen ounces of emulsion. The speed of this would be from sixteen to seventeen on Warnerke's sensitometer. By adding to ten or fifteen ounces of the finished slower emulsion two grains of potassium nitrate, one grain potassium bromide, and half-grain chrome alum, and keeping the compound at a temperature of about 80°, it gained very much in speed, and in twenty-four hours would register "the highest sensitometer numbers," or as was said in the discussion which followed, twenty-four and even higher. Mr. Henderson remarked that if he wanted an emulsion giving clear shadows and great density he would convert the silver nitrate into acetate or citrate instead of carbonate; such an emulsion would be particularly suitable for line work or lantern slides. Anyone who has had any experience in emulsion making will find no difficulty in following Mr. Henderson's instructions. He may, perhaps, be tempted to wash the sediment of carbonate of silver before going further. This will do no harm. Trouble will come, however, if he leave the sediment much liquid, because the gelatine will become too weak to set.

499. Emulsion Troubles—To Avoid.—As regards opaque spots and frilling. Opaque spots may be due to either dust or grease in the emulsion. The former does not seem very likely, so it may be the latter which causes the gelatine to leave the bromide while plate is setting, and, not being restrained at those points by the gelatine, the silver is reduced at once by the developer. The remedy is to add either a little strong ammonia to the emulsion which dissolves it, or, if eighty grains of gelatine are wanted, weigh out one hundred and soak in water; melt, and allow to stand, when the grease will rise to the surface; allow to set, when the top may be cut off and only the bottom used, or when melted the solution may be poured into good methylated spirit, which precipitates the gelatine entirely free from grease. Transparent spots may be due to the use of chrome alum in the emulsion, from minute air-bells in it when coating, or from dust on the plate or negative when exposed. The remedy for air-bells is to allow the emulsion to stand before coating. The other remedy is obvious. To avoid frilling, nearly if not all, platemakers use a substratum before coating the glass with the gelatino-bromide emulsion. Forrest's substratum is made up as follows:

White of egg	1 ounce.
Water	30 ,,
Methylated spirit	1 ,,
Carbolic acid	20 drops.

The carbolic acid is added to the spirit while stirring well, when it is poured into the albumen and water, previously mixed together. Another method is to take fifty grains of gelatine and half an ounce of acetic acid and warm until dissolved. Then take up a solution of chrome alum, ten grains to the half-ounce of water. In seventy parts of methylated spirit add two and a half parts of the first and one part of the second solution. After filtering, the plates can be coated and dried previous to coating with the emulsion.

500. Ferrotypes—To Make.—In this process a dark metal plate is coated with a slow emulsion which, when given a full exposure and developed with a developer weak in pyro, produces a thin negative which, when backed up by the dark metal plates, looks like a positive. To produce a good result the developed image should be of a light yellow tone, full of detail, but without density, and

appearing like a weak and undeveloped negative. If the tone is cold, and apparently brilliant, there is too much pyro in the developer, which should be diluted with water, so as to allow development to proceed slowly. An over-exposure gives a picture which develops too rapidly and is too dense. An under-exposure comes up slowly, with no detail. The plate is fixed in a solution of potassium cyanide and thoroughly washed. If after fixing it be immersed in a solution of alum and citric acid, it can be dried by heat in a few minutes. Ferrotypes are usually, however, produced by the wet-plate process, for which the following directions are given: *Materials Required.*—Ferrotype plates, collodion, glass bath and dipper, ferrous sulphate, glacial acetic acid, silver nitrate, potassium cyanide, alcohol, varnish. *Formulæ, Collodion.*—Ammonium iodide 3½ grains, cadmium iodide 2½ grains, cadmium bromide 2½ grains, alcohol-ether 1 ounce, pyroxyline 6 grains. *Silver Bath.*—Nitrate of silver 30 grains, water 1 ounce. *Developer.*—Ferrous sulphate 1 ounce, glacial acetic acid 1 ounce, alcohol 1 ounce, water 16 ounces. *Fixing Bath.*—Potassium cyanide 5 grains, water 1 ounce. *Varnish.*—Gum mastic 20 grains, benzole 1 ounce. *Manipulations.*—Dust ferroplate, hold it horizontally by one corner, pour sufficient collodion over it to half cover it, flowing it over plate by tilting latter from side to side and return excess to bottle by raising plate into vertical position. Keep plate rocking until collodion has set, and when this occurs place it on dipper and lower into bath. Leave the first plate in the bath for a couple of hours to saturate it with iodide. To take a picture, treat another plate exactly as above, but leave it in bath for only four minutes. Remove it slowly, drain it for a minute or two over blotting paper, place it in dark slide and expose. The exposure will be at least twenty times as long as that required for a rapid dry plate, and when this is over remove plate from slide, place it flat in an ebonite or other dish, and flow sufficient developer over it to barely cover it. The image will gradually develop, and when sufficiently intense wash plate and fix in cyanide. After a two minutes' rinse under tap, drain and dry over lamp, then flow varnish over film, and finally make quite hot. Another developer is—Ferrous nitrate 110 grains, ferrous sulphate 60 grains, nitric acid 20 minims, alcohol *quant. suff.*, water 4 ounces. Fixing bath of cyanide twenty-five grains to the ounce. Another formula is given as follows: Thoroughly clean the enamelled iron plates and coat with this collodion: Ammonium iodide 30 grains, sodium iodide 10 grains, cadmium iodide 20 grains, cadmium bromide 20 grains, pyroxyline 50 grains, methylated alcohol (·820) 5 ounces, methylated ether (·725) 5 ounces. As soon as the collodion has set the coated plate is immersed in the sensitising bath made as follows: Nitrate of silver 320 grains, potassium iodide 1 grain, distilled water 8 ounces. Dissolve the silver salt in two ounces water, and the potash in half-ounce water. Add the latter to the former, and add the remainder of the water. Filter and test for acidity. If the blue litmus paper is not turned red after an immersion of some short period, a few drops of dilute nitric acid (one in twelve) should be added till the bath is decidedly acid. The plate is exposed whilst still wet, the exposure being about ten times that for gelatine dry plates of ordinary rapidity under similar circumstances. The best developer is—Protosulphate of iron 4 ounces, acetic acid 4 ounces, sugar-candy ½ ounce, water 64 ounces, the candy producing the lustrous whites so much admired in ferrotypes. Fix the developed positive in—Cyanide of potassium ½ ounce, water 16 ounces. Wash for ten or fifteen minutes, dry, and varnish. Enamelled iron plates for coating may be obtained from most dealers.

501. Ferrotype Dry Plates—To Work.—Ferrotype dry plates are manufactured by the Phœnix Company, and doubtless they will serve as a guide for most others. As regards rapidity, they are about the same as slow landscape plates, *i.e.*, they require an exposure in a good light (not bright) of about two or three seconds. The formula for development is not wholly published, for it is partially made up of a solution called the Phœnix Stock Solution. However, here it is:

No. 1.

Pyrogallic acid	1 ounce.
Salicylic acid	10 grains.
Nitric acid	6 minims.
Water	12 ounces.

Dissolve the salicylic acid in sufficient methylated spirit before adding the pyro.

No. 2.—Phœnix Stock Solution.

For developing use: No. 1, 15—60 minims; No. 2, 4 drams; water, 4 ounces. If the plate be under-exposed, add another thirty minims or more of No. 2; if over-exposed, add one ounce more water. The image should appear in about one minute; if not, add a few drops more No. 1. It is better to proceed somewhat tentatively, commencing development with fifteen minims of No. 1, and adding more if required. The great point to be remembered is that the image should be developed with the least possible amount of pyro, in order to get a white deposit of silver. Again, it is always best to wet the plate before development, as this not only prevents air-bells, but tends to prolong the development. After the plate is developed wash thoroughly, and immerse in the following fixing solution:

Cyanide potassium	2 drams.
Bromide potassium	80 grains.
Water	10 ounces.

Let the plate remain in this until all the bromide of silver has dissolved, and if, after this, the picture looks hazy, add a few drops of tincture iodine to the cyanide, and immerse the plate in it for a few *minutes;* in fact, until it appears perfect. Then thoroughly wash and use the alum and citric acid bath (alum and citric acid one ounce each to twelve ounces water). Then wash thoroughly, and the picture may be dried before the fire, provided the plate is held horizontally. Then varnish with any good white negative varnish. Plates prepared according to the Phœnix process were also developed with ferrous oxalate, fixed in potassium cyanide, and then bleached with a strong solution of mercuric chloride and washed.

The following directions are also given for preparing ferrotype dry plates: The film of emulsion should be extremely thin, and very short exposure should be given. The development ought to be with ferrous-oxalate developer, to which a liberal addition of potassium bromide has been made. After a thorough rinsing with water, the plates are fixed with a potassium cyanide solution containing one part of the salt dissolved in twenty parts of water. Thorough washing is now required, after which the plate is immersed in a weak solution of mercuric chloride (corrosive sublimate) until the image is thoroughly whitened. Again wash, soak in methylated spirit to remove water from the film, and dry at a gentle heat.

502. Film Celluloid—To Clean.—The gelatine film is easily cleaned off by the aid of boiling, or very hot water (Messrs. Guitermann say not to use the water too hot, but to soak film in water at 90° F. for an hour, and then scrub off emulsion in water not exceeding 100° F.), and the best time to do this is as soon after the film is fixed as possible, and before it has been allowed to dry. It is usually known if a film or other negative is worth keeping or not soon after it has been fixed,

and if it is not good enough to keep, and is washed off at once as above indicated, it will be done much more easily and more quickly than would be otherwise possible. A simple method of keeping the films flat, or nearly so, while recoating, will be to fix them down by their edges only to a piece of glass by the aid of strips of gum paper; if the glass is, say, half-an-inch larger each way than the celluloid film so much the better. If the film is very thin, it will be best to stick it temporarily on by the aid of glycerine, or perhaps water, but the trouble would be too great probably to make it worth while to bother with thin films at all.

503. Film—To Isochromatise.—Any plate or film may be made to assume orthochromatic properties by immersing in following dipping bath (Thomas's):

No. 1.—Stock Solution.

Erythrosine	5 grains.
Methylated spirit	5 ounces.
Water to...	1 pint.

No. 2.—Stock Solution.

Ammonia ·880	2 ounces.
Water to...	1 pint.

For use, take one ounce of each solution and make up to ten ounces with water, boiled or distilled. The film should remain in the bath three minutes at ordinary temperatures. It is advisable, as a precaution, to guard against dust and air bubbles, to sweep the surface of the film with a swansdown or felt squeegee, or wide camel-hair brush. Rinse the film well in clean water after removal from the bath, and see the water drains evenly from the surface, and then dry. Drying may be accomplished in a few minutes by soaking the plates for a short time in methylated spirit. The entire operation should be conducted in a *ruby light*. This dipping increases the general sensitiveness of the film. The dipped films retain their orthochromatic properties for at least six weeks. (See also No. 514.)

504. Foggy Emulsion—To Prevent.—The causes of red and green fog are various, such as want of sufficient acid in the emulsion, too much boiling and consequent deterioration of the gelatine, the presence of burnt gas fumes or sulphuretted hydrogen in the dark room, etc. A similar trouble when making gelatino-bromide emulsion was traced to a bad sample of silver nitrate. The cure is simple, and consists in adding a small quantity (say a drop to every four ounces) of pure perchloric acid to the washed and filtered emulsion. Or, again, too high a temperature whilst in the water bath after having washed it in alcohol. The temperature should never exceed 100° F.: if it does, it will, in nine cases out of ten, cause fog. As the object is only to melt the gelatine, it will be much better to work at about 80° to 90° F., and have patience. If plates have any tendency to show red fog, the best preventive is to develop them without the use of ammonia as the alkali, as a developer containing ammonia gives red fog, while hydroquinone and caustic soda have failed to produce it with the same batch of plates. If the fog is of the dichroic kind, pink to red by transmitted light and green by reflected, ordinary silver nitrate is probably the cause — the recrystallised should always be used. If it still turn up, the fault is with the gelatine. Such, specially prepared for photographic work, should be used. If this is the case, a fresh sample should be tried, when the fog will probably cease. If the fog is red by reflected light, it is caused by an excess of silver nitrate in the formula. To find out if this is the case, multiply the amount of silver nitrate by twelve if using potassium, or by ten if using ammonium bromide, and divide the result by seventeen. The answer will be the exact amount (nearly) of potassium or ammonium bromide necessary to exactly react with the silver nitrate. Four to six grains should be added to this to be certain of having an excess of bromide, and by using that amount, the trouble will cease.

505. Halation—To Prevent.—Halation is the term given to the halo which often surrounds windows in photographs of interiors, and blocks up the details. It is, too, often found to occur in landscapes taken in a strong light, the tops of trees and other objects which are surrounded by strong light being lost in a mist or entirely obliterated. It is caused by reflection from the back of the plate, and occurs most strikingly in plates of the "cheap" class, which are often thinly coated. With very thickly-coated plates it rarely occurs, except when taking brightly-lighted interiors. To prevent it, the plate should be "backed" with a mixture of burnt sienna, gum and water (see No. 481, which gives several formulæ for the purpose). When present the negative may often be improved as follows: Take a thin piece of rag free from dust and grits, pass it tight over forefinger, moisten it with alcohol, and rub the film of negative till the rag is blackened, and halation sufficiently removed for practical purposes. Be careful not to permit any crease in that part of rag which is moistened and touches film, otherwise various transparent comets and streaks are not unlikely to ensue. If it be a good window, the detail of which is worth preserving, take two negatives of interior, one for the building itself, and one for the window, from same standpoint. When printing the interior one, mask its window, which will be subsequently printed in from the window negative, the remainder of print being, of course, masked during the latter operation. Another method, if the halation round the window is not very dense, is to print the interior to the required shade, and then put a piece of cardboard over the frame with a hole cut in it a little larger than the window, and print it up. Another and very excellent method is to cover the negative, except the window, with two thicknesses of waxed paper (now so common). This allows the window to print in, and much improves the printing quality of a thin or over-exposed negative. If the window is so dense that it will not print, paint it over with a camel-hair brush until sufficiently reduced with the following solution: Potassium ferric oxalate (the green salt separating in old oxalate developer) 10 grains, hyposulphite soda solution (strength, one to five) 1 ounce; add a small quantity of gum mucilage, to prevent it running. After reduction, well wash the negative.

506. Isochromatic Plates—Method of Working.—These plates are invaluable for copying oil paintings in which there is much red. For instance, take a portrait of a staff officer, in copying which with ordinary plates the red coat comes out black, and sadly contrasts with the face above it. With the isochromatic plates, however, the coat and gilt buttons are well rendered and full of gradation. With regard to landscapes, these plates bring out deep shadows under trees or in glens in a marvellous manner, and by using the yellow screen, foliage and distant hills, etc., are well rendered. They are specially useful on dark or foggy days. Isochromatic plates are made in three rapidities—"slow," "medium," and "instantaneous." The "slow" are specially suitable for copying pictures and coloured objects, and when these contain much blue a yellow screen should be used to decrease the actinic power of that colour; as a rule, these screens require about three times the normal exposure. The "medium" are specially suitable for landscape work and interiors, or all purposes for which a plate of the ordinary speed is used, while the "instantaneous" are specially suitable for shutter work

and portraiture in white light; they register about twenty-four on Warnerke's sensitometer, and are of the usual speed of plates of the ordinary extra rapid class, but if the light is at all yellow, they are infinitely quicker, because they are extremely sensitive to yellow, and for this reason the light of the dark room should be of deep ruby, and the plates shielded from all direct light during development. Iso plates will keep as well as an ordinary plate, and render yellow in better gradation of tint than any other plate, and the screen is only required to decrease the actinic blue rays. For landscape work a screen is not required except in particular cases, such as hazy distance, which would be blocked without the use of the screen. When the distance is fairly clear, the screen is a disadvantage rather than a benefit, as it tends to destroy aerial perspective and atmosphere.

507. Metallic Lustre on Plates—To Prevent.—The metallic lustre in question is chemical fog, caused by an abnormal excess of silver nitrate in the emulsion; or by decomposed gelatine, caused by the emulsion being stewed too long when made by the boiling process. These are the faults of the maker; yet a plate not possessing the tendency to fog from these causes may be made to show symptoms of it by under-exposure and forced development, or by the over-development of a correctly-exposed plate. If one of the two latter, try the potash and soda; it is less likely to appear with this. If the fog does ensue to the same extent, then try the oxalate. If, after this, there are still stains, then, in all probability, the plates are wrong, as oxalate will not produce the fog if the plates are right. To remove fog from plates affected, immerse after fixing and washing in

Ferric chloride	50 grains.
Potassium bromide	30 ,,
Distilled water	4 ounces.

The fog will disappear in this in a few minutes, but the density will be reduced. Rinse well, and apply the ferrous oxalate developer, when the density required will be obtained. The plate should then be refixed and washed.

508. Opals, Albumenised—To Make.—Previous to albumenising give the plates an edging of indiarubber solution about a quarter of an inch broad. To albumenise, pour a small pool of the albumen solution on the centre of the plate, and gradually work the solution all over the plate in the same way that a negative would be varnished. Use the same albumenising solution as is used for albumenising paper. The following directions also are given for coating opals with salted albumen, and sensitising. The first point is to prepare the albumen. A number of eggs, according to the quantity of albumen required, are broken, and the whites carefully separated from the yolks and strings. To each ounce thus obtained, eight grains of ammonium chloride, dissolved in a small quantity of water, are added, and the whole is then beaten up with a whisk to a complete froth, and this must be very thoroughly done, otherwise the membranous matter cannot be properly removed, and will give rise to markings. Instead of ammonium chloride other chlorides may be substituted, as sodium chloride or barium chloride, remembering that one hundred grains of ammonium chloride contain as much chlorine as 109 grains of sodium chloride, or as 228 grains of barium chloride. After allowing the froth to settle for about twenty-four hours, the clear albumen is filtered through muslin or flannel, and is ready for use. The opal plate is carefully cleaned, and needs a preliminary treatment as follows. Soak the plates in the following:

Gelatine	200 grains.
Nitric acid	½ ounce.
Water...	20 ounces.

Then scrub with a clean brush in *hot* water and drain. This is, of course, stale news to those who prepare their own collodion bromide emulsion. When the plate is dry, pour a small pool of albumen on the centre, and with a glass rod spread it evenly over the surface. This is best done by holding the rod at both ends with thumb and first finger of each hand, and guiding it with the tip of the second finger placed on the edge of the plate. Place the plate on a level slab to dry, and behold! it is albumenised. Sensitise in a bath of thirty-five to sixty grains of nitrate of silver to the ounce, remembering that the stronger the bath the shorter the time required to sensitise. Another and quicker method of drying the plates, and, to a certain extent, ensuring an even coating, is as follows: A common earthenware pan is half filled with sand, and on this a couple of handfuls of lighted charcoal are laid, and over this the plate is dried in the following manner: A piece of thin wire is twisted at each end into a loop, and bent in the form of a bow. The coated plate is supported by fitting two opposite corners into the two loops, coated side down, and the arrangement is suspended over the fire by a string held in the left hand, a whirling motion being given to the cord by the fingers of the right hand, causing the plate to spin rapidly round; this throws off the surplus albumen, and the plate is quickly and evenly dried. The plate must not be over-heated, or fine cracks will be visible all over the surface. This method of drying is used in the preparation of lantern slides on albumen.

509. Opals, Bromide—To Make.—The same emulsion and procedure as advised in No. 494 is pre-eminently suited for opals, and if kept in small bottles the plates can be coated, exposed, and developed right away without drying, for the emulsion will keep for six months in a cool place. To coat, level a piece of thick slate, marble, or flag, and, after thoroughly cleaning the opal, place it on a pneumatic holder, pour a pool of the emulsion on it, and coax it about with a glass rod, and when covered place on the level setting block. When set can be used or dried at pleasure. A developer to suit the emulsion is saturated solution of potassium oxalate 8 ounces, ditto sulphate of iron 1 ounce, potassium bromide 10 grains. Be sure to make the iron solution *decidedly* acid with sulphuric acid, and for under-exposure add iron up to two ounces. The sheets of opal are cleaned by being well rubbed with a five per cent. solution of caustic soda, then washed and dried, and used as soon as possible after having been cleaned. No substratum is needed in this case, as the emulsion does not sink in as with paper. Possibly a few remarks on the mode of development will be of interest. The richest and deepest blacks, combined with the greatest possible delicacy of gradation, are undoubtedly produced by pure potassio-ferrous oxalate, made by dissolving ferrous oxalate in potassium oxalate, and not, as it is usually made, by mixing potassium oxalate and ferrous sulphate. Made in the latter way, the solution contains a large quantity of restraining potassium sulphate, formed by double decomposition, and this tends to destroy to a great extent any delicate gradation present in the negative, or, rather, to hinder its counterpart being produced in the print or enlargement. A good deal of the loss of gradation usually complained of in enlargements is to be traced to this cause. To make a first-class developer proceed as follows: Dissolve two ounces of oxalic acid in six ounces of boiling water, and an ounce of

ferrous sulphate in six ounces of water, previously acidified with ten drops of strong sulphuric acid. Having filtered the solutions, mix them, and let the mixture stand twenty-four hours. At the expiration of that time transfer the whole to a filter, and wash the precipitated ferrous oxalate with at least six changes of boiling water. Drain it as dry as possible, and preserve it in a bottle in a moist condition. Keep a stock solution of potassium oxalate containing an ounce of the salt dissolved in three ounces of water acidified with oxalic acid, and to make up the developer measure out a dessert-spoonful of the moist ferrous oxalate into ten ounces of the potassium oxalate; raise the whole to boiling point and filter. When cool, add potassium bromide to suit requirements (very little, as a rule, requisite), and use at once. Or the ferrous oxalate can be procured *dry* from Messrs. Burgoyne and Co., 16, Coleman Street, London, E.C. In the latter case take a weighed ounce of the dry ferrous oxalate for every ten ounces of the boiling solution of potassium oxalate, and filter as before. It is true that this method of development is somewhat more expensive than the commoner plan (the ferrous oxalate costing 2s. 4d. per pound), but the beauty of the results it yields more than compensates for the slight extra cost. Whilst any of the *slow* gelatino-bromide emulsions (No. 494) are suitable for coating opals, the two following may be given as specially suited for this purpose. Dr. Eder's formula for compounding the emulsion is as follows: Solution A, ammonium bromide 18 parts, potassium iodide 2—4 parts, gelatine 50—80 parts, water 400 parts. Solution B, silver nitrate 30 parts, water 400 parts. The two solutions are prepared in daylight, and are mixed with constant shaking in the dark at a temperature of 60° C. The mixture is then placed in boiling water for a time varying from five to thirty-five minutes, according to the rapidity required. For a slow opal ten minutes is sufficient. The emulsion is then allowed to solidify, and is washed by squeezing through canvas in the usual way. After remelting, a sufficient quantity of the hot emulsion is poured over the opal plate (previously levelled), the plate is placed on one side to set, and finally dried. Another emulsion for coating opal plates for enlarging on, which is simple to make and easy to work, is the following gelatino-chloro-bromide emulsion. Make these solutions:

Solution No. 1.

Nitrate of silver	154 grains.
Citric acid	154 ,,
Distilled water	28 drams.

Solution No. 2.

Pure common salt	54 grains.
Bromide of potassium	39 ,,
Gelatine	62 ,,
Distilled water	28 drams.

Mix both above solutions together, with constant shaking, at 140° F., and then add

Nelson's No. 1.

Photo gelatine	124 grains.
Heinrich's gelatine	248 ,,

previously swollen and dissolved by heat in

Glycerine	16 drams.

When thoroughly amalgamated allow to stand for a few minutes, then pour into a flat dish to set. When thoroughly set, break it up with a silver spoon, put all into a piece of clean coarse canvas, and squeeze into a basin of distilled water, stir up for about ten minutes, collect on a filter of washed chamois leather, and drain slightly. Repeat the washing twice, then collect the emulsion, and drain thoroughly. Remelt the emulsion at 120° F., add half a grain of chrome alum dissolved in one dram of distilled water, and add also six drams of absolute alcohol. Then filter the emulsion through a clean piece of chamois leather, thoroughly washed, and it will be ready for coating the plates. All the above operations must be conducted in the dark room.

510. Opals, Collodio-chloride—To Make.—The following collodio-chloride formula answers capitally. The emulsion is made as follows:

No. 1.

Silver nitrate	31 grains.
Methylated alcohol	28 drams.

Dissolve by the aid of heat immediately before using.

No. 2.

Strontium chloride	31 grains.
Methylated alcohol	28 drams.

No. 3.

Citric acid	31 grains.
Methylated alcohol	28 drams.

No. 4.

Pyroxyline or celloidin	62 grains.
Methylated alcohol	28 drams.
Methylated ether	28 ,,

To make the emulsion—Take of No. 2, 150 minims; No. 3, 150 minims; No. 4, 28 drams. Mix and add gradually, with constant agitation, No. 1, 75 minims. Give the plates an edging of albumen or india-rubber solution a quarter of an inch broad, and, after coating, allow them to dry thoroughly.

511. Opals, Ferro-prussiate—To Make.—Select some opal glass, free from scratches, etc., and put it into a solution of washing soda for a time, then wash in clean water and dry. Then take one ounce gelatine, wash it well in clean water, squeeze out the water, and place it on a clean towel. After about an hour dissolve the gelatine in twenty ounces of hot water, and filter through buckskin or cotton pushed into a funnel. Then coat the opals with the solution warmed to 130° Fahr. In cold weather it will be necessary to warm the plates first. When the solution is spread evenly on the glass lay it on a cold slab placed horizontally, and as soon as the coating has become stiff enough not to run, set up the opals to dry. This will take some hours. Many plates may thus be prepared, and will keep for a long time in a place dry and free from dust. Now mix the sensitising solution—

A.

Citrate iron and ammonia	7½ drams.
Distilled water	4 ounces.

B.

Potassium ferricyanide	5 drams.
Distilled water	4 ounces.

Mix, filter, and immerse the prepared plates for three minutes, avoiding air bubbles. Do this in subdued light. Set up to dry, then expose under a negative. Time, about double of that required for silver paper. After printing wash in clear water thoroughly. A rich blue picture will remain. Another method is: Coat with ten per cent. solution of gelatine and dry. Immerse for about two minutes in

Water	100 parts.
Ferricyanide of potassium	8 ,,
Ferric ammonium citrate	8 ,,
Glycerine	10 ,,

and dry quickly. They should keep for about a week. The solution should be prepared fresh for each batch of plates. Instead of the sensitising solution first given, either of the following may be used:

1.—Ammonio-ferric citrate 64 grains to 1 ounce water.
Ferricyanide 48 ,, 1 ,,

or 2.—Citrate ... 1 ounce to 3½ ,,
Ferricyanide 1 ,, 6 ,,

or 3.—Citrate .. 7½ drams to 4 ,,
Ferricyanide 5 ,, 4 ,,

In all cases equal parts are used. If a deeper blue is wanted immerse in a bath of sulphuric acid 1 ounce, saturated solution of iron protosulphate 1 ounce, water 1 ounce, or acetate of lead ½ ounce, water 2 ounces. For collodion first coat the opals with plain collodion thus—

Pyroxyline (high temp.)	60 grains.
Meth. alcohol (·820)	3 ounces.
Meth. ether (·725)	2½ ,,

Make this a few days before using, and allow it to settle, using the clear liquid. When it is set, sensitise by immersion, first in

Ammonio-ferric citrate	1 dram.
Water	1 ounce.

Then in

Ferricyanide potass.	1 dram.
Water	1 ounce.

Or, better, take equal parts of each, and leave them in it ten minutes. All these operations can be done in gaslight. Do not wash too much, as the opal becomes thin by it.

512. Opals, Print-out—To Make.—The following will answer: (1.) Sodium chloride 40 grains, potassium citrate 20 grains, water 1 ounce. (2.) Silver nitrate 120 grains, water 1 ounce. (3.) Heinrich's hard gelatine 300 grains, water 4 ounces; mix 2 and 3, and by candlelight emulsify into 1. Coat in usual way. The following, also, is a good formula for collodio-chloride print-out opals. Prepare the following solutions:

A.

Silver nitrate	35 grains.
Methylated alcohol	30 drams.

B.

Strontium chloride	35 grains.
Methylated alcohol	30 drams.

C.

Citric acid	35 grains.
Methylated alcohol	30 drams.

D.

Pyroxyline	70 grains.
Methylated alcohol	30 drams.
Methylated ether	30 ,,

To make the emulsion—

Take of B	300 minims.
,, C	300 ,,
,, D	7 ounces.

Mix and add gradually with constant agitation—

A	150 minims.

Very beautiful results are got from the following formula, which is used extensively in France: Soak soft gelatine 10 grammes, Heinrich's hard gelatine 30 grammes, in 400 c.c. distilled water for one hour, apply, heat and dissolve; add fourteen grammes of anhydrous calcium chloride dissolved in one hundred c.c. of distilled water, shake well and add silver nitrate twenty-two grammes dissolved in one hundred c.c. water, and again shake; set it quickly in iced water, and wash in one water only, melt again, and add six grammes of citric acid in sixty c c. distilled water, then lastly add five grammes of thymol in thirty c.c. of alcohol; this will keep the emulsion from going stale; coat in the usual way, and at as low a temperature as convenient.

The next is also good and requires no washing:

Nelson's No. 1 gelatine	175 grains.
Coignet's ,, ...	175 ,,
Ammonium chloride	18 ,,
Strontium chloride	18 ,,
Citric acid	50 ,,
Tartaric acid	25 ,,
Alcohol	8 drams.
Water	10 ounces.

After soaking the gelatine and dissolving in one portion of the water, dissolve the salts of ammonia and strontium, also citric and tartaric acids in another, and lastly the silver separately; add the chlorides and acids to the gelatine, and lastly the silver, and agitate; keep at a 100° Fahr. for ten minutes, add the alcohol, and coat away. Perhaps Ashman's formula may be preferred by some, for it gives very rich tones, but does not print as quickly as the above.

A.

Nelson's No. 1 gelatine	60 grains.
Dissolved in water	1½ ounces.

B.

Sodium chloride	40 grains.
Citrate of potash	40 ,,
Water	1 ounce.

C.

Nitrate of silver	150 grains.
Water	1 ounce.

B is added to A, and raised to 150 Fahr., C also at 150 is added slowly. Boil for fifteen minutes, allow to cool down to 150, then add one hundred grains of Heinrich's gelatine previously soaked in two ounces of water, and stir until dissolved, allow to set, and then wash, remelt, and add alcohol one ounce, salicylic acid one grain. For toning, the following will suit any of the above formulæ: Cold tones—Ammonium sulphocyanide ½ ounce, water 20 ounces, gold chloride 8 grains. For warmer tones, add to the bath—Acetate of soda ½ ounce, water 10 ounces.

513. Opals, Wet Plate—To Make.—Well clean the plate with dilute nitric acid, and coat with a substratum of a five-grain solution of gelatine applied warm. Use an old and ripe collodion and a bath made up with nitrate of silver one ounce to fourteen ounces of water, and made acid with nitric acid. Develop with

Pyrogallic acid	1 dram.
Citric acid	1 ,,
Spirits of wine	1 ounce.
Water	20 ,,

Do not develop too far, as the action continues after washing is begun. Well wash, and fix in hypo eight ounces to a pint of water. Well wash, and after slightly draining, coat with an albumen solution made of

White of	1 egg.
Water	30 ounces.
Ammonia	8 drops.

Well shaken with broken glass and filtered, place where free from dust to dry, and when dry, varnish. The above albumen solution will also serve for a substratum if preferred. The above is based on articles written by G. H. E. Sutton and W. B. Bolton. The following formula is recommended:

No. 1.

Ether sp. g. ·725	10 fluid ounces.
Alcohol sp. g. ·805	5 ,,
Pyroxyline	100 grains.

No. 2.

Alcohol (as above)	5 fluid ounces.
Iodide of cadmium	50 grains.
Bromide of ammonium ...	20 ,,

Shake till dissolved, and then pour in No. 1. Having thoroughly cleaned the opal plate, rinse with distilled water, drain, and coat with the following substratum: White of 1 egg, water 1 quart, liq. ammonia 4 drops. When the substratum is dry coat with the iodised collodion. When this is fully set sensitise with the following bath:

Nitrate of silver (recrystallised)	5 ounces.
Distilled water	80 fluid ounces.
Nitric acid (pure)	12 minims.

Saturate with iodide of silver and filter. Either of the following developers is recommended:

Protosulphate of iron	6 drams.
Glacial acetic acid	2 fluid ounces.
Citric acid	60 to 80 grains.
Sugar-candy	30 ,,
Water	20 fluid ounces.

Or

Pyrogallol	5 grains.
Citric acid	3 ,,
Acetic acid	45 minims.
Water	1 fluid ounce.
Alcohol	*quant. suff.*

Fix in hypo four ounces to the pint of water. The above formulæ answer well with collodion transfer on to opal. Fine black tones in wet plate opals can be obtained, after fixing and washing, with a platinum toning bath. Dissolve chloride of platinum one grain in four ounces of water, and neutralise with carbonate of soda. Having been reacidified with nitric acid, the solution is ready for use. Any good positive collodion will do, but Monckhoven gives the following formula:

Iodide of cadmium or ammonium ...	15 grains.
Pyroxyline	15 ,,
Ether	3½ ounces.
Alcohol	1½ ,,

The pyroxyline and iodide are first introduced into a dry flask or bottle, and the alcohol poured upon them, and the mixture shaken violently for about a minute; the ether is then added, and the contents further agitated, and finally set aside all night. The clear supernatant portion is carefully decanted, leaving a white deposit at the bottom of the bottle, and is kept in the dark in a well-stoppered bottle—by preference in what is known as a "cometless" collodion bottle. This collodion is apt to give fogged pictures unless a few drops of the following iodine solution be added, enough to impart a sherry colour to the collodion:

Iodine	150 grains.
Alcohol	3½ ounces.

The bath is

Nitrate of silver	2½ ounces.
Distilled water	35 ,,
Potassium iodide	3 grains.

The iodide, in the least possible quantity of water, to be added to the nitrate dissolved in about a quarter of the water. After shaking (and thus partially dissolving the silver iodide), the rest of the water is added, when a further emulsion of iodide will appear. Filter and slightly acidify with nitric acid. Success, however, greatly depends upon the development. Develop with

Ammonio-sulphate of iron ...	75 grains.
Glacial acetic acid	75 minims.
Sulphate of copper	7 grains.
Water	3 ounces.

The points on which success depends are—(1) The collodion should be thin, for otherwise the result would be patchy; (2) the image should not be over-developed, but to retain half-tones; (3) a black deposit, full of gradation, to show up against the opal; (4) thorough fixation, and for this use potassium cyanide 200 grains, water 20 ounces. Be careful to wash well before fixing, as the acid in the developer might decompose the cyanide, with evolution of hydrocyanic acid.

514. Orthochromatic Plates—To Make.—(1.) V. Schumann's method.—Soak the plate in a one to two per cent. solution of ammonia for two or three minutes, and then immerse in

Distilled water...	100 parts.
Ammonia	2 ,,
Alcoholic solution of cyanine (1 : 500)	5 ,,
Alcohol	5 ,,

Wash and dry.

(2.) Messrs. Thomas's dipping bath.—Stock solution No. 1:

Erythrosine	5 grains.
Meth. alcohol	5 ounces.
Water to	20 ,,

Stock solution No. 2:

Ammonia ·880	2 ounces.
Water	20 ,,

For use take one ounce of each solution, and make up to ten ounces with boiled or distilled water. The plate should remain in the bath about three minutes at ordinary temperature. Rinse with water, see it drains off evenly, and dry.

(3.) Dr. Scolik's.—Soak the plate for two minutes in a one per cent. solution of ammonia, then immerse for about seventy seconds (not longer, as the sensitiveness is reduced) in

Erythrosine solution (1 : 1,000) ...	25 parts.
Ammonia	4 ,,
Water to...	200 ,,

Or in the alternative azaline bath:

Alcohol	500 c.c.
Chinoline red	1 gramme.

To which is added fifty c.c. of a solution of

Alcohol...	500 c.c.
Chinoline blue	1 gramme.

(4.) F. Ives's method for collodion plates.—Flow the plate with strong alcoholic solution of chlorophyll from blue myrtle or plantain leaves, and then immerse in water strongly tinged with blue shade eosin. There are many other dyes, especially among the coal tar products, which confer orthochromatic properties on the film, and for dipping plates the solution of dye, according to Mr. Bothamley, should be in the proportion of one of dye to 20,000 or 30,000 of water. A process which has succeeded well is that communicated by Wellington to the Photographic Club (*B.J. of Photography*, 1887, p. 710). To carry this out take chloral hydrate 1 ounce, cyanine 10 grains, water 4 ounces. Boil for half an hour, let cool, and add, little by little, an ounce of strong ammonia. After a few minutes the cyanine will be precipitated, and when this occurs decant the liquid, wash the precipitate thrice by decantation, drain off the water, and dissolve in eight ounces alcohol containing 120 grains soluble quinine sulphate, the latter having been previously dissolved by boiling it with a small quantity of the alcohol. This solution will keep good for about as long as the dipped plates, viz., from four to six weeks. For use add a dram of it to twenty ounces of water, and then make the whole alkaline with a dram of ammonia. Dip the plate in this for two minutes, drain and dry, and do not use the same quantity of solution for more than one plate. The best plates to use are those containing a large proportion of silver bromide and comparatively little gelatine. To avoid fog it is essential to dip and dry the plates in absolute darkness. It may be well to point out that to obtain plates *which will keep* the cyanine must be added to the emulsion. The whole of the operations must be conducted in a deep ruby red light (and exposure to this must be avoided as much as possible). The plates are, of course, much more sensitive after bathing. Any good dry plate may be used except those containing iodides, which are unsatisfactory. (See No. 503.)

515. Orthochromatic Plates—Treatment of.—Orthochromatic plates of whatever make, like ordinary plates, keep longer or shorter time according to method and place of storage. If kept dry and protected from atmospheric changes they will keep indefinitely, but if proper precautions are neglected they will soon deteriorate. Formulæ for working are always issued with the plates, and it is best to adhere to them. It is an error, however, to think that any special treatment is required, as the ordinary formula to which one is accustomed will answer the purpose quite well. The difference in treatment is not in development, but in exposure. This must be done through a screen of suitable tint, either immediately in front

or behind the lens. On this depends the success or otherwise of the operation. The screen should not be too deep in colour, or the blues will be too much lowered in tone, and the yellows too prominent. It is easy to vary the effects to any extent by varying the screen. It should be clean, free from striæ, or scratches which would injure definition. They can be made of any depth of tint in a few minutes, and stored away for use. Proceed as follows: Take good clear gelatine and soak in water till soft. Drain water off and warm till melted in the water it has absorbed. To each ounce of gelatine used add 120 drops of glycerine. Now purchase at the chemist's a penny packet of aniline yellow. A very small portion of this will colour a considerable quantity of gelatine, so it must be added sparingly to the warm gelatine till a light golden yellow tinge is given, looking at it by daylight. Filter through muslin or flannel. Have ready a few pieces of glass of good quality and free from bubbles or scratches, and clean them thoroughly. Ordinary quarter-plates will do. Level one on a table or stand, and pour a small pool of the stained and warm gelatine on to the centre of the plate, and before it sets lower another clean glass on to it, taking care not to enclose any air bubbles. The excess will, under the pressure of the top glass, ooze out at the sides. Allow a few minutes to set, when it may be cleaned, and the edges bound like a lantern slide. For use, place immediately in front or behind the lens, and in contact with the flange. It should always be in position at time of focussing, or the focus might be altered and loss of sharpness ensue.

516. Pinholes—To Prevent.—"Pinholes," or minute transparent spots upon the negative, are most frequently caused by the presence of minute particles of dust upon the film, which during exposure prevent the light getting to the film at those particular spots. To prevent pinholes, therefore, steps must be taken to guard against dust. The plates should be wiped over before being placed in the slide with a camel-hair brush, or, better still, with a piece of velvet stretched on a stick. The slide itself should also be dusted out first, whilst both it and the interior of the camera bellows should be rubbed lightly over with glycerine, to which any dust that may be flying about will stick in preference to the plate. The slides, too, should be carried in a case which is fairly dust-proof.

517. Plates—Best Method of Coating.—Hold the plate with a pneumatic holder in the left hand, and flow a pool of emulsion half covering the plate, then just tip the plate so as to cause it to flow all over, nearly the same as varnishing a negative. A good method is to use a small teapot, a large flat dish, and a pneumatic holder. In the teapot place the emulsion. Take the holder in the left hand, and with it pick up a plate, holding it over the flat dish. Now with the right hand take the teapot, and pour a small pool of emulsion right on the centre of the plate. Guide the emulsion over the plate, catching all spillings in the flat dish.

518. Plates—Best Method of Packing.—There is no better way than that of film to film, with a piece of tissue between, and wrapped up in packets of four; in fact, the Ilford method, and if chemically pure tissue paper is used there can be nought better, for they have no injurious effects even under trying circumstances. The only precaution is to keep the tissue in the dark, for if kept in a strong light some is absorbed, and if placed at once in contact with the film for a few weeks, it is certain to fog, and this is probably the cause of complaints against this manner of packing, but if the above precaution is taken, no fear of any danger need be entertained. Another safe method is by inserting strips of paper round the edges, so as to keep the surfaces of the plates separate from each other.

519. Plates, Foggy—To Renovate.—An unfailing remedy is the following; after applying it the plates work with a brilliancy equal to new: Bichromate of potash ½ ounce, water 9 ounces. When dissolved add two or three drops of hydrochloric acid, and filter. Soak the plates in this for ten minutes, well wash, and dry in perfect darkness. The plates will be as sensitive as before the bath if all the bichromate is washed out; if not, it makes them less sensitive. After this treatment it is advised, before developing, to soak for ten minutes in

Tartaric acid	1 part.
Water	1,000 ,,

and to develop with an old hydroquinone bath, or one well restrained with bromide of potassium. Another method by which gelatino-bromide plates fogged by exposure to light, or by over-cooking during manufacture, may be easily restored and rendered very clean working is by steeping in a one per cent. solution of free bromine, to which a small quantity of iodine has been added, or the following may be used:

Potassium bromide	1 ounce.
Potassium iodide	1 dram.
Water (warm)	2 ounces.

Add hydrochloric acid two ounces, potassium bichromate one ounce; when dissolved dilute to eighty ounces. The above solution may also be used to bleach out negatives having green fog; wash and redevelop with ferrous oxalate, and they will be perfectly clear. Plates restored by the above solution will require eight times the usual exposure, and must not be developed by ammonia. They make good lantern plates.

520. Plates—How to Pack for a Tour.—In packing plates for a tour there are two things to be considered—firstly, facility for packing and unpacking; secondly, bulk and weight. Messrs. Hunter and Sands sell a "book" for holding sensitive plates which answers the purpose admirably. Another excellent method of packing is described by Mr. Andrew Pringle, which is briefly as follows: The plates are packed in half-dozens in non-actinic paper, the ends of which are tightly folded at the *ends* of the package, not on top, as this prevents solidity (the secret of successful packing). The plates are then placed in a flat mahogany box, the top and front of which slide in grooves and come right away from the box. Two pieces of wood, each bearing two springs, are made, one to go between the front of the box and plates, and the other between the top of box and plates. By these two pressures the plates are prevented from moving in any direction. If there are not sufficient plates to fill the box, put some felt pads on the top for the springs to act on.

521. Plates (Spoilt)—To Clean.—Place the plates in hot water, and then into glacial acetic acid, which will instantly dissolve the gelatine; or the wet plates may be rubbed over with a pad of cotton wool dipped into a cream composed of tripoli or pumice powder and glacial acetic acid. Another simple method of cleaning plates is to make them into bundles, with small pieces of wood between (burnt matches do very well) to prevent them from sticking together, and then soak them in hot soda and water for about half an hour, when the films may be easily removed. If the plates have been varnished the varnish must first be dissolved off with methylated spirit, and then soak

as above, or simply soak them and scrape the films off with an old knife. Another plan to quickly and effectually clean spoilt dry plates: Get a pound of quicklime and pour on it a gallon of cold water. When the ebullition has ceased, add a pound of pearlash and stir up well. In about an hour, or when clear, pour off the clear liquid into a bottle for use as required. If the spoilt plates are placed in a dish and the solution poured over them, the discoloured film is very quickly removed, and a wash in clean cold water completes the process. Or, soak the plates in sulphuric acid diluted in the proportion of one dram of acid to one ounce of water, and the film will, after a few hours' soaking, readily strip off. The plates should then be rinsed thoroughly under the tap, and polished with kaolin and water, and again rinsed. They will be found perfectly clean when dry, and will only need just a rub before using. If the time can be spared, covering with a thin paste of whitening and water, allowing to dry, and then wiping off with a clean cloth, will also be found effectual.

522. Plates—To Prevent Action of Dark Slides on.—Remedy: Get some lampblack and mix with glue and water, then with a soft brush paint over the joints, or, better still, all over the back of the dark shutter. This preparation will be found very useful for all cases of light entrance in both camera and slides. It is found also that by using this on any dark paper placed between the plates for interiors halation is prevented better than any other method.

523. Wet Plates—To Prepare.—This is done by coating a glass plate with collodion and sensitising it in a nitrate of silver bath. Either positives or negatives can be produced—the former having been sufficiently described under the heads of Ambrotypes and Ferrotypes. For details of coating, sensitising, etc., see those heads, the difference between positives and negatives mainly consisting in the development. For the negative process it will suffice to give formulæ, for details refer to articles named (Nos. 480 and 500), also to Development (No. 171). The usual strength for the collodion is—

Pyroxyline	5 grains.
Alcohol (·820)	½ ounce.
Ether (·725)	½ ,,

Methylated alcohol and ether may be used for their cheapness, and answer perfectly well. The collodion is then iodised with five grains iodide of potassium, and one grain bromide of potassium. The plate, being well cleaned, is coated with this collodion, and as soon as the collodion has set is immersed in a silver bath made as follows: Silver nitrate forty grains to the ounce of water, saturated with silver iodide, either by adding two grains of potassium iodide and filtering, or by leaving in it for a short time a couple of plates well coated with collodion. The bath is then tested for acidity, and enough *dilute* nitric acid or acetic acid added just to turn blue litmus red. The plate is moved up and down two or three times, and left until all greasiness disappears. It is then developed by pouring over either

Protosulphate of iron	1 ounce.
Acetic acid	2 ,,
Alcohol	1 ,,
Water	16 ,,

Or

Water	12 ounces.
Pyrogallic acid	9 grains.
Acetic acid (glacial)	3 drams.

There are numerous developers, some of which are given under Development, and one strongly recommended is—

Ferrous sulphate	300 grains.
Acetic acid (glacial)	200 minims.
Formic acid	100 ,,
Methylated spirit	240 ,,
Water	10 ounces.

After development the plate is washed—fixed in

Potassium cyanide	120 grains.
Water	10 ounces.

washed again, dried, and varnished.

524. White Substratum—To Make.—The following are several formulæ for making a white substratum which will serve to coat opalines or paper: (1.) Take of masticated rubber 300 grains, benzole 3½ ounces. When *thoroughly* dissolved, stir in sufficient sulphate of baryta to make it as white as required. (2.) Barium sulphate ½ ounce, gelatine 1 ounce (soaked in water for two hours), bichromate of potash 2 ounces (saturated solution), chrome alum ½ ounce. Add water by degrees to make up to six ounces. Expose to light for several days, and then pour on to clean polished plate glass, let dry, and cut up to right size. (3.) The following is the formula for a good substratum: Nelson's gelatine or pure egg albumen 5 grains, water (to dissolve in) 1 ounce, whitening 1 ounce, boiling water 3 ounces. The two latter should first be mixed, and then the gelatine solution added. (4.) Put gelatine in a beaker, and add sufficient barium chloride to cover it. After allowing it to soak for half an hour, surround the beaker with hot water until the gelatine is completely dissolved. Now add sodium sulphate slowly, stirring rapidly whilst the addition is being made. Pour hot upon glass or paper. If it is required for use without the glass support, the glass should be carefully cleaned with French chalk, and the pellicle will strip off when dry. (5.) For opalines, the following answers well: Grind with a muller and plate flake white to a powder, and add gum water till a tolerable thickness is obtained, then add a drop or two of glycerine, and for white paper to be matched a small pinch of blue is necessary, for rose a little carmine or cochineal, and for mauve a little more blue. It must be used as soon as prepared, as if kept it dries, and is useless. The thickness, colouring, grinding, etc., must all be a matter of personal experiment, for no hard and fast rules can be laid down for guidance. (6.) For double transfer paper the following will answer well: Hard gelatine 1 pound, fine sulphate of baryta, or permanent white, 8 ounces, water 5 pints. Soak the gelatine in water until soft, then raise the temperature until solution is complete. Mix the baryta with water to a creamy consistency, and add to the gelatine solution. Then add water to five pints. Mix thoroughly. Then either stir into the mixture a solution of fifty grains of chrome alum in four ounces of water, or, as recommended by the Autotype Co., after the paper is coated soak it for half an hour or so in a two per cent. solution of alum just before required. With the former method the gelatine tends to become more and more insoluble by keeping, whereas in the latter the surface of the gelatine is more easily brought to the required condition. The sulphate of baryta should be reduced to as fine a state as possible by trituration. To coat the paper the white compound should be strained through muslin into a dish, standing in another of larger size, containing hot water. The paper to be coated is rolled up tightly face outwards, and the roll is laid upon the surface of the compound. The free end should then be gradually raised, and the surface of the paper will gather up a thin and even coat of the mixture. The paper having been coated should be hung over a stick and allowed to dry.

525. Yellow Collodion Film—To Make.—Make a tincture of turmeric (curcuma root) by

digesting two ounces of powdered or crushed turmeric in ten ounces rectified alcohol for three days, and filter. Make the collodion in the usual manner, but substitute a sufficient quantity of this tincture for the alcohol used to give the film the colour required. The following stains will be found effective for the purpose required: (1.) An alcoholic solution of turmeric flowed over the plate which has previously been treated with a bath of alum one ounce to water five ounces. (2.) An alcoholic solution of saffron. The same treatment as (1). (3.) 0·175 ounces of picric acid (=eighty grains) are dissolved in 1·05 ounces of hot water. The plate is first flowed with dilute sulphuric acid (one in five), and is then flowed with the picric acid solution. (4.) 0·35 ounces (=160 grains) of aniline yellow are dissolved in 10·5 ounces of spirits of wine, and the plate is flowed with the solution and dried. If aniline red be added to this stain all shades from orange to bright reddish yellow can be obtained. These all give transparent yellow films without deposit, and will be found suitable for the zinc process.

CHAPTER XIII.

PORTRAITURE.

526. Cameo Portrait—To Produce.—To obtain a bold relief make a solution of gelatine, and pour it into a shallow tray (made by sticking a rim of wax round) to the depth of about one-fifth of an inch. Sensitise this in a three and a half per cent. solution of bichromate of potash, and expose for about fifteen minutes in sunshine. To develop, squeegee it on to a piece of waxed glass exposed side up, and soak it in cold water, when the unexposed parts will swell up. Dry the surface moisture off, oil it, and take a cast in plaster of Paris. Another way: Take a negative, fix, wash, etc., and soak it for ten minutes in warm water. Then flood the plate with a solution made of nitrate of silver one grain, pyro (dry) three grains, water one ounce. Leave it in this for three or four minutes, then rinse with *warm* water, and dry with gentle heat. When dry, the lines of the negative will stand out in bold relief. The following process gives bold relief, and is used to prepare electrotypes. It was invented by Bolhövener, of Munich, as the Lichthochdruckverfahren process: One kilo of finest glue is softened by soaking in water, and then dissolved in a little water at 25° R. (=88° F.); twenty grammes of potassium bichromate are then added and allowed to dissolve. A glass plate is thinly coated with oxgall, and the above solution poured on it in the same way as collodion is used to coat a plate. This plate is dried in the dark. In a day or two the film can be easily detached from the glass, and is exposed under a negative. After exposure the film is glued to a wooden block, and developed by washing with water by means of a soft brush or cotton pad, when the plate stands out in bold relief. It is then treated with a solution of tannin, and dried. When it is reproduced galvano-plastic prints are taken from the electro in the usual manner. This process is also called photo-typography.

527. Dead Background—To Make for Positive Portraits.—To produce this effect take ultramarine 24 grains, loaf sugar 7 grains, gum arabic 6 or 7 drops, oxgall 4 or 5 drops. These ingredients must be mixed on a piece of ground plate glass and ground with a muller, either of agate or of glass, with one smooth surface. With this grind all together until thoroughly mixed and very fine. Then get a sable pencil of moderate size, take up some of the colour from the glass, and go around the edge of the portrait on one side, and work from the portrait to the edge of the glass; then do the same on the other side. Now leave to dry, which it will do in about a minute; when dry, take a dry sable pencil and go over the ground with the powder dry colour of the tint the ground is wished to be. If a very fine ground is desired, grind the colours with a little Canada balsam and turpentine, and with this work over the background instead of the plain colours, but be sure not to let it touch the head or dress of the figure or the picture will be spoilt.

528. Double Portraits—To Produce.—Several very clever illusions can be effected by means of double exposure, and this is considerably easier than reflection. One of the best is a man playing chess or cards with himself. This is done by means of a black background. In the centre of the picture place a table on which are put the required ornaments; then place (on one side of the table only) a chair on which the subject sits, and arrange him or her according to taste. Be sure and not have any part of the subject overlapping the table. Expose the plate, and note the time accurately. Remove the chair and take it round to the other side; arrange subject, and give exactly the same exposure as was given before.

529. Drapery—To Improvise.—The best imitation of Grecian robes can be obtained by using "Liberty" art fabrics and oriental silk; they are very cheap and effective. They can be obtained from Messrs. Liberty, of Regent Street, London. A very useful and good imitation also of the classical Grecian robe may be made of the material supplied by drapers called nun's veiling, a soft woollen thing falling in graceful folds, and if procured of the tint called ivory (if a very light figure is needed) some charming effects may be obtained. It may be purchased from one shilling per yard upwards, and being of double width is well suited to the purpose. Another way is to make them of calico, dyed a slate colour. Dip some pieces about two inches wide and about a yard long in some dark brown dye, and it will do splendidly for trimmings for the costume, the colours coming out well in the photograph. The photographer can show his ingenuity by sewing the trimming in various fancy patterns on the dress, which is much improved by so doing.

530. Freckles—To Mitigate.—They may be mitigated in a considerable degree by bathing the face in very warm water immediately before sitting. A still more successful way to prevent their appearance on the negative is to get the sitter to apply puff powder of a yellow colour to the face. Common violet powder will answer if with it be mixed any harmless yellow powder such as turmeric.

531. Ghost—To Produce Effect of.—A good sample of "ghost picture" may be obtained by photographing a group of men playing cards, etc., through a wet sheet, a man rushing in between the sheet and the group with outstretched arm just as the first exposure is made; then remove

the sheet, and expose on the group in the usual way on the same plate. Another way: A model got up as a ghost is posed in the middle of an apparently terrified group of performers, and a plate is exposed; the lens is capped before the exposure is completed; the ghost quietly walks away; a further uncapping and completing of the exposure gives a ghost picture. *La Nature* improves upon this original method. The terror-stricken victim is seated in front of a house, and an ordinary exposure given. The sheet-clad ghost then stands before him, the camera is brought forward so as to take the ghost of a size that almost fills the picture; a momentary re-exposure is then given, which is quite enough to cause a shadowy impression of the ghost, but not to injure the rest of the picture.

532. Miniature Portrait—To Produce.—Procure an ordinary engraving, pin it out flat on a well-lighted wall, in the centre of which lightly stick the photograph to be reduced. Now place the camera at such a distance as to enable the picture to be reduced the required size, and focus the engraving. By this means the photograph itself, which would be too small to see distinctly, would be also in focus. Micro-photographists, please note.

533. Opal Portrait—To Modify Background on.—The easiest method of obtaining this is by vignetting. If development opals are used, cover the opening with tissue paper, and give a longer exposure. Or gum thin tissue paper on back of negative, and work upon that over the objectionable background with stump and black-lead. Another method is to work on the opal itself, as described in Dead Background (No. 527), *q.v.*

534. Ordinary Room—To Produce Portraits in.—It is certainly not the easiest task to produce a soft rounded portrait in a room illuminated by one window only, but, at the same time, many good effects can be obtained. It is said that the portrait studies of one of the most medalled workers now exhibiting are almost all taken in an ordinary room. For a soft portrait care must be taken to avoid too strong a lighting, and the sitter should receive as full an illumination as possible on the shadow side from screens placed in the direct light from the window. A piece of white cardboard should be arranged at such an angle as to soften the shadows under the eyes and nose, and for this end also it is often advisable to screen the light from the upper half of the window by a blind or dust sheet. With very little trouble, very pleasing Rembrandt effects can be obtained by placing the sitter against the light. The lens should, however, be protected as much as possible from the direct light from the window, and the plate should be backed, or there is danger of the result being marred by more or less halation. Mr. Robinson, in his "Picture Making by Photography," recommends placing behind the sitter a simple two-leaf screen. The light from the window falls on the leaf behind the shaded side of the head, leaving the other leaf in dark shadow, with the effective result of producing a background that is dark behind the lighted side of the head, and light behind the shadowed side. The excessive hardness which spoils so much amateur portraiture is probably due to too strong illumination of one side of the face as compared with the other. The remedy is simple. Place the sitter three or four feet from the window, so that the light falls partly on the side, and partly on the front of the face, and on the other—the dark side—place a clothes-horse or large screen, on which is hung a white sheet or tablecloth, of sufficient size to reflect the light to the dark side of the face. The best way to adjust the distance and angle of the white reflector is to focus the sitter, and observe the lighting of the face on the ground glass while an assistant moves the screen and white cloth nearer or further, and alters its inclination or angle until the best effect is produced. This can be ascertained easily in a few minutes. Avoid casting a shadow of the nose on the cheek. The screen should, as a rule, come as near to the sitter as possible, without coming within the field of the ground glass. It is impossible to give precise directions about exposure; with an extra rapid plate, good light, and a R.R. lens at f/8, it should be about four or five seconds. It is better to err on the side of over-exposure than under-exposure. For a dark or ruddy-complexioned sitter it might be worth while trying isochromatic plates; and, in order to lessen the necessity for retouching, some photographers recommend that the sitter should slightly powder the face all over with a puff and toilet powder. The development of the negative also is of importance, second only to that of the lighting of the sitter. To obtain softness and detail use amidol, eikonogen, or metol, with little or no bromide of potassium, and without excess of sulphite of soda. Should one of these not give sufficient density, the negative can, if developed with amidol, be rinsed and further developed with quinol; or, in the case of eikonogen or metol, a little quinol (one grain to the ounce of mixed developer) can be added to get density.

535. Outdoor Portraits—To Obtain.—Various expedients have from time to time been improvised with the object of obtaining studio effects out of doors, ranging from a blanket thrown over a couple of lines to a regular portable studio—in fact, what system or contrivance to select depends, to a very great extent, upon one's pocket. One of the cheapest and most effectual outdoor studios can be constructed from materials found in nearly every house. For the framework of the studio take the large family clothes-horse. This is usually quite seven feet high by about five feet wide (if wider so much the better), with two folding wings – one on either side—of the same size. This will be amply large for ordinary single figures. The simplest form of drapery or background—and a very good one—will be obtained by throwing a blanket over the central leaf of the clothes-horse; taking care that the coloured stripes which are often found in blankets do not form part of the background, and also that the blanket is free from creases, otherwise ugly shaded marks will spoil the effect in the photograph. A somewhat yellow blanket will be found useful. This of course will give a more or less plain ground; if a fancy one is required, a chintz or other curtain may be substituted, the side wings may be covered with sheets, either white or coloured, according to the lighting and shading required, the lighting being controlled by varying the angle with the background. It will now probably be found that the top light is too strong, so that it will be necessary to reduce it. This can be done by placing a large card across the top from one way to the other, and bringing it forward more or less over the head of the sitter, or the back part may be a card, and a piece of coloured muslin may be used in front to graduate the top lighting. In some cases it will be found advantageous to place a sheet or newspaper on the ground to act as a reflector. In this way, by studying the lighting on the sitter, and altering the positions of the wings and top light, very good portraiture can be done without any expense. Should something more permanent be required, the following will be found

very effective. Whilst still using the clothes-horse, pivot the wings to the central frame, so that they can be easily taken off and reversed right and left and upside down. Now cover the central frame-work with two backgrounds, one plain and the other graduated, or tinted (either bought or home-made), one on either side. Now proceed to cover the two wings in a similar manner, the first, say, with grey on one side and black on the other, and the second one with white on one side and a medium share of grey on the other. By varying the position of these two wings, almost any sort of lighting may be obtained. Thus for strong contrasts the black side frame may be placed on the shadow side, and the white or light grey on the light side, or if soft results are required, transpose the two side wings. By turning the central frame round, either a plain or coloured ground can be obtained The top light should be controlled by a screen covered with white cloth, and by moving it more or less forward, the shadows under the eyes, chin, etc., can be controlled and softened. Another good method is to procure four pieces of deal, each four inches square and about eleven feet long, putting two of them in the ground at a distance of nine feet from the dwelling house or out-house. Let them be side by side ten feet apart, and stand nine feet above the ground; then place the other two at a further distance of nine feet and ten feet apart, the same as the first two. Then fasten a piece of stout galvanised iron wire, about nineteen feet long, to the dwelling house or out-house, as the case may be, and run it along the top of the two posts, fastening it close to the top of each post on the outside; then run some wire along the other two posts, fastening it in the same manner; there will then be enclosed a space eighteen feet long by ten feet wide. Now get two or three curtains made with rings on each side, to run easily along both wires. The curtain immediately above the head of the sitter would be better if of a dark material, the others white. It is probable some curtains may also be required at the sides; if so, more wires may also be run along the inside of the posts. It will then be found that the top curtains overlap the side ones by about four inches, and thus prevent the sun from shining through at the junction of the top and side curtains. In that way both curtains may be moved about as circumstances may require. The deep shadows under the eyebrows and nose will be avoided, and, with care, fairly good lighting obtained; but it is advisable to use a hood or shade of some kind in front of the lens, which not only prevents any light, except that which is reflected from the sitter, from entering the lens, but also increases the brilliancy of the image on the ground glass to an enormous extent. The best plan is to get a light deal box, a little larger than the camera, and about twelve inches or fourteen inches long, open at both ends, then cut away about six inches from two sides, which will allow the hand to be introduced for removing the cap of the lens, or to work the shutter; let it be mounted on a stand similar to a tripod in such a manner as to be able to be raised or lowered as required, and should also be made so that it can also be tilted if required; the inside of the box must of course be painted a dead black. It is surprising how useful such a contrivance is, and it is advantageous to use it even in a studio. Another form of portable studio can easily be made from inch deal, 6ft. in height and 4ft. 6in. in width, by having a frame made this size, and with a top or canopy on iron bars at about 135° angle. Side wings may also be made in the same way, and these should be made to swing on pivots, so as to exclude or admit light at will. The canopy should be pale blue muslin and the sides of the same colour. The background may be one uniform light or dark tint, as desired. This apparatus, which is not expensive to make, gives very good effects. Or, if this is a little too much to do, place the sitter in the shade facing the north or north-west, and use a diffuser, which can be made by making a circular frame of cane about two feet in diameter, and covering this with fine white or pale blue linen or calico. Hinge the frame at one side to a stand about six feet high, and fasten a string to the other side of frame, and carry the string through a hole in the stand, and raise or lower it by winding round a hook. This will, when placed in position over the sitter's head, diffuse the light, and prevent to a great extent the deep shadows which are so objectionable. A combination of this diffuser and an ordinary domestic clothes-horse forms a capital substitute for a portable studio. Be careful not to use too strong a light on the side and from the top, nor too much pyro and restrainer in the developer. By extemporising something as suggested, and giving longer exposures, using a very large surface as a reflector and developing fairly quickly, using considerably less pyro and restrainer and more accelerator, more harmonious gradation will be obtainable. As regards lighting, a front and side light ought to give good results for out-door portraiture. Dark faces are probably due to insufficient development, possibly with the addition of under-exposure, or perhaps the background used is too light. Use a fairly dark background, and, if possible, cut off some of the top light, which causes heavy shadows under the eyebrows. Or if a three-fold screen be used having one side placed at right angles to the side forming the background, and the other side at an angle of 45°, and a white cloth placed on the ground, the illumination will be fairly even; the background should be of a rather dark neutral grey and the sides white, the side at 45° being placed on the shaded side of the face. The camera should be at least twelve feet from the sitter.

536. Photo-crayon Portrait—To Produce.—This is a method of producing a delicate style of portrait, consisting of a transparency on glass, the lights of the portrait being formed by a tinted paper backing. The picture is made from an ordinary portrait negative, which should be soft, sharp, and clean. Place the negative in a copying camera for transparencies, or in the window of a darkened room, and proceed to make a transparency from the negative. Provide a screen outside the camera, and in advance of the negative, of a somewhat oval shape, and allow the light to pass through this aperture on to the negative so that only the head and shoulders are visible, the rest being vignetted gradually away. Make the image to yield a head of about an inch and a half in size. Any ordinary good bromo-iodised collodion will do if half a grain of chloride of ammonium to the ounce is added. The nitrate bath should be as nearly neutral as can be worked without fogging. The developer should be—

Pyrogallic acid	2 grains.
Citric acid	½ ,,
Glacial acetic acid	30 minims.
Water	1 ounce.

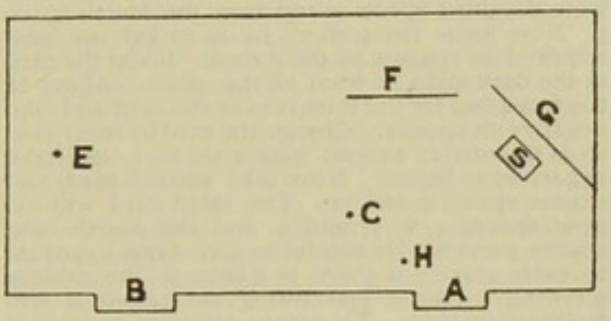
The exposure should be abundant. If the image is under-exposed, or too much developed, it will be a disagreeable colour, and be deficient in delicate definition. During development the action must be carefully watched, something like developing a glass positive, and directly the details are visible, without washing off, saturated solution of hypo-sulphite must be flooded over the plate to fix it. When fixed, the plate must be well washed and dried, and, if the operation is perfect, the transparency will show, when laid on white paper, as a

portrait with a white vignetted margin, the whites in all cases being supplied by the paper backing. Much of the beauty of these pictures is due to the tinted backing not being in absolute contact with the image. These pictures can be produced by the magnesium light.

537. Plate, Head on a—To Photograph.—This curious phenomenon is produced by getting the sitter to hold half a plate against his throat above his collar, and covering the remainder of his body, including the hands, by hanging a black cloth in front, then cover the face, get the sitter to hold out his right arm as if in the act of holding something, and take another plate without shifting the camera. In printing, superpose so as to get the bodiless head with plate beneath exactly over the outstretched hand.

538. Portraits—Best Method of Producing.—The following hints are abridged from a well-known writer: One of the most important of all accessories for home portraiture is the background. Nothing is so painful as to see a fine head spoilt by some not always artistic wall paper, which is generally so sharply focussed that one may count every petal on some impossible flower, or see joins and irregularities in the said paper. If it is desired to turn out artistic work, wall papers must be avoided as a rule; rarely do the patterns lend themselves for use as backgrounds, and even when they do should be thrown out of focus, so as to become mere suggestions rather than concrete shapes. A practicable background may be made out of the so-called felt paper, or wide brown paper as used under carpets; this may be obtained from any house furnisher, about six feet wide and any length. A more durable background may be made of the materials used for blinds, and with this two or three backgrounds may be obtained without much expense. Thus a pale buff may be chosen which will give a pale tint suitable for dark people, and by choosing also a deep green or deep red, a dark background is provided suitable for fair hair, light or white dresses, and children. It is advisable to choose rather a lighter tint of any colour than is actually desired, as in the poorly lit room the tint will appear darker than it really is.

In attempting portraiture in rooms not specially built for the purpose, the great difficulty to contend with is want of light, and power to control what light there is. The light streaming in from a narrow window gives a somewhat bright illumination to one side of a sitter's face, and the other is in somewhat dark shadow; and as the plates used have a tendency to exaggerate this shadow, without an inordinately long exposure, "soot and whitewash" results are obtained. To modify this state of things must be the artist's chief endeavour, which can be mainly accomplished by placing the sitter, and the use of reflectors. A large reflector like a sheet will be found more useful than a small one, and may be conveniently supported on a clothes-horse. It is frequently desirable to use a reflector outside the window—as it is well known how snow on the ground lights up a room; a sheet spread on the ground, when practicable, is very useful. As to lens, the rapid rectilinear is to be avoided, as it has such a depth of focus and cuts so sharply, that that roundness and softness which is obtained by the use of a portrait lens are lost, and it is difficult to compensate for this by any system of throwing the image out of focus. In the absence of a portrait lens, the next best is a single lens of rather long focus, working at a somewhat large aperture, say f/8. The best plate to use is as sensitive a one as can be obtained, and, by preference, *colour-sensitive*, that is, isochromatic or orthochromatic, because there is less work for retouching, and freckles and sallow skins or yellowish lighting have, therefore, less influence. The farther the sitter can be placed from the window, the softer and more harmonious the lighting, and the better will be the results obtained. The following diagram may serve to illustrate the best positions for sitter, camera, etc.



A and B are two windows; B should be blocked out entirely by blinds or curtains. The softest and most harmonious lighting may be obtained by placing the sitter at S, the background at G, reflector at F, and the camera at either C or H, according to whether profile or full face be required. For full length the camera will have to be placed about E. An important point to note is "which side of the face gives the best picture." The question of how to avoid the "dying duck" expression, and to obtain a pleasing expression on the sitter's face is by no means easy to decide. A very good plan is to place a decent-sized mirror in front of the sitters, and allow them to look at themselves in that, when, as a rule, with sitters of mature age and sound judgment, it is by no means a difficult operation for them so to command the facial muscles as to put on a pleasing look when they can see themselves. In using artificial light the most usual means are magnesium, employed either as ribbon or in a flashlight. A good plan is to pose and focus the sitter, and to place on one side, which should be the shadow side, a lamp about one yard off and slightly to the front, just so as not to show on the focussing screen. Then use a pair of household steps, placed slightly to the side of the camera; mount these, and have some helper to remove the cap of the lens at the moment that twelve inches of magnesium ribbon are lighted. The burning ribbon is waved about so as to equalise the illumination, and the two final inches are brought so as to illuminate the shadow side of the face. A large white reflector should be used the same as with ordinary daylight.

539. Postage Stamp Portraits—To Produce.—This can be best accomplished by using one of those sets of lenses—either Victoria, which takes nine on whole-plate, or Gem, which takes twenty-four. Of course, by employing as many lenses as images required. Twelve Gem lenses would about cover a half-plate. Another method: Fix the picture on a perfectly black background, and focus the size required. Note also the limits within which the carte can be moved so as to remain on the plate. Then expose with the carte in one position, cap, move the picture, re-expose, again cap, and so on. Another method: Copy the portrait in the camera, print twelve positives, cut them to the size of the bust required, and fix them to a large card in four rows of three each. Now place the carrier over the ground glass screen and mark out the size of a quarter-plate. Divide this into twelve spaces of about one inch square, and copy the twelve photos so as to get one on each square. The only trouble in this

method is to get all the prints equally printed (and toned, if necessary). Another method: Take four thin black cards the size of the quarter-plate; on these rule out spaces in the same way as before (as on the ground glass screen). Now counting these spaces—1 2 3, 4 5 6, 7 8 9, 10 11 12. From the first card cut out space 1, from the second space 2, from the third space 4, and from the fourth space 5. Now focus the c.-d.-v., so as to get the bust required on space 1 on the screen. Insert the card in the dark slide in front of the plate. Allow in the focussing for the thickness of the card and take negative on space 1. Change the card by reversing, so as in turn to expose spaces 10, 12, 3, and take negatives as before. Now take second card, and expose spaces 2 and 11. The third card will expose spaces 4, 6, 7, and 9, and the fourth card spaces 5 and 8. Be careful to give same exposure to each space; if there is a base to the camera allowing a lateral and tilting movement it will facilitate matters. To ensure accurate register of ground glass screen and plate in dark slide when focussing, insert two pieces of card, same thickness as those used in the dark slide, between the *screen frame* and back of camera at top and bottom.

540. Soft Portrait—To Produce.—By hanging a lace curtain between the sitter and the camera, and, of course, quite out of focus, the light will be very much softened, the threads of the curtain producing an effect similar to that of chalk drawing.

541. Visiting Cards, Photographic—To Produce.—The most artistic way would be to make some stamp photographs of oneself, and mount them neatly on visiting cards, having a black border printed around them. Another method: A very artistic effect could be obtained by making a transfer on to the cards with Eastman's transferotype paper. If this is done neatly and well, a better result could not be wished for. A Woodbury print might answer the purpose. Another: To make visiting cards, expose a piece of bromide paper under negative of self, masked, so that the head occupies the left top corner only. Across the card, from the left bottom corner to the right top corner, write the name, and in the right bottom corner the address. This must be reduced to the proper size in the camera, and, having got a negative of photograph and autograph, proceed to print in bromide, and enamel. Whilst on the glass, paste a good thick note-paper to the back of the print.

542. Waist—How to Reduce in Portrait.—The retoucher may slice off, or curve the lady's waist after his own idea of shape and form and size, by first mediumising the negative and applying the retouching pencil either by stippling or comma-like touches. Supposing, for example, the lady's waist is straight, make a curved pencil line commencing about half-way between the arm and waist, gradually taking off more of the figure until the waist is reached, then more suddenly curving outwardly again over the hip, tapering off the line gradually. After this graceful curve is made, it is a case of stippling out with a pencil that part of dress which is cut off into the background, making it match as near as possible. If a plain background, then it requires rather skilful working, but if a figured one, fancy curtain, or foliage, etc., it is much easier to follow out the pattern or design. If any difficulty is found in sufficiently obliterating that portion of the dress or waist, it is finished off with a little blue colour or Indian ink (according to density required) and fine brush. This may necessitate a very slight spotting out of the print. Occasionally, however, one finds upon examining a print that the dress is a light one, with a darker background behind, in which case the whole of the work has been done on the print itself by means of a spotting-out brush. This is never so satisfactory, as in faded prints, probably having been exposed to a strong light in a shop window, although the photograph fades, the spotting remains unaltered, thus clearly showing the desirability of working on the *negative* instead of the *print*. Sometimes, however, scraping the negative has to be resorted to. This is a most critical manipulation, and is seldom successfully achieved unless by a skilled experienced retoucher. The method is, briefly, by using an exceedingly sharp knife with dexterity on the white dress, reducing the film almost to transparency by scraping. It is advisable to practise up this branch, because one can then improve wrinkled outlines of dress, etc., refractory locks of hair, too large a boot, and hundreds of little things which often play too conspicuous a part in the negative, and which are scarcely observable at the time of operating on the sitter. Sometimes a ridiculous effect is perpetrated by arranging a subject against a background consisting, say, of a carved doorway, perhaps giving him a royal crown on his head—or, if a leafy background and posed for a profile position, a leaf may come in direct line with the nose, making it twice or thrice the length. Here steps in the stippling with the pencil on the negative or spotting on the print with spotting-out brush, precisely on the same lines as the waist business. In many cases the reduction of the lady's waist may be effected by means of "spotting," as well as numerous other embellishments that adorn the finished print when turned out of a first-class establishments, such as correcting eyebrows, filling in wide partings, straightening noses, curving mouths, softening hard shadows, etc., etc. This description of what might be termed "artistic" spotting is done with water colours, either before or after burnishing, applied with the finest of brushes and the most minute of "stippling" touches. The spotter's box should contain these colours: indigo, lake or carmine, burnt sienna, Chinese white, and Indian ink, with brushes Nos. 0 and 2, some stiff gum water, and a china palette. The various tints required for matching the different tones of photographs are gained by arranging the palette thus: In a few drops of gum are ground about equal parts of lake and Indian ink until the colour appears of a deep purple. Blend this tint and work it well over the palette with the finger to ensure thorough mixing, and when nearly dry add a little indigo to one part and a trifle of burnt sienna to another, thus gaining several distinct shades that will blend with all the tones the prints may present. The Chinese white is used for touching out any black spots, and to render the other tints opaque when required for cracks and defects in copies, etc. When dry, the palette should look as bright as a burnished print, and ought not to be used until the gum is of the exact consistency to ensure that gloss. When the work is to be applied upon the *finished* photograph, if the spotting is preferred *before* rolling, the gum for mixing need not be so thick, or it might stick to the bar, and so remove the delicate manipulation of the artist. In applying the colour, only have the brushes just moist enough to take up the smallest quantity upon the extreme tip, as if they are allowed to *wet* the palette, the gloss will be destroyed and our work be very much *en evidence*. The favourite method of the "professional," to gain this exact degree of moisture, is to put the brush in the mouth, and as the colours are quite harmless there is perhaps no better practice to those who are not over-fastidious.

543. Watch Dial Portraits—To Make.—One method of making these effective decorations is to sensitise a previously talced glass with a collodio-chloride emulsion. When thoroughly dry, print the reduced portrait thereon, using a suitable oval or other shaped mask, tone and fix in the usual way, and dry over a spirit lamp or spontaneously. The film is then softened with methylated spirit, and soaked in water acidified with a few drops to the ounce of acetic acid. In this bath the film may be easily floated off if gently manipulated with a camel-hair brush. A sheet of paper is then passed beneath the film (while under water) and lifted out in contact. At this stage it is easy to cut out the portrait along the lines of the mask with a pair of small, sharp scissors. Next, pass the portrait on its temporary support into a dish of plain water, where they will again separate. Take the watch dial (previously albumenised) and pass it beneath the film in the water, and gently entice it into position by means of a camel-hair brush, being careful to avoid air bubbles. Raise from the water bath and allow to dry spontaneously. A coat of clear hard varnish over the whole dial will complete the operation. A suitable collodio-chloride emulsion for the purpose is Mr. Leaper's print-out formula as follows:

A.

Alcohol...	1 ounce.
Ether	1 ,,
Pyroxyline	12 grains.

B.

Silver nitrate	60 grains.
Water	1 dram.

C.

Strontium chloride	64 grains.
Alcohol...	2 ounces.

D.

Citric acid	64 grains.
Alcohol...	2 ounces.

Mix thirty minims B with the whole of A, add a dram of C and half a dram of D. Shake well after each addition and coat at once. These portraits can also be produced either by the carbon process or the Eastman transferotype paper.

544. White Dresses and Statuary—To Photograph.—These are always difficult subjects to tackle. We have to deal with great contrasts, and our results must show those contrasts softened down. Practically the plates must be developed so that the details in the high lights may not be blocked out before the details in the shadows become visible. If working with pyro, reduce the quantity of it, and also of bromide, in the developer, as they tend to give great contrast. Instead therefore of taking two grains pyro, begin with one-eighth of a grain, and thirty minims of each of the following solutions:

No. 1.—Restrainer.

Ammonium bromide	48 grains.
Distilled water...	1 fluid ounce.

No. 2.—Accelerator.

Liquor ammoniæ ·880 ...	1 fluid ounce.
Distilled water	9 ,,

And water two ounces.

Pour over the plate, wait patiently till the details appear, and let alone till all detail is visible. Then add another one-eighth of a grain pyro as before, and once more allow development to go on. After some minutes this will yield a negative rich in detail, but of insufficient density. Wash off the developer just used, and apply another made up as follows: Pyro 2 grains, ammonia accelerator 60 minims, bromide 120 minims, of Nos. 1 and 2 above, with water 3 ounces. Allow this developer to act till sufficient density is attained, then fix in the usual way. The precise manner of developing plates, however, depends very considerably upon the amount of exposure given them. Should they be at all inclined to be under-exposed, no amount of alkali or other special treatment will produce a satisfactory negative. At the outset it is advisable to judge of the quality of the negatives by the prints they give, and not by the appearance of the negative itself, for the most pleasing-looking negatives frequently give decidedly inferior prints. The pyro ammonia developer is recommended as the one which gives the most control. There is no doubt whatever that negatives of *every subject* should be fully exposed, and in the particular instances mentioned a certain amount of over-exposure will be of immense advantage, as in this class of work what is required is a soft negative, plenty of detail and half-tone, and brilliancy and sparkle can be obtained in printing. At the same time flat and poor negatives are not desirable, for there must be a certain amount of brilliancy also in them, otherwise no amount of after dodging will produce anything but flat and poor prints.

CHAPTER XIV.

PRINTING—VARIOUS PROCESSES.

545. Amphitype Process—To Print by.—A process in which the light forms a positive and a negative from one and the same picture. Paper is treated with a solution of tartrate of iron or peroxide of mercury, then with a solution of ammonio-citrate of iron in excess, and then exposed in the camera. A negative is obtained which gradually fades out in the dark, but reappears as a black positive if placed into a solution of nitrate of mercury, and afterwards treated with a hot iron.

546. Anthotype Process—To Print by.—A photographic process discovered by Sir William Herschel, and founded upon the sensibility of the expressed juice of flowers. Certain precautions are necessary in extracting the colouring matter of flowers. The petals of fresh flowers are carefully selected and crushed to a pulp in a marble mortar, either alone or with the addition of a little alcohol, and the juice expressed by squeezing the pulp in a clean linen or cotton cloth. It is then to be spread upon paper with a flat brush, and dried in the air without artificial heat. If alcohol be not added, the application on paper must be performed immediately, as the air (even in a few minutes) irrecoverably changes or destroys their colour. If alcohol be present this change is much retarded, and in some cases is entirely prevented. The following manipulation is recommended: The paper should be moistened on the back by sponging and blotting off, it should then be pinned on a board moist side downward, and the alcoholic tincture applied with a brush, it must then be dried as quickly as possible; the results are, however, very fugitive, and the process is practically of no use.

547. Argentotype Prints—To Clear.—The clearing bath recommended for use with the argentotype paper is as follows: Sulphuric acid ½ ounce, water 1 quart. This is used after fixation. But the following may also be used: Acetic acid 20 drops, water 1 quart, used directly after the developer is poured off. This is a much better method of removing the iron from the pores of the paper. Another clearing bath is –

Alum	2	ounces.
Citric acid	1½	,,
Water	8	,,

Or the following can be used:

Water	80	ounces.
Alum	1	,,
Sulphuric acid	1	,,

Place the print in this, and gently rub the surface with a piece of cotton wool. Then thoroughly wash and dry as usual.

548. Argentotype Prints—To Prevent Blisters in.—Blisters in argentotype prints may be caused by—(1) Too strong a fixing bath; (2) having the washing waters at different temperatures; (3) or lime in the water. Remedies: (1) Use a weaker fixing bath, and leave prints in it longer; (2) keep all washing waters, developer, fixing bath, etc., at the same temperature; (3) if it arises from this, the water must be boiled for ten minutes before using. Another preventive of blisters is to put methylated spirit in the developer, half an ounce of spirit to ten of developer. By attention to these points blisters will be a thing of the past. The same remarks apply also to all the developed bromide prints, by whatever name the process is known, of which "Argentotype" is one.

549. Blisters—To Avoid.—Blisters in silver prints upon albumenised paper are very frequent at times, and they are most annoying. When they occur they usually make their appearance upon the most prominent part of the picture, and the prints are utterly ruined. The observance of the following precautions has been found, however, to prove a pretty effective cure: First of all, to place the prints after toning in a bath of strong salt and water, say two or three ounces to the quart; secondly, to fix in a bath made alkaline by adding ten or fifteen drops of strong ammonia to the fixing bath; thirdly, not to remove the prints direct from the fixing bath, but to gradually dilute the bath away. This seems, indeed, the most important precaution of the lot. Place the bath containing the prints in the washing tank, or, if no washing tank is used, allow a very small stream of water to run in at one corner, occasionally turning the dish and moving the prints about. The hypo, therefore, will be gradually diluted out, and when this is done, the regular washing can be proceeded with. A final precaution here is to see that the washing is not too fierce, *i.e.*, that the sprays of water do not knock the prints about heavily, but, rather, that they should be kept steadily and quietly in motion. If these precautions are adhered to, blisters will be almost entirely avoided.

550. Blurred Prints—To Avoid.—In printing large sizes, any difference of moisture in either pad or paper is apt to produce cockling, which causes blurs. It is easy to make all equally dry by drying pad before the fire, and keeping sensitised paper in a drying tube. Unfortunately, sensitised paper, bone dry, does not print so well, so the best plan is to keep both paper and pad (which should be dried if unequally moist), say, all night in the same room. A backing of the oiled paper employed for copying books has been used successfully; that would, of course, prevent any absorption by the pad.

551. Bromide Prints—To Reduce.—Make the following solution:

Perchloride of iron	40 grains.
Citric acid	75 ,,
Water	1 quart.

Immerse the print in this about two minutes, wash well, then immerse in hypo. The reduction will take place rapidly, and should be carefully watched and removed, and well washed as soon as the reduction is sufficient. Another way: Soak the enlargement in a weak solution of cupric chloride until sufficiently reduced, then wash well and refix in hypo. For a good intensifier bleach the image with bichloride of mercury, and blacken with diluted ferrous oxalate developer. The oxalate solution being diluted, gives much more control over the operation, and blackening proceeds slowly and evenly. Bromide prints may also be reduced by immersing them in chlorine water, afterwards fixing in hypo. To make chlorine water, shake up some bleaching powder and water in a glass flask, to which a bent glass tube is attached by means of a hole through the cork. Add a little sulphuric acid, and slightly heat over a spirit lamp; pass the gas which comes off into water until saturated.

552. Carbon Process—To Work.—Buy the tissue ready sensitised, place it upon the negative in an ordinary printing frame, time the exposure in the most simple manner with the actinometer, take the exposed tissue from the frames, and place it in cold water with pieces of single transfer paper, lift them out and force together with a squeegee; place between blotting boards for a few minutes—until, say, half-a-dozen pictures have been thus treated—then, beginning with the first, simply develop them in warm water. When done, a rinse in cold water stops the further action; a few minutes in a solution of alum, and a final rinse in cold water, complete the operations. But this simple and easy process does not suit negatives taken in the ordinary manner, as it inverts the image, making the left hand appear right, and *vice versâ;* however, it happens that with the employment of dry plates there is a ready mode of overcoming this difficulty by simply putting the plates in the slides with the glass side towards the lens instead of the coated side.

553. Carbon Solar Prints—To Make.—Gelatine, refined lampblack, bichromate of potassium, and water, are mixed in suitable proportions. The vessel containing these ingredients is placed in a water bath, which is heated until complete admixture and the requisite degree of fluidity are reached. It is then applied to the drawing paper upon which the picture is to be finished in the form of fine spray, by means of an air blast from a cylinder charged with compressed air. The coating thus applied is granular in form, which permits the light to penetrate it to such an extent that the middle tints are saved from being washed away in the development. The pigment dries quickly, when it is ready to be exposed to the image of the solar camera, and the requisite exposure is only about one-tenth to one-fifth of the length of that required for silvered paper. The picture is developed by washing off the unimpressed or soluble pigment with hot water. For this purpose the print is wetted, and placed in an upright position on a stretcher covered with muslin; the water, under considerable pressure, is showered upon it through a rose connected by a short hose to a double faucet supplying it both with hot and cold water. The temperature and pressure are easily regulated by increasing or lessening the flow of either or both at will. Finally, the print is washed to remove the little remaining chromium salt from the paper, which being done, it is ready for mounting. The surface of the print is entirely without gloss, and the "tooth" of the paper is improved by the stippled effect consequent upon the method of applying the pigment. When required for water-colour work, a neutral grey is used instead of lampblack alone.

554. Clouds—To Print.—Print the landscape or building, etc., as usual, and then paint all over it with water-colour gamboge, leaving the sky alone bare. Then place the cloud negative—either made or purchased—in the printing frame, lay the print on it, and print, as usual, when, of course, the clouds will print on that portion only that was not coloured, *i.e.*, the sky. The gamboge will come off in the first washing water. Another way to print in clouds, make first of all a rough paper print, and divide it carefully along the sky-line. Place the sky half of this between the sky of the negative and the paper on which the second print is to be made, and print out the landscape. This done, cover the landscape of the print with the landscape half of the mask, and print in the clouds from the cloud negative. Of course, care must be taken that the landscape and clouds are lit in the same way. Another way: If the sky does not print white, or nearly so, block it out with black varnish used on the glass side of the negative. Having printed the view, take the back of a printing frame and lay the print on it. Then adjust the cloud negative, and if it is a film negative lay a sheet of glass over it to keep it in contact with the print. Now lay a cloth over the printed portion, in folds, and move it about during the time of printing, so as to avoid the formation of hard lines. Clouds can be taken best (on ordinary plates) when lighted from one side or behind. To take white clouds against blue sky, isochromatic plates and a yellow screen should be used. In all cases the exposure should be very short, and a developer giving strong contrasts used. The following answers well:

Hydroquinone	8 grains.
Potass. bromide	3 ,,
Sodium sulphite	45 ,,
Sodium hydrate	5 ,,
Water	2 ounces.

If it is desired to add clouds to a landscape negative, a little ingenuity will effect the purpose. If the sky prints a delicate grey, beautiful fleecy clouds can be gained by using transparent oil colours, such as lake, Prussian blue, and burnt sienna, which will adhere to the polished surface without any difficulty. All working up of skies should be performed upon the reverse side of the negative, as the slight thickness of the glass or film tends to soften the effect of the work upon the ensuing print. Apply the colours (which in these cases do not require any medium) direct from the tubes by means of the finger tip, covered either with kid or chamois leather, using a "dabbing" or slipping motion, and in intelligent hands any amount of gradation can be obtained by careful and delicate manipulation of the before-mentioned tints, using the brown where the highest lights are desired, the blue for the next, and the lake for the greyish tones. If the skies print perfectly white a very useful adjunct to the printing room is a sort of all-round sky negative, easily made by covering a suitable-sized piece of glass with either matt varnish or tissue paper, and paint or stump thereon a series of clouds and "sunset" streaks, either with crayon or water colour, charcoal or blacklead, and when the print is taken from the negative cover up the view part, and expose the rest under the cloud negative for a few seconds, turning the negative, if wished for every fresh print, thus gaining a variety of effects from the one series of clouds. With a little knowledge of art, clouds can readily be worked direct upon celluloid films with blacklead and stump, but unless very

carefully done might print coarse, should that side be next to the printing paper.

555. Clouds—To Print on Bromide Paper.—If a few prints only are wanted from each negative place the cloud negative in a printing frame with the bromide paper, and expose, shading the paper where the landscape is to be printed; but this method is rather slow. If a quantity are required the best way is to make a transparency of cloud and landscape negatives, place both transparencies in a frame, and make a negative by contact. Another way to print clouds in bromide, make a mask from a print for the landscape, and place between an old plate and cloud negative if a glass one, or between two glass plates if paper negative, so that the mask is one thickness of glass from the print. The idea of this is to keep the mask straight, and tone down the joint. Print view in ordinary manner, but take care to mark skyline with pencil, so as to be able to place in correct position behind mask. Whilst printing clouds, keep a piece of cardboard, cut to shape of mask and serrated, or with cotton wool attached, moving on the edge of mask, so as to prevent a sharp outline being made. Make a note of exposure for each cloud negative at certain distance from the light used, which should be a weak one, so that in future prints the clouds may be of the same strength. Or take a silver print, and very carefully cut the sky from the landscape. Expose to the light till black, which will give two masks. Place the mask exactly over the sky of the original negative, put bromide paper over, and expose. While the paper is in the frame, just slit it at each end, so as to know where the sky commences. Now substitute a cloud negative, place the other mask over the exposed part of bromide paper, lay it on the cloud negative, expose, and develop as usual.

556. Cockling of Sensitised Paper—To Prevent.—After sensitising, the paper should be hung up by two corners by clips on a line, or it may be laid over a glass rod, face up. Practically, at this stage the only danger to guard against, except dust, is that of the bottom corners curling up and touching the inner part of the paper. It is advisable to place a scrap of blotting paper at the lowest corner of the paper whilst drying. When surface dry, and before it has curled seriously, it may be laid out flat between sheets of pure blotting paper, and put under a weight until quite dry. Mr. Burton, in his "Practical Guide to Photographic Processes," describes two methods of rolling up sensitised paper after drying, and both are simple and effective. After drying partially as above, roll the paper, before it becomes unmanageable, on a roller albumenised side outwards, allowing the beginning of one sheet to lap under the end of the one before, and when a sufficient amount has been rolled up, wrap a piece of plain albumenised paper round the whole. The second plan is somewhat similar. Take a continuous roll of any ordinary pure white paper, rather broader than the sheets to be sensitised. The end of this is to be rolled a few times round a wooden roller, then a sheet of sensitised paper is laid face down on that part of the plain paper which is between the two rolls, and the rolling on to the second roller being continued, the sensitised paper is carried in with the continuous roll of plain paper. After all the paper has been passed on to the roller, and the whole has stood for an hour or two, the continuous paper is unwound, and the sensitised sheets as they come out are laid in a pile and preserved under pressure. The continuous paper should be thoroughly dried after each time of using, by being rolled from one roller to another in front of a hot fire. If the sensitised paper is required to be kept for some time, it will be found beneficial to soak the continuous paper in a carbonate of soda bath, and thoroughly dry before use, leaving the paper in the roll until required for use.

557. Colours—To Print in Various.—The following directions are given for printing in varying colours: *Red.*—Prepare the paper with solution of nitrate of uranium twenty-four grains to the ounce. Expose eight or ten minutes in sunshine. Wash for some seconds in warm water, and then immerse in solution of red prussiate of potash (potassium ferricyanide) ten grains to the ounce. Wash in several changes of water, and dry. *Green.*—Take a red print prepared as above, and immerse for a minute in solution of nitrate of cobalt. Remove without washing, and dry before a fire Fix in solution of ferrous sulphate twenty grains, sulphuric acid twenty grains to the ounce. Wash once in water, and dry before a fire. *Violet.*—Prepare the paper as in the red process. After exposure, wash in warm water and develop with solution of chloride of gold two grains to the ounce. Wash and dry. *Blue.*—Prepare the paper with potassium ferricyanide one hundred grains to the ounce, and dry in the dark. Expose till the shadows have acquired a light blue tint. Immerse for a few seconds in a cold saturated solution of bichloride of mercury; wash once in water, and then put it into a solution of oxalic acid saturated when cold, and heated to about 100° F. Wash three or four times, and dry.

558. Combination Prints—To Make.—Probably the simplest method of combination printing is that in which the figure, etc., to be introduced is taken against a light-coloured background or carefully "blocked out" before printing, printed on the paper, and then carefully painted over with gamboge; the paper is then printed under the second negative, the figure first printed being unaffected. The gamboge will come off in the first washing water. The general method, however, is to paste non-actinic paper over the portion of each negative which is not to be printed. Care must be taken to make the line of junction correspond; this is most easily done by cutting both masks from the same sheet of paper. The junction should generally be made in some portion of the background which is not prominent. The masked negatives referred to above are what are generally called combination negatives. If a negative of a combined picture is wanted on one plate, the best method is to make a transparency on a printing-out plate, and make the negative by contact from that. Assuming, for instance, that it is wished to combine in one albumenised print—(1) Clouds, (2) ordinary landscape, (3) a church, (4) a figure, proceed as follows: Make silver prints of the landscape, the church, and the figure, and without toning cut out with sharp scissors the church and figure from the last, and separate the landscape print in two at the skyline. Now with a tiny speck of gum fix the paper *sky*, the church and the figure on original negative in proper places, and make another print in which these places will remain white. Put this print under the cloud negative, slipping between the two the *landscape* half of the print, and print in clouds. Now on church and figure negatives block out with gamboge and water all but figure and church. Print each of these separately on landscape print, and the thing is done Of course, care must be taken to block out carefully, and to place the cut-out prints, etc., in their proper position. If for printing bromides or platinos, the best plan is to make a negative by copying an *enamelled* combination print made as above on an ordinary plate, and

employ this in the usual way. As another instance, take a negative of a friend fishing, who has just drawn out a small fish, and as a joke is desired, take another negative of a Wellington boot, obtain a print from this, and cut out the boot, placing it as a mask over the fish and at the end of the line. Print out the friend and surroundings, and then block him out with the gamboge; it is done in a few minutes. The white portion may then be printed on the boot negative, and the gamboge will wash off easily before toning. Note.—Always block out the portion *printed*, for it cannot be washed off and printed again.

559. Curling in Silver Prints—To PREVENT.—One method is to give them a final soaking before drying in a bath containing a little glycerine; but as this will cause them to remain always slightly limp, it is not to be advised from many points of view. If prints are rolled when *nearly* dry upon a ruler, face outward—they usually curl themselves inward—the tendency to bend in one direction will be counteracted, and unless exposed to heat afterwards they will lie fairly flat. If they have curled up badly they can be flattened by laying them face downwards upon a piece of blotting paper, and then, with a flat-edged ruler placed upon them, drawing them sharply upwards. Another method is to dry them flat, placing them between successive sheets of blotting paper, and finishing by drying under a heavy pressure until all the moisture has been taken out of them. The method mentioned above of adding glycerine and alcohol to the final washing of silver prints does not usually cause them to fade or mildew, but cannot be recommended on account of the slight dampness left by the glycerine, which causes all dust the prints may come in contact with to adhere most disagreeably. The cause of curling and cockling in silver prints is often to be traced to the description of paper used. Very highly albumenised is much more liable to this annoying feature than that known as "thin Saxe," which, though not so brilliant, perhaps, is decidedly more convenient for unmounted specimens. One method of surmounting this difficulty is to take the prints from the last water direct upon a glass or opal, lay them evenly one on another, and with a clean soft cloth absorb all possible moisture, then place them between sheets of white blotting paper, putting them away to dry for a few hours under a heavy weight. This generally is sufficiently efficacious for thin papers; but if thick, and still evincing a disposition to curl, remove from the blotting papers before quite dry, and roll them right side out upon a wooden roller—or, say, the cardboard tubes used for bromide papers. Make each print catch the last before rolling until all are wound neatly round, and when quite dry no tendency to curl should remain. Passing several prints through the cold rollers of a burnisher, between two pieces of cardboard, is an easy way of removing all unruly curling, as is also stroking upon the backs of prints with a flat-edged ruler or paper knife.

560. Diazotype Prints—TO PRODUCE.—The diazotype or primuline process, which was discovered by Messrs. Green, Cross, and Bevan, takes advantage of the property which certain diazotised dyes possess of being so altered by exposure to light that they cease to form colouring matters with certain anilines and phenols. Various colours can be obtained, and the process is equally applicable to paper, fabrics, or gelatine; it readily lends itself to decorative applications, although the colours are not very brilliant, nor can a pure white ground be obtained. A solution is prepared containing

Primuline	10 parts.
Water	1,000 ,,

The water is heated nearly to boiling point, and the primuline added and dissolved by stirring. The material (linen, silk, plush, or velvet) is immersed in the hot solution for five minutes, and care taken that the dye is evenly distributed. The material is afterwards rinsed in cold water and dried. In this state it is insensitive to light and will keep. It is sensitised by immersion in a solution composed of

Sodium nitrite	4 parts.
Oxalic acid	6 ,,
Distilled water	1,000 ,,

The material should be immersed and well saturated, drained, rinsed, and pressed between thick blotting paper. It must be sensitised and dried by weak gaslight. The process is a *negative printing process*, that is, requires a positive to produce a positive. It must be exposed (which can be done before quite dry, as it will not keep) under a transparency for about thirty seconds in sunlight to about ten minutes in diffused daylight; the action of the light bleaches the material, so that a faint image is seen. It is then developed by one of the following solutions:

For Red Tones.

β-naphthol	6 parts.
Sodium hydrate	8 ,,
Water	1,000 ,,

For Yellow Tones.

Carbolic acid (crystals)	10 parts.
Water	1,000 ,,

For Orange Tones.

Resorcinol	6 parts.
Sodium hydrate	9 ,,
Water	1,000 ,,

For Purple Tones.

α-Naphthylamine	12 parts.
Oxalic acid	1·2 ,,
Water	1,000 ,,

For Blue Tones.

Eikonogen	12 parts.
Water	1,000 ,,

For Brown Tones.

Pyrogallol	12 parts.
Water	1,000 ,,

After development, the material is well washed in water and dried. For purple prints the material should be rinsed in dilute solution of tartaric acid and dried without washing. Paper should be sized with a two per cent. solution of gelatine, with a little chrome alum, and sensitised by floating. Transparencies and opals can be made by coating glass with

Primuline	80 parts.
Gelatine	480 ,,
Chrome alum	2 ,,
Water (distilled)	9,600 ,,

Allowing to set and dry, and then sensitising by immersion in the sodium nitrite solution. Designs in different colours can be made by thickening the developers with boiled starch and applying with a brush. Wool and silk require longer exposure than cotton or linen, and the blue or purple developers are not so suitable for the former. Plush or velvet should be deprived of their dressing by washing previously to sensitising.

561. Discoloured Prints—TO RENOVATE.—The *photos must be first unmounted*, as nothing can be done with them while they are on the mounts. This is best and quickest done in the following manner. First cut the mount off all round the print to within about a quarter of an inch of its edge, and then place it face upwards into a perfectly clean dish, and pour over it *clean boiling water* until it is completely covered, and

leave to soak for about half an hour. At the end of this time, if the print has not floated off the mount, carefully pour off the water and repeat the operation. As the hot water makes the print extremely tender, it is easily torn, so it is best to leave it in the water until quite cold, but the mount can be removed with advantage before this if the dish is large enough to float the print clear of the mount. Only unmount one print at a time in the same dish. *To remove any stains* try immersing it for five to ten minutes in a clean and freshly-made fixing solution (hypo 4 ounces, water 20 ounces, strongest liquid ammonia 1 dram; two drams might be better, but try one first). This may reduce the density of the print slightly, and will probably give it a colder tone; after this the print must be carefully and thoroughly washed in cold water. If the prints are rather over-printed and stained as well, Adam Salomon's method of reducing over-printed proofs may be tried. The formula is—

Cyanide of potassium	5 grains.
Strongest liquid ammonia	5 drops.
Water	20 ounces.

As this solution acts very rapidly immediately after it begins to take effect, only one print at a time should be operated upon in the same dish, and the solution must be kept in constant motion the whole time. From *one to five minutes* is usually quite long enough to reduce a very dark print to the proper depth, and, most likely, one or two minutes would be quite long enough for a stain, without affecting the depth of the print much. Thoroughly and carefully wash, as above, which is rather difficult, because the prints have such a strong tendency to curl into a small roll when in the washing water, and also when in the solutions. The stain being most likely caused by acid being present in the mount, and perhaps also in the glue, the alkaline and bleaching solutions mentioned should effect their removal. The prints are now remounted upon mounts known to be of good and pure quality, when there is no reason why they should not keep in good order many years, but how long silver prints will keep in perfect condition is probably unknown, as so much depends upon every operation connected with them, the materials used, and the care taken of them. Adam Salomon's solution also gives the prints a cold grey tone (rather pleasant), but if they are burnished or hot-pressed the tone is made much warmer again. This opertion may reduce the prints somewhat, so it may be followed, if necessary, by retoning, as recommended on page 93 of PHOTOGRAPHY ANNUAL, 1891 (see No. 565).

562. Egyptian Vignettes—TO PRODUCE.—By this term is meant vignettes on a dark background. There are two methods of producing this effect, viz., by masking out and double printing, or by producing a vignette negative with clear glass for background. The first way is obvious to any one who has used masks, so it may be dismissed briefly by stating that the process consists simply of vignetting a print in the ordinary manner (see No. 596), and then masking out this vignette, and printing in a vignetted border in the reversed manner, *i.e.*, dark at edges and graduated towards centre. The other method saves trouble, and if carefully done yields superior results to those who like the effect. Inside the camera, and sufficiently far to give a soft outline, a cardboard stop is placed, having a hole cut in it of the required shape and size, and serrated evenly round the edge by means of an instrument described in PHOTOGRAPHY ANNUAL, 1891, page 556. The negative is then taken, taking care to use a light-coloured graduated background, and the vignette is thus obtained on the negative directly. Another way of producing these is to use a stand made as follows: On a light wooden base fix an upright bamboo with few knots in it, so as to allow a piece of wood to slide in the hollow of the bamboo. This piece has holes bored in it at intervals, so that a pin may be passed through them and the height of the stand adjusted. It also has a cross-bar on top, on which may be hung various sized and shaped vignettes as required. These vignettes are pieces of blacked cardboard with small openings in the centres. After focussing adjust the stand in front of the lens so as to get a soft vignette, expose and develop as usual. Another method: On the front of the camera or lens place an oblong box projecting from ten to fifteen inches over the lens, and wide enough inside not to intercept any light from the subject passing to the lens. Cover the inside with black velvet. In front opposite the lens make an opening adjustable to the size of the head to be vignetted. It is also desirable that the box should be arranged telescopically, as by that means a sharper or more diffused vignette can be produced at will. A simpler form can be made by cutting a vignette from an 8 × 10 or larger mount, and covering it with black velvet—of course, cutting out the opening in the velvet as well—and mounting it in front of the lens by means of adjustable rods or wires. Sometimes the vignetter is placed inside the camera in front of the plate.

563. Engravings—TO BLEACH FOR PHOTOGRAPHING.—The soiled paper, print, or engraving is to be first placed in a bath composed of a quarter of a pound of chloride of lime, and the same of soda, to about a quart of water, and allowed to remain till the paper has regained its proper tint. Next, it is removed with the utmost care into a dish of cold running water, and allowed to remain for at least six hours, the chloride of lime being by that time removed. When the paper is thoroughly dry by exposure, it must be dipped into a third bath of size and water, which will restore its firmness. Finally, it is placed between printers' glazed boards and passed through a press, which will restore the original smooth surface, in which condition it will be suitable for photographing. If prints are stained by oil, grease, coffee, candle drippings, or ink, different treatment will be needed. Hydrochloric acid diluted with five times its bulk of water forms the first bath, and into it the engraving is placed for not longer than four minutes, and then carefully washed as above. A grease spot is to be removed by placing the sheet between two pieces of blotting-paper, or covering with powdered talc, and applying a heated iron to the spot, which will melt the grease and cause it to be at once soaked up by the porous paper. Dirty finger-marks are to be removed by covering them over with a piece of clean yellow soap for two or three hours, and then washing with a sponge and hot water. The sheet is afterwards dipped in weak acid and water, followed by another hot water bath, and ultimately by cold water. Ink stains are to be destroyed by dipping the paper into a strong solution of oxalic acid, and then into one of hydrochloric acid and water (one to six); finally, the usual continuous cold bath.

564. Fabrics (Textile)—TO PRINT ON.—Messrs. Dreyfus & Worth give the following method: The surface of the material is to be prepared successively with three baths, care being taken to sensitise only such portions as are to be exposed, and to dry after each bath. The *first bath* consists of a mixture of three, six, or nine drams, according to the intensity desired, of a saturated solution of common salt with three and a half ounces of distilled water. The *second bath* is a

solution of 170, 310, or 465 grains of nitrate of silver in three and a half ounces of distilled water. The proportion of nitrate of silver depends upon the whiteness of the ground; ten per cent., for instance, for a light-coloured silk, and fifteen per cent. for a dark coloured. When the material is dry, it is placed on a plate of glass, and exposed under the negative or drawing for from five minutes to an hour, according to intensity of the light The *third bath* consists of 155, 310, or 465 grains of hyposulphite of soda in three and a half ounces of water, the strength as before being graduated by the shade or depth of impression. Finally, the material is thoroughly washed in rain water and dried. (See also No. 588.)

565. Faded Prints—To Restore.—One of the most reliable methods for restoring a faded print upon *albumenised* paper is the following, which emanates from a good old authority—Davanne. If the print is mounted, it must be soaked off, and well washed to ensure its freedom from any mountant Then immerse in a solution of neutral chloride of gold and potassium, in proportions of four grains of gold to four ounces of water. Let the print remain in this until sufficiently restored, wash well, and then refix in an ordinary hypo bath—two ounces of hypo to ten of water—and thoroughly wash in the usual manner. These manipulations should be carried out in a subdued light. Another way: If the print is a valuable one, and has turned yellow, not stained, it would be as well to first endeavour to make a negative from it with an ordinary plate, *not isochromatic*. The yellow image will then produce a much darker print from the negative. A method which was introduced by H. Laudaurek, of Teschew, for combined toning and fixing bath for the regulation of faded albumen prints, and for which he was awarded a silver medal by the Photographic Society of Vienna in 1888, has been extensively quoted in the photographic press, and is as follows:

A.

Distilled water ...	5,000 c.c. or parts.
Sodium tungstate ...	100 grammes or parts.

B.

Distilled water ...	400 c.c. or parts.
Carbonate of lime (pure)	4 grammes or parts.
Chloride of lime ...	1 ,, ,,
Gold and sodium chloride	4 ,, ,,

B is made up in the order given in a well-corked yellow, or non-actinic coloured, bottle, and allowed to stand for twenty-four hours, then filtered into another similar bottle. The faded prints are well washed and placed in a mixture of 150 parts of A, and four to eight parts of B. They should remain in this bath for about ten minutes, until they take a beautiful clear purple tone. They should then be washed and fixed in solution A 150 parts, hyposulphite of sodium 15 parts, until all the yellowness has disappeared, which in some cases will require an immersion of three to five hours. Finally, wash thoroughly in running water, or many changes. Another method is to proceed as follows: Immerse the prints for ten minutes in the milky-looking first water that comes from the washing of albumenised prints prior to toning—this proceeding assists very materially the re-toning—then immerse in the toning bath, which must be at a temperature of seventy to eighty degrees. This will bring out in about ten to fifteen minutes the *almost* disappearing detail (that which has gone is done for). When the colour, etc., seems good enough, rinse in water, and place the prints in a solution of hypo 1 ounce, liquor ammonia 4 drams, and water 20 ounces, for fifteen minutes, and the yellow colour will disappear, and so accentuate the image; wash well, and if the prints are valuable, mount and *copy* them, and the final result will be a decided advance on the original. Don't be tempted to bleach the whites of prints with mercuric chloride, for it will certainly jigger them.

566. Feer-type Prints—To Produce.—This is one of the diazotype processes, and was discovered by Dr. Feer, in 1889, and differs from the primuline process in producing a positive from a negative, whilst the image prints out during exposure like a silver print. Both this and the allied primuline process depend upon the property which is possessed by diazo compounds of being acted upon by light in which condition they are differently affected by phenols and amines. For the primuline process, diazo-primuline is decomposed where the light acts, and so loses its power of yielding colouring matters in combination with a phenol; whereas, in the Feer-type, the sensitising agent used is a mixture of phenol and a diazo-sulphonic acid, which is colourless until the light acts upon it and decomposes the diazo-sulphonic acid, when the liberated diazo-compound is able to exert its powers of forming colouring matters with the phenol or amine, thus *producing* the colouring matter where the light acts. The paper or fabric is sensitised with one of the following mixtures, dried in the dark, and exposed behind a negative for about five minutes to sunlight. The print is afterwards fixed by washing with water or dilute hydrochloric acid, and afterwards with water. This washes out the unchanged compound, and the print only requires drying to finish it. The following are the sensitising solutions:

No. 1.

Sodium toluene-diazo-sulphonate...	25 parts.
β-naphthol	25 ,,
Sodium hydrate	8 ,,
Water	1,000 ,,

No. 2.

Sodium ditolyl-tetrazosulphonate	25 parts.
Metaphenylene-diamine	29 ,,
Water	1,000 ,,

No. 3.

Sodium ditolyl-tetrazosulphonate	25 parts.
Resorcinol	12 ,,
Sodium hydrate	16 ,,
Water	1,000 ,,

No. 4.

Sodium ditolyl-tetrazosulphonate	30 parts.
Resorcinol	20 ,,
Sodium hydrate	15 ,,
Water	1,000 ,,

No. 5.

Sodium ditolyl-tetrazosulphonate	30 parts.
α-Naphthol	25 ,,
Sodium hydrate	7 ,,
Water	1,000 ,,

No. 6.

Sodium ditolyl-tetrazosulphonate	30 parts.
Phenylene-diamine	20 ,,
Water	1,000 ,,

Finely powder all salts and dissolve in the water by the aid of gentle heat. A mixture may be used in equal parts of Nos. 4 and 5, or of 5 and 6. The paper may be impregnated with the mixture, exposed under a negative for ten or fifteen minutes, and after exposure washed in dilute hydrochloric acid, then with water and dried. Another mixture is diazo-pseudo-cumidine sulphonate, which with β-naphthol and sodium hydrate gives red images, with α-naphthylamine violet, and with resorcinol orange.

567. Flat Prints—To Secure in Drying.—The reason of the flatness of published prints is

because a *suitable paper is selected*, for while a Saxe paper not very highly albumenised is quite easy to keep flat, a thin paper with an enamel-like surface, such as double albumenised paper, is almost unmanageable. On taking the prints from the washing tank proceed as follows: Lay the prints face upwards in a clean towel, and blot off the superfluous water, now place the prints between *chemically pure* blotting paper. When all the prints have been so treated, place a board on the top of the pile and weight down. After a few hours the prints will be dry, then take, say, one dozen of them between two sheets of cardboard, and pass through a rolling press. In the absence of the latter, put the prints in a pile under a heavy weight or in a press for a time, and on removing they will be perfectly flat, in which condition they will remain, but paper highly albumenised will always have a tendency to curl if not kept under pressure. If the prints have curled they can be flattened by placing face down and pulling under a card in an upward direction. Another excellent method for drying prints for unmounted work is to purchase one dozen white linen handkerchiefs, and have them thoroughly washed and the wrinkles removed by ironing. Then place the prints alternately between them in sandwich fashion, and press them down for forty-eight hours, either by some heavy book, such as a volume of the *Graphic*, or by a board with a fourteen pound weight on it. The prints are then removed, and before they have an opportunity of curling, fixed in the cardboard by the corners as is done in the shop windows. The above plan is found to answer very well, and by it prints from a quarter-plate to any size can be dried without any trouble whatever. Care should, however, be taken that the prints are pressed on some smooth and soft tablecloth, so that no impression may be made by the heavy weights. Whatever method may be adopted, do not dream of using towels, as they are much too rough for such a purpose.

568. Fuming Box—To Make.—The simplest fuming box is one of the self-closing tin cans used for packing golden syrup and other semi-fluid substances; placing inside a small vessel with a little cotton wool in it, and dropping the ammonia on the wool. Fume fresh paper for about ten minutes, or when the paper is discoloured leave it in the box for an hour or two. Add a little chalk and a few drops of boiling water to the gold solution. Another really simple and very efficient plan is to utilise an old plate-box for the purpose. Cut the paper a little larger than required, and pin it by the four corners to the inside of the lid. Then sprinkle about fifteen drops of strong ammonia on the bottom of the box, put on the lid, and allow to stand for about ten minutes, when the paper will be well fumed. Another way: Provide a box of sufficient size to hold several sheets of paper. A light rack of three or four bars, apart six or eight inches, is suspended a few inches from the top of the box. To the bars wooden clips are affixed at intervals, corresponding to the length of the sheets of paper. One edge of the paper is then caught in these clips. To prevent the paper curling, sticks of the length of a sheet of paper, with a clip at each end, are provided, which being fixed at the lower edge of the sheet weigh down the paper and keep it straight. A false bottom must be made and perforated with holes. Fix in the box, and under this on a tray place a small dish of liquor ammonia. The tray must slide in and out, for the sake of convenience. Make a few holes also in the bottom of the box itself, and a few smaller ones in the lid to create a draught. The current of air causes the fumes to circulate and evenly combine with the silver. Fume the paper for fifteen minutes. In damp weather slightly dry the paper after fuming. Or make a box of any required size, but it should be at least eighteen inches deep. Put strips of wood round the edge, so as to overlap, and tack strips of felt to the upper edge of box to prevent the escape of gas. About two or three inches from top, a frame covered with coarse netting is hinged. Two or three holes, about an inch in diameter, should be made near bottom of box, and a saucer or dish provided for ammonia, which should be the strongest obtainable ('880). Put about one ounce of this in the dish, and place the paper to be fumed on the netting, and put on lid and expose for a minute or two (note the time), and then cut a corner off paper, and expose to sunlight. If the colour is red as it darkens, the fuming has not been sufficient, but when it prints grey and then purple it has been sufficiently fumed, and the shortest time which will produce this change should always be used. It will vary with different brands of paper.

569. Green Glass—To Print under.—This was originally advocated by Dr. Liesegang. The chemical action is probably that the green light produces a slightly different molecular aggregation of the silver, the molecules absorbing the rays of light more equally, and thus give a black tone. Mr. Debenham thinks that the organic salts of silver which give the characteristic richness to an albumen print are particularly insensible to the rays passing through the green glass, the image from which would therefore be essentially a chloride one. It has two great advantages—from weak negatives brilliant prints can be obtained on ordinary commercial albumen paper, and secondly by its use tones closely resembling platinotype can be obtained. Faded negatives, which will not give even a passable print, by its use produce prints equal to those taken when the negative was perfect. Its chief disadvantage is the slowness of printing—from four hours to two days—dependent upon the denseness of negative and the light. If the green glass is placed outside the printing frame somewhat softer tones are produced than if it is placed inside the printing frame. It can be attached outside the frame by elastic bands or drawing pins, and should well cover the glass negative underneath. If used in printing on matt surface paper, dark—nearly black—tones are obtained when no other method can persuade to yield anything beyond a reddish purple tint. The best glass for the purpose is a blue-green, and similar in colour to that of the green railway signal. Of course the exposure has to be prolonged, but for weak negatives the use of the green glass is of great value.

570. Hollow Surface—To Print in Carbon on.—With reference to a concave surface, the whole of the process is the same as for flat surface work, and having the concave surface ready, lay the wet print into the cavity, and press down evenly as far as possible with the fingers, but as it is utterly impossible to squeegee this down as on a flat surface, another method must be resorted to, and that is to use a small knob of wood, and, laying a piece of oil paper on the print, start rubbing in circles and gradually working round and round until the outside edge of the print is reached, and the whole success lies in the careful way this is done, as if any air spaces exist between the paper and the glass or support, it will most likely come away when removing the paper from the gelatine during development; the rubbing should not be too hard. It may be found that the print will be inclined to crease, and this must be watched and rubbed out, but steady and careful rubbing and practically moulding the paper to the cavity is what is required. With reference to convex surfaces,

which may appear an easy operation, it seems the more difficult of the two owing to the print slipping about when attempting to attach it. In attempts at moulding the paper to the bevel, however, the greatest likelihood of success is by chancing whether the print is in proper contact with the glass, and having another bevel placed on the top, and clipping the two glasses together with American clips, but the real fault is in the tissue, the paper not being thin enough to allow itself being modelled to the support, and, after all, perhaps using the concave method for both systems is the easiest, viz., applying the tissue single or double, as required to the concave surface only, and using the results for convex under the glass, and for concave by using two glasses. Although this description treats of glass work more than anything else, this equally applies to other mediums with a rounded surface, such as preserve jars would have, and has no difficulties, but in all cases perfect contact must exist, or failures will arise.

571. Kallitype Prints—To Produce.—The following is the process of working: Care should be taken to keep the paper as dry as possible. It is best kept tightly wrapped up in waxed paper. Kallitype in printing very much resembles the platinotype process. The image is printed until all details are well out. About five or ten minutes in a good light is an average exposure. The prints are then immersed in one of the following developing solutions:

For Black Tones.

Rochelle salt	1 ounce.
Borax	1 ,,
Water	10 ,,

Ten to twelve minims of solution of bichromate of potash (twenty grains to ounce).

For Purple Tones.

Rochelle salt	1 ounce.
Borax	2 drams to ½ ,,
Water	10 ,,

Ten to twelve minims of solution of bichromate of potash (twenty grains to ounce).

For Sepia Tones.

Rochelle salt	½ ounce.
Borax	1 dram.
Strong hydrochloric acid	5 minims.
Water	10 ounces.

Solution of bichromate of potash (twenty grains to ounce) ten minims.

The prints for the "sepia tone" bath must be printed very deep, and a drop or two more of hydrochloric acid must be added occasionally as needed. In immersing the prints in the developer be careful to remove all the air bubbles. Any number of prints may be developed at a time, the development generally being completed in from ten to fifteen minutes. If greater contrast is needed, the addition of one drop of a solution of bichromate of potash (as above) may be made to each ten ounces of developer. Too much of the potash solution will destroy the half-tone. Five dozen half-prints may be developed with ten ounces of solution—then it will be well to throw the developer away and make fresh — as the developing solution serves the double purpose of developing the image and also that of rendering the iron used in the manufacture of the paper soluble in the ammonia fixing bath. Therefore if it be used too long the prints will be liable to show yellow stains when finished. The developer is very cheap, and it is best to use plenty of it. The essential method of developing is to keep the prints moving about freely during the whole time they are in the solution. They should not be removed from the developing solution too soon or the yellow colour will not entirely disappear in the fixing bath. After the prints are developed they are immersed for fifteen minutes in the following fixing bath:

Liq. ammonia ·880	4 drams.
Water	1 quart.

If a considerable quantity of prints are being fixed, it is as well, to insure perfect fixation, to leave them in a second fixing bath made up the same as above for another fifteen minutes. Washing in several changes of water for about a quarter of an hour will be sufficient, and the prints can then be dried between blotting-paper. The process is very simple, and with ordinary care success is certain. The sepia tone is the most difficult to obtain and needs some practice, but the other tones are very easily obtained. The process is very cheap also. The want which it is intended to supply is a similar paper to the platinotype at a cheaper cost. It is printed much in the same way as platinotype, and a result much resembling that paper can be obtained. Some of its advantages are—(1) Cheapness, both of paper and development; (2) variety of tone obtainable; (3) permanency is claimed for it. Dr. Nicol states that it can be used on albumenised paper. Black, purple, and red tones can be obtained by varying the amount of borax in the developer, which can be used over and over again, and old developer may be used to make up new. Mr. Bothamley has tested the permanency of the prints, and finds that the black image is not altered by exposure for forty-eight hours to the products of combustion of sulphur in the air, or by immersion in a sulphurous acid solution.

572. Matt-surface Prints—To Produce.—Prints with a matt surface—that is, plain unglazed—may be obtained by using a paper without gloss, such as plain salted paper; or by using a prepared matt-surface chloride paper; or by squeegeeing a brilliant-surfaced paper upon finely ground glass; or by flowing a glossy print with ground glass varnish before the final mounting. The platinotype, bromide, and plain paper processes are those most generally used for the production of matt-surface prints. A good matt-surface may be given to prints on ordinary albumenised paper by the following process: Mount the print in the ordinary way, but be careful to avoid any lumps. Well roll, and then sift on finely-ground pumice powder. Rub gently with palm of the hand, using circular motion. Examine from time to time. Continue operation until the proper surface is obtained.

573. Metal—To Print on.—The following description is taken from Wilkinson's "Photo-engraving": Having secured a good negative, in which the lines are clear glass without veil, and the rest of the picture sufficiently dense to stop the passage of light, a sensitive solution of bitumen is made by powdering in a mortar a small quantity of the best photographic bitumen, a glass beaker is half filled with methylated ether, and into it is poured the powdered bitumen. Stir with a glass rod, and cover beaker with a piece of thin sheet rubber to prevent evaporation. Allow to stand a few hours, stir again, and pour away ether, draining the liquid as closely as possible, so as to get rid of those constituents which are soluble in the ether. Now add fresh ether, stir thoroughly, and again allow to stand and settle, putting on cover as before. After again settling, the ether is poured away, fresh being added, the mass well stirred and allowed to stand for a few hours, all liquid and semi-liquid matter being carefully drained off, after which the residue in the beaker is removed to a glass plate, and spread out over its surface, so that any ether may quickly evaporate. The object of thus purifying with ether is to get rid of those constituents of the bitumen which are insensitive

to light. When this ether has evaporated, take of the residue half an ounce and dissolve in pure benzole (free from water) fifteen ounces, allow to stand all night, then filter through filtering paper, placing a sheet of glass over funnel to prevent evaporation. Zinc or copper plates will require polishing with rotten stone and finishing with rouge, and if, after polishing, the surface is at all greasy, immerse in a weak bath of nitric acid or alum and water; wash well, and rub away any scum, then with a clean piece of blotting paper remove the water from the surface, and dry over a spirit flame. To coat a metal plate with bitumen, place it in a whirler, and when fixed in position dust surface, flow over it sufficient of the filtered bitumen solution in benzole, lower the whirler, and set it in rapid motion for about a minute, when the film of bitumen will be equalised, and any superfluous solution got rid of. The bitumen film being dry, and the negative being in the printing frame, film side up, place the coated metal upon it, face down, and having put a piece of brown paper over the back of the metal apply pressure evenly and gently. The exposure to light will vary from ten minutes in the sun to two or three hours in the shade; but if the crude bitumen is used, or the film be too thick, the exposure will be enormously increased. Prints on metal are developed by flooding the exposed plate with turpentine, and, if the exposure has been correct, the image will gradually make its appearance. Great care must be used, and when the last details are visible remove the plate from the dish and rinse with water. Now, if the image is quite perfect, immerse plate at once into a *very* weak mixture of nitric acid and water, keep the dish rocking for a minute, remove plate, and wash thoroughly under rose tap. The acidulated water will have removed the shiny appearance of the metal, and the matt surface will enable operator to see if all details are visible. If not visible, another immersion in turpentine will complete development. If there is a breaking up of the image, or the details dissolve away, then the exposure has been too short, and the plate will require repolishing, and another exposure should be made. The image being satisfactory, the water is blotted off with clean blotting paper, and the plate allowed to dry. The development of the bitumen image is not very rapid, except when the exposure has been just right; if longer than necessary, a prolonged immersion in the turpentine will suffice, as, within certain limits, there is a large degree of latitude permissible in the exposure of sensitive bitumen, provided the exposure has been sufficient. When methylated chloroform is used as the solvent, the development is much more rapid, and progress must be very closely watched.

574. Negatives varying in Quality—To Print from.—*To print from a hard negative*, and secure a good result, dodging is necessary. This takes the direction of shielding the thin parts of the negative in order to allow the very dense parts to print. A good plan is to coat the glass side of the negative with collodion, coloured with aurine, and to scrape away the collodion from the dense parts. Another good way is to coat with ordinary spirit varnish, coloured with tincture of iodine. If only a slight amount of protection is necessary, coat with ordinary negative varnish, and rub up the surface with the finger where protection is needed, so as to make it more or less like ground glass. Another plan is to cut out rough masks, and print the dense parts first, using the mask to shade the thin parts, but care must be taken in this case to keep the mask in motion, or there will be a hard line on the print.

To Print from a Flat Negative.—Good results are difficult to obtain in this case; but matters can be improved either by printing under green glass (which can be bought at the dealer's), or by staining the *film* of the negative purposely with pyro—that is, place the negative in a dish, and pour over it a solution of pyro, and allow it to soak until stained all over—or by printing on bromide paper and exposing at a long distance from the light. If the negative is irregular, that is, has a weak foreground and intense distance, expose the printing frame placed obliquely in a box, so that the most light may fall on the part of the negative which is densest, and the least light on the weakest part sheltered by the side of the box.

575. Negative with Strong Contrast—To Print from.—One way which is very successful is to gum a piece of tissue paper over the back of the negative at the edges. Over the dense portions the paper is cut away, and over the clear parts it is worked on with a lead pencil. In very extreme cases, paint on the tissue paper with some transparent non-actinic colour, such as burnt sienna, instead of the lead pencil. Another way also very good is by means of local reduction. This must be done before the negative is varnished, or else the film of varnish must be removed with methylated spirit. Any good reducer will do, but two are recommended, one of which must be applied with a small camel-hair pencil. The first is ferric chloride. A solution of this containing fifteen grains to the ounce of water is painted over the dense parts with the brush; the negative is then swilled and placed in the hypo bath. If the reduction is not sufficient, the operations are repeated till it is. The second is a mechanical reducer. A piece of soft chamois leather or rag is stretched over the tip of the finger; it is then moistened with methylated spirit, and the film gently rubbed over the dense parts with it. The outer surface of the gelatine is rubbed away, carrying the silver with it. Another way: Assuming that the negative is a half-plate one, fix it so that it won't shift, in the centre of a whole-plate printing frame with glass front. Now, placing a sheet of white paper over the negative, and holding the whole in front of a window, trace out very accurately in pencil the outline of the figures, and with sharp scissors cut the piece out. Next procure a sheet of black paper big enough to cover the glass of the whole-plate frame, and, using the aperture in the piece of white paper as a stencil, trace the outline on the black paper and cut the piece out. Now with a few pieces of gummed paper, or even a few dabs of pitch, fix the black paper with its opening in the correct position *in front* of the whole-plate frame carrying the half-plate negative, and print through to the required depth. Finally, remove the black paper mask (of course, without disturbing print or negative), and complete the printing. A few experiments will soon decide to what depth the printing must be carried before the mask is removed. If a number of prints are required from the same negative, a frame of cardboard can be made fitting tightly in front of the printing frame, and to this the black paper can be gummed. In this way the same piece will serve over and over again. Another way is to coat the plain side of the negative with matt varnish, and use the pencil or stump intelligently, and then print at the bottom of a deep box. Tissue paper can be used instead of the varnish. After taking out the print—which must not be printed deeply—expose the whole print to diffused light for a short time, so as to tone down the contrast. Again the negative may be locally reduced by carefully moistening with a brush, the dry film on the parts desired to be reduced with the ordinary fixing bath, and then applying a drop of dilute solution of ferricyanide of

potassium to each moistened portion. Only the part previously moistened with the hypo will be reduced, and when the reduction is complete, *i.e.*, sufficient, turn the water on full, and put the plate into the stream, so as to wash off the solution at once. Of course, a reducer applied to the whole film would not be beneficial in any way, as it would remove the slight detail possibly present in the shadows. As regards complete cure, it should be said that a soot and chalk negative cannot be completely cured, and can only be dodged to give a decent print. The best cure, of course, is to stop down, and expose and develop for the shadows—in other words, get a good negative, and the prints will generally take care of themselves.

576. Over-printed Photographs—To Utilise.—Employ the paper print as a transparency, rendering it translucent by waxing or other means. All that is required is a good deep print, and the toning not carried too far.

577. Paper—To Keep White in Printing.—After placing the paper in position on the negative, lay an old piece of sensitised paper over it before putting on the pad, and, should the print have to remain in the frame for several days owing to wet weather, etc., it will come off as good as when it was floated.

578. Plum-coloured Bromide Prints—To Produce.—Solutions for developing one volume of A to four volumes of B.

A.

Ferrous-ammonium sulphate	480 grains.
Potassium metabisulphite	120 ,,
Water	5 ounces.

B.

Potassium oxalate	4 ounces.
Water	20 ,,
Oxalic acid	4 grains.

With this developer washing with acid after development may be safely omitted. If, however, a slight yellow stain is perceptible after fixing, it may be removed by soaking the prints (after washing out the hypo) in a strong solution of tartaric acid. Another fairly successful method is with Morgan and Kidd's paper developed with hydroquinone, soda sulphite, and potassium carbonate. A *full* exposure must be given, and developer very weak, and takes about forty-five minutes to develop. The result is a very pleasing blue black, but certainly not a warm plum. Other methods are—(1) Warm brown or sepia tones may be produced on Eastman's bromide paper by giving one half longer exposure and using hydroquinone developer (Thomas's formula), or a diluted ferrous oxalate developer made as follows:

A.

Saturated solution of potash made acid with oxalic acid.

B.

Sulphate of iron	480 grains.
Bromide of potash	40 ,,
Citric acid	50 ,,
Distilled water	4 ounces.

For use, mix one ounce A, quarter of an ounce B, and three-quarters of an ounce water. A good negative is necessary to secure first-rate results. (2.) Use alpha paper with the combined toning and fixing bath recommended for it. This will give a great variety of tones from red to blue, which will include almost any one desired, and as the toning and fixing are combined, may suit almost any requirement.

579. Pizzighelli Paper—To Print.—This paper prints better when damped with a piece of moist blotting paper before putting into the printing frame. It should be allowed to remain in the frame until the print looks exactly as it is wished to look when finished. It is then taken out and fixed in a bath of dilute hydrochloric acid, and after washing allowed to dry. If, after printing, the picture has not depth enough, the density may be increased by developing in a bath of oxalate of potash or soda. The paper may also be printed quite dry, and the image brought out by immersing in water. Before using see that the negative is securely varnished so as to resist the damp—a necessary condition of success. It is a good plan to take an old negative box larger than the paper used, at the bottom place two thicknesses of fairly *wet* blotting paper, then two thicknesses of dry blotting paper, and above this a piece of cardboard about the same size, or rather larger, than the sensitive paper. Shut the paper up in this overnight, and it is ready to print in the morning. In the printing frame, back it with blotting paper, and do not print in sunlight. Print rather deeper than it is wanted to finish, and after steaming it over the spout of a kettle of boiling water, immerse in the acid bath (hydrochloric acid diluted one in seventy) for ten minutes, and pass through second acid bath; wash well and dry. Another writer says: Do not over-print, or it will yield a flat and buried appearance with no vigour or pure whites. A peculiar feature of this paper is that printing continues after it is taken off the frame, as the reduction of the platinous chloride once induced continues in the dark, therefore if, on taking a print off the frame, it is not printed deep enough, or there is not sufficient detail, it should be placed for a few hours in a rather damp place—of course in a non-actinic light. Then make a solution of (pure) hydrochloric acid, one part in sixty, and divide into three baths. Place the prints, face downwards, in each of these in succession for three minutes. The use of these baths is to clear out the yellow deposit which is on the paper. If there should be the slightest trace of yellow in either print or bath after the third immersion it should be placed in still another. As the cost of these baths is trifling, it is not advisable to use them over and over again, but to throw No. 1 away and substitute a fresh No. 3 for each batch of prints. After coming out of the final acid bath the prints should be well washed for two or three hours, and the process is completed.

580. Platinum Proofs, Over-printed—To Reduce.—They may be reduced somewhat by fixing in a *very* much stronger acid bath, and leaving them in longer. Over-printed proofs can be saved by developing with the bath below the normal temperature if noticed soon enough. There seems, however, no means of reducing over-printed platinographs which can be relied upon. One method which sometimes succeeds is by adding to the final acid bath half the quantity of nitric acid to the hydrochloric acid used. To prevent over-printing, at the same time to secure detail, place a piece of ground glass or an opal plate in front of the negative. The cold process will stand much more printing than the hot process. When really over-printed, and no means of reduction will succeed, a very considerable improvement may be effected by judiciously touching up the darker shadows with Indian ink and gum water. This, by darkening the shadows, throws the lighter parts into stronger relief, and produces the same apparent effect as reduction.

581. P.O.P. Prints—To Harden.—Various substances and treatments have been suggested for hardening or tanning gelatine films, but in ninety-nine cases out of a hundred it may safely be said the complex and dangerous potash alum is

employed. Lately, however, attention has been directed to the use of formalin—or formaldehyd, or formyl aldehyde — for rendering gelatine films insoluble. Formalin is a trade name for a forty per cent. solution of formic aldehyde in water. Formic aldehyde (CH_2O), at ordinary temperature, is a gas, freely soluble in water. For hardening gelatino-chloride paper, a forty per cent. solution is probably too strong, and it might be diluted considerably, and the prints immersed in the solution for a short time. It is hardly yet on the market, but manufacturing chemists, such as Hopkin & Williams, 16, Cross Street, Hatton Garden, London, W.C., would supply it.

582. Porcelain—To Transfer Prints on.—Paint the face of the print with Canada balsam diluted with an equal quantity of turpentine. Press on to the porcelain, and when quite dry the paper may be removed by wetting it with cold water and gently rubbing with cotton wool. Another way of transferring to porcelain is to use Eastman's transferotype paper, which is a positive paper analogous to the negative film, having an emulsion suitable for positive printing, coated on a soluble gelatine. After printing, developing, and fixing, it is squeegeed down on to the porcelain or other receptacle, and after drying the plate is placed in a tray of warm water, which enables the paper to be stripped off. Another way, which, however, requires more practice, is the "dusting on" or "powder process." This consists in coating the surface with a hygroscopic composition, which upon exposing through a positive or transparency becomes so altered where the light has acted that it will not absorb moisture from the atmosphere, whereas the portions which have been protected from the light quickly become tacky, and thus when dusted on with a powder like graphite, it adheres to the sticky parts, reproducing a negative from a negative, or a positive from a positive, of course *reversed*. Several formulæ are given, but a sample one is

Saturated solution of ammonium bichromate	5	drams.
Honey	3	,,
Albumen	3	,,
Distilled water	20 to 30	,,

This is flowed on and dried. The plate requires skill in exposure, and in developing other pigments may be used, as, for example, those suited for enamelling or baking on a porcelain plate. Or it can be accomplished by the carbon process: Obtain some engraving black sensitive tissue. Meanwhile, take a negative of drawing or photo, and when taken cut out a mask of black paper to fit over the negative, leaving margins of about a quarter of an inch, the central portion being, of course, cut out. When the tissue arrives, expose a piece of it under the negative provided with the mask between itself and the tissue. The exposure will be about half that required with silver paper. Now immerse the clean piece of porcelain in cold water with the exposed tissue, and when the latter is limp, squeegee it on to the porcelain, and set the two aside for five minutes. Next immerse both in water heated to 35° C., when after a few minutes the tissue will peel off from the porcelain, and by gently dashing the warm water over the black mass left thereon a positive will gradually develop out. When developed, wash in cold water, treat with a weak solution of alum, and dry in the cold.

583. Printing—To Employ Meat Jack in.—Besides rendering vignetting a comparatively easy process, it enables one to print from a cracked negative with little or no trace of the flaw, and is specially valuable when it is necessary to partially protect portions of a negative during printing. With the help of a few scraps of paper, cotton-wool, sheet lead, and a little careful manipulation, harmonious results may be obtained from inferior negatives.

584. Prints—To Reduce.—A print that has had a too long exposure in the printing frame, and therefore would be too dark if toned and fixed with others having the correct exposure, can be saved by taking it after *fully* fixing from the fixing solution, and, without washing, exposing it to daylight until dry, when it will be found to be much lighter in colour. If sufficiently reduced, it must now be well washed, to rid it of the hypo, and, if necessary, should be soaked in clean alum solution, and again thoroughly washed, to dispose of any yellowness that may have taken place in the print. Another method of reducing over-printed silver prints after toning and fixing is as follows: Make two solutions —(A) A saturated solution of carbonate of ammonia, and (B) ferricyanide of potassium 1 ounce, water 1 pint. Pour some hypo solution into a porcelain dish, and add some of A solution (about half a dram to the pint of hypo), and then add sufficient of B to make the mixture a pale lemon colour. Take one of the prints to be reduced from the fixing bath, and immerse it in the above mixture. Let it remain until sufficiently reduced, and then replace it in the fixing bath. Then repeat with the other prints. If the reduction does not take place within a reasonable time add a few more drops of B. Prints of almost any density may be reduced by this method, or they may be reduced satisfactorily by one of the following methods. *Use after fixing.* Prints much over-printed yield satisfactory results. No. 1: Make a solution of potassium *ferricyanide* 1 ounce, water 10 ounces. When all the prints are fixed add to the fixing bath enough of the ferricyanide solution to make it a light lemon yellow colour, and then put in the over-printed proofs one or two at a time. Reduction will commence at once, and when judged sufficient remove immediately to the washing water. This is a most satisfactory method, as the reduction takes place evenly, and the tone is not altered much. No. 2: Make a solution containing cyanide of potassium 2 grains, water 1 pint, and after fixing immerse prints in this. The reduction takes place slowly, and may occupy from half-hour to one hour; the tone is likely to be injuriously affected. There are also two other methods of reducing over-printed silver prints: (1) By immersing in a solution of cupric chloride; (2) by using a chloride of lime or platinum toning bath. The first method is as follows: Make two separate solutions of

No. 1.	
Calcium chloride	147 grains.
Distilled water	2 drams.
No. 2.	
Copper sulphate	249 grains.
Distilled water	10 drams.

Shake the solutions until thoroughly dissolved, then mix and filter. Immerse the prints until sufficiently reduced, wash, and tone as usual. The second method (and by far the best) is to slightly wash the prints, and tone with —

Choride of gold...	1 grain.
,, lime	1 ,,
,, soda	1 ,,
Distilled water	5 ounces.
Or	
Platinum perchloride	15 grains.
Bicarbonate of soda	15 ,,
Nitric acid (pure)	15 drops.
Distilled water	15 ounces.

Wash prints well after toning, and fix with a

rather strong hypo bath. By these means *very much* over-printed prints can be saved.

585. Prints—To Wash.—A good rotary motion can be given to the water in which prints are washing by directing the feed water through an indiarubber tube against the edge of an ordinary *papier-maché* tray in an oblique direction, near an angle and pointing towards it; the tray should be considerably larger than the prints to be washed. Another method: Have a watering can holding about half a gallon of water, and after dipping the prints into water, place them in the can and hang on tap over sink, tilting so that waste water may run off through the spout, leaving tap turned on, so that the can is always full of clean water. In a very short time they will be found ready for toning, and after fixing the same process will clear away the hypo. In cases where it is necessary to wash prints with very little water, place three dishes in a row, filled with water. Place the prints *one* by *one* from the fixing bath into No. 1 dish; thence into No. 2, giving each three or four turns as it is placed in, and finally into No. 3, where they may remain an hour, after which give a final rinse at the tap, and place between blotting-boards to dry.

586. Print Washer—To Make.—The following are descriptions of several print washers that have been found to work satisfactorily: (1.) Have a tin made 13in. in length and 10in. in depth. On the end of the tin, about two inches from the bottom, make a round hole 1in. in diameter; in the side of the tin, about two inches from the top, make another hole the same size. Place the tin under a tap, and to the tap fix a piece of *red* rubber tubing long enough to fit in the top hole of the tin. (The tubing must be of the same diameter as the holes.) To the hole near the bottom fix another piece of tubing running away to a sink. To use it, stop up the bottom hole and fill the tin with water, then let the hole go, and the water will rush out. Regulate the tap, so as to always have six inches of water in the tin. (2.) For a simple and yet efficient washing apparatus nothing is better than a circular trough; this can be made of zinc by any tinman. The dimensions of the tank, of course, depend on the number of prints to be washed; the circumference can be increased, but the depth must not exceed 7in., or the prints will not keep moving. This receptacle is exactly like a round cake tin; a very good size is 18in. diameter and 6in. deep. A hole should be cut nearly at the bottom of the tank, and a syphon made of a piece of compo gas pipe. Inside the tank, on three stops, a perforated bottom of zinc, made funnel shape, should be placed to prevent the hypo rising, the syphon at the bottom carrying off the hypo as it settles. The water to the tank should be supplied from a tap by an indiarubber pipe entering the tank at an angle; this causes the prints to revolve round and round, and keeps them from sticking together. When the tank is made give it two or three coats of Aspinall's bath enamel, and a capital and efficient washing tank is provided at the cost of only a few shillings. (3.) Get two pieces of zinc or tin of a circular form, 18in. in diameter. Draw a line from side to side through the centre. Divide this line into three parts, and cut off a third from the top. The remaining parts form the sides of the washer, and should be 12in. from top to bottom, and 18in. across the widest part. These sides are connected by means of a band of tin or zinc, 8in. wide, and of a sufficient length to go round the zinc plates, leaving three inches to spare at each end. These ends are then curled round to form convenient handles. The two pieces cut off from the sides are soldered on at the lower part of the sides; their straight sides downwards form a stand for the washer. To produce a constant change of water, the following arrangement is fixed up in the washer: First, the inlet tube, which is a tube fixed along the curved part at one side, and reaching to within three inches of the bottom. This is connected with a cross tube reaching from side to side, closed at each end, and having a row of holes on its under side, this arrangement having the appearance of an inverted **T**, the long arm being curved to fit the washer. The outlet is simply a perforated tube, placed across the other side of the washer, about three inches from the top, passing through the one side of the washer, and having a piece bent at right angles outside sufficiently long to clear the side. When in use the inlet tube is attached to the water supply tap by means of an indiarubber tube, the water striking the curved surface producing continual motion, and the surplus water escapes by the outlet. (4.) Take an ordinary cubical biscuit tin (such as Huntley and Palmer's larger ones), and give it a good coating of Brunswick black, and make a tray of either perforated zinc or of wire to fit it, placing it at about three inches from the bottom of the tin; also make a syphon of the shape of an inverted U, placing it so that one leg of the U is almost at the bottom of the tin, and the other acts as a discharge pipe, the bottom part of the U (top of syphon) to be within two inches of the top of tin. When placed under a tap the hypo, being the heavier, will go to the bottom, and be carried away by the syphon, the prints resting on the tray. The tins are about 15 × 15 × 15. (5.) First of all, make a large circular zinc tank, about 30in. in diameter, and 18in. high all round. In the centre of the bottom of the tank bore a small hole, just large enough to admit an iron pipe, about ⅜in. in diameter. Let this pipe project to a height of 8in. inside the tank, and on the end fix a hollow circular ball, perforated with small holes in every direction. Then, by any suitable means, introduce a perforated sheet of zinc to fit inside the tank about 2in. from the top. This will allow the waste water to escape without interfering with the prints. When water is laid on the pipe underneath, a current will be produced in every direction, which will thoroughly wash the print in a very short time. (6.) Make a zinc or sheet iron tank, 2ft. square, and 2ft in height, with V-shaped bottom, and then make a hole in the bottom at the point of the V, and carry therefrom a lead pipe up to the tank to within about two inches of the top. The pipe is then bent into a neck, and forms a syphon to carry off the hypo-contaminated water. A false bottom of perforated zinc is then laid in. This rests on the top of the V, and keeps the prints off the bottom. A leaden supply pipe pierced with holes, the holes pointing at an angle with the bottom, is then laid on the false bottom, and the water being turned on, a rotating current is caused, which keeps the prints in motion, while the hypo-contaminated waste is carried off by the syphon.

587. Scratched Negative—To Print from.—It often happens that the glass side of a negative has large scratches on it, which show on the print, and it has been recommended to print such negatives with a "roasting jack" arrangement If, however, the scratches be carefully cleaned and then filled up with Canada balsam thinned in benzol or chloroform, or, better still, in xylol, when dry the print will show no trace of the scratch, the refractive index of balsam being very nearly that of glass. Of course scratches on the film are fatal, and if large are never satisfactorily remedied.

588. Silk or Fabric—To Print on.—Photographs printed on fabric for dessert doyleys,

etc., look very well indeed, and if the tyro wants to propitiate the home authorities, this tip will obtain his gratitude. Suppose it is desired to print on silk (which, by-the-by, is on the market ready sensitised), pour twenty ounces of boiling water on one hundred grains of chloride of ammonium and sixty grains of Iceland moss (the best quality only costs one shilling per pound). When nearly cold, filter and immerse the silk in it for fifteen minutes. When dry, sensitise by immersing in a twenty-grain solution of nitrate of silver, acidified with nitric acid, for sixteen minutes. When dry, to prevent its being displaced in the printing frame, attach the piece of silk to a thin card, somewhat smaller than itself, by folding the edges over and securing with gummed paper (stamp paper does well). Overprint slightly, and tone in an acetate or borax bath. Tone rather bluer than required when finished. Rinse in water and fix for twenty minutes in the ordinary twenty per cent. hypo. Then wash well. Of course, after printing and before toning the cardboard is removed. Another method is to sensitise linen or cotton (doyleys, etc.) with the platinotype sensitising solutions. Print as usual and develop with the hot bath. The results are quite easily obtained, and are very effective.

589. Snow—To Utilise in Printing.—Experiments have been made to ascertain the value of snow as an aid to printing with the following results. It was found that when snow is on the ground the printing press should be turned towards the snow, and not to the sky. Four prints from the same negative were successfully made by turning the frames, the first towards a north sky, without clouds, the second towards the snowy surface, the third towards the same surface lighted by the sun, and the fourth directly towards the sun. It was observed, by noting the duration of the different operations, that the direct light of the sun acted from one-third to one-fourth quicker than if it were simply reflected by the snow; that this reflected light acted twice as quickly as the simple light of the north sky without the sun, which had an action five times slower than if it were reflected by the snow, thus showing that when clean snow is lying on the ground it is better to place the printing frames so that they receive the light reflected from it. This fact has been noticed with regard to winter landscapes, where—when under ordinary circumstances an exposure of, say, thirty seconds would be given—on account of the mass of snow, a much shortened exposure is given. Some experiments made with a sensitised paper actinometer, and also with Watkins's exposure meter, tend to prove that the light given out by the snowy surface is about half that falling upon it. The actinometer was three feet from the snow. It is also commonly stated that the exposure for a negative on a snow scene should be about equal to that given on the same scene *in summer*, and this appears approximately correct. Now, seeing that the light at middle day in winter has only one-third to one-fourth the photographic power of that at the same time in summer, it is evident the snow must reflect an enormous amount of light as compared with objects generally.

590. Stereoscopic Transparencies—To Print.—The best way of printing stereoscopic transparencies without cutting the negative is undoubtedly to first take the negative on a celluloid film, and then to bind the negative, film-side uppermost, on to a piece of glass (stereoscopic size) with two india-rubber bands. Place the glass, with the negative film towards the eye, into the stereoscope, and adjust the negative to the glass on which it is bound until it shows the proper stereoscopic effect. Then secure them in that position by a narrow strip of gum paper down the centre, back and front, binding both together thereby. This gives a stereoscopic negative, from which either paper prints or glass transparencies can be printed with facility or certainty. With a glass negative either cut the negative or mask out by any convenient means all except the two required portions on the twin negative, and print by contact on two smaller sized transparency plates—say lantern size. After developing, etc., transpose the transparencies, mounting them as usual on the ordinary ground glass. Of course the choice lies between cutting the negative and cutting, so to speak, the transparency, unless the great trouble is gone to of printing first, say, the right of the negative on the left of the transparency plate, and then the left of the negative on the right of the transparency, shielding the other portion at each operation. Another method is given by Mr. J. Leisk: Into a shutter or large board fitted against a window cut an opening, quarter-plate size, and fill in with a piece of ground glass. Above and below this opening nail two strips of wood with grooves, so as to allow a half-plate to slide through, bringing either picture alternately opposite the opening. Copy with ordinary size lantern plates, turning the negative film side away from the camera, thus producing reversed positives; but these after cutting three-sixteenth of an inch, are put right by mounting film side down on a plain glass slide, the upper surface of which is coated with matt varnish, the whole being bound round the edges the same as lantern slides. The reversed picture being viewed through the glass appears right. It is improved by a black mask between the glasses. No doubt this seems complicated on paper, but it is wonderfully simple in practice. With paper, of course, the prints can be cut and mounted reversed, or, if the negative is perfectly upright, take a strip of sensitive paper double the length of one print, and fold the two ends back so as to meet at the middle of the strip, then print both sides while paper remains folded. After printing cut through the middle, and two stereo prints are obtained, each of which may be mounted in one piece. The best method, however, is to obtain the transparency in the camera direct from the negative. The same camera and lenses may be used as for the negative, but the front will require arranging so that the distance between the lenses may be varied. The camera slides on a board at the end of which is a box, and fitting in a hole at back of which is the negative. A strip of wood is fixed so as to divide the two halves of the negative from each other. A sheet of white card or opal glass is used as a reflector. The arrangement described is shown at page 596 of the Photography Annual for 1891.

591. Transferable Prints—To Produce.—Coat the paper with a solution of Nelson's gelatine one ounce in ten ounces water, and when dry coat with the collodio-chloride emulsion. After fixing put the print in warm water, when the films will leave the paper, and may be transferred. Avoid the use of alum or the hydroquinone developer. Eastman's transferotype paper will also answer the requirements, or the carbon process, which is excellent for transparencies for transfer. Another way is to take a well-faced paper of fair strength, coat it with a level coat of soft gelatine that has not been heated over 90°; this must be allowed to set and partially dry slowly—say hanging over the sink. Next, whilst it is still mellow, coat it thickly with albumen, salted with chloride of sodium; this should be dried in the same manner as the previous coat, and sensitised

in a sixty to seventy grain silver bath, dry as rapidly as possible. This gives an insoluble coat of albumen overlaying a soluble coat of gelatine. All that is needed is to print and tone in the usual way in cold baths, and fix in hypo at about eighty, when the albumen film can be at once attached to any other support needed. The following process will also make a transferotype: Stretch trebly gummed paper (procurable commercially) upon a coating frame, and coat it with a thick layer of collodio-chloride printing-out emulsion. When dry, print under a negative in the ordinary way. Meanwhile, coat the surface intended to receive the picture with a ten per cent. solution of gelatine, and permit it to dry. The picture being sufficiently printed, immerse both the paper and the gelatinised glass beneath the surface of cold water, remove when limp, and squeegee in contact. Set aside for half an hour, keeping the back of the paper damp, when it will be found possible to peel off the paper, leaving the image on the support. The subsequent toning and fixing are then performed in the usual way. This process is due to Liesegang. The following is another process: "A gelatinised sheet of paper is damped, and when evenly saturated it is placed on a piece of plate glass, to which it is attached by means of bands of paper pasted partially on the glass and partially on the edge of the paper. When dry it is thus stretched quite flat. The dry sheet is then coated with a solution of collodion containing about one to two per cent. of gun cotton, and one and a half to two and a half per cent. of castor oil. This coating is allowed to dry. The glass, with the prepared paper upwards, is now levelled if a gelatine emulsion is to be used, though if collodion emulsion is used, this is not absolutely necessary. The paper is evenly coated with emulsion, and for printing out Capt. Abney's collodio-citro-chloride emulsion gives fine results." Having coated the paper with emulsion, and allowed it to dry, it is printed (after being detached from the glass), then toned and fixed as usual. After washing, it is allowed to dry, and the film is carefully peeled off by hand, and is ready to be transferred to opal, ivory, glass, etc. The coating of emulsion should be about one millimetre thick. Instead of the collodion emulsion, Barker's gelatine printing-out emulsion might well be used, or a gelatino-bromide emulsion.

592. Transferotype Prints—To Make.—A sheet of the transferotype paper having been exposed to light under a negative is developed. If it is ultimately intended for, say, an opal picture, then the development is carried no further than is shown on its surface, as being a good picture, pure in the whites and perfect in the details. But if it be intended for a lantern or stereoscopic transparency, then is the development carried a little further—so far, indeed, as to obliterate the details in a larger degree, leaving only the very highest lights immaculate. At this stage the development is arrested and the photograph is fixed, washed, and held in readiness for transferring. If for an opal picture, the development, as stated, is such as to show a good image on the paper. In either case, whether for opal or transparency requirement, the paper containing the picture, after having been fixed and washed, is laid down upon and squeegeed into contact with its future receptacle. By developing with pyrogallic acid, a pleasant dark brown tone is obtained, but the best results are obtainable by the ferrous oxalate developer; a solution of four parts of neutral potassium oxalate with one part of ferrous sulphate, both in saturated solutions, being employed. After being blotted and allowed to become surface dry, the plate, with its adhering paper, is placed in a flat tray of warm water, when, after about a minute, the paper may be stripped off, leaving the image adhering to the glass. It will have been divined that the transferotype paper, previous to having been coated with the sensitive emulsion, has received a substratum coating of gelatine of a highly soluble nature, while the emulsion gelatine is soluble in a much less degree. The water in the stripping bath must only be warm enough to dissolve the substratum.

593. Transparencies, Bromide—To Produce.—Naturally a picture with a paper backing will not be so good, as a transparency, as one in which the emulsion is on glass, but still bromide paper transparencies are to be made. It is necessary in the first instance to use a thin paper, as it is impossible to render the thick paper sufficiently transparent. In printing it is necessary to expose and develop so that the image appears far too dense when looked at in the ordinary way by reflected light. It is necessary to look through the paper to ascertain correct density. It can then be fixed and toned in any usual way, bearing in mind that the eventual object is a picture to be viewed by transmitted light. The print having been fixed and washed, a clean piece of glass (the same size as the print) is taken and edged on one side with strong gum or glue; the damp print is then placed face down on the glass, and squeegeed down. When dry the print will be quite flat, and is then ready for making transparent. Various waxes or oils can be used, say paraffin wax, linseed oil, or oil vaseline. If the latter be used (as recommended by Professor W. K. Burton), it should be applied and rubbed into the back of the print, and allowed to remain for a couple of hours, then the surplus can be removed with a dry cloth. A second sheet of glass is now placed in the back of the transparency, and the two glasses with the print between bound up after the manner of lantern slides. It is perhaps better, however, to get rid of the paper, and a method which has been found successful for window decoration is as follows: Lay the print flat on a glass plate, and coat it with a collodion, the ingredients of which are—

Pyroxyline	50 grains.
Castor oil	50 minims.
Methylated ether (·730)	2 ounces.
Methylated spirit (·805)	4 ,,

When this has dried, place the print in a bath composed of one dram of hydrofluoric acid to ten ounces of water (distilled). This will soon loosen the film, which should be carefully lifted up at the corners and removed from its paper support, when it should be placed in a dish of clean water and washed. Apply to the window by means of a warm solution of gelatine, about ten grains to the ounce, squeegee, and allow to set and dry. Great care must be exercised in dealing with the acid, which should not be touched with the fingers, or painful sores will ensue. Another way of rendering bromide or other prints transparent is by means of spermaceti or white wax, applied to the warm paper thus: Lay the print upon some blotting paper, and insert in an oven until warm through and hot enough to melt the wax, rub briskly over until transparent, and to remove any excess of grease place a sheet of blotting paper upon waxed side of picture, and pass a moderately hot smoothing iron over it. To utilise prints treated thus for window decoration will require some skill, as the grease will prevent them being pasted on to the glass. A mounting solution of thin glue, containing a little turpentine, will sometimes answer the purpose, but if the window is subject to the sun's rays prints quickly peel off. It is also possible to adorn the window *à la crystoleum*, that is, attach the picture with ordinary starch, when quite dry

rub as thin as possible with sandpaper, and then apply, by means of a large brush, either copal or mastic varnish for mellow tinted prints, or castor oil should white ones be preferred. Charming results are easily obtained by the application of oil colours to the transparent print when mounted upon the window, but it must be borne in mind that only the transparent tints are available, such as the lakes, siennas, gamboge, and indigo and Prussian blues. Silver prints being upon thin papers would suit this work better than bromides, and, if the edges were protected during the waxing process, they could be easily attached by means of strong gum.

594. Untoned Prints—To Restore the Colour of.—Few things are more vexing to an amateur who has little time at his disposal than the discovery that the prints made with such care ten days or a fortnight previously, when taken out to be toned are the colour of ancient parchment in those parts which should properly be white. It has been found that if the photographs are placed immediately before toning into a bath of about one part of strong ammonia to fifty of water, washed in a similar bath after toning, and about one part of the same useful chemical be added to fifty parts of the fixing solution, when ready to mount the whites are invariably restored to their pristine purity. Another method, discovered by Mr. Tyte, is to treat the brown prints with the following bath:

Solution of perchloride of iron ...	1 fluid ounce.
Strong hydrochloric acid ...	2 ,,
Nitric acid	½ ,,
Water	3 quarts.

Plunge in this bath, keeping them moving all the time, until the whites are bleached; then wash in pure water, and pass into a weak bath of hypo-sulphite of soda, not more than four or five per cent. In order to remove acid before the hypo-sulphite bath, enough finely powdered chalk or whiting to produce milkiness may be added to the last washing water, but all iron salts should be washed away first. As this bath reduces the whole picture, the brown sheets should be somewhat over-printed.

595. Uranium Prints—To Produce.—The salts of uranium are used in printing processes in which they play a part analogous to ferric salts, the print being usually developed with silver nitrate. If suitable paper be floated for five minutes on a bath composed of

Uranium nitrate	80 grains.
Water	1 ounce.

and when dry, exposed to sunlight under a negative, a faintly visible image is produced. If this is immersed in a solution of silver nitrate, a black image is produced by the reduction of the silver salt to a metallic state. The print is fixed in a weak solution of hyposulphite of soda. Or the silver nitrate may be mixed with the uranium nitrate in the sensitising bath, which produces a print-out paper requiring only to be fixed in the hypo bath. Abney recommends development with potassium cyanide, and fixing by washing in a weak acid bath. Niépce de St. Victor advised sensitising on a ten per cent. solution of uranium nitrate, and developing with a two per cent. solution of ferri-cyanide of potassium, which gives a beautiful red image, which may be toned to a greenish black by means of a slightly acid solution of perchloride of iron. M. de Brebisson's method is to sensitise on a solution of 186 grains uranium nitrate to three and a half ounces of water. Immerse five minutes, dry, and expose under strong light rather longer than for a silver print. Develop with a solution of sixty-two grains nitrate of silver to three and a half ounces of water. Tone with chloride of gold five drams of one per cent. solution in seven ounces of water, and fix in weak hypo. Mr. Handry's process is to prepare the paper with gelatine and nitrate of uranium. After exposure, the image is intensified with aceto-nitrate of silver, which brings out all detail in thirty or forty seconds. The print is then placed in the following bath:

Water	100 parts.
Ferrous sulphate	6 ,,
Acetic acid	4 ,,

and toned in a chloride of gold solution, half a grain to the ounce.

596. Vignettes—To Produce.—A very pleasing finish to many photographs, especially those of single heads, and in many cases to views, is vignetting. This is accomplished in several ways, the simplest being to get a sheet of tea-lead, such as lines the tea chests. Bend this round to fit over the printing frame, and then, having marked upon it the shape the vignette is desired to take, and a little smaller than the commencement of the fading away is desired, cut out an aperture in the centre of the lead, and, with the fingers, turn the edges slightly upwards. Print in a diffused light slowly, and the gradation, if it has been properly done, will be all that can be desired. A sheet of brown paper pasted over the frame, and cut out in a similar manner, will do well if the edges are jagged and uneven, so as to avoid a hard line. One of the best methods of doing this is to make use of a little instrument sold by Marion and Co., for evenly or otherwise serrating the edges of the vignetting card or paper. There are several other methods, one of which is—cut an oval in a piece of cardboard, serrating the edges, and lay it on the frame when printing, with the oval over the head. The card should be well raised from the plate, and it is generally advantageous to lay a piece of white tissue paper over the opening. The higher the card is raised the softer and more gradual the vignette will be. This method is used by nine out of ten professionals, but vignette papers certainly have some advantages for amateurs. The shape of the vignette paper used would be largely a matter of taste, and a few trials of different shapes would soon make it easy to choose them. Another way: Place the negative before a window, with a piece of white paper in front of it, and with a pencil trace out the outline of the figure on the paper, cutting this off at the bottom, so as to make an (approximate) egg-shaped oval. Cut off the borders of the figure traced on the paper, and employ the centre as a stencil to trace the outline on a piece of cardboard. Now with a penknife cut this out of the cardboard about ¼in. *inside* the pencil mark, and then serrate the edges of the cardboard all round to a depth of about ¼in. This gives a vignetting card with a serrated aperture, corresponding to the negative. To use this, fix it about an inch in front of the printing frame, which keep in motion whilst printing is going on. A light background is best for making negatives for vignettes. One made with "Feltine" answers admirably. Supposing it were wished to *produce* a vignetted print with only a delicate buff shadow; if so, a background of a light slate tone must be used, and such a one can be purchased from any large house furnisher in the shape of a material called "Lancaster blind"; this can be rolled up, and is quite washable, or a large sheet of light brown *carpet paper* can be used; then produce the negative, place it in a printing frame, and from a piece of cardboard cut a pear-shaped oval opening, leaving about one-eighth of an inch clear from the top of the head and sides of the face, and just below the top of the shoulders; fix this in position on the *front* of the

frame, and secure with a tack at each corner; then tip the edge of the opening all round with gum, and cover it with a piece of white tissue paper, replace the negative in the frame, and place the sensitive paper in position, and hold the frame up to the light. Then see if the opening is right or not. If too large (as it ought to be) run a brush charged with any photo black varnish over those parts of the tissue paper that allow too much of the negative to print. When this is done commence to soften the vignette by applying the tip of the black varnish (a penny camel-hair brush is good enough) brush. This makes a dot on the margin of the tissue paper. Now allow about half the diameter of the dot to remain clear tissue, and then make another dot, and so on all round. This breaks the light up, and produces a beautiful graduated effect, for two or more rows of dots can be placed wherever it is wished to procure effect in softness. If any part of the negative prints too slow—say, the drapery—it can be assisted very much by applying a solution of clear gum to the tissue paper immediately over the part. This makes the paper more or less transparent, and so prints quicker. Note that vignettes *must* be printed in diffused light, and unless the opening is covered with tissue paper proper softness cannot be obtained.

597. Yellow Chloride Prints—To CLEAR.—The yellow colour is caused by the alum decomposing the hypo and precipitating sulphur in the film, and is also dangerous to permanence. It cannot be removed, but may to some extent be corrected by immersing the prints in a dilute solution of aniline blue (Judson's dye) until the yellowness is masked. The prints should be tinted blue to dry white, as the colour is much more pronounced when wet, just as the laundress makes the clothes blue so that they may be white when dry. To prevent the yellow tint, pass the prints from the combined toning and fixing bath first into the plain fixing bath, then wash in running water for half-an-hour, alum, and again wash as before for two or three hours.

CHAPTER XV.

PROCESS WORK.

(COLLOTYPE, WOOD ENGRAVING, CERAMICS, ETC.)

598. Acid, for Etching—Best to Use.—It depends upon the metal and process what acid is used, but nitric acid is most generally used, and there is nothing better. It may be made more active by increasing the strength, but then the final result is not so good. For photo-zincography, ten to twenty etchings are usually required. For zinc plates, hydrochloric acid may be used in place of nitric, but it is better to dip the plate in a copper sulphate solution previous to etching. For copper and steel plates used in photo engraving, a solution of potassium chlorate in hydrochloric acid is best. In photogravure, a saturated solution of ferric chloride in methylated spirits diluted with twice its volume of water may replace the nitric acid. In all photo-relief block work, either line or tone, several etchings are necessary. A good strength for the first etch is acid 1 part, water 40 parts. Keep the plate in motion; patience must be exercised in order to bring about a satisfactory result. An alcoholic solution of perchloride of iron can also be used, but its action is much slower than nitric acid on zinc, and much more energetic on copper.

599. Aqua Tint—To Produce.—The aqua tint is produced by first coating the plate with bichromatised gelatine; then, after printing, pour over the surface a solution of resin and camphor in chloroform. When the plate is heated, these two latter quickly evaporate, leaving the resin in minute particles on the surface of the gelatine. These make the tint. The following is a short extract from a paper read by Mr. Bolas at the Photographic Convention of 1889. By transferring a coarsely-grained collotype to stone or zinc a very good grain image is obtained, and the coarse reticulation of the gelatine is very much facilitated by adding chloride of calcium to the sensitive mixture. Printing surfaces thus obtained, whether lithographic or typographic, resemble those of Pretsch or of Dallas on one hand and those of Sprague on the other. In order to obtain a transparency in which the tints are translated into points, lines, or dots, Algeyer and Bolhoevener have recently suggested a method in which a collotype plate is exposed under a negative, and after the plate has been soaked and inked up in the usual way, the fatty ink is reinforced by dusting with an opaque powder. This method is, of course, dependent on the reticulation of gelatine for the production of a grain. The easiest way to obtain a ground such as is required for aqua tints is to use the finest gilder's putty, and dab it evenly over the previously cleaned glass plate. The secret of success lies in using the putty in just the right condition as regards tackiness; it must not be too hard, and, again, must not be too thin. The ordinary aqua tint ground is, however, of resin (best white) and absolute spirit. Keep three bottles of different strengths in order to suit the grain of the ground to the subject. Make trial spots and examine with a magnifying glass. When right, coat the plate and lay flat at once if a round grain is required, but keep the plate sloping longer for such subjects as waterfalls, etc. Stop out the lights, border with wax, and etch with hydrofluoric acid (take care in using it, as it produces very disagreeable sores), wash off, dry, stop out first lights, etch again, wash, dry, and stop out second lights, and go through the same process for the third lights, and if the ground will stand it, apply the ordinary touching stuff, varnish, and etch the very dark parts. N.B.—Avoid "accidents," *i.e.*, specks of dust when coating.

600. Burnt-in Plaques—To Produce.—About ten years ago a patent was taken out for what may be called an imitation ceramic enamel process. It was shortly as follows: A print is taken in carbon tissue, transferred to the plaque, earthenware, or any other desired surface, and when dry coated with several coats of good colourless copal varnish, allowing one coat to dry before applying the next, and rubbing down all brush marks with glass paper, and polishing with tripoli, putty powder, etc. The prepared plate is then "fired" at a temperature of about 150° to 200° Fahrenheit, or more, for several hours, and it is not necessary that a muffle or regular enamel furnace should be employed, an ordinary gas stove will answer the purpose satisfactorily. After stoving, the surface may be polished with pumice powder, tripoli, and then putty powder.

601, Burnt-in Transparencies—To Produce.—There are two processes generally employed for these, the first of which is as follows: A collodion positive is made on glass, developed with acid pyro, and fixed. It is then toned in different solutions, according to the final colour desired. If the final image is to be gilt, a strong solution of gold trichloride is employed; if steely grey, chloroplatinic acid; if dead black, gold iridium chloride; if warm brown, a mixture of gold trichloride and uranium nitrate. When toned and dry, the glass is carefully heated in a special furnace to burn off the collodion film, then taken out and coated with a special glaze and again heated to fuse the latter. The second is—The powder process, in which a plate is coated with the following solution: One and a quarter ounces of ammonium bichromate is dissolved in five ounces of water and filtered. To this add water 30 ounces, honey 3 ounces,

albumen 3 ounces. Mix only as much as required for use; it does not keep well. Flow this over the plate, dry with gentle heat (in non-actinic light), and expose under a positive transparency to sunlight about one minute, when a negative image should be visible. Then rub the image with a large camel-hair brush charged with an extremely fine enamel powder (or metallic powder) until a perfect positive is produced when examined by transmitted light. The plate is then washed thoroughly with alcohol acidified with acetic acid, dried, washed with water, thoroughly dried, and burnt in the muffle as under: A gas muffle furnace, as made by Fletcher, of Warrington, answers the purpose admirably. Put the picture on a bit of tile in muffle, heat up gently to avoid cracking, and watch. First, the collodion film disappears, then the plate becomes red hot and the image disappears; a few seconds after this withdraw it. The following is a *resumé* of Mr. N. K. Chevril's directions for producing transparencies on porcelain, which appeared some years ago in the *Photographic Times:* A piece of glass is cleaned with nitric acid, and then given three coats of collodion. Then, before the third coating has quite set, plunge the plate into the silver nitrate bath of strength thirty grains to the ounce, which should be kept sunned when not in actual use, and when used rendered acid in the proportion of two drops of nitric acid to half a gallon of solution. Keep the plate in this bath until all greasy marks disappear, then take out and place in a funnel to drain for five minutes, when it will be ready for the camera. Behind the negative from which the reduced transparency is going to be made it is best to place a piece of finely-ground glass, and if this be used, the exposure with a fairly large stop will be from five to twenty seconds. Development comes next, and the developer is made as follows:

Pyrogallic acid	12 grains.
Glacial acetic acid	4 drams.
Alcohol	4 "
Water to fill twelve ounce bottle.	

This must be made three days before use, and must not be kept too long. Development should proceed very slowly, and the image, when examined by reflected light, must not be "filled up" in the dark parts. The plate must now be well washed, and fixed in dilute potassium cyanide, and again well washed. When the washing is complete, break off a corner of the collodion, and direct a small stream of water upon the bare glass. This will gradually loosen the collodion film, and the action can be aided with a pointed stick along the edges of the plate. When quite loose place the plate in water and slip the film off. To make the toning bath proceed as follows: Place twelve ounces of water in a bottle, add to this fourteen drams of a solution containing a quarter of an ounce of potassio-chloride of iridium in eight ounces, shake well, and add seven grains of chloride of gold, little by little. Soak the film in this bath till the desired tone is reached, wash gently, and place in some dilute ammonia solution for twenty seconds; then plunge into water containing the porcelain tablet, and then, gently manipulating the tablet, get the film in its right position on the latter (this operation is rather difficult at first, and requires considerable care from the operator); allow tablet and film to dry together, protected from dust. As soon as dry get the tablet gradually hot, and then place it in a gas muffle, and as soon as the whites of the picture are seen coming out clear, take it and coat with glaze. The solution is made by taking a thimbleful of glaze in a two-ounce bottle and filling up with alcohol. To make the glazing mixture take

Uniodised collodion	½ ounce.
Methylated ether	½ "
Alcohol	½ "
Water	6 drops.

Then add sufficient glaze solution to make the collodion look milky. When cold coat the plate with this mixture, as in varnishing, heat again, coat with glaze again, and again heat. These operations should take place about six times altogether, in order to give a perfect enamel.

602. Ceramic Photography—To Work.—This is a process by which photographs may be reproduced by being burnt in on porcelain or copper-plates, forming plaques or enamels. It is carried out by two methods: (1.) The substitution process, in which a collodion film is toned with either platinum, gold, iridium, palladium, manganese or uranium, or a mixture of these; being metals which will stand the necessary firing. It is then transferred to the porcelain or plaque upon which it is required to be burnt-in and carefully fired, then coated with glaze and refired. For fuller particulars see Burnt-in Transparencies (No. 601). (2.) The dusting-on or powder process, in which a surface made tacky by being coated with glucose or dextrine, is developed by being brushed over with a fine powder, which, of course, for this purpose, instead of being graphite, will be a powdered enamel, which will yield the required colour after firing. See Dusting-on Process (No. 607, also No. 601 for details of burning-in).

603. Collotype Process—To Work.—The collotype process is simpler than photo-lithography, but requires a press and lithographic roller. A ground plate glass is first covered with a substratum of soluble glass solution, with albumen; this is dried, and the plate then coated with solution containing gelatine and either bichromate of ammonium or potassium, and again dried. It is then printed under a negative, *which must be reversed*, till a light brown image is produced. The plate is then laid film side down on a piece of black velvet, and exposed to light through the back for a few minutes; it is afterwards *developed* by being washed in cold water until all yellow colour is washed out. When dry it is printed from in a lithographic press, being first damped with a solution of salt and water containing glycerine; this keeps it damp, and it is inked with a lithographic roller and ink, being again damped when the high lights begin to get smudgy. To make a collotype plate that will give perfect impressions proceed as follows: As a substratum for the plate take ten ounces of ordinary dinner ale, six or eight drops of silicate of soda, and well shake into a froth in a bottle and let it stand for twenty minutes and filter. Take a clean glass plate (patent is best), and with a camel-hair brush go over one side of the plate, and set on end to dry. When dry go over the plate again, this time letting it dry the other way up. Again dry, allow a gentle stream to run on it for thirty seconds, and again dry on end. When again dry coat with the following solution: Forty-four grains of Nelson's ordinary gelatine, soaked for a quarter of an hour in cold water, then heated in the oven till all is melted. Then pour into it the following *hot* solution: Water ½ ounce, bichromate of ammonia 6 grains. Well mix and filter. On no account allow the solution to boil. Take an 8 × 5 plate with the dried substratum upon it, and flow over half an ounce of the hot gelatine solution. Place at once on the bevelled glass in the drying box. It should dry in two hours, and is ready for instant use. Expose under an ordinary negative for an hour, then wash in cold water for one and a half hours, and dry in the open air, which takes from

four to six hours, according to weather. When dry, damp with very weak glycerine and water, allow the moisture to slightly evaporate, roll it up with lithographic ink, with a velvet roller and print, taking impression off at once. The drying box may be made thus—twenty inches high, twelve square, levelling glass six inches from top of box, three sheets of loose blotting-paper on it for the plate to rest on, a piece of iron about 6 × 4 × 3 heated in the fire, and placed six inches under the levelled glass. There should be three or four holes at the bottom sides of the box and three at top to secure a thorough draught, and the heat should not be more than 120° F.

604. Copper Plates—To Clean for Photogravure.—Cover a small block of wood, quite true and smooth on one side, with fine emery cloth, and work the plate down with this, using some oil, until the etching is got rid of; then polish the plate with fine emery flour and oil, and finish with powdered chalk and a felt pad. The hand is very useful in getting a good polish—jewellers give the last polish to bright silver goods with the hand and Crocus powder. This is very fine, a kind of fine rouge. However, oil and chalk is the proper thing, take care to avoid scratches, and to remove any small holes, flaws, or surface markings. If the plates have not been etched, clean off the resist with turps or methylated spirit, lay the plate upon a flat support, and sprinkle *with fine emery powder.* Moisten this with a little of a mixture of equal parts of wood naphtha and turps, polish thoroughly with a piece of clean lint until the whole is quite dry and bright, now sprinkle with a little washed whiting, moisten again with the naphtha and turps, and polish off with another clean piece of lint. It is then ready for use again. The important points are—keep the plates perfectly flat, and be sure and thoroughly remove scratches and other marks before polishing.

605. Copper Plates—To Print on for Engraving.—The simplest method is to use a solution of asphaltum in chloroform or benzole, flowing the solution over the plate very thinly, allowing it to dry, and exposing the plate for half an hour to direct sunlight, or its equivalent in diffused light. The plate is then developed by smearing olive oil over the whole of the surface of the plate, and then adding olive oil and turpentine, which dissolves away those portions of the film not acted on by light, leaving the metal bare for the etching fluid. As soon as the development is complete the oil and turpentine are washed off. The etching solution is composed of

Potassium chlorate	1 part.
Hydrochloric acid	10 ,,
Water	48 ,,

When the plate is etched sufficiently the plate is washed and the asphaltum removed by benzole, and the plate is ready for the press. This gives the best results for line work. For engraving in half-tone—Fox Talbot's original process of coating a plate with an ethereal solution of camphor and resin, and when dry heating the same till the resin melts, and then when cool coated with a solution of gelatine ½ ounce, saturated solution of potassium bichromate 1 ounce, water 10 ounces. When dry it is exposed under a positive, and then etched with a saturated solution of ferric chloride, to which one sixth of water has been added. When the etching is complete the plate is washed thoroughly and dried. Waterhouse recommends the use of a carbon print on the copper plate, and coating the gelatine with waxed sand, and when dry dusting off the sand and coating with graphite powder, and taking an electrotype from the image. Ehrard, of Paris, has another method. He prepares a transfer as for zincography, and after going through the usual routine to transfer it to a copper plate he plunges it into an electro-plating bath for a few minutes. The copper is thus covered with a thin film of silver, the lines of the engraving being protected by the greasy ink. After rinsing in dilute acid the plate is put into a bath of mercuric chloride, when the silver is converted into the double chloride. After washing, the ink is removed and the lines are bitten in as before.

606. Daguerreotype Process—To Work.—The following is a short description of the process. Take a copperplate of the required size, and cover this with a thin film of metallic silver by means of the electro-plating process. The silvered plate must then be most thoroughly polished by means of a fine piece of chamois leather and a little jeweller's rouge, and must also be perfectly free from scratches. The sensitising operation, which should be performed immediately after polishing, consists of exposing the polished plate to iodine vapour. The iodine may be scattered on the bottom of a box, and the plate fastened to the top, in the same manner that prints are fumed. The plate will now receive a thin coating of iodide, and will change colour. When it reaches a ruddy colour, it must be taken out of this box and placed in another similar one, on the bottom of which is placed a mixture of bromine and calcium hydrate. The bromine here attacks the silver iodide previously formed, and forms silver bromo-iodide. When the plate becomes steelish-grey in appearance, it must be withdrawn from the box and placed in the first box, which contains iodine, and must remain in for a third of the time that it originally remained there. The plate is now ready for exposure, which must take place within a few hours of sensitising. The exposure, which can only be learnt by practice, will occupy only a few seconds. The plate is now developed by exposing it to the vapour of metallic mercury. This may be done in an iron box similar to the one used for iodising. The plate is fastened face downwards to the lid, and the mercury on the bottom heated to 150° by means of a spirit lamp. If exposure is correct, the image will now come out brilliantly. Fix by immersion in a solution of sodium hyposulphite, and finish by pouring a *very* dilute solution of hyposulphite of gold; with application of a little heat, this adds greatly to the brilliancy. Wash for a few seconds, and when dried the operation is completed.

607. Dusting-on (or Powder) Process—To Work.—The principal uses to which this beautiful but much neglected process is applicable are as follow: (1) The production of reversed negatives for photo-mechanical processes; (2) the production of ceramic or vitrified photographs; (3) the reproduction of transparencies on glass; (4) the production of coloured opals or transparencies. About twenty years ago J. Werge produced some very fine backgrounds on portrait negatives by means of the powder or dusting-on process, in the following manner: The portrait was taken with a dark background, and developed and fixed in the usual manner. The negative was then coated with the bichromate, etc., solution, dried and exposed behind a suitable background negative. The picture was then developed with a brush, taking care that the powder was applied carefully all round the figure, but not over it, the surplus powder being then brushed off and the negative finished. By the powder process a negative is obtained from a negative and a positive from a positive, but it has been proposed by "developing" with a white or light powder and backing the glass with a black substance, to produce a positive from a negative, when viewed by reflected light. The

process is as follows. Clean glass plates are coated with the following filtered solution :

White sugar	75 grains.
Dextrine	60 ,,
Glycerine	5 drops.
Potassium bichromate	30 grains.
Water	3 ounces.

And dried over a spirit lamp or stove. Whilst warm the plate is exposed behind the negative to be reproduced for two or three minutes in sunlight, or fifteen to twenty minutes diffused light. The plate is then exposed to the atmosphere in the dark for five or ten minutes or more, according to its humidity, and then developed by carefully dusting a fine impalpable powder over it, by means of a soft brush or tuft of cotton wool. When finished, the surplus powder is brushed off, the plate coated with collodion, and washed to remove the yellow colour. The following points require care: Filter the solution; have clean plates; dry on a levelling stand; do not let the plate get too "tacky," or it will "develop," or "fog," all over. It is better to expose it to the air for a short rather than a long time before starting developing; development will be slower, but will proceed regularly. Another formula is as follows:

Gum arabic	12 parts.
Glucose	20 ,,
Honey	4 ,,
Ammonium bichromate (sat. sol.) ...	30 ,,
Water	240 ,,

Coat a perfectly clean glass plate with the above solution, and after draining for a few minutes place it on a pad of warm felt or blotting paper in the dark to dry. When dry expose under a negative in the usual way if a negative is wanted, or a positive if a positive is wanted. The exposure is about seven minutes in the sun, or twelve minutes in the shade. After exposure take the plate out of the frame and gently breathe on it. Then apply the powder, which is either dusted on with a camel-hair brush or a plug of cotton wool. The plate must then be varnished to protect it. Any powder colour will do, provided that it is finely ground. Great care is necessary through the whole process. Another method is given, though differing very slightly, as each worker differs in some small details. Regarding the more suitable subjects for this process, it will easily be observed, after some practice, that negatives possessing great contrasts, and those representing rocks, trees or buildings, would be preferred to portraits, unless groups well surrounded with accessories—studio or otherwise—for in this "dusting on," plain spaces, like "vignetted" negatives would present, might show any unevenness sometimes unavoidable. Proceed by coating a perfectly clean glass the exact size of the negative to be reproduced with a solution of gum arabic 2 drams, glucose 1½ drams, glycerine 20 drops, water 4 ounces. Dissolve and let it stand in a warm place until all is well mixed, filter, and add (in the dark room) one dram bichromate of potassium. Flow over the plate as if using collodion, and dry over a spirit lamp or gas stove, being careful not to heat it too much While still warm, place it under the negative to be copied, and expose it in a printing frame to good daylight for, say, ten to fifteen minutes. Warm slightly, and lay the film side up upon white paper, and apply fine powder blacklead with a large camel-hair brush. The warmth and lead combined bring up the image, and where more density is required breathe slightly, so that the lead may adhere. Keep dusting it on and off until satisfactory—if over-exposed, the lead will not take properly; if under, it will stick to every part; correct exposure shows by the detail gradually and evenly appearing. Wet the edges with the finger, and then coat with collodion. If the film is to be transferred to paper or opal, or reversed for a negative, soak in water containing a little citric acid until it leaves the glass, turn the film over while in the water, and float on to its fresh support, drain, dry, and varnish in the usual manner. Another formula is recommended by Professor Burton, which is as follows:

Stock Solution A.

Best quality gum arabic	1,000 grains.
White loaf sugar	1,000 ,,
Bichloride of mercury	5 ,,
Water	40 ounces.
Methylated spirits	10 ,,

Stock Solution B.

Bichromate of ammonium... ...	2 ounces.
Water	20 ,,

The two solutions must be thoroughly filtered, and when required for use three parts of A are added to one part of B. A piece of polished plate glass is coated with the above in the same way as a wet plate with collodion and dried by gentle heat. It is then exposed to direct sunlight behind the negative until a faint image is seen, and is then warmed, and powdered lampblack or blacklead rubbed on gently with a camel-hair brush until the required density is obtained. Some practice is necessary to ensure good results, both in calculating the exposure and in dusting on. Negatives of medium density are most suitable for the process. The process is particularly suitable for making lantern slides and coloured opals; or various powders may be used and any colour produced.

608. Electrotype — To Produce from Photograph.—The relief should be well soaked in alum, washed, again soaked in methylated spirit, and dried. It has then to be rendered conductive; to do this sprinkle with "electrotype" blacklead, and well polish with a soft brush until a perfect and even coating has been obtained. Then wrap a fine copper wire round each end of the plate. To this the wire from the zinc of battery (two Daniell's cells will be suitable) is attached, and the relief placed in the depositing solution. A suitable solution is made by dissolving four parts of best copper sulphate in twenty parts of water, and adding one part of sulphuric acid. To the copper plate of battery attach a sheet of copper a little larger than the plate, and hang in solution opposite the relief. In from twelve to twenty-four hours a sufficiently thick coat should be obtained. Should any part not receive its coating of copper remove from the solution, wash, dry, and again blacklead. After removing the deposit it is made more rigid by moistening the back with zinc chloride and pouring in soft solder so as to form a layer about a quarter of an inch thick. This is then planed flat and fastened by pins to a block of hard wood, sufficiently thick to be "type high." Another description is as follows: First make a cast in plaster of Paris by rubbing the relief over with a little linseed oil to prevent the plaster from sticking, then shake plaster into water in a cup, stirring all the time till just as thick as cream. Say the plate on which the relief stands is quarter-plate, place it in the lid of a quarter-plate box well oiled, and pour over the plaster, but be sure to get rid of any bubbles. When the cast is quite set, slip a knife between the plate and cast, when they should separate; place cast in the oven, and when quite dry soak in melted paraffin; with a soft brush clean off all the wax while hot from the face, then well blacklead the face and sides, twist some clean copper wire round, leaving some free. It must now be placed in the battery. If the relief is only a small one a single Daniell's cell will answer. One can be made very easily by folding brown paper several times round a ruler, fastening the edges and turning one end

in, and sticking that with sealing-wax. This will make a porous cell, make a saturated solution of sulphate of copper in a glass jar, or earthenware jar, and add a little sulphuric acid; fill the porous cell three parts full with water, made slightly acid with sulphuric acid, a piece of amalgamated zinc put into this, and the connection made by fixing the free end of the wire round the cast to the zinc. Some crystals of copper sulphate (blue vitriol) should be kept at the surface of the copper solution in order to maintain its strength. If the relief is a good size, then another arrangement will be necessary in order to cover the plate in anything like reasonable time. Two Daniell's batteries of one quart each (cost about fifteen shillings the pair) will be wanted to deposit the metal. A tank must be filled with saturated solution of copper sulphate, to which is added some sulphuric acid. A sheet of copper, the size of the cast, is attached to the wire that comes from the copper element of the cell, and the cast to the wire from the zinc. These are placed in the bath, but not touching one another, and left until the deposit is thick enough. The shell is then backed with type metal, and mounted.

609. Engraver's Block—To Sensitise.—Take

Gelatine	45 grains.
White soap	45 ,,
Water	5½ fluid ounces.

Soak the gelatine in the water for five or six hours, then dissolve it with the aid of a water bath. Cut the soap into small pieces, and add to the gelatine solution, stirring the whole with a glass rod to insure a perfect mixture; then add powdered alum until the froth disappears, and strain through muslin. Cover the block with this mixture and a little zinc white, then wipe off so that a very thin film will be left, rubbing it gently so that the film may be of as even a thickness as possible. After drying, apply with a wide badger-hair brush a coating of the following:

Albumen	3½ fluid ounces.
Water	2½ ,,
Sal ammoniac	67½ grains.
Citric acid	19 ,,

Whip the albumen to a froth, and allow it to settle; to the limpid portion add the water, then the sal ammoniac, stir, and then add the citric acid. When the block is dry sensitise with a solution of

Water	3½ fluid ounces.
Nitrate of silver	187 grains.

Pour this upon the surface of the block, spread it evenly with a glass rod, and pour off the excess. When the block is dry expose under a negative in the usual manner until it is printed the exact shade required. When printed immerse the printed surface in a very strong solution of salt for about three minutes; then wash in a stream of water for a short time, and fix it by placing it face downwards in a saturated solution of hypo. After fixing wash under a stream of water for about ten minutes; when dry it is finished and ready for the engraver. Another is F. E. Ives's method. A block (say three inches by four inches) is whitened by putting on two or three drops of thick salted albumen and sprinkling with pure dry *white lead* (zinc white must *not* be used), spreading and mixing with the ball of the thumb until the coating is thin, even, and smooth. Rub till nearly dry, and then with gentle strokes smooth it almost to a polish. When perfectly dry polish with a brush and sensitise for two minutes with a sixty-grain solution of nitrate of silver. Print under a reversed negative, wash for not more than thirty seconds, and tone and fix at once by placing face down upon a solution of hypo (one to six), to which has been added a pinch of soda carbonate and a little gold chloride; fix for twenty minutes, wash the block, and when dry it is ready. The salted albumen is made thus: Eighty grains ammonium chloride are added to the whites of six fresh eggs beaten to a froth, and a few drops of ammonia added, but *no water*. If the block is very porous from over-seasoning it must have two coats of albumen, but the blocks must not be green, and the thick albumen rubbed into the face of the wood, and then coagulated by the silver nitrate, preserves the wood from injury by wetting it. More usually, however, the photograph is *produced first*, and then transferred to the block by one of the following methods: Make a print on Eastman transferotype paper, float film off in hot water, take it up on paper support, and transfer *face down* to dish containing methylated spirit, in which is a piece of stiff white paper same size as print. Remove original support, and then take up film on stiff paper, put face down on block, rub into contact, and dry. A little practice is necessary, so begin with small sizes. Another method is to coat good, hard writing paper with two coats of gelatine, sensitise in bichromate of potash, dry in the dark, expose under negative, soak in cold water, ink up with greasy transfer ink, and dry. The image is transferred to the wood block either by pressure or rubbing down into contact. This method is simple and rapid, the resulting image being perfect. Still another method is to transfer a collodion image upon the block (for particulars of which see No. 627).

610. Etching Glass Plates—How to Proceed.—Clean the glass thoroughly, warm, and then pour the melted wax over it as in varnishing a plate, and allow to set upon a *levelled* slab of glass or slate. This will ensure an even coating. Either white wax or paraffin wax will answer well. By mixing the wax with *tallow* it can be spread on like butter, and the acid will not lift it; *this is the secret*. The strength of acid depends on the work. For a transparent etching strong acid is needed. The weaker the acid the more frosty or matt will be the etching. After working the design, put a border of putty or wax round the edge of the plate. The hydrofluoric acid may be diluted with an equal quantity of water, but the *strong* commercial acid may be used without the wax lifting. This is more likely due to the glass not being *properly cleaned* before applying the coating of wax. Another method is the following; Select a sheet of finely ground glass, and coat it with bichromate albumen made thus—Beat to a thick froth the whites of three eggs, add ninety minims strong ammonia, and forty-five grains of finely-powdered potassium bichromate. Let the mixture settle for a few hours, decant about two ounces of it, and filter this very carefully. Well rub the glass plate with a pledget of wool dipped in strong caustic soda, thoroughly rinse it under the tap, drain for a few seconds, fix in pneumatic holder, and flow the prepared albumen over it twice in opposite directions. Drain off excess, and holding the plate film downwards, twirl the ball of the pneumatic-holder between the palms of both hands so as to jerk off the excess, and leave a very thin even coating on the plate. Lastly, dry it spontaneously on a levelling stand. If prepared in the evening the plate will be ready for printing from the next morning. Expose beneath the negative for one minute in sunlight, or for an equivalent time in the shade, and after exposure pass a printer's roller, charged with ink well thinned down with turpentine, over its surface. In about ten minutes, or when the turpentine has evaporated, immerse the plate in cold water, and gently rub it with a clean sponge, so as to remove the superfluous ink, which will come off from those portions unacted upon by light, owing to the albumen being still soluble there, although

insoluble at the other portions. After well rinsing in cold water, pass a sponge charged with weak gum over the plate, and roll it up again with a roller charged with a harder ink (*i.e.*, ink containing less turpentine). Lastly, immerse the plate so prepared in a weak solution of hydrofluoric acid until it is seen that the glass has been sufficiently acted upon, and finally remove the ink with turpentine. This gives the design in the original ground glass on a ground of glass more or less smoothed by the acid. If a positive had been employed instead of a negative, the design would be clear glass on a translucent ground. Another way of obtaining a result similar to the last is to use polished glass, printing under a negative, and using hydrofluoric gas instead of the solution, or a translucent design can be got on a clear ground by using a positive and etching with the *gas*. A leaden vessel is employed for this purpose, large enough to be just covered by the plate, and at the bottom of which is a mixture of finely-powdered fluor spar and sulphuric acid. A gentle heat applied to this will cause the gas to be regularly evolved. The operation will in the latter case be best conducted out of doors, as the fumes of the acid gas are anything but pleasant. The ink and small rollers can be got from any printing establishment.

611. Etching Ground — To Colour.— Melt white wax with a slow heat, and when just fluid stir in an impalpable powder of No. 3 chrome yellow (from any wholesale paint shop), and if a still deeper ground is wanted add a little Indian red powder. Continue the stirring until the wax begins to set, but beeswax or paraffin wax softens too much in even an ordinary warm room to make clean lines with a needle; it must therefore be mixed with about one-twentieth its weight of gum elemi—this will harden it without making it brittle. When the depth of colour required is obtained, and the wax has cooled down to about the consistency of butter, place it in a piece of rather thin coarse calico or muslin, and force it through by twisting the loose or neck portion. This will rid it of any grit, etc., that the wax or other ingredients may contain. A solution of gamboge or of turmeric in alcohol, warmed and shaken up with the melted wax, will colour it yellow, the alcohol separating when the wax solidifies. Aurine (rosolic acid) dissolved directly in the warm wax will colour it orange. The proportions to be used will, of course, depend upon the depth of colour required.

612. Etching Ground—To Photograph on.—This may be done by printing on ordinary carbon tissue from a positive, and transferring the tissue to the plate and developing, and then dipping the plate into a bath of glycerine and water, and blotting off the superfluous moisture, and using the tool while the film is wet, then allowing it to dry, and inking up with thick litho ink, and etching in the usual way. It can also be done by printing from a positive on litho transfer paper, developing the print, inking up and transferring to plate dusting on resin and melting, so as to coat the ink image, and then etching. Another method is by sensitising the surface of a copper plate with bichromatised gelatine, in which is mixed graphite or other graining substance, and exposing under a positive, then bite through with perchloride of iron. The etching fluid passes through the parts protected from light by the positive, and etches the copper in exact proportion to the solubility or insolubility of the exposed gelatine surface. This is the simplest of the many processes.

613. Fish Glue Process — To Work — This is a process of half-tone etching on copper which seems unusually easy to work, and which appears to have originated in America, being first printed in the *Artist Printer*, and quoted in the *Practical Photographer* for April, 1893. It consists in coating a prepared plate of copper with a mixture of fish glue (Le Page's) and albumen sensitised with ammonium bichromate, and after printing and washing, burning it in a stone (zinc will not stand the heat, or it would be much cheaper than copper) up to a temperature of 750° F., and then etching with perchloride of iron, when it can be inked up and printed from. The first step is to clarify the glue—which otherwise contains a good deal of sediment. This is done by heating up to boiling point.

Fish glue	8 ounces.
Water	8 ,,
White of egg	8 ,,

and filtering into a jug through a couple of thicknesses of fine muslin. The clarified glue may be bottled for future use. It is next sensitised as follows: Take

Fish glue	4 ounces.
Albumen	2 ,,
Water	2 ,,
Ammonium bichromate	120 grains.

And shake up in a wide-mouthed bottle with some pieces of clean glass. After frothing, it is allowed to stand twelve hours in the dark, then filtered, when it is ready for use. The copper plate is well polished, and immediately before using rubbed over with a tuft of wet cotton dipped in zinc white, to take away all greasiness. It is then flowed over with the solution, which is allowed to flow into the sink, coated again and placed on a whirler so as to receive an even coat, and all surplus thrown off, then dried and printed under a negative for five to ten minutes in the shade. It is then placed in water for two minutes, washed under a tap, flowed over with alcohol and allowed to dry. The copper plate is then heated in a stove until of a brown colour, and allowed to cool gradually. It is then etched for from ten to twenty minutes in a saturated solution of perchloride of iron, washed and dried, then inked in and a proof taken; if of insufficient depth etched again until a good proof is yielded. A plate so prepared can be obtained in twenty-four hours from the time of obtaining the negative, and a fish-glue block has yielded over twenty thousand impressions, and still in good good condition. It is described as "undoubtedly *the* process for half-tone workers." Further details are given in two articles pp. 15 and 37 in the *Photogram* for January and February, 1894.

614. Flexible Support—To Make.—Take hard gelatine 1 pound, fine sulphate of baryta 8 ounces, and water 5 pints; mix well, and stir into it a solution of fifty grains of chrome alum in four ounces of water. Coat the paper with this, and when dry it must be waxed by coating it two or three times with the following: Yellow resin 360 grains, yellow wax 120 grains, ether 1 pint. Melt wax, add resin, lastly ether. Apply on paper with tuft of cotton wool. Another is made as follows: Paper is coated with gelatine, which is rendered insoluble. The paper is then dried, and coated with a varnish of bleached lac and borax. Finally it is passed through hot steel rollers. A very good substitute for the above is a thin sheet of white celluloid, commonly known as ivorine. As with Sawyer's support, this must be waxed before use with the following: Pure beeswax 5 grains, rectified benzole 1 fluid ounce. Pour a few drops on a soft piece of flannel, and rub the support with a circular motion, finally polishing with a piece of dry flannel. To use above cut pieces a little larger than the prints to be transferred

—on a piece of flannel put a few drops of the following waxing solutions: Benzole (rectified) 1 ounce, *real* beeswax 5 grains, and rub in a circular manner the face of a cut piece of the support, finally polishing with a fresh piece of flannel. Then immerse support and print in cold water for five minutes or more until perfectly flaccid, place the support face upwards upon a glass plate under the surface of water, put the print upon it, draw rapidly from water, and squeegee down. Leave under pressure and under blotting paper for half-an-hour, and then strip backing-paper as usual with hot water. Then squeegee film upon its permanent support, and *when dry* the flexible support may be removed by inserting the point of a penknife under a corner and raising it.

615. Gelatine for Photo-stereography—To Harden.—A *very* high relief requires a negative that has quite clear shadows and opaque lights, to enable the light to penetrate very deep without touching the lights of the picture. Supposing that the negative is strong and dense, a gelatine is required that will absorb a large quantity of water, and the very best *hard* gelatine will alone do this; dissolve one and a half ounces of this in twelve ounces of hot water, and add five per cent. of albumen, also dissolve one ounce of potassium bichromate in twelve ounces of hot water, and add the two solutions together, and agitate. Coat transfer paper with this, expose, and allow it to soak for fifteen minutes before fixing it to its support; develop as usual, and soak it for ten minutes in a saturated solution of chrome alum, only give it *one* rinse, and dry by *warmth*. If this is carefully done, a very high relief is obtained, and the alum left in the gelatine will enable it to withstand a very hot stereo-metal. This is photo-stereography, and for bold work it answers *well*. Another method is to take it from the water and lay it on a level table, and a plaster mould is taken from it. Some *fresh* plaster of Paris is sifted through muslin, and mixed, as follows, in a clean basin. Put some clean water, and carefully stir in enough plaster to make a fine paste; then lay an iron or wooden chase, half an inch deep, on the relief, and fill in with plaster, gently rubbing it all over the mould. To shift any air-bubbles, scrape the top level with a piece of iron hooping, and allow to set. The mould is then removed by turning the chase over and inserting the point of a knife, and lifting it off. This plaster mould may be stereotyped, or a wax mould made from it and electrotyped in the usual manner, and mounted type-high for printing blocks. Another method is to develop a carbon print on a polished copper-plate, thinly silver-plated. While the print is still wet, fine sand, which has previously been slightly waxed, is dusted on it. When all is dry the sand is removed by gentle friction, leaving the gelatine in a grained condition. Blacklead is then gently rubbed on the picture adhering to the gelatine. An electrotype cast is then taken, and constitutes the printing plate.

616. Gelatine Relief—To Obtain.—The following directions for producing reliefs for the Woodburytype process will yield strong reliefs. For producing a negative in relief a special transparency is required, one with a great range of density; it is also necessary that it should have an edging of clear glass, and also that the high lights be quite clear. Sheets of patent plate, a little larger than size of print required, are prepared by well cleaning them, rubbing one side with talc (French chalk), and coating with a film of plain collodion made as follows:

Pyroxyline	80 grains.
Ether (meth.)	4 ounces.
Alcohol (meth.)	4 ,,
Castor oil	6 minims.

When quite dry, coat with the sensitised tissue, the formula for which varies, but the following will be found reliable:

Nelson's sheet gelatine	3½ ounces.
Glycerine	100 grains.
Sugar	1 ounce.
Indian ink	2 grains.
Phenol (carbolic acid)	2 minims.
Bichromate of ammonium ...	300 grains.
Ammonia ·880	1 dram.
Water	12 ounces.

Soak the gelatine in ten ounces of water, and then melt with heat, and add the glycerine, sugar, phenol, and ammonia. Dissolve the Indian ink in the other two ounces of water, and add to the other ingredients. Finely pulverise the bichromate and stir it in. The solution is heated to 140° F., and the plates, which have been warmed and perfectly levelled, are coated by pouring a measured quantity on and carefully spreading it over. About half an ounce for quarter-plate is the proper quantity. When set they must be dried very rapidy or they will be spoiled. Up to now they can be manipulated in a moderate light, but when dry at least as much care must be taken as with ordinary silver paper. They are best used at once, or within a day or two at the outside. The exposure and development are the same as with carbon or autotype printing, except that the latter takes longer. It is performed solely with hot water, and must proceed spontaneously. Some means must be arranged for keeping the plate under water in a vertical plane. At first the temperature should not exceed 105° to 110° F., and the water should be changed frequently. When all the bichromate salt has been dissolved out it can be raised to 150° to 160° F. As already stated, time must be allowed, the operation being seldom complete in less than two hours, and may take as long as two days. It should be continued till the parts of the film representing the high lights are all but dissolved away. The plate is then rinsed in cold water, and placed for ten minutes in a four per cent. solution of chrome alum. It is then once more washed to remove the alum and drained, and placed in a bath of methylated spirits for an hour, and then dried. When dry the film can be stripped from the plate if necessary. The following method of procedure answers fairly well with Ilford slow plates, but to obtain anything that will compare with a Woodburytype film, a very thickly-coated plate must be employed. Give a rather full exposure, and make use of the following developer:

A.

Potash-hydrate stick ...	180 grains.
Sodium sulphite	180 ,,
Water	3 ounces.

B.

Pyro	48 grains.
Water	8 ounces.

C.

Potassium bromide	60 grains.
Water	1 ounce.

Mix six drams B with two drams A, and put plate in the mixture until all detail is out, then add ten drops C, and continue development until sufficient density is got. Development complete, well wash plate and immerse it in a ten per cent. solution of chrome alum, warmed to 30°—40° C., gently brushing it whilst in the solution with a soft brush. When sufficient relief is got well wash in water and fix in hypo. During hot weather the plates are very liable to frill at the edges, but this can be obviated by edging them with a solution of indiarubber in benzole.

617. Line and Wash Drawings—To Reproduce.—As a line drawing consists simply of black and white lines, with no intermediate gradations, it is obvious that the treatment necessary to produce a good photograph will differ considerably from that required for, say, an ordinary landscape. The blacks must be quite black, and the whites quite clear and free from veil. Having fixed the drawing to be copied (preferably upside down, to facilitate focussing) to an upright easel, focus the image on the ground glass, and insert the dark slide carrying a quarter-plate, and from the top corners of the easel to the top corners of the camera stretch two strings, over which place a large sheet of brown paper extending to within a foot of the easel, so as to exclude extraneous light from the lens. Now take a piece of clean magnesium ribbon if f/16 stop is used, say 1½in. to 2in., and ignite it at the right-hand side of the print, a foot away from the print, and just outside of the brown paper, gently raising and lowering it so as to evenly illuminate this side of the print. Now burn a similar piece of ribbon on the left hand side in a similar way. During this operation the ordinary gas in the room should be turned down, and don't forget to uncap and cap the lens. Make up the developer as follows:

A.

Sodium sulphite	3 ounces.
Citric acid	40 grains.
Water (boiling)...	5 ounces.

Then add when cold

Pyrogallic acid	1 ounce.

And make up to ten ounces with distilled water.

B.

Bromide of potassium	1 ounce.
Water to...	10 ,,

C.

Ammonia ·880	1 ounce.
Water	9 ,,

Remove the plate from the dark slide, dust, and place in a bath of gallic acid 4 grains, water 2 ounces, for two minutes. For the developer take of A 60 minims, B 60 minims, C 40 minims, and add further quantities of C, ten minims at a time, as required. Keep the dish and the plate covered as much as possible. When development is complete pour off the developer, and rinse the plate twice in metabisulphite of potassium ½ ounce, water 20 ounces, then place direct in fixing bath, sodium hyposulphite 4 ounces, water 20 ounces, for twenty minutes. Probably the negative will now appear free from veil, but with the contrasts not sufficiently intense. Wash the plate well, then place in mercuric chloride ½ ounce, hydrochloric acid 30 minims, water 10 ounces, until it is bleached through. Now wash in a stream of water for a quarter of an hour, then place in a ten per cent. solution of ammonia (·880) until it is quite blackened; wash for ten minutes, and dry. In intensifying, much want of success is to be attributed to insufficient washing between operations. To copy drawings well requires a good many precautions. The first thing to do is to remove any stains from the paper on which they are made if possible. The next thing is to back them with a paper of a suitable colour—sometimes clean white blotting paper is best, without creases, at others dead black paper, or an orange red, or other non-actinic paper is good. This is more than ever necessary if the drawings are made upon thin paper, which is usually the case, which is also generally very full of creases before the photographer gets them to copy; printed matter is also very often on the other side of the drawings. In this case they *must be backed with black or non-actinic paper*, as by so doing, strange as it may appear, only the drawing it is wished to copy will appear upon the negative, which, with proper exposure and development, will show clear lines upon a black or, at all events, very dark ground without any of the print or anything else that may be upon the other side of the original drawing showing in the least. If, however, it had been backed with white paper instead of black, or other non-actinic paper, the prints on the other side would be plainly visible, and no dodging in either the exposure or the development would prevent it. If a sheet of flat clean glass, free from scratches, air bells, and of fairly equal thickness, is fixed over, and in close contact with, the drawing, much better results will be obtained than is otherwise possible, as it will be kept quite flat and free from creases during copying. Reflections from the surface of the glass must be avoided in the usual manner. The light should come from behind the camera, and preferably from the top. A reflector at a suitable angle is placed just below the drawing, to reflect the light upwards. The space between the camera and the drawing is covered with white tissue paper both at the top and at the sides, it being pinned or fastened so as to prevent any direct light from reaching any part of the drawing or the lens. This is in order to prevent the grain of the paper being reproduced as much as possible. A white card will be the best reflector to use, but in very dark weather a looking glass may be substituted, particularly if dark drawings are being copied.

618. Litho Transfers—To Make.—Any good surfaced paper is floated on a bath composed of gelatine (Nelson's flake) 8 ounces, glycerine 1½ ounces, common salt 2 ounces, water 50 ounces. Great care should be taken that the solution is not overheated, and that the paper is coated without bubbles. It is then dried in a temperature of 60° F.; it takes ten hours to dry, and will keep for years. When required for use it is sensitised in the following bath: Bichromate of potash 1 ounce, common salt ½ ounce, ferricyanide of potash 100 grains, water 30 ounces. After sensitising it is dried in the dark in a temperature of 70° F.; when dry, it is exposed under the negative in an ordinary printing frame. It is preferable to print in sunlight. When the image appears a dark fawn colour on a yellow ground, the transfer is sufficiently printed. It is put into cold water for about ten minutes, till the soluble gelatine has taken up its full quantity of water; then taken out, placed on a flat piece of zinc, stone, or glass, and the surface dried with blotting paper. A hard transfer ink is now used, composed of white virgin wax ½ ounce, stearine ½ ounce, common resin ½ ounce. These are melted together, and when mixed, four ounces of chalk printing ink are added, and the mixture reduced to the consistency of cream with turpentine. A soft sponge is saturated with this mixture, and rubbed gently over the paper. An ordinary letterpress roller, charged with a little ink, is then passed over, rolling slowly and carefully, the result being a grained transfer in greasy ink. It is now placed in a weak bath of tannin and bichromate of potash for a few minutes, and when taken out, the surplus solution dried off with blotting paper. The transfer is hung up to dry, and when thoroughly dry the sensitive surface is exposed to light for two minutes. A weak solution (1 in 100) is used for damping the transfer, and this should be applied to the back four times with a soft sponge, then carefully placed between clean sheets of blotting paper, and the surplus moisture removed. A cold polished stone is then set in the press, and after everything is ready the transfer is placed on the stone and pulled through twice. The stone or scraper is then reversed, and the transfer pulled through twice again. A moderate pressure and a hard backing paper should be used, care being

taken not to increase the pressure after the first pull through. The transfer is taken from the stone without damping, when the ink will have left the paper clean. Gum up the stone in the usual way, but, if possible, let the transfer remain a few hours before rolling up. Do not wash it out with turpentine, and use middle varnish to thin down the ink.

619. Photo-electrotypes and Stereographs—To Produce.—This requires a good relief, which must be made by the methods given in No. 616. Dust this over with powdered French chalk, and "dust off." Then place it in a suitably-sized brass box made of ⅛in. sheet brass, the sides about ½in. deep and ¼in. thick, must be screwed to the bottom; place the whole in an oven, and get as hot as the hand can bear, remove to a perfectly level place, and pour in a steady stream a molten mixture of bismuth eight parts, tin three parts, and lead five parts. This melts at about 208° F., stir it well with a piece of stick, and keep the dross back when pouring; a thickness of about ¼in. will do for the cast, but a little thicker will make a more solid casting. Allow it to cool, and then unscrew the sides and liberate the plate. If the instructions have been carefully followed this will produce a very sharp plate with every detail, and capable of giving 1,500 to 2,000 copies. Before mounting, the back must be planed or rasp-filed flat, and then mount type high on a piece of sound, hard wood. The next process is the paper method. This is done from a high relief negative. Commence by oiling the negative, then lay a piece of tissue paper on a piece of glass, and paste all over with a thin flour paste a piece of soft printing paper, and lay this on the tissue. Rub down a little, and place it on the relief negative. Cover it with a damp cloth, and beat it *well* in with a fine and very stiff hog-bristle brush. Then paste a piece of blotting paper, and repeat the beating, after which two more pieces of tenacious soft paper, and finally back with cartridge paper, and dry thoroughly, and under medium pressure; when dry, place in the brass box as before (after dusting the paper with French chalk), and weigh down the paper with four strips of metal at the margin, or it will rise when the metal is poured on; three or four impressions can be made from the paper before it deteriorates. Photo-electrotype is like photo stereography, only suited to line work, and may be carried on as follows, from the same high relief negative that the paper matrix was made: Make a plaster cast in fine dental plaster of Paris, and when quite dry soak in melted paraffin wax, and with a soft brush clean *all* of the face whilst hot, now blacklead it well on the face and sides, and wrap two or three folds of quite clean and bright copper wire, and twist it tight to make contact, and it is now ready for the bath, which is composed of a saturated solution of sulphate of copper, with ten per cent. of sulphuric acid added. Two one-quart Daniell's batteries will be required to deposit the metal, and a piece of copper the size of the plaster cast is attached to the wire that comes from the copper element of the battery, and the plaster cast attached to the wire that leads from the zinc. Now place these, but not touching one another, in the vessel containing the copper sulphate, and do not disturb until the copper deposit is thick enough for the purpose. Then back up and use in a type press. Some crystals of copper sulphate should always be in the solution to make up for that used. This does not give near so beautiful results as photo-galvano etching, which will give half-tone results. This process consists of a fatty ink litho transfer, as much ink as can be got on. Transfer this to a clean copper plate (or zinc will do), and, in the case of the copper being used, immerse in the sulphate of copper solution attached to the anode or the copper element of the battery, and a large copper plate attached to the cathode or zinc element. The action then goes on and dissolves the copper from the parts not protected by the fatty transfer ink, and so engraves the plate as deep as desired. If a zinc plate is used for the etching, a solution of sulphate of zinc must be used, proceeding in every other way like copper method. The results are really beautiful if the etched plate is carefully prepared and properly printed from, and certainly equals a fine photogravure, and is well within the reach of anyone.

620. Photogravure—To Work.—This is a process for photo-mechanical printing, in which a copper or zinc plate is coated with some substance sensitive to light, such as bitumen or bichromated gelatine, and after being printed under a negative and developed, is *etched*, so as to obtain a plate for printing from the same as an engraver's copper plate. It is hardly suited for amateurs, as it requires great practice, and the most successful firms who publish photogravure prints (such as Goupil and Braun) keep their processes, to a great extent, secret, and are supposed to do a good deal of after work with engraver's tools upon the plate. Some details are given in Copper plate—Printing on (No. 605), but one of the most successful, as well as practicable, methods is Klic's. In this the copper plate is finely polished, then inserted into a dusting box, which is a cubical box mounted on pivots, into which is introduced a quantity of Syrian asphalt, finely powdered, or a mixture of asphalt and resin. The box is rotated so as to be filled with the fine dust, and the copper plate, previously polished and cleaned with weak caustic potash solution and ammonia, washed, whitened, rinsed, and dried, is introduced. After remaining five minutes it is covered with a very fine dust of asphalt. It is then heated so as to melt the powder and give a grained surface. A carbon negative is afterwards developed on the surface, and when well washed, so as to dissolve all unaltered gelatine, the plate is etched in a series of baths of gradually decreasing strengths (forty-seven, forty-one, thirty-eight, thirty-five, and twenty-seven per cent.) of perchloride of iron; about one minute in the first bath, two or three in the second, and so on, till the highest lights are just darkened. The plate is then cleaned, and is ready for printing.

621. Photo-lithography—To Work.—Some transfer paper must be obtained or made; formulæ for making this are given in No. 622. The negative which is to be used should show the lines quite clear, and the rest of the film very dense or opaque, wet plates, or very slow dry plates, being the best for the purpose. The transfer paper is exposed under the negative in the usual way, and as the image is visible, there is no difficulty about this. The colour of the unexposed paper is yellow, and the printing must be carried on until the lines are a deep tawny colour. The transfer paper is then developed as follows: The whole of the surface of the paper is covered with a thin film of transfer ink, and may be put on with a sponge, taking care to obtain a very thin and even layer. The image should just show through the ink, but only just. The best way of getting an even coating is to ink up the smooth face of a stone or metal plate with a litho-roller. Then place the face of the transfer paper in contact with this, and pass the stone or plate through the press. The ink now requires removing from those parts which the light has not affected. To do this, float the paper on hot water inked side up (water

about 100° Fahr.) After a time the surface will appear as a relief, the line showing as depressions. Remove the transfer, and lay ink side up on a stone or other flat surface, and pour warm water on it, then sponge gently with a soft sponge, and the ink will come away from all the parts not representing lines. Keep on with the warm water until the gelatine from the whole of the surface where the ink has been removed is washed away. Wash well in cold water and hang up to dry. When dry it is ready to transfer to the stone. Damp the transfer paper from the back either by means of a sponge or by very evenly damping a piece of stout printing paper, and laying this on the back of the transfer with a zinc plate or other waterproof material on top of all, leaving them together for several hours. Warm the stone in front of a fire, then place on the bed of the machine, being careful to pack it until quite parallel with edge of scraper, so that the pressure of scraper is even over every part. Now lay the damp transfer on the stone very carefully, so that it does not move the least after the surfaces have touched. The tympan is now brought down and the bed travelled under the scraper several times, gradually increasing the pressure each time by bearing more strongly on the lever. Now turn the scraper end for end in its box, and travel the bed a few times more with considerable pressure. The back of the transfer is now well wetted with water, and after a little while, when it is soaked in, the paper may be removed, leaving the image on the stone. If cold water does not cause it to leave, hot may be used. Another method: A piece of ordinary gelatine tissue, such as is used for carbon printing, is sensitised with bichromate in the usual manner, and exposed under a *positive cliché* of the subject to be lithographed. When sufficiently exposed it is placed in water for a few seconds, and then laid face downwards upon the surface of a clean and polished lithographic stone. A squeegee is passed several times over the back to drive out the water from between the surfaces, and after a few minutes warm water about 100° Fahr. is poured over the surface to develop the picture exactly as a carbon picture is developed on paper, zinc, or any other surface. The paper which supported the gelatine is first loosened by the hot water, and may then be taken off; and afterwards, by gently spreading the water over the surface, the surplus gelatine is removed, leaving only that portion which constitutes the picture, which has been rendered insoluble by the action of light during exposure. The resulting image is, of course, a negative from the *cliché* employed being a positive one. The whites should be represented by the bare stone without any film of gelatine upon them. If there be any clouding upon the whites, the exposure has been too great; but a great latitude of exposure is possible, as the film of gelatine forming the image need be of no particular thickness, the only absolute requisite being that it be continuous wherever there should be whites in the picture. Having developed the gelatine picture upon the stone until the whites are perfectly bare in all parts, a final rinse is given with alum water, and the stone is allowed to dry. When the surface is perfectly dry, the image will generally show if the exposure and development have been successful, the white stone showing clearly in every part through the pigmented tissue; and the result should be a sharply defined negative picture. The edges are now gummed round in the usual manner, and the stone is inked up with a roller with ordinary lithographic ink. Directly this is done the surface of the whole stone is wetted and well rubbed with a piece of flannel dipped in gum water; by this means, with gentle handling, the gelatine that formed the negative picture is rubbed away, and the ink only remains in the places where the stone was bare when the roller was applied; and if everything has been properly conducted, the result is a very perfect positive design full of delicacy, which may be worked like an ordinary lithographic stone. Further directions are as follow: For photo-lithography a thoroughly good negative is required. The whites of the original must be represented by opacity, and absolute sharpness of definition to the very corners of the plate is necessary. To produce such a negative a lens free from distortion is required. The wet collodion process is no doubt best, as negatives possessing the necessary density and freedom from fog can be obtained. Having obtained a negative quite sharp, it must be intensified to the utmost limit, avoiding fog. If gelatine plates be used, Messrs. Mawson and Swan's "photo-mechanical" are the best; they give great density and clearness in the shadows. Instructions for development are given with the plates. It will be found advisable before developing to put the plate for about a minute in a bath of

Water	2 ounces.
Gallic acid	5 grains.

This will add density to the negative. The print will depend upon (1) the paper for transfer; (2) the suitability of the negative. Professor Husnik, in his patented process, gives the following directions: One part of finest gelatine is swelled, then dissolved in twenty-four parts of water, a solution of chrome alum (one to one hundred of water) is added, and the solution poured into a zinc dish heated to 42° C. Remove any scum from surface, float paper one sheet at a time and dry. The paper is again floated on gelatine, and suspended by the opposite corner to that in first drying. Now prepare solution of white of egg 1 part, water 2 parts, and on this float paper. Dry and then sensitise on following bath:

Water	14 parts.
Bichromate of potash	1 ,,
Methylated spirit	4 ,,

Add sufficient ammonia to turn the solution a bright yellow. Double transfer paper used in the carbon process may be substituted if only small quantities are required. The paper after sensitising should be used within a few hours. After drying the sensitised paper is exposed under the negative for a few minutes to the sun; it must be examined in non-actinic light, when the image is brown or grey upon a yellow ground, details being visible; it is removed from printing frame, and covered with a thin coating of transfer ink (the commercial ink must be thinned with turpentine, so that it presents only a grey appearance). The ink is best applied with a fine sponge. The print is placed aside to allow the turpentine to evaporate, being all the time protected from actinic light. The print is then placed in cold water, any air bubbles being removed from the surface. In about half-an-hour the uppermost layer may be removed, together with the ink not forming part of the picture; slight friction will be necessary. Development is brought about by passing a well-moistened pad of cotton wool over the print a few times. It is well to perform this operation upon a sheet of glass. Now thoroughly wash to get rid of the chromium salt, and dry with blotting paper. The print should be moist, but not *wet*. The stone is warmed, and the paper transferred to it; it should adhere sufficiently to prevent any probability of moving while in the press. The stone should be rubbed over with pumice powder; the warming can easily be effected by pouring on spirits of wine and igniting.

622. Photo-lithographic Transfer Paper—To Make.—To prepare the paper in small quantities, procure what is known as book-post paper, remove the size by immersion in boiling water. When dry float a sheet of proper size for three minutes on the following gelatinising solution:

Potassic dichromate	44 grammes	: 677⅛ grains.
Gelatine (flake) ...	44 ,,	: 677⅛ ,,
Glycerine	2 c.c.	: 34 minims.
Water	1 litre	: 35 oz. 1 dr. 36 ms.

If fine-cut gelatine be used sixty-six grammes (or 1,016 grains) must be used. This solution is, of course, kept fluid over a hot water tin. The paper is suspended by two corners to dry (this, of course, causes the coating to be thicker at the bottom). A second coating is then given, suspending the paper by the two opposite corners. The paper, even when damp, is slightly sensitive to light, and must be dried in the dark room. It is then exposed under a negative, and when the print appears of a well-defined fawn colour against the yellow shaded parts, the paper should be removed to the dark room for subsequent treatment. The following is a formula for an ink for the printing process which Abney recommends:

Ordinary lithographic printing ink	16 parts by weight.
Burgundy pitch	6 ,,
Bitumen	2 ,,
White wax	1 ,,
Palm oil	1 ,,
Middle linseed varnish ...	8 ,,

The ink and varnish are intimately mixed, the pitch and bitumen are melted, the wax next melted in, and then the palm oil, and stirred in until they readily catch fire. The ink and varnish are now stirred in, and the mixture run into pots for storage. Lieut.-Col. Waterhouse recommends the use of the following in preference to gelatine as cheaper and giving better effects: Follow the usual practice of preparing the paper by giving it two coats of—

Arrowroot	40 parts.
Bichromate of potash	20 ,,
Water	1,000 ,,

Float on the hot solution, and hang up second time reverse way to first. Glaze paper in press before use. The exposure is the same as for gelatine paper.

623. Photo-litho Transfers from Bromide Prints—To Make.—This process is done on gelatino-bromide paper, and the method is to first make a print on bromide paper from a good line negative by artificial light, develop with alkaline pyro, then wash and place on a board, and blot off the water with a soft cloth. Next dab all over with a sponge saturated with transfer ink thinned well with turpentine. Let the turpentine evaporate, and roll up the whites quite clear with a glue roller. Now soak the print in the pyro again, and expose to light for a few seconds. Wash quite free from pyro, hang up to dry, and transfer as usual. The formula given by Dr. Eder for transfer ink will be found far ahead of any other, and is

Asphalt	20 grammes.
Colophony resin	100 ,,
Oil of turpentine	40 ,,

Dissolve at a low heat, and add

Yellow wax	20 grammes.
Mutton suet...	140 ,,
Gum elemi	230 ,,
Marseilles soap	30 ,,
Thin litho varnish	60 ,,
Lampblack	80 ,,

A very gentle heat must be used, and all ingredients free from water; the whole well stirred, and great care taken not to allow the mixture to take fire. When well mixed with heat turn out and mix with a muller.

624. Plaster Casts from Transparencies—To Make.—It is sometimes desirable to convert a photograph into a plaster plaque which can be mounted on a tablet for exhibition. This may be done by making a transparency of the subject, and, after fixing (alum not having been used) and well washing, the plate is subjected to heat, which brings the image into relief. If the transparency is made by the bichromated gelatine process the relief will be more strongly marked than with an ordinary gelatine plate. While the relief is moist and at its best, pour on No. 1, ordinary plaster of Paris as used in casting, mixed with a little alum to harden it. When dry the plaster leaves the gelatine without trouble, giving an accurate and beautiful casting.

625. Reticulation in Gelatine Prints—To Obtain.—By transferring a coarsely grained collotype to stone or zinc, a very good grain image is obtained, and the coarse reticulation of the gelatine is very much facilitated by adding chloride of calcium to the sensitive mixture. The following answers very well:

Gelatine	6 parts.
Water	60 ,,
Bichromate of ammonia	1 ,,
Chloride of calcium	2 ,,

Printing surfaces thus obtained, whether lithographic or typographic, resemble those of Pretsch or of Dallas on the one hand, and those of Sprague on the other. With regard to the above formula, Professor Burton says he has succeeded better with a very considerably larger quantity of bichromate of ammonia.

626. Screen for photo-mechanical Printing—To Produce.—The following is the method generally employed. A steel or copper plate is first ruled diagonally, and from this a print is made upon white paper; the size of the plate should not be less than 15in. square, the ruling being 100 to 125 lines to the inch. The negatives or screens should be made of different sizes, and may be made by the wet collodion method, or upon Mawson's photo-mechanical plates developed with hydroquinone. To produce the crossed line screens, two exposures are made, the slide being taken to the dark room between the two exposures, and the plate turned upside down. The screens must be entirely free from blemish, and should be made upon very thin patent plate glass. Another method is to rule or engrave the lines on glass, and then fill them up with an opaque varnish. Grain negatives may be produced either from a surface upon which fine lines have been ruled or dots produced, or from some reticulate surface or material. In the first case, a sheet of white paper must be ruled by machine with either straight vertical, horizontal, diagonal or crossed fine lines, from fifty to 150 lines to the inch. Then mount on stiff cardboard, keeping it very clean at all times. To facilitate focussing in copying, mark a large cross at each corner. To copy the sheet place it on an easel, keeping it perfectly parallel with the camera. Make a series of negatives of various degrees of fineness and size, suitable for various purposes, and when finished varnish the film with a good, hard filtered varnish. These screens must be made by the wet process; ordinary gelatino-bromide plates are quite unsuitable, though chloride plates might be used, but they require such a long exposure that there is a likelihood of the camera moving in the time. Another way is perhaps

easier: To do this obtain some fine copper or brass wire gauze, and mount it over an open frame. Place this in front of the camera, and cover over the intervening space to exclude all light except that which enters through the meshes of the gauze. In this way a better negative is obtained, as the lines appear black, and the holes are not filled up, whereas in copying a lined-paper there is a certain amount of blurring on account of the reflection from the black lines of the drawing Use thin glass for the negative, and be very careful in development. A magnifying glass is of use in inspecting the plate from time to time. It is better to reduce a coarse-grained gauze than to copy a very fine one the same size. Another method: To produce a grain on an ordinary photograph, china-ink may be sprinkled over it with an air brush, or a coarser grain is obtained by sprinkling with a knife over a toothbrush charged with china-ink, or the half-tones of a painting or photograph may be broken up by placing muslin, *crêbe*, or gauze between the negative and sensitive surface. To make a *grain* for photo-litho grind a fine polished stone with fine emery (well-sifted), using a piece of litho stone as a muller; the grain being even and sharp, thoroughly wash and dry, then work it up with a glazed roller, charged with a stiff ink, care and patience being required for this, as the ink must be stiff and distributed quite even. Upon the face of the inked stone a piece of sensitive transfer is placed and pulled through the press, and the grain is printed upon the transfer paper. The inked sensitive transfer paper is now exposed to light under a thin, flat negative, and after exposure is thoroughly soaked in water and placed on the inking board, then blotted, and inked with a glue roller charged with transfer ink. In inking the grained stone, and also inking up the exposed print, let the ink be used as *spare* as possible: this is the grand secret. After development the transfer is dried and placed in a damping book, and transferred to a smooth stone in the usual way. This is Messrs. Bullock's method, and there is none to excel its beautiful half-tone results.

627. Wood — How to Photograph on.— There are many ways of photographing on wood blocks, of which the following are a few. Without exception, the best method of photographing on wood for the engraver is the following: Coat a hard, thick writing paper with two coats of gelatine. For use, sensitise in a bath of bichromate of potash, and dry in the dark; expose under negative, line or half-tone, until image is well printed; soak in clean, cold water for fifteen or twenty minutes, then place on photo-litho inking board, blot off water, and ink up with a glue roller, charged with transfer ink, thinned with a little olive oil, the rolling being continued until the image in all details is developed and covered with a film of ink. If required to transfer to the wood at once, soak in methylated spirits for ten minutes, then blot off, and place in position on the wood block, subject to pressure in a copying press, or rub down with a bone knife, and upon lifting away the paper the image in ink will be upon the wood. If the print is not required in a hurry hang it up to dry, and just before transfer damp the back, and let it remain until quite limp, then transfer. Another way: If there is objection to a silver image on the block, a very good one can be obtained by the cyanotype process modified thus. Make a thin, well-boiled starch solution and brush it evenly over the block. When dry, brush over its surface a solution of ammonio citrate of iron 40 grains, water 1 ounce. When dry, expose under negative in the sun for a few minutes, according to density of negative, or in diffused light from thirty to sixty minutes. To get "contact" with negative and block use stout rubber bands slipped round the block and outer edges of the negative, and wooden strips if it requires wedges. When printed wash over with a solution of ferridcyanide of potassium 1 dram, water 1 ounce, and the picture will immediately develop. When strong enough, wash off with a soft sponge, and the block is ready for cutting. When dry, the lines in this process are very fine and distinct, and are not liable to block up as much as when the iron and potassium salts are mixed *before* printing. Nearly all the formulæ published for this purpose are defective in one vital point, *i.e.*, the block during the operation becomes *wet*. In this respect, engraver's boxwood is peculiar, and to wet a block is generally to spoil it. Without going into the preparation of the block, it will suffice to say the wood is cut transversely, and hence readily takes up moisture, and large blocks are made by gluing several small pieces together, and moisture upsets the glue. There are, however, many ways of coating the surface to be engraved and photographing on this, one of which is as follows: From a negative of the subject desired make a thin positive on glass by the wet collodion process. This positive should be of the proper size on clean glass, without any substratum. Tone and fix as a transparency, and lay in a dish of water containing a small percentage of sulphuric acid, to loosen the film. To strip it lay on it a piece of wet albumenised paper a little larger than the glass. Press out bubbles and surplus water carefully, turn back one corner of the paper, and take it off gently, carrying the film with it. Have the block smoothly whitened with Chinese white in gum water, and the surface slightly damp. Place film in place and strip off the paper. Allow the block to dry spontaneously. Another way: Plane up the wood, and sandpaper it until perfectly smooth and even. Next prepare the following: Simeon's hard gelatine 2 drams, powdered Castile soap 2 drams, water 16 ounces. Soak the gelatine for twelve hours, then dissolve in a hot water bath; add the soap in small quantities at a time, stirring with a glass rod until dissolved. When this has occurred, add powdered alum until the froth just disappears. Filter through paper. A little zinc white is now dusted over the surface of the block, and sufficient of the gelatinous mixture added to it to form a thin paste, which is worked all over the block with the ball of the thumb, until an even coating is obtained, after which the block is dried. As many as will be required can be prepared at one operation, as they will keep. To sensitise dip the prepared surface for half a minute into the following solution: Gum arabic 60 grains, glucose 45 grains, potassium bichromate 30 grains, water 2 ounces. This must be made as required, as it will not keep. The block should after dipping be dried over a lamp, and exposed whilst hot under a clear black and white reversed positive. The exposure will be about five minutes to good sunlight. Remove the block from frame, warm it very slightly over a lamp, and dust some of the finest electrotyper's plumbago over the surface, into which the powder must be worked with a broad flufty brush. The image will gradually develop, being formed of plumbago adhering to those portions which have been least exposed. When sufficiently developed it may be at once handed to the engraver. Another method: The plate is cleaned as usual, and dusted with powdered talc, and polished off; it is then coated with positive collodion, sensitised, exposed, etc., as usual, and fixed with cyanide of potassium, and placed in a dish of warm water. In the meantime, have the block blackened with rubbing drop black on it, or ordinary blacking, and coat and drain well with a solution of the commonest glue 1 ounce, hot water 12 ounces; the common glues are the best, for they take a much longer time to set than better

ones, and so a much thinner coat can be got with draining. Place the block in a vessel of water, having it immersed about three inches, then bring the photo from its dish, place it over the block and under the water; by touching the edges of the film it will readily leave the glass; then turn it about any way under the water, and when in position raise the block gently out of the water, bringing the film with it; if it is puckered at all, it is owing to raising too roughly, and must be placed in the water again; if satisfactory, place at angle to drain, and dry in a warm, airy place. The whole operation, from focussing to getting block ready for drying, will not take a practised hand more than twenty minutes. The common glue will not block the tool at all if the block drains well, and when cut all can be removed immediately with a sponge and warm water. A very good way to black the block is to hold it over a petroleum lamp with its chimney removed. The glue water will not remove it if applied in the same manner as applying varnish to a negative, and under no circumstances be induced to use a black varnish, for it is next to impossible to do a good job, for the graver slips as if it were cutting on glass. Another method: Make a paste from

Ammonium chloride...	10 grains.
White of	1 egg.
Water	1 ounce.
White zinc	*quant. suf.*

by dissolving the ammonium chloride in the water, stirring in the egg, and adding sufficient zinc to make a paste. Spread over the wood (which must be free from grease) with the fingers, as thin as possible, and polish with the fleshy part of the hand. Stand on its end, and, when dry, sensitise by placing the coated portion in a sixty-grain solution of nitrate of silver. Protect the wood from the nitrate of silver by coating the edges with tallow. At the expiration of two minutes blot off with filter paper, and dry in same position as before. Now expose under reversed negative until all detail is sufficiently out, and fix by resting the surface in a weak solution of hypo. Wash the face of block rapidly, and in such a manner as to prevent the water from soaking into the wood.

628. Wood, Photographing on—To Use Dry Plates for.—It would be an easy matter to transfer a gelatine film to a wood block, but when done, the thing, from an engraver's point of view, would be useless. It would be impossible for an engraver to cut through such a thick coating of gelatine. The very reason why a collodion film is used is because it gives such an extremely thin film. If anyone likes to try the experiment, however, the following is the method: First make a negative from the drawing, and from this make a transparency upon a Thomas's transparency plate of the required size. When dry, strip the film and transfer to wood. The best method is that proposed by Mr. W. T. Wilkinson, and is as follows: Thoroughly clean the *back and edges* of the plate, level it, and coat the film side with thick, plain collodion, allow to set for one hour, place in cold water until the film no longer appears greasy when lifted, then immerse (in *an ebonite dish*) in dilute *hydrofluoric* acid (one of acid to twenty of water), and allow to remain until the corners of the film can be lifted away from the glass. Do not hurry it, wash under tap for a few seconds, put the plate into clean water (film up), and detach from plate, leaving film floating upon water. Coat the wood face with gelatine solution (gelatine 1 ounce, water 20 ounces, chrome alum 5 grains, and filtered), let it dry and slide it under film, adjust in position and lift from water, cover the film with tracing cloth and squeegee down. When dry it is ready for use. It will dry quickly after immersion in methylated spirit. There is no doubt that the wet-plate process gives the best results, but since the introduction of special dry plates, the dry process can be used for making the negative with much success. The printing may be done on the block by any of the methods in No. 627. The best plates to use are the special photo-mechanical plates supplied by Mawson & Swan or J. D. England. These are slow plates, giving great density with clearness in the shadows and clear lines.

629. Woodburytype Relief—To Make.—This consists in exposing a thick film of bichromated gelatine to light under a negative. It is then washed, soaked in alum and dried. The film is then put upon a bed of metal and a pressure of five hundred tons put upon it. This leaves an impression on the metal, which is put in a press, and some liquid gelatine ink is poured upon it. A sheet of paper is now placed over, and pressure applied. The proof is now fixed in alum and dried. This process is usually conducted in five stages, as follows: (1.) Preparing gelatine. Rub a clean plate of glass with beeswax until it has a very thin coating on it. Then some strong collodion is poured over it, and allowed to dry. Coat the plate on the collodion side when dry with a strong solution (hot) of gelatine, containing bichromate of potash and a little Prussian blue. The plate must now be placed on a level surface, and allowed to dry. When the film has set, the plate must be placed in a drying box containing fused calcium chloride. This will absorb all the film's moisture. The film can now be taken off the plate. All this must be done in the dark room. (2.) Impressing the film. Take the negative and place it in a printing-frame with its film in contact with the Woodbury film. Now expose it perpendicularly to solar rays. (3.) Development. After exposure, wash away unimpressed gelatine; to do this the film must be pasted by an indiarubber solution to a clean glass plate, and the edges varnished. Place in hot water, which dissolves all the gelatine not acted on by actinic light. Dry the film, and detach from the glass plate. (4.) Making die. On a block of type metal specially prepared, the collodio-gelatine mould is laid, the gelatine side downwards. It is now subjected to a great pressure for a few moments, thus the dies are formed which are ready for the printer when trimmed. (5.) Printing from die. Rub over the die with a little oil. Then pour some hot gelatine solution containing any translucent colouring matter desired. Before the gelatine sets, place the paper (non-absorbent) on the top and submit to pressure. The print is now obtained. The die needs re-oiling every six or seven copies. This is the old-fashioned method of deep relief. Fuller particulars of another method of preparing the relief follow: To commence with, a negative is required with considerably greater contrast than would be required for silver printing, the depth or height of the relief will be greater, the greater the contrast in the negative and the less amount of pigment in the film. The following is the formula for preparing the tissue:

Nelson's transparent sheet gelatine	3½ ounces.
Sugar	1 "
Glycerine	100 grains.
Phenol	2 minims.
Indian ink	2 grains.
Ammonia ·880	60 minims.
Bichromate of ammonium ...	300 grains.
Water	12 ounces.

Soak the gelatine in about ten ounces of the water and the Indian ink in the remainder. When the gelatine is well soaked melt it by heat and add

to the solution the sugar, glycerine, phenol, and ammonia, then add the Indian ink and water, and lastly stir into the whole the bichromate of ammonium, which should be finely powdered. Pieces of patent plate glass are required a little larger than the desired print, cleaned and rubbed over with French chalk, and coated with plain collodion, which is allowed to dry spontaneously. Now heat the solution to about 140° F, the plate should also be warmed, and a measured quantity of the solution poured on to it, and carefully spread, slightly more than half an ounce for a quarter-plate. The plate is now dried. When the films are dry, strip from the glass with the aid of a knife, and if not for immediate use pack them in tinfoil to protect from damp. The exposure is made by placing the film collodionised side in contact with negative in the printing frame, and a piece of glass placed on the back to protect it from damp. As regards the length of exposure, which is longer than for carbon, an actinometer must be used. It is printed in the sun, and care should be taken that no damp gets to it. To develop, as the tissue requires support, coat a piece of glass with rubber dissolved in pure benzole, and allow to dry till it is only sticky, and attach the tissue to this by the collodionised side, taking care to avoid air bubbles, pressure being used to bring them into perfect contact; a wringing machine with rubber rollers will easily effect this. The development is performed with hot water, starting with it at the temperature of 105° F., and frequently changing the water till the bichromate salts have been washed away and the water comes off colourless. Now raise the temperature to 150° F., and as development usually requires two hours or more, a metal grooved dish in which a number of plates can be developed at the same time should be used. When the development is completed, but little gelatine should have been washed from those parts which represent the shadows; if under-exposed, the film will be so reduced that the relief will be but slight, while from over-exposure parts of the film will remain insoluble, and show the original surface (the theory of the action of light rendering this mixture of gelatine insoluble will make this obvious). When development is complete, rinse for a few minutes, and again wash to free from alum, drain till surface is dry, and place in methylated spirit for an hour, and then allow it to dry, when it is stripped of its support and the rubber rubbed off the back with the tips of the fingers. After some twenty-four hours keeping to allow the film to thoroughly contract it is ready for the production of a mould.

630. Zinc Etching Process—To Work.—The zinc etching method of phototype block-making is, speaking generally, decidedly the best method; but it is only best when there is a regular run of work, so that the inking rollers and other appliances can be kept in very perfect order. Moreover, it involves some delicate manipulations, and many compromises between opposing conditions. Consequently, although very easy and certain for the regular practitioner, the labour of making a few blocks by it is great, and, considering all things, the chances of the first blocks being successful are comparatively small. One great difficulty with beginners appears to be with the inking up. Without altogether condemning bitumen for this work, good results are obtainable from placing the plate to be etched in a box containing finely-powdered resin shaken up and allowed to settle on the face of the plate. The plate is then heated to fix the resin to the plate. The resin is allowed *just*, and only *just*, to melt. This having been done, the plate is cooled, and the etching process is proceeded with. When the plate is ready for inking, it should be warmed and inked with a thin ink which is dense in colour, and the surface partially cleared with the palm of the hand, leaving the ink only in the half-tones and shadows, whilst the high lights are quite cleaned. The plate is then warmed again, but allowed to get cold before being placed on the bed of the press. The ink should be applied with a dabber.

In W. K. Burton's book, "Practical Guide to Photographic and Photo-mechanical Printing," the following details are given: After the slight etching the plate is warmed, and when the image becomes tacky asphalt powder is dusted over till it will take up no more, the excess of powder is dusted off, and the plate heated till the powder is incorporated with the image. This must be carefully done lest the finer lines thicken from the spreading of the asphalt. It is only after the etching in the first weak bath that any ink comes in; after the etching the plate is washed, dried, and the asphalt cleaned off with turps. The image is then inked up preparatory to the second acid bath. A very thin ink is used, about the consistency of butter, and is made by mixing equal parts of paraffin, tallow, beeswax and ordinary printing ink, and is applied with a very light pressure on the roller. Some further details which may assist a beginner are given below: The biting should at first be slight, so that the lines are not underbitten, then finely powdered resin is sprinkled over the plate when dry, and it is warmed, the fringe of resin forming a protection. A roller, charged with litho ink (No. 2, mixed with middle varnish, is the best), is then passed over it several times, more resin sprinkled over, and the plate heated. The strength of the acid must be increased, and the plate bitten to about ·015in. When dry, the resin and heating are again applied, and the plate is cooled, gummed, inked, resined, and heated as before, sometimes as many as eight to twelve times, when the plate should then be capable of yielding fair impressions. Now for the ink. The ordinary chalk litho ink of a superior quality is made as follows: Litho ink 16 ounces, middle linseed varnish 8 ounces, mulled together. Then Burgundy pitch 6 ounces, bitumen 2 ounces, melted over a clear fire until all water is driven off. White wax 1 ounce is also melted, and the whole mixed together with palm oil 1 ounce, and then the ink is run into vessels for keeping. A far superior ink for litho transfers is the following, of Dr. J. M. Eder:

Asphalt	20 grammes.
Colophony	100 ,,
Oil of turpentine	40 ,,
Dissolve by warming, and add	
Yellow wax	20 grammes.
Suet	140 ,,
Gum elemi	230 ,,
Marseilles soap	30 ,,
Linseed oil varnish (medium strength)	60-80 ,,
Finest soot	80-100 ,,
Or, instead of the soap, substitute	
Transfer colour	40 grammes.
Venetian turpentine	200 ,,

All to be well cooked and rubbed together. This ink works equally well on stone or zinc. As regards the roller, it should be of the ordinary glue and treacle kind. Some succeed by covering the roller with a short nap velvet, nap outside, and inking up firmly but lightly. No particular directions are given about inking up, as it is a matter of knack and practice, which cannot be imparted by any amount of written instructions.

CHAPTER XVI.

SUBJECT.

(HOW TO PHOTOGRAPH.)

631. Animals at the Zoo—To PHOTOGRAPH.—It is necessary first to obtain permission to take photographs in the Zoological Gardens by applying to a Fellow of the Society. The applicant is then supplied with a card admitting to the Gardens for three months between nine a.m. and three p.m., with photographic apparatus, Saturdays and Sundays excepted. Monday should be avoided on account of the extra attendance, and also Friday mornings. With a tripod and camera the worker will find a difficulty of getting near enough, unless he is very venturesome, as the picture will be divided up by the bars of the cage. The celebrated lion pictures by Mr. Dickson were taken by a camera and tripod, but not without several narrow escapes, and the display of an enormous amount of patience by that gentleman. A hand camera that will take a quarter-plate sharp to the edges is therefore recommended. Capital pictures can be got of the lions and tigers in the outdoor enclosures by placing the camera close up to the bars and resting it on the stone side, as on a bright day fully-exposed negatives can easily be obtained; no definite opinion can be formed as to size of stop and exposure, as so much depends on the light and subject. Many interesting pictures can also be obtained of the other animals in the Gardens with care, such as attention to get all the giraffe on the plate, etc., a good stock of patience, and the sympathies of one or two keepers.

632. Astronomical Objects—To PHOTOGRAPH.—Anyone who possesses an ordinary drop shutter can easily photograph the moon. Take off the eyepiece of the telescope and fit on in its place a plain drop shutter. Place it, however, horizontally, and in place of sliding shutter fix in a slip of stout cardboard. This must have two openings, the one on the left being fitted with a piece of yellow glass; while that on the right is left open. When pushed quietly on, it exposes without shaking the telescope. In front of the shutter place three small screws to rest the plate on, and then all is ready to begin. Put a piece of fine ground glass in place of plate, and focus carefully. If the telescope is a reflector there is no need to adjust for chemical and visual foci; if a refractor, a little experience will soon settle things. If necessary a piece of watch spring can be screwed on to hold the plate down. Then place the sliding shutter so that the yellow glass is in position; remove the focus screen and insert plate. Watch the moon through sensitive plate until in position, then quietly push the shutter along. There is no great need for very rapid plates. An exposure of half a second is ample. Of course, for stars or planets a driving clock is needful, and the performance becomes more complicated. Carefully focussed and developed the negatives will make good enlargements. To photograph the stars is much more difficult, but it is best to begin by placing the camera with the lens focussed on "infinity," and at full aperture, and pointed to the zenith. For perfect results, a night when the moon is below the horizon should be chosen, but for experimental purposes this is not necessary. The camera can be laid on a chair to prevent the dew from injuring it. An exposure of five minutes should be given, and the plate developed in the absence of even ruby light for about a quarter of an hour. The images of the stars will not be visible in the dark room, but when fixed it will be found that the brighter stars have drawn appreciable streaks in the form of minute curves upon the plate. A plate may also be tried upon "The Plough," when it is nicely situated rather low down in the north, and in this case the camera can be used on its stand, or supported upon a bedroom window ledge. A portrait lens should just take in this constellation, and by reference to star maps it can easily be seen how small in magnitude are the stars which affect the plate by trailing their images upon it. A further step may be taken by forcing the stars to pile up their light upon the plate; and this is the very essence of celestial photography. *Imprimis*, the telescope must be most rigidly fixed upon its stand, and be capable of having altitude and azimuth motions imparted to it by the observer. Of course, if the instrument is mounted equatorially this is an easy matter, but if the worker is careful, and not afraid of a little trouble, fairly good results may be secured by proceeding as follows: The camera should be strapped to the end of the telescope below the object glass. A friend should be at hand to uncap and cap the lens. The operator should sit with his eye to the eyepiece, and having brought a first magnitude star into the centre of the field, the image should be thrown considerably out of focus, and an appreciable disc will then be seen. This can with ordinary care be kept in the exact centre of the field while the exposure is given, especially if a transit eyepiece is used, and the two observers can take ten minutes spells at following the guide star; the photographic lens being, of course, gently covered while the workers change places. The exposure can be prolonged for as long as is liked, the longer the plate is uncovered the fainter the stars which will impress themselves. This will give a little practice, and it will be seen that great difficulties will crop up by attempting to use the object glass of the telescope for photographic purposes. Some other means must be devised of following the "guide star," such as

strapping another telescope at the side of the one which will be used for photography. The visual and actinic focus of the object glass will not be the same, and the plate will, therefore, have to be placed slightly nearer (about one-thirtieth of the focus) to the object glass. The results will probably be disappointing, but the difficulties are not overwhelming, and a painstaking worker can overcome them, and will know that he is working in the least trodden of photographic paths. It should be mentioned that a small weight should be fixed to the eyepiece end of the telescope as a counterpoise to the camera.

633. Clouds—To PHOTOGRAPH.—To obtain good cloud effects, observe the following rules: (1) Use *slow* plates; (2) *back* them; (3) use a *rapid* long-focus lens *well stopped down;* (4) develop slowly; (5) exposure, one second.

634. Fabrics—To PHOTOGRAPH ON.—By far the simplest method of printing on fabric is to use the platinotype process, which is quite permanent. With silver it is more difficult. However, the process is as follows: Boil the fabric in water containing a little potash, dry, and albumenise with ammonium chloride 30 grains, water 6½ ounces, and the white of two eggs, all beaten well together. Sensitise in a seventy-grain bath. A seventy-grain bath is one containing seventy grains silver nitrate to the ounce, a sixty-grain bath contains sixty, and so on. Another method: Wash the silk or other material well to free it from all dressing, and immerse in following for three minutes:

A.

Tannin	60 grains.
Distilled water	3½ ounces.

Dissolve.

B.

Common salt	60 grains.
Arrowroot	60 ,,
Acetic acid	½ ounce.
Distilled water ...	3½ ,,

Dissolve the arrowroot with gentle heat, then add the other ingredients, and mix the two solutions A and B. After immersion, thoroughly dry the fabric, and then sensitise on the following bath:

Nitrate of silver	50 grains.
Distilled water	1 ounce.
Nitric acid	½ drop.

Hang up to dry in dark. Print, wash, and fix as usual. Use the sulphocyanide toning bath. Prints done in this way are not absolutely permanent, but if well washed are quite as much so as ordinary photographs.

635. Flowers and Fruit—To PHOTOGRAPH.—Use isochromatic plates in conjunction with a yellow screen, the depth of colour of which will depend upon the relative intensities of the reds and blues in the original. Formulæ for preparing plates and screens are given in Nos. 503 and 506, or the plates are procurable from Edwards and Co., Hackney, London, and the screens from Gotz, 19, Buckingham Street, Strand, London. The exposure can only be found by trial, and the stop used should be the largest possible, compatible with good definition. If an accurate representation of the objects only is wanted, work out of doors with a strong light coming from behind the camera, but if an artistic picture, work indoors, using as source of light the *top* of an open window, the bottom portions of which have been temporarily covered over with brown paper. Arrange the object so that the light makes an angle of forty-five degrees with both the axis of the lens and the plane of the ground glass. The actual size of the area admitting the light will depend upon the size of the object, an area of four square feet being suitable for an object one square foot, placed twelve feet from it. If the object is larger, the area admitting the light must be increased or the object placed farther off. To obtain the best results "outdoors" some little preparation is needed. Hang up a light background facing north if possible); about a yard in front of this place the table covered with some plain dark cloth. Now stand a screen on one side, so as to partially cut off the light on that side. Then suspend a light wooden framework, covered with muslin or white tissue paper over the top; this will soften the light, and prevent the "hardness" which is otherwise sure to show itself. Now arrange the flowers or fruits, or both, in as artistic a manner as possible. Then focus, using whichever stop may be found necessary to just put the whole of the subject in focus, leaving the tablecloth and background slightly out of focus if possible. As in all other kinds of photography, *the exposure* can only be governed by existing circumstances, such as time of day, time of year, etc., but give a full exposure, that is to say, do not *under-expose*. Begin development with a small quantity of pyro or hydroquinone, and when the details are pretty well out gradually add them till the required density is obtained. In all things be careful to avoid harsh contrasts. *Use isochromatic plates* if possible. If, however, subjects can be taken indoors, by all means do so. The lighting will be more under control, and they will not blow about in the wind. Arrange near a window, with background as before, and use a white card to reflect light from side farthest from window. The exposure will be much longer than out of doors. A great deal of the beauty of these subjects depends upon suitable arrangement, and the use of proper accessories, jars, pots, dishes, etc.

636. Frost Pictures—To PHOTOGRAPH.—Place a piece of black velvet, large enough to cover entire field of view, outside of window at an angle of forty-five degrees, or a black card or board would do as well. About five seconds is the correct exposure at midday, and using a lens working at f/27. They require a thickly-coated and therefore moderately slow plate, a small stop, quick exposure, and slow development (see No. 231).

637. Ghost—To PHOTOGRAPH.—The effect of making two exposures will evidently show the background through the sitter. If the figure be clothed in white flowing robes and kept a little out of focus, the background and accessories being sharp and dark, the effect will be greatly enhanced. A shorter exposure to the figure than to the background will make the effect more ghostly. Another method: To meet the requirements of a clever young man who wanted his own portrait with a "ghost," he to bring his own camera and plate, and develop at his house with his own chemicals, the following plan was adopted. A red ghost was painted on a plain background, and afterwards painted out with a light neutral tint. On exposing on the background the ghost appeared. The sitter was seated where the "ghost" came just above his shoulder, and he was greatly mystified at the time when a faint image appeared on the plate. The idea was suggested by the fact of copying a painting of a prize ox. Although nothing could be seen by the naked eye of an extraordinary nature, a negative could not be obtained in which the cow had less than three heads, the one apparent in the picture being the smallest of the three, inasmuch as the painter had painted out the two previous ones.

638. Glass-covered Articles—To PHOTOGRAPH.—In the event of a clock or other

article protected by a glass shade being in the picture, the shade should be removed from it during four-fifths of the exposure, by which means the whole of the details will be beautifully shown, the shade itself being also depicted in a softened manner, and the reflection from its surface then being not offensively strong. Of course the clock should be stopped during the exposure. The reflection from the glass covering of framed pictures can be got rid of by placing a cork behind one side or the other, as the reflection may demand.

639. Illusions—To Photograph.—These illusions *may* be done by reflection, but would require a very large mirror, at least the height of a man; and in such as shaking hands there is this difficulty, that the real man's *right* hand will apparently be shaking the reflected *left* hand; also, the two images are not required to be an *exact* reproduction of each other's attitude, but to introduce some variety. The best way is to employ combination printing—make negative of man shaking hands with someone; then in second negative place him in the second position; make print from first negative, and cut out of print and stick on negative as mask all those portions which require blocking out, *e.g.*, the figure of the someone not intended to appear; the remainder of print forms mask for the second negative, care being taken to select lines for cutting along which will be easily touched out, as the edge of cuff of shaking hand. As examples of such, there is man shaking hands with himself, playing chess or cards with himself, fighting duel either with revolvers or fencing-sticks (this particularly demands variety of position), man surprised by ghost of himself - a very gruesome one, looking at himself in coffin—a girl kissing her double, etc. Several very clever illusions can be done by means of double exposure. One of the best is "a man playing chess or cards with himself." This is done by means of a black background. In the centre of the picture place a table on which are put the required ornaments, then place (on one side of the table only) a chair on which the subject sits, and arrange him or her as desired. Be sure and not have any part of the subject overlapping the table, for, if you do, in the finished print you get the sitter with his leg and the table leg all in one. Expose the plate, and note the time "accurately." Remove the chair and take it round to the other side; arrange subject, and give exactly the same exposure as before. The resulting negative, if carefully done, will give a perfect picture of Mr. —— playing cards with Mr. ——. Of course, from this, others can easily be invented, as this supplies the key to a great variety.

640. Interiors—To Photograph.—To avoid halation in interiors, the following procedure will be found useful. Use any liberally coated plate (by preference one which has a fair amount of iodide in it), and give three or four times the proper exposure. Before development, soak for a few minutes in a ten-grain solution of bromide, rinse, and develop with about one grain of pyro, one grain of bromide, and one drop of ammonia to the ounce. Be patient, and do not increase the pyro, or fog is likely to result; but ammonia may be added as necessary. A piece of tissue paper placed lightly over the lens-hood when taking interiors greatly softens the contrast, and, to a certain extent, prevents halation. It may also be pointed out that the Sandell plate with multiple coatings has been highly successful in preventing halation in difficult interiors. It is difficult to over-expose them, and as interiors generally present very great contrasts, a liberal exposure, with developer weak in pyro, is desirable. The metol developer may also be recommended for such subjects. Exposure is difficult to decide without using an actinometer, of which Watkins's exposure meter has special instructions for interiors; but taking panoramic view as 1, from 100—800 may be taken as ratio in sunshine, 200—1,600 in diffused light, or at noon of a June day f/16. Ilford ordinary plates, say 1—8 min. sunshine, although exposures of half an hour to an hour are frequently required in special circumstances. The camera should be provided with swing back and rising front, and lens *must* be rectilinear.

641. Interiors—To Soften the Light.—When an interior, such as that of a parlour, is photographed, a certain degree of hardness and patchiness often results from the windows being kept open during the exposure. A softer and better effect may be obtained by keeping the blinds down during the greater part of the time. This softens and diffuses the light, although it increases the time; just previous to closing up the camera the blinds may be opened to give the necessary high lights.

642. Large Heads on Small Bodies—To Photograph.—Perhaps the best method that can be employed is to have resource to combination printing. In this case, having procured two suitable negatives, one of a medium sized head, which call No. 1, and another of a comparatively diminutive body, No. 2, take a piece of waste sensitised paper, and make a print of the head, which must be very neatly cut out with scissors, and after carefully gumming the albumen surface, still more carefully place it into position on the shoulders of the figure, and the film side of negative No. 2. While this is drying take negative No. 1, and carefully "block out" (with photographic black varnish) everything around the head. By this time the gummed print will be dry, so put it into a printing frame with the necessary sensitised paper, and print in the ordinary way. By the time this is accomplished the paint on No. 1 will be dry, so put it into the frame which No. 2 has just been taken out of, and take also the print and again place it into position, taking great care that it is "well filled up," and again put out to print. It will now require to be watched very carefully until printed to the same depth as the other parts of the picture. Another plan: Take a mount such as would be used to mount oleographs on, size about 20 × 30. Now draw on the small body legs and arms, drawing the collar of the coat right up to the top edge of the mount. (The top edge here would be the middle of one of the long sides of the mount, as the mount has to be held longways when finished.) Now ask someone to stand up and hold the mount, bringing the collar of the miniature coat (the collar should be drawn rather large) up under the chin as neatly as possible. It is as well to cut a curve out of the mount to fit the chin. Have a background the same tint as the mount. The background should be of the swinging class, like a bedroom mirror. It should be slanted towards the head of the sitter. Now take a photograph of the whole.

643. Lightning—To Photograph.—A very interesting study is "lightning photography." It is a puzzling one to the beginner, yet it is, perhaps, the simplest form of photography which can be imagined. If the photographer has had much experience he will doubtless know the point at which the camera requires to be racked out to insure the lens being in proper focus for a distant object. If this is so, there need be no further trouble than, when night comes on, and the lightning commences to play, to rack out the camera to this point, fix it up, and direct it towards that

portion of the sky from which the lightning appears, then place the dark slide in the back and draw the slide, remove the cap and wait for the flash. It being night, no harm can come to the plate by reason of this exposure during the interval of waiting, and the lightning will impress itself upon the plate without any need of shutter or other contrivance. If the point at which the camera is in focus for distance is not known, there will probably be a lamp somewhere or other within sight, and in this case a rough focus can be obtained upon that.

644. Luminous Photographs — To MAKE.—An ordinary positive proof is rendered luminous in the dark by the following process: Spread as evenly as possible a thin coating of starch paste on a sheet of cardboard, and when still tacky dust over it powdered calcium or barium sulphide (Balmain's luminous paint), rubbing with a brush in order to make it adhere everywhere. On the other hand, imbue a positive proof—printed rather light, toned and fixed as usual—with castor oil, and rub off the excess with a clean rag. This done, paste the transparent proof on the prepared cardboard, and dry the whole before the fire. When the proof thus backed is exposed to light, the rays are transmitted through it to the sulphide, which absorbs them, and afterwards radiates them again as light, it being phosphorescent. The proof will be, therefore, luminous in the dark. Another method: Mount an ordinary albumen print in optical contact with glass. When dry rub away the paper from the back with powdered pumice, or cuttle fish, as in crystoleum painting; when this is done varnish with Canada balsam, thinned with turpentine, and coat the back with either phosphorescent barium sulphide, or with luminous paint, which can be bought ready prepared.

645. Machinery—To PHOTOGRAPH.—To obtain the best results the machine should be painted with white lead and turpentine, and a little black, to give it a grey tone. The lighting should be from the front and a little top; and the exposure in an ordinary machine shop would be difficult to overdo. But for a guide, say the machine is twenty-five feet from the light, and a mid-angle lens used (as ought to be) at f/64, and "ordinary" plate, fifteen minutes would give a good detailed negative, and it will be found a great advantage to hang a sheet behind the machine. This brings it out bolder, and prevents any part merging into machinery that may be behind it; and if any side has a very deep shadow a few inches of magnesium ribbon burnt so as to "light" that point will relieve it, care being taken that the light does not directly strike the lens. If the machine is not painted with the "flatting," about double or more exposure will be required, and by all means block any window that faces the lens, or result will be bad. The best direction for the light to fall for photographing machinery would be between the angles of 45° and 90° with the front, and a little from above the machine. The exact direction will depend upon the form of the machine, which parts require to be shown up, etc. Cross lighting might be utilised for showing up parts that lie in opposite directions to the light. All bright parts should be deaded by dabbing them with a thin paste of whiting and water; or, better still, the whole machine should be given a coat of the following paint: Lampblack (dry), gold size and turpentine. This can be easily removed with a rag and turpentine when finished with. The exposure will depend upon the area of light admitted, and can only be determined by experiment. Begin by giving, say, ten minutes, and if insufficient, increase by five minutes at a time till right exposure is hit. Metol might be found a good developer for such subjects.

646. Marble—To PHOTOGRAPH.—Hang a black velvet or cloth curtain in front of marble, leaving a hole only for the lens to peep through, and light by means of two oil lamps, one on each side. An isochromatic plate would shorten the exposure considerably, if artificial light were used. The most satisfactory way of doing this, however, would be by artificial light. Give two flashes, arranged so as to form an angle of about 60° with one another, with the object at the apex of the angle. They must be placed on a line with the camera—neither in front nor behind it. The flashes may both be made with the same lamp, as they need not be made at the same time. It is only necessary that the camera be kept perfectly rigid during and between the flashes. By daylight screens must be put up to stop reflections. Positions for same to be found by experiment. If white marble, better "back" the plate. To overcome difficulty of unequal illumination—(1) Either obtain the assistance of a friend, and hold a black cloth over the light half of the monument, moving slowly to vignette the margin of cloth into the shadow. Continue this for perhaps one half the exposure, and then expose on the whole of the tablet, or (2) make a cap of cardboard to fit the lens, cutting away sufficient of the cover to expose, say, one-third or one-half of the lens. Place this partial cap upon the lens, and turn it into such a position that it equalises the light falling on the plate, enlarging the aperture if necessary. Leave this cap on during the whole time of exposure, which it will prolong, but correct the illumination.

647. Metal Surface—To PHOTOGRAPH UPON.—Coat the surface with one of the various print-out emulsions in the market, or if the trouble is no objection use the bitumen or carbon process; or, again, if colour is no object, flow a solution over the plate the same as is used for the ferro-prussiate paper, which will give a blue print. Another method is to coat the surface with a thin film of albumen, and dry it. Treat it with a very dilute solution of nitrate of silver, containing a large proportion of alcohol, and again dry. Wash, and once more coat with albumen. After that is dry, iodise the film by dipping the plate in solution of proto-iodide of iron, containing a considerable quantity of acetic acid and alcohol which has been made some time, so that acetic ether is developed. To sensitise, immerse in a strong solution of nitrate of silver strongly acidified with acetic acid. The plates are exposed while wet, and developed by a strong solution of proto-sulphate of iron. It is extremely sensitive.

648. Microphotographs—To MAKE.—The production of these small views, or micro-photographs, is a branch of work which requires very considerable patience and skill, inasmuch as it is necessary to perform the operations of development, etc., in the field of a magnifier or small microscope, since the size of the image is so minute. The majority of the micro-photographs sold are made on the Continent, and details of their manufacture are not given in English treatises. The collodion process (wet plate) is used, or collodio-albumen may also be employed. In either case the collodion used for making the plates must be absolutely structureless, for if it is not the magnified images will have a disagreeable reticulated appearance. Pyrogallic acid is preferable to sulphate of iron for development, since it gives a much finer deposit. The process consists in making a positive by copying an illuminated negative, a

1in. microscopical objective being used for this purpose. An apparatus devised by Mr. Hislop, and described in Mr. Sutton's "Dictionary of Photography," may be employed. It consists of a rigid mahogany board about 6in. wide and 3ft. 6in. in length. At one end two uprights are fixed, between which a miniature camera, fitted with the microscopical objective, can be moved up and down, so as to allow it to be placed opposite the centre of the negative to be copied. The objective is screwed to a brass tube, projecting from the camera towards the negative, the tube being fitted with stops of various sizes. A micrometer head for the fine adjustment of the lens is also necessary, because the majority of microscopic objectives are corrected only for the visual rays. The sharpest visual focus must be found by means of a powerful magnifying glass, and the chemical focus ascertained by racking the lens in or out to various distances until the proper chemical focus is found. When this has been done the same correction may always be applied unless the negative's distance from the lens is altered. The negative is placed in a frame at the required distance on the long mahogany board. The illumination may be natural or artificial, but must, of course, pass through the negative. The variations of light, negative, and collodion plate render it impossible to give any idea of exposure. After exposure the little plate is placed under a low power microscope, in yellow light, and a few drops of developer poured over it. Development must be watched through the instrument, remembering that a transparency is required, and that, therefore, rather greater density than otherwise should be obtained. After fixing and drying the tiny plates are examined through a magnifier of about the power which it is intended to subsequently attach them to, in order to see whether they are perfect and worth the subsequent trouble of mounting. The photographs chosen are then cut into small squares with an ordinary diamond. Care must be exercised that no dust adheres to the film side of these small squares. The little lenses (or Stanhopes) to which the view is to be cemented are now placed on the top of a small stove, and very cautiously treated. A drop of Canada balsam is placed on the end and allowed to soften, and the little square transparency taken up in a pair of forceps and pressed, gently at first, afterwards more strongly, into contact with the melted cement. The two are then allowed to harden together for some hours. In order to be certain that the operation has succeeded, and that the contact is perfect, the transparency is examined through the rounded end of the little glass cylinder, to which it is cemented, which acts as a microscope and gives a magnified and distinct image of the object. If air bubbles show they are most likely due to unequal pressure in cementing the glass. The balsam must be resoftened by placing it for a few minutes on the stove and the operation repeated with greater care. Drawings of the apparatus employed in this work are given in Dr. Monckhoven's treatise, "Traité Generale de Photographie." Another description is as follows: The apparatus required for the purpose is an ordinary microscope, with a 1in. to 2in. objective, if corrected for photography so much the better, and a wet plate outfit. Ordinary photographic lenses do not give sufficiently good definition for this small work, so it is absolutely necessary that a microscopic objective be used. Zeiss's apochromatics are recommended, as they are corrected for photographic use. The collodion has to be carefully chosen, as many samples show too coarse a structure when the dried film is magnified. The only way to get the right one is to try till a structureless one is obtained, and then lay it on one side for this particular purpose. The microscope must be placed in a horizontal position, and the eyepiece removed. The stage is best made of glass, as a brass one is soon ruined. A negative, quarter or half-plate, is prepared of the minute picture required. The former size is best, as then it can be illuminated by means of the optical lantern. The negative is supported at a distance from the end of the microscope tube. This is best done by means of the camera, placing it in the position of the ground glass, and supporting the microscope tube in the place of the lens. With the inch object glass the distance will be about one foot. The negative has now to be illuminated by artificial light very evenly, an enlarging apparatus or lantern with condensers will do this most perfectly. Ordinary ground glass is too coarse to focus on, so a 3in. × 1in. slip must be coated with the collodion, sensitised, washed, and allowed to dry. Upon this the image may be focussed by means of a powerful hand-magnifier, or another microscope placed behind. If an objective uncorrected for photography is used, the plate must now be moved a little away from the objective. The exact distance cannot be given, but must be found by various trials, and will always be the same with the one objective. The 3in. × 1in. slip is now coated with collodion and sensitised, and placed in position; if an optical lantern is used the exposure may be about five seconds. After exposure, the development is best done with the pyrogallic and citric acid developer. Fixing may be done in a strong solution of hypo, and the picture well washed with pure distilled water. When dry, the photograph must be mounted with Canada balsam. When required on any other object, as the lenses, etc., one of these is sensitised instead of the glass slide, or the picture on the slide after washing may be coated with a ten per cent. solution of gelatine, and, when set, stripped and transferred to the other support.

649. Moonlight Effects—To PHOTOGRAPH:—The so-called moonlight pictures are made in the following way: Point the camera (on a very sunny day) straight to the sun, but not including it. Make an instantaneous exposure of one hundredth part of a second, and develop. To heighten the effect soak the resulting print in a weak solution of aniline blue; if the colour is too intense it may be lightened by soaking the print in ammonia water. Capital pictures may be made this way. Another writer says the exposure should be about the normal one for the view. It is a mistake to under-expose. First develop with a developer very weak in pyro, say quarter to half grain per ounce, till details are just out. Wash this off, and use a developer strong in pyro and very much restrained, which will give density in the high lights. This must only be allowed to act a short time; wash, and finish negative as usual. They appear best printed on blue-tinted paper, which can be obtained from several dealers.

650. Moon—To PHOTOGRAPH.—Remove the eyepiece of the telescope and the lens of the camera, and insert the tube of the telescope inside the camera, covering any aperture in the front of the camera with dark cloth, then focus in the usual way, and having inserted the dark slide, expose. Use a rapid plate, preferably quarter-plate, or 3¼in. square, and give an exposure of about one-fourth second. A photomicrographic camera is preferable, as being very much lighter and easier to adapt by sliding tube inside or outside that of the telescope. The above supposes the possession of a telescope, if possible equatorially mounted, but if it is desired, to use a camera and dispense with a telescope, and use a single lens, it is recommended to employ a

smaller stop, say f/32, as the image got is so small that it would require enlarging to be of any use. It is important, however, to know that a long-focus lens is necessary. Nothing shorter in focus than 21in. should be used, and with this a picture of the moon may be obtained about one-fifth of an inch in diameter, which, if enlarged ten diameters, would give a passable picture 2in. in diameter. Any-one possessed of two lenses, one long focus, say 31in. focus, and another a short focus, say a small stereo lens, can produce large photographs of the moon. For trial, let the larger lens be pointed at an object, and the smaller lens be placed behind and some inches beyond the focus of the larger lens; an image of the object can be produced of any size by altering the position of the two lenses. This plan answers the purpose of a telescope, the smaller lens magnifying the image produced by the larger lens. With slow plates the exposure, with f/32 and single lens, should be one second.

651. Multiple Image—To Photograph.—Fix the picture on a perfectly black background, and focus the size required. Note also the limits within which the carte can be moved so as to remain on the plate. Then expose with the carte in one position, cap, move the picture, re-expose, again cap, and so on. There are also two other ways at least. The first of these is very simple. Copy the c.-d.-v. portrait in the camera, print twelve positives, cut them to the size of the bust required, and affix them to a large card in four rows of three each. Now place the carrier over the ground glass screen, and mark out the size of a quarter-plate. Divide this into twelve spaces of about one inch square, and copy the twelve photographs so as to get one on each square. The only trouble in this method is to get all the prints equally printed (and toned, if necessary). The next method consists in taking four thin black cards the size of the quarter-plate; on these rule out spaces in the same way as before (as on the ground glass screen). Now counting these spaces—1 2 3, 4 5 6, 7 8 9, 10 11 12. From the first card cut out space 1, from the second space 2, from the third space 4, and from the fourth space 5. Now focus the c.-d.-v. so as to get the bust required on space 1 on the screen. Insert the card in the dark slide in front of the plate. Allow in the focussing for the thickness of the card, and take negative on space 1. Change the card by reversing, so as in turn to expose spaces 10, 12, 3, and take negatives as before. Now take second card, and expose spaces 2 and 11. The third card will expose spaces 4, 6, 7, and 9, and the fourth card spaces 5 and 8. Be careful to give same exposure to each space, and if the camera had a base allowing a lateral and tilting movement it would facilitate matters. To ensure accurate register of ground glass screen and plate in dark slide when focussing, insert two pieces of card, same thickness as those used in the dark slide, between the *screen frame* and back of camera at top and bottom.

652. Person holding his Head—To Photograph.—One method recommended is a double exposure on the same plate—on the second one placing the head where it is wished to appear, and covering everything else with black—but a perhaps more manageable method is "double printing." Take the first negative with everything in its place as it is wanted to appear, except the head; and for purposes of expression and selecting the best position it might be better to place a bust where the head should come. Then take a second negative with the head in the place marked on the ground glass where the bust came, and as nearly as possible the same size. Make a print from the first negative, and cut carefully out of it the exact outline of the head taken from a print of the second negative. Stick this mask on the second negative, and stick the cut-out head on the bust in the first negative. On printing the first negative, of course, there will be a blank where the head comes, particularly after the silver paper of the mask has darkened. Then print a second time, using the second negative masked all but the head. Keep changing the position of the frame in printing, so as not to leave a white line where the join comes, and, if necessary, touch out any places which show. Another method: Take a black background, then arrange another black cloth so as to hide the body from view, leaving the head only visible. Take half a plate and place it against the throat at such an angle that on the ground glass of camera it will look like a whole one. Expose on this. Then, having marked the exact position the plate was in, stand in such a position that the hand may come just under where the plate was, so as to appear to support it. Raise the cloth in front of the body to such a height that it just cuts off the head already exposed, and then expose for the body, giving same length of exposure in each case. This method will be found to give satisfactory negatives of this class. Red backgrounds will do equally as well as black.

653. Post-mortem Work—To Photograph.—As "sitters" are not likely to move, there will be no difficulty in securing good lighting, and it might be better to burn magnesium wire within a reflector. However, whether wire or flash be used, burn it *behind* a screen, say of tissue paper, or tracing cloth, or a sheet of ground glass, so as to diffuse the light and prevent hard lights and shadows. On the *opposite* side of the subject to that on which the light is burned should be a reflector, which may be a white sheet thrown across a stand, or a large sheet of white paper, and there will be no difficulty in securing full exposure by burning several flashes one after the other, *slightly* altering position of the light each time. A good reflector to use behind the light is an old umbrella, covering the interior with white paper. The following mixture works well: Potassium chlorate 1 ounce, antimony sulphide ½ ounce, sublimed sulphur ½ ounce, powdered magnesium ½ ounce. Powder the chlorate *by itself* very finely, and then mix it with the other ingredients with the finger on a sheet of paper. *On no account attempt to use a mortar and pestle for this purpose.* About two drams of the mixture, ignited by bringing a match in contact with it, placed about five feet from the subject, will give a fully-exposed negative. A screen made of thin muslin should be placed between the burning magnesium and the subject, as close to the former as convenient, and the lens should be screened from the flash whilst the exposure is being made.

654. Seascapes—To Photograph.—Use: (1) Slow plates; (2) a good shutter; (3) a single lens; (4) a quick exposure; (5) slow development; (6) *plenty of patience.* For further details—a few hints are given especially to those wishing to expose plates on board ship. For plates there are none better than *Ilford ordinaries*, and it will be found that the less chemicals taken the better. The best plan will be to take sufficient ready-made developer, in two solutions (made according to the formula given with the Ilford plates). Take this in well-stoppered pint bottles. It is best to develop the plates when on the voyage, if possible, or error may be made in respect of the exposures; but it is perhaps not advisable to fix them till return (or, rather, till reaching land), so that there may be no difficulty about an unlimited supply of water where-with to wash them. Take also a large tin of *chrome*

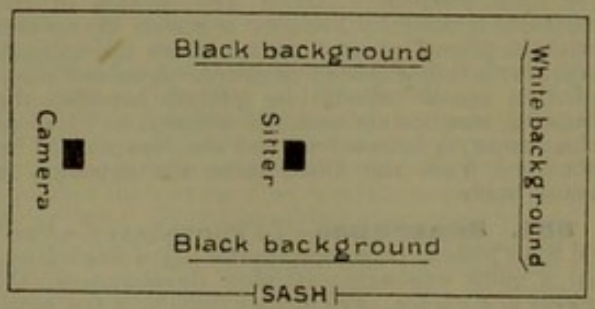
alum and one of *citric acid*, for if plates are not fixed it is desirable to proceed as follows. Make a solution of

Chrome alum	½ ounce.
Citric acid	1 dram.
Water	35 ounces.

Immerse the negative, when developed, in this for two minutes, drain, and flood with a weak solution of *sugar*, and dry. Before being fixed the negative must be well washed.

655. Science Work—To Photograph.—In photographing small natural objects, such as fossils, dried plants, and grasses, etc., good results have been secured by arranging the camera on a long table placed at an angle of about sixty degrees to a window having a north aspect. The blind is let down half-way so as to cut off most of the top light, and by using a white screen on the other side of the table. it is easy to get the necessary detail in the shadow side of the object. If by "science work" is meant the reproduction of illustrations in books or other diagrams, then use artificial light in preference to daylight, the light of two Argand burners being sufficient. The exposure is not long, generally being about forty-five seconds; whilst the regularity and certainty with which the exposures can be made saves time and plates. The necessary board for carrying camera and easel can be fixed in the dark room. and the exposure and development of the plates can be superintended at the same time.

656. Silhouette Photographs—To Make. Two black backgrounds, made of cloth or of velvet, one white background, and a piece of black cloth, are all that is required for making silhouettographs by the Stumman process. Arrange in the glass room the two black backgrounds so as to form a sash passage two yards wide, parallel to the sash, and distant from this about one yard. Cover the two black backgrounds with a piece of black cloth to form a roof. In this manner a small tunnel is formed, one of whose outlets is turned towards the camera; at the distance of a yard from the other outlet place a very white background, and light it well. The person of whom it is desired to make a silhouette portrait is placed in this little improvised tunnel, so that



the profile is cast sharply on the white ground. The part of the face turned toward the objective being but very little lighted, on the ground glass of the camera is seen only a silhouette on a white ground. The time of exposure should be rather short. The plate is developed in the ordinary manner, but the development is pushed a little in order to get a very white background.

657. Silver Goods—To Photograph.—One method, which has succeeded well, is as follows: Paint the plate over with thin gold size, and when nearly dry, dust over by shaking from a muslin bag some magnesia, which has been coloured a light grey neutral tint by a mixture of ivory black and ultramarine blue, just sufficient to tint it. When dry, brush off surplus powder with a very soft dry plate brush. The articles then prepared may be arranged on a table draped with a black or crimson cloth, placed out of doors, with a screen behind, the medals suspended from the edge of the table. Another way is to photograph them on black velvet. They should not be taken in too bright a light; so, if a room suitable for the purpose could be obtained it would be best, as it would not matter about a long exposure, and in a room they could be lighted a great deal better than outside. There are several ways to avoid reflection, but one of the best is steaming the articles. This can be done by first arranging and focussing them, then put the plated goods in a cold cellar, or some such place, and put a lump of ice in each cup and cover the top of it over. When the plated goods are thoroughly cold bring them back into the warm room, and place them in their proper places, uncover tops of cups, and see the focus is correct. The articles will then be covered with steam, which gives them a dull appearance. They should then at once be photographed.

658. Sound Figures—To Photograph.—Take a stretched membrane (a small kettle drum answers), and speak or sing over it, the membrane will vibrate, and if fine sand is strewn over it, this will assume certain curious forms, which can, of course, be readily photographed. Photographs may easily be taken from the curves and nodes formed as stated above on a vibrating medium strewn with fine sand, emery, sulphur, etc. The apparatus for producing such nodal lines consists simply of an ordinary fiddle bow, a thin membrane stretched on a frame, and a metal bell. Clamp the bell mouth up in a vice, strew the membrane with sand, etc., resin the bow, and play away on the edge of the bell, holding the membrane near the bell: the sand will gradually form into lines and curves. Another way of forming these lines is to get a metal plate, bore a hole through the centre, and screw it to an upright piece of wood, and fiddle on the edge, having strewn it with sand as before, and wherever the plate is touched at the edge a nodal line is produced. Their number increases with the pitch of the note emitted by the plate, and the law governing the vibrations of plates of this kind is "In plates of the same kind and shape, and giving the same system of nodal lines, the number of vibrations per second varies directly as the thickness and inversely as the area of the plates."

659. Spectra—To Photograph. — Directions for photographing the solar spectrum are given in No. 660. The same apparatus and adjustments are required if it is desired to obtain the spectra of different substances, but it is necessary to use a prism, or prisms, of a material which absorbs as little as possible of the most interesting part of spectrum under observation, and to use plates rendered sensitive to suitable colours. Thus, for the sodium spectrum ordinary plates would be useless, as they are not sensitive to the most characteristic sodium lines, but isochromatic plates would do; while for lithium a plate would have to be sensitised for the red with malachite green and naphthalene blue. Diffraction spectra are difficult to photograph, although very useful for purposes of measurement.

660. Spectrum, Solar—To Photograph. —Without the aid of diagrams it is almost impossible to give a novice any adequate idea of how to photograph the spectrum. Assume,

however, that the spectroscope is of the usual form, *i.e.*, prism in centre, telescope, and two tubes with collimators and slits. Obviously only one of these latter will be required. The collimator or slit should be movable, so as to get the focus of the collimator lens accurately on the outside of the slit. A heliostat is arranged to throw an image of the sun (by means of an interposed condenser) on the slit, and hence the lens of the collimator is either partially or entirely filled with the rays. The light, then, is refracted and dispersed by the prism, and then reaches the lens of the telescope, or preferably the lens of a camera, by which the image is focussed on the screen, etc. Use Edwards's isochromatic plates and pyro and ammonia developer, employing the screen for the blue rays. The chief difficulties in this sort of work arise in the adjustment of apparatus, the focussing of the image, and the fact that the centre of the mirror, axis of condensing lens, and of the collimator must be in the same straight line. Again, the prism must be placed so that the particular rays may be refracted in the angle of minimum deviation, and the camera and its lens should be placed so that the rays for which the prism has been adjusted should occupy the centre of the sensitive plate. The difficulty in focussing arises from the fact that the focus of the violet rays is shorter (as they suffer the greatest deviation) than that of the red rays.

The following directions are given for adjusting the apparatus: The lens of the collimator must be adjusted so that its equivalent focus falls exactly on the outside of the slit. Then the prisms must be so placed that, as far as possible, the light passes through them at the angle of minimum deviation. To effect this it is necessary to take some particular Frauenhöfer line in the spectrum, and, placing the prism roughly in position, the image should be observed, and the prism turned in one direction, when it will be found that the line will at first seem to move in one direction, then at a certain point it will stop and turn back. The prism must be so placed that the line is practically steadfast—that is, when it ceases to move in the one direction and begins to turn back. The lens of the camera may either be used, instead of the ordinary object glass of the spectroscope, when the lines are focussed on glass, which must not be ground, but only very fine obscured, or, better still, use a focussing glass and clear glass. It must, of course, be taken into consideration that the focus of the different rays of the spectrum is not the same, therefore a camera must be used which will allow of the adjustment of the plane of the focus to suit the different refrangibility. If the ordinary object glass of the spectroscope be used, the plate may be placed in the position of the eye-piece, but the former is generally the better plan. Again, there is the difficulty of the sensitive salts of silver being practically insensitive to some of the rays unless certain dyes are used, and for this purpose the plate must be a bromo-iodide plate, containing about five per cent. of iodide, and should be ortho-chromatised by being bathed in a mixture of cyanine and erythrosine or eosine Should it be desired to obtain a photograph of the less refrangible rays of the spectrum, it would be advisable to use a screen, so as to cut off the whole of the rays up to a certain point. Such screens are used for copying pictures, one to cut off practically all rays from H to F, another cutting off all up to D, and another cutting off all from A to B; thus, by exposing the plate to the action of one part of the spectrum through one screen and then through another, a better result will be obtained. It is necessary for the best results that the focal length of the lens used to condense the rays of the sun should not exceed the length of the collimator when divided by the aperture of the lens – that is to say, the image of the sun should be seen as a brilliant disc on the centre of the collimating lens. The centre of the mirror of heliostat, the axis of the condensing and collimator lenses, should be in a straight line. The correct distance of the collimating lens from the slit may be found by using a very fine ground glass on which a mark is made in lead pencil, and a compound focusser should be focussed for this mark, and then place the focusser against the slit, which should be rather widely opened, and point the lens at some distant view, and slide the slit nearer to or farther from the lens till the view is in focus. Another element of error will be found if the lens of the collimator is not perfectly corrected. The image, though sharp, will be surrounded by coloured fringes, and the distance must be fixed according to the part of the spectrum to be examined—thus, if the blue end is to be examined, the image surrounded by red fringes should be focussed, and *vice versâ* for the red. The best work in photo-spectroscopy is now done by concave diffraction gratings, but these are rather expensive, but much easier to work with. Fuller information will be found in papers by Captain Abney in the Transactions of the Royal Society, 1866, and Proceedings Royal Society, No. 217, 1887, and in a small pamphlet by Captain Abney on the same subject.

661. Stained Glass Windows—To PHOTOGRAPH.—It is advised to dip the plate in one of following: (1.) V. Schumann's method.—Soak plate in a one or two per cent. solution of ammonia for two or three minutes, and then immerse in

Distilled water	100 parts.
Ammonia	2 ,,
Alcoholic solution of cyanine (1·500)	5 ,,
Alcohol	5 ,,

Wash and dry.

(2.) Messrs. Thomas's dipping bath.—Stock solution No. 1:

Erythrosine	5 grains.
Meth. alcohol	5 ounces.
Water to	20 ,,

Stock solution No. 2:

Ammonia ·880	2 ounces.
Water	20 ,,

For use take one ounce of each solution, and make up to ten ounces with boiled or distilled water. Plate should remain in the bath about three minutes at ordinary temperature. Rinse with water, see it drain off evenly, and dry. (3.) Dr. Scolik's.—Soak the plate for two minutes in a one per cent. solution of ammonia, then immerse for about seventy seconds (not longer, as the sensitiveness is reduced) in—

Erythrosine solution (1·1,000) ...	25 parts.
Ammonia	4 ,,
Water to	200 ,,

Or, in the alternative azaline bath:

Alcohol	500 c.c.
Chinoline red	1 gramme.

To which is added 50 c.c. of a solution of

Alcohol	500 c.c.
Chinoline blue	1 gramme.

(4.) F. Ives's method—Flow the plate (collodion) with a strong alcoholic solution of chlorophyll from blue myrtle or plantain leaves, and then immerse in water strongly tinged with blue shade eosine. It may be mentioned, in conclusion, that there are many other dyes, especially among the coal-tar products, which confer orthochromatic properties on the film, and that for dipping plates the solution of dye, according to Mr. Bothamley, should be in the proportion of one of dye to 20,000 or 30,000 of water. Following is a colour-correct developer by M. E. Dendle: Exposure at least should be fifteen

seconds. Place plate for one minute in a bath of equal parts of a ten per cent. solution of potassium bromide and ten per cent. potassium sulphocyanide solution. Rinse with water and develop.

Water	1 litre.
Hydroquinone	8 grains.
Sulphite of soda	60 ,,
Caustic potash	8 ,,

It keeps well. It develops slowly, but should temperature be high, plate must be taken out and the developer diluted with water. Image has not the appearance of being developed in ordinary way. It has first a light colour, which turns black rather quickly. Plate is fixed and washed in usual way. If development has been correct the high lights only lose a little, and one gets soft and pleasant tones.

662. Subterranean Objects—To Photograph.—An apparatus has been constructed for subterranean photography in cases where the only means of communication to underground localities is a narrow shaft, and the instrument must be manipulated from the surface. It consists of a camera of small size, the plate being about 2in. square, and the focus of the lens of comparatively short range. The camera, mounted in a metallic case or tube, open on one side, can be lowered by means of a cord or small chain attached to the tube. The camera is pivoted within the tube at its upper end, so that it can be kept at any angle by means of a cord or small chain fastened to the lower end of the camera. Above and below the camera are placed rows of incandescent lamps. When the apparatus is lowered and the camera made to incline outward from the case, the current is turned on and the plate exposed. The photographs thus obtained are said to be excellent. For ordinary mines or underground workings, an ordinary camera - tripod or hand—may be used, the illumination being effected by magnesium. The flashlight may be employed with good effect. Care must be taken to use sufficient magnesium, as the places are absolutely dark, and usually the objects reflect very little light, as in coalmines. A powerful developer is necessary, with a liberal supply of accelerator.

663. "Tableaux Vivants" under Limelight—To Photograph.—It will not be found practicable to take groups with *any ordinary* limelight arrangement. It is best to light the group with limelight, focus, and then use two or more magnesium flash lamps (depending upon size of group), together with the limelight, for exposure, which would then be instantaneous. Or the limelight may be assisted during exposure by burning several strands of magnesium ribbon. The exposure under the conditions named with limelight alone would certainly not be less than ten minutes. If, however, four extra large jets can be commanded, such as are employed for scenic effects in theatres, it might be managed with an exposure of about three minutes. If the limelight must be used, the lighting should be from above, downwards, at any angle of about 45°. Reflectors will be urgently necessary, as the shadows will be nearly black. The most portable form of apparatus would be a theatrical limelight box, which could be placed on the top of some housemaid's steps, and the light inclined downwards at the proper angle. Of course it is impossible to give, offhand, the exposure, but it is best to try one figure beforehand, if possible, giving ten seconds, and then try another plate with twenty seconds. This is really the only safe plan, for *experientia docet* as no other teacher can.

664. Theatre Interiors—To Photograph.—Use Edwards's instantaneous isochromatic plates, and photograph through a piece of blue glass. Develop with a rather strong developer, preferably hydroquinone. It would be desirable to use the "flashlight," that is, if the proprietor would allow it, and then it would be very difficult to take one even with "flashlight" while the people were on the move. In a theatre lighted with electricity, a photograph could be taken with a hand camera and a reasonable exposure, but as regards those lighted with gas (they always are lighted even during a day performance) it would be out of the question. Again, the camera would have to be fixed on something to keep it steady, and the British public have hardly yet arrived at that state of perfection when they will sit behind, say, a whole-plate camera without raising, well, just a murmur. Some time ago there were some very excellent photos of scenes from "David Garrick" taken on the stage, *but* at a private rehearsal for this purpose.

665. Wild Birds—To Photograph.—As in the majority of cases there would be not sufficient time to set up apparatus, focus, etc., the best plan will be to use a hand camera, preferably one taking quarter-plates, with a finder. From negatives thus produced enlargements can easily be made. For photographing birds in an aviary a portrait combination succeeds well. As the bird is to be shot while stationary, the question of size is determined by the distance from the bird, and a good birdstalker should get good results with any hand camera. As, however, the chance of getting near the game varies inversely with the size of the camera; and again, the trouble of focussing, introducing the dark slide and drawing the shutter may all be in vain, owing to the object having departed by the time the shot is to be fired, it is advised to use any camera on the detective principle which has a fixed focus (or nearly so), and which also *has two finders* in the lid, so that it may be possible to approach the bird, be sure it will be on the plate, and fire! They can be enlarged afterwards to life size. It would be best no doubt to actuate the shutter from a distance by means of pneumatic release, electricity, or string; the difficulty in this case would be in telling when the birds were in focus in the camera, though this could be obviated by setting camera in position and focussing some object to come in the middle of focussing screen, and then retiring to a distance after placing slide in camera and leaving all ready for exposure, and then waiting patiently until the birds come opposite, or somewhere about the object previously focussed, and then, "fire away." It will be unnecessary, of course, to give information how to attract the birds to the desired spot by means of seed, bread, etc., as no doubt all dodges of this kind are familiar to all.

CHAPTER XVII.

STUDIO AND DARK ROOM.

(BACKGROUNDS, ETC.)

666. Accessories—To Make.—A capital imitation rockwork may be formed with stout brown paper soaked in weak glue and bichromate of potash. This is set in position, allowed to dry in the light, and finished off with a wash of plaster of Paris darkened with lampblack. A pulp is also used which consists of paper and glue water, a species of *papier maché*, in fact, and is made as follows: Soak one pound of glue in half a gallon of water, and dissolve by heat. Meanwhile, procure a quantity of paper of any description, newspapers, wrapping paper, etc., cut or tear it into small pieces, and steep it in boiling water for an hour; let settle, pour off the water, and mix the paper pulp with the glue water to the consistency of very stiff paste. Another way: Carefully prepare the framework so that it is as near like the finished article as possible. Then take a quantity of rough, coarse brown paper, steep this in water for several hours until quite limp, then lay it on some flat surface, and roll out as much of the water as possible with a round stick, such as a broomstick. The framework is then brushed over with a thin solution of glue, and the damp sheets of paper laid on, sheet over sheet, with a coating of glue between each sheet. Any small alterations can now be made in the shape by pressing into the required shape with the fingers, and where the paper joins it must be rubbed down. It may then be set aside till dry, when it can be painted the desired colour. Another recipe: Thoroughly soak soft newspapers in paste made of one pound of flour, three quarts of water, and a tablespoonful of alum, thoroughly boiled and mixed. Make the final mixture about as thick as putty, and it will harden like *papier maché*. This paper may be used for moulding and shaping all sorts of things. Rough wooden framework is needed to build on. The rough framework may be covered with *soaked* brown paper (previouslv pasted) in sheets, any deficiencies being first filled up by the above composition. The brown paper will then completely adapt itself to the shape, and several coats will become "hard as a board." The outside may be coated with thin glue, and then sprinkled with coarse sand or sawdust if additional effects are desired.

667. Amateur Background—To Make.—The less pictorial the background the better the "victim" will look, and a plain *brown* holland that can be rolled and put on one side in a moment will answer for almost all purposes, or use a piece of the Lancaster blind material, which can be obtained in various shades, and may be washed with soap and sponge; if a landscape background is required, and one can be sketched, this is *the* material to do it on. Use distemper, and it can be washed off when damaged or tired of. Make the distemper of glue size, whiting, drop black, and a little umber; stretch the "ground," and choose a something from some illustrated journal (there are many pretty sketches at times in "Cassell's"); make a rough sketch from the one chosen with chalk, and then fill in with the distemper, and with a *damp*, broad painter's dust-brush blend and soften the whole. Never mind how crude it looks, so that it is not "stiff." It will look wonderfully well in the photograph. For indoor work the ordinary furniture and paper of a room can generally be made suitable, as they need not be very strongly defined. Picture-frames, etc., should not be allowed to occupy a prominent position, and anything with violent contrasts should usually be removed; but everything depends upon the particular circumstances, and the only rule that can be given is to allow nothing to detract from the prominence of the sitter. For outdoor work perhaps the best background is an old stone wall, if accessible. Foliage generally makes a bad background; it is generally too dark, and if the sky shows through it it looks spotty and very unpleasant. Never get the sky behind the head of a sitter, and never take a portrait against a new brick wall. The "holland" background referred to above will save the necessity to do so, or on an emergency a dark-coloured blanket may be made useful. For ordinary work, a light and dark plain background are required for vignettes, etc., a third for interiors, and a fourth for exteriors. Perhaps the least objectionable pattern for the former is one representing the two sides of a room, with panelling, etc., and for the latter one representing a conservatory, with glass roof and flowers. These can be purchased from any photo dealer. If it is desired to make them, the following hints may prove useful: For plain backgrounds an ordinary blanket answers well, a light-coloured and new one for light backgrounds, an old and yellow one when a darker background is desired. In any case take care to place the blanket considerably behind the sitter, so as to be well out of focus. Common light brown wrapping paper or "Feltine" are also very good, both of which can be procured at carpet warehouses. The paper should be well wetted, and glued at the edges whilst wet to a wooden frame, when it will dry out quite flat. If something more durable is wanted, moisten a piece of unbleached calico sheeting, and stretch it whilst wet on a frame, tacking it to the edges. When dry size it with ordinary size dissolved in three times its weight of water, and then colour it to the desired shade. There are several methods of doing this, one of the simplest of which is called soap flatting. To make this procure some mixed

oil paint of the requisite shade, and mix it with a strong solution of common soap, in the proportion of one pound of soap in half a pint of boiling water for every pound of mixed paint. The soap is first cut into thin shavings, then boiled with the water until dissolved, and the paint stirred in gradually with a stick, and worked up until the whole is thoroughly even and smooth. Another method of procedure is called oil flatting, and is more durable than the preceding. In this case dry white lead and lampblack in the proper proportions are mixed to the consistence of thin paint with turpentine, containing one-third of its volume of japanner's gold size. If the background is to be of one tint, the paint is first applied in the ordinary way with a brush, and then stippled before the paint is dry with another brush, so as to destroy the brush marks. This stippling consists in gently dabbing the surface with the point of a dry brush (a common round hearthbrush, costing fourpence, is as good as anything), keeping the brush as dry as possible by occasionally rubbing it on a piece of old cloth, and using only the extreme tips of the fibres. Designs are painted on a background in a similar way, stippling in all surfaces of any extent, and softening hard outlines as far as possible. A good plan is to make lantern slides of some of the background designs frequently published, and project these, by means of a lantern, on the prepared background. Then, with a bit of charcoal, lightly sketch in the outlines, and use the colour over these. Remember, the softer the background outlines are the better the finished photograph will look. The following is a distemper for colouring backgrounds: Take whiting 1½ to 2 pounds, lampblack 3 ounces, damp blue 4 ounces, glue 1½ ounces. Dissolve the whiting in two quarts of water, add nearly all the blue, then add the black, gradually drying after each addition by dipping in it a piece of paper and drying at the fire, till the exact colour required is got. Then, having dissolved the glue in warm water, pour it in to keep the colour from falling off, mix thoroughly together, and strain through canvas.

668. Backgrounds, Natural—To Make.—To make a background from nature, proceed in the following manner: Select a striking bit of scenery, or group of trees, etc., and photograph it. Print a *light* copy, fix (without toning) then with a pantograph, or similar arrangement, go over the outlines of the picture, reproducing it in an enlarged form on a stretched sheet of calico or canvas. The design may now be washed in and shaded, using distemper colours for the purpose.

669. Background, Objectionable—To Alter.—This purpose can best be effected by resorting to combination printing. Proceed in the following way: First block out the objectionable backgrounds, leaving only the figure to be printed from. This is best done with black varnish, and if the space to be covered is large, it is convenient to block out portions of it with orange paper, since varnish is apt to break up when applied to a large surface. When it is possible, the varnish should be applied to the back of the plate, since by this plan a softer outline is produced, but in some cases it is impossible to do this, as, for instance, in small detailed outlines. It must then be blocked out from the film, although the practice is apt to produce very sharp lines. At the top of the plate, just outside the margin of the picture, two registering corners should be made. This may be done by cutting into the orange paper with a knife, and, if necessary, removing the film outside the marks. Now take a print from the negative. It will represent the figure against a background of pure white blankness. From this point cut out very carefully, either with a pair of scissors or with a knife, on a sheet of glass, the printed portion of the picture. Lay this on the negative of the background it is wished to introduce, and secure in the desired position with a spot or two of gum on the back. Now take the white part of the print, and cut out the register marks very accurately. These marks will, of course, appear black in the print. Lay this white portion on the background and negative, so that it exactly fits the printed portion already secured there, lay a weight on it, and with strips of gummed paper mark where the registering falls. At this point, if a print were taken from the figure negative, the corners cut, and laid to the register marks of background negative, the resulting print would be found to combine properly the two, but the joins would be hard and cutting. In order to correct this, the edges must be softened. Lay the background negative on some transparent desk, such as a retouching easel, and wherever there are sharp lines cut away the printed portion fastened thereto, and substitute for it black varnish on the back of the plate. Of course, this substitution must take place before the paper is cut away. Before leaving the subject notice should be taken of the liability of albumenised paper to stretch with the damp, which, unless pains are taken to prevent it, will certainly spoil the calculations of the printer. Another method is to proceed as follows: Take a print from each negative, when toned and dry, take a pair of sharp scissors, and carefully cut away the background from the portrait. Mount the background print, and then stick the portrait on in the desired position. It must now be "touched up" with water colour till satisfactory. Now copy the print in the camera, taking care to light it from the front, or a shadow will be cast from the edge of the cut-out print on the negative. The edge of the portrait must be retouched up a bit in the desk. When finished, it should look complete, *i.e.*, should look as if the portrait and background were taken at the same time. In this way it is quite possible to put a different dress on a lady's portrait without showing the process. It is not an easy job, but care and a little time should do it.

670. Background, Portable—To Make.—One method is first make or procure two deal poles as the sides of the background of the required height. These poles must, of course, be furnished with feet. Screw two large hooks into the tops of the poles to hang the background on. The background itself must be made to wind round a pole like a lantern screen. Then the *modus operandi* is as follows: Erect the two poles on the ground, unroll the background, and support the pole it is fastened to on the large hooks. The background is then ready with the exception of the *reflector*. A good plan for this is to make a similar pole to the sides of the background, but higher. The reflector can then be fastened to the top of this, or, better still, be made adjustable. The reflector itself may be made of white paper or linen stretched over a rough framework. Another: A very efficient and cheap background for open air portraiture can be made as follows: Make three frames 4ft. 6in. × 6ft. 6in. each from strips of wood 2in. × ½in. thick. Cover No. 1 with light grey cloth on one side, and medium dark on the other side; this will form the background. Cover No. 2 light grey one side and black on the other. No. 3 dark grey one side and white on the other. Hinge these three to either (in the direction of their length), No. 1 being in the middle, with webbing, so that the side wings may fold either way. Now make another frame of the same size, and cover it with white cloth; this will form the loose top screen. With this simple apparatus a

great variety of light effects can be produced. If the sun is bright, place the black wing towards the sun, subduing it on that side, whilst the white wing will soften the shadows. To produce more shadows and greater contrast, turn the frame upside down, so that the white wing will be towards the sun, and the black wing will further shade that side the sitter. Then put on the top screen; if there is too much shade under the eyes, nose, etc., move the screen forward, and if more shadow is required push it back. Still further variations can be obtained by using the dark grey background with the dark and light grey wings on either side as occasion may require. When not in use, the apparatus can be folded up into a space 4ft. 6in. × 6ft. 6in. × 3in.; or it can be made still more portable by making each wing or frame hinged down the middle, but this is at the expense of rigidity, and entails a little more time in putting up.

671. Backgrounds—To Make.—Tack the material (which should be stout unbleached calico, to be obtained at any draper's) on to a wooden stretcher, avoiding wrinkles and folds. Then brush into it a solution of dextrine, sufficiently strong to render the calico sticky; the strength is best found by trial, as it differs in different materials. When tacky, apply the colours in the form of powder with a large dry brush, working them well into the stuff. It is well to keep the atmosphere of the room as moist as possible in order to check the drying of the dextrine.

672. Background—To Paint.—The best material for a background is unbleached calico. Before painting size the calico with

Starch	3 ounces.
Water	10 ,,

Boil until it begins to thicken, then brush it over the calico with a stiff brush. The following is an excellent colouring:

Common whiting	12 ounces.
Powdered glue	4 ,,
Treacle	6 ,,
Water	½ gallon.

When thoroughly mixed add

Ivory black	1 ounce.
Ultramarine (powder)	½ ,,
Red ochre (powder)... ...	½ ,,

Brush over the calico with a broad flat brush, taking care not to have it in streaks. Another method: Let the required dimensions be 9ft. × 5½ft. Make a frame of battens (procurable at any saw mill), brace them at the corners with cross pieces, so that when screwed together its shape will be thus:



Secure calico (9ft. × 5½ft.) at four corners by ¾in. tin tacks. Add more tin tacks gradually, so stretching the cloth that it presents one even surface without a wrinkle. Now stand it above (as per cut above), and proceed to coat it with size (one pound to one quart of hot water), brushing it well into material. While drying, prepare the tint. Stir a couple of balls of whiting with a little hot water, until mixture assumes the appearance of white mud. Now add in small quantities black pigment ground in water (obtainable at a colourman's), until a dark grey tint is acquired. It is well to remember that it dries much lighter than would be expected. Add some size and water (proportions being three ounces to half-pint of boiling water). Stir well and leave overnight to set into jelly. Now charge a brush (clean) well with the cold colour, and, commencing at top left-hand corner, apply the paint with even strokes, first horizontal and then vertical. Do not hurry too much, but only cover a square foot at a time; on the other hand, it should not take more than twenty minutes. It will dry in a few hours, and may be left as it is, or hung on roller. Method for a flatted oil background. The most general method of obtaining a dead surface on oil colour is by turpentine flatting, which is done as follows: After the background has been coated with ordinary paint, and become dry, it is gone over again with some of the same colour, but this time mixed with turpentine only. By this means the glossy character of the paint is destroyed, and the surface left dead. Owing to the difficulty of applying this coating without leaving brush marks, it is usual for one person to apply the colour while another stipples over the surface with a large badger-hair brush. There is a very simple method of producing backgrounds, which is well suited to the amateur. It consists in applying colour mixed with dextrine or other similar material as a dry powder to wet canvas, and then working it in with a brush. Backgrounds of this description are very durable, and are easily repaired should they happen to get injured by water or by abrasion. Another material, all ready for painting upon, is Lancaster blind linen, which makes most durable grounds that will roll up and stand rough usage without creasing or cracking, a great advantage over canvas, which demands most careful handling to keep it in good condition. Carpet paper, as used by house furnishers for covering uneven floors before carpeting, is another article most effective where backgrounds can be stationary, and presents an agreeable surface for working upon in powder colours. For *tinted* background the following directions are given: First get canvas, preparing at home is quite as serviceable for use, and very much more reasonable. For *large* backgrounds get best *linen sheeting*, of fine even quality, to size required. For smaller work, such as busts, etc., *plain white* or *plain buff linen*. Window material is very nice to work on, and it is strong. Now, before painting, it must be sized to render it less absorbent of the colour. Make a glue size as follows: Soak two ounces of *best* glue in cold water until quite soft, then put in a warm oven and melt down, making up with water to a pint and a half. Now get a good large brush (house painter's sash tool), new preferably, but must be clean, and *thoroughly* wet the fabric with the warm glue size. For this operation the background material may conveniently be tacked (at top only) on a spare bedroom wall. Don't miss patches in the sizing, or the afterwork will be "patchy" and "spotty." Let sizing get *perfectly dry*, or it will "paint up." Now for painting materials. Get one or two large sash tools (clean), and one each of Nos. 3, 5, and 7 artists' hog-hair flat brushes; a pennyworth of stick charcoal, for sketching outlines in; two or three of Rowney & Son's *double* tubes of flake white; one of blue black; one of Indian red. Rowney's "School of Art colours" are as good as any at 3d. a double tube. Get, at any house-painter's, *half-a-pint of turpentine*, a *quarter* pint each of Japan goldsize and linseed oil. Mix the "turps," goldsize, and oil together in a bottle—this is the "dilutant medium" ready for use. Now mix two parts blue black and one of Indian red out of the tubes, mix well on a slate (smooth state) with a thin knife; this is darkest tint No. 1. For tint No. 2, take three parts of No. 1, and add one part of

flake white to it; mix well on a separate slate. For tint No. 3, take one part No. 1, add three parts flake white to it, also on a separate slate. *In using above tints, dilute this solid colour with just enough "medium" to make it spread comfortably—say like a stiff cream!* For plain graduated ground, paint all the "canvas or linen" over with white first, then paint tint No. 3 in, then No 2, then final dark touches with No. 1. If desired softer than the brush mark leaves it, "stipple" with a good *large brush (dry brush)*. Stippling is dabbing the *points of the brist es only* on the colour; it blends the several tints softly. By a little more ambitious attempt good work may be done. Copy suitable engravings, woodcuts, etc., in the camera on a quarter-plate, or make original bits of nature come in; put the *negative so made* in a *magic lantern* or in the camera, and enlarge on to the background (the magic lantern is best). Trace the outline so formed carefully on to the dry-sized canvas, then paint it in; if from an engraving or print, copy the *original carefully*; let the brush marks be soft, *yet clear*. Keep all portions that may come behind the sitter in a *soft white light*. A few bright lights on the edges of objects give sunlight to the accessory portions. Make up mind *before* starting which *side the light* is to *come from*, and keep high lights on *that side* of all objects. Use charcoal for sketching in; a *dense* negative is no good; a nice *sharp, clear* one is good for eyesight. Another way is to lightly sketch in with charcoal any design wished, and paint it in with various tints of grey, gained by putting more or less lampblack to the foregoing mixture. If the trouble of designing anything pictorial upon the canvas is not desired, a charming effect is obtained by roughly splashing in "clouds" graduating from light to dark, and from right to left, according to the design of posing the subject, with a few carelessly executed twigs and ferns at one side as a finish. Vandyke brown and white make agreeable tints.

673. Caricature Backgrounds—To Make.—An old way of making caricature pictures is to draw a figure, animal or bird, on a stout sheet of card, so that the head of the person being caricatured can be photographed above it, the head fitting into a neck, etc., drawn on the card. For instance, a picture of a goose may be drawn, on the back of which is a headless figure, the neck extending to the top edge of the card; the head of the real sitter holding the card in front of him completes the figure. The junction between the neck and the head can be easily made imperceptible by retouching. A background the same colour as the card is preferable; the junction of the card and background in the negative can also be removed by retouching.

674. Chalk Backgrounds—To Make.—Cover the canvas with plain paper of any colour or shade, to be obtained under the name of *plain grounds* from paper-hangings manufacturers. When dry, any design can be drawn with chalks in bold strokes, and softening the edges by just rubbing them with the finger, much in the same way as the pavement "artists" go to work. Common brown paper (known as carpet paper) about five feet wide is supplied at all carpet warehouses at a few pence per yard, and answers the purpose admirably. Of course, for durability no background can compare with a flatted oil, but this is hardly "in chalk."

675. Dark Room—To Make.—A few hints are given as to fitting up a dark room which may possibly be useful. First of all as to blocking up the window. This must be done if any work is going to be done in the daytime. The cheapest way to do it, and also the most effective, is to make a wooden frame exactly fitting into the window frame. To cover the frame procure some wide silesia lining from the draper's. Cut out two pieces of paper the size of frame, and to each of them paste one thickness of silesia, and allow them to dry, and then glue one on one side and one on the other of the wooden frame, the brown paper sides being face to face inside. Before gluing completely round cut out a 2ft. square in one corner, and insert under the brown paper a thickness of canary medium each side. This forms a very pleasant light to work by for some purposes. If plates are going to be developed, a rude shelter covered with two thicknesses of paper—orange medium—is quite safe, but daylight illumination for the dark room is not so good as artificial for many reasons. It is not available at night; paper media slowly fade owing to the bleaching action of light; the sun may blaze on the window at one time and at another a very poor light may be obtained. Now as to water supply. If water can possibly be laid on give up a good deal for that convenience. If it cannot be got, an old filter with all the sand, etc., knocked out of it makes a good cistern; whilst a sink is easily made from some stout sheet lead, a piece of lead tubing being soldered to the bottom to conduct the water to a bucket placed below. Get a good-sized table for developing, and a smaller one, quite separate, for the fixing solution, which is best kept in a porcelain grooved trough. Have two or three rows of shelves above the developing bench, so that any solution can be reached in a moment, and a nail or two handy for hanging camel-hair brush, etc., which are likely to be wanted. Another description: The following plan is recommended, as it is very economical and easily carried out. First as to the window. If it faces east it will not receive the full glare of the sun during that part of the day the room is required, therefore have the plain glass removed to make room for the ruby, which costs only eightpence per foot or get a carpenter to entirely block the window with matchwood, which should be made movable by screws run through it into the window frame. Then a portion of the matchwood (9in. square would be ample) should be cut out, and a piece of ruby glass one foot square firmly glued over the aperture; this should be carefully done to exclude stray light. The latter of the above methods is the best, as from a hook above it might be hung as many pieces of ruby or canary glass over the glued ruby as would be perfectly safe from the most rapid plates. In addition, developing, etc., could be done after dusk by placing a lamp on the window-ledge, or by hanging it from the wall outside, and thus lessen the need for ventilation. The cost for this should be about five shillings, which would include a paraffin lamp with wick regulator. The light which comes through the doorway could be quickly excluded by a red baize curtain running on a rod above the door. The rod would cost about ninepence, and the curtain about one shilling per yard. Now as to a small sink. Get a long piece of garden hose, and pass it through a hole—which should be slightly smaller than the piping—either in the matchwood or door. At the end of the tubing which comes into the dark room a large funnel could be fastened to receive the water either direct from the dishes, etc., or from a small sink which can be purchased from any plumber's at a small cost. As to a cupboard, it might be advisable to dispense with one, and have in its place a good chest of drawers, with the top ones about 9in. deep, and the lowest about 15in. deep. On the top of this a sink could be placed for developing, an operation which should be worked from the back of the drawers, in order to prevent any stray

chemicals or drops of fluid falling into them. With regard to ventilation, a good plan would be if there are ten or twelve plates to develop, to develop half of them, then draw the curtains and swing the doors, a plan which works very well in practice, or, by very fine fretwork, a small piece of each door could be removed, and the apertures covered with lantern chimneys. The pieces of wood could be replaced by putty and varnish, with scarcely any sign of damage.

676. Dark Tent—To Make.—If the tent is not required to fold up, a large packing case can easily be made into a tent. Obtain the following pieces of wood: A board, 20in. × 9in., which will form the base; two strips, ¾in. wide and 18in. long; one strip, 20in. × 29in. On one side of the board hinge the two 18in. strips so as to stand perpendicularly, and fold flat on the board, cut sockets on the insides of these, and cut the ends of the 20in. strip to fit into these sockets. Hinge the two 9in. strips on to the top end of the 18in. strips, and put small metal struts to support them horizontally. This gives the framework. The light-tight cloth must be sewn to fit over this, and attached on the inside by means of small hooks fitting round the strips. Into the cloth should be let a piece of some favourite non-actinic medium (cloth, of course). This tent will be found very handy and portable. A handle should be attached to the outside of the board, and a screw thread into the bottom to allow of its being fixed upon the tripod. The following description of a very useful dark tent may be of use to some, although, of course, it may be modified in various ways. The wooden part of the tent consists of a box with a hinged lid, the depth of the one part being six inches, and of the lid three inches, and the length and breadth according to requirements. This box should be made of ¾in. pine, and a hole a foot square should be cut out of the deeper tray in the centre, and covered with yellow or ruby calico to form a window. When in use the lid part is let down in front of the operator and parallel with the ground, the body, or deeper part, being at right angles to the ground, and the whole supported on the tripod by means of a thumbscrew; or, if used indoors, the lid part is simply placed upon the table with the deeper body part (containing the window) facing the operator. In the body part a ledge is placed near the top to contain the water tank and bath, and on either side of the window pockets are placed to hold the developing or other bottles, whilst at the bottom further provision is made for bottles, trays, etc. Of course, the developing, etc., is done on the turned-down lid, which forms the table. Now, for the tent proper. From the top corners of the body part of the box projects a light wooden hinged framework, which, when not in use, folds into the box; it is supported at its other ends by two light rods, which project from the outer ends of the lid or table—these rods are also hinged so as to fold within the lid of the box for packing. On the framework is suspended a cover of twill—the outer thickness being made of dark yellow twill, and the inner lining of turkey red twill. This hangs down to the ground round the operator, and, if in the open ground, is secured by wire staples, or it may be wrapped around the legs of the operator if used in a room. The advantage of this tent is that when closed it will contain within it—the camera, bath, bottles, and measures—in fact, almost everything needed can be packed within it—and for a half-plate size the dimensions of the box when closed are about 24in. × 24in. × 9in. The following dark tent is recommended by Captain Abney. It consists of a baseboard 21in. × 13in., and three light wooden frames the same size. The first is hinged to the back of the baseboard, and supported by two wooden struts 13in. long, hinged to the front. The second frame is hinged to the top of frame No. 1, folding forward, and supported by two struts 21in. long. Frame No. 3 is hinged to frame No. 2, folding outwards, so that when in use it is supported by the hinges. This is a very handy tent for changing plates, etc., and doubles up conveniently for packing.

677. Electric Light—To Use in Studio.—Supposing the light is required for single portraits, at least two lights will be required, a chief illuminator and a subsidiary one. The light must be high enough to avoid shadows falling on the background, and should be placed to the side of the sitter, about a yard or two in front, and about four feet overhead. The second lamp should be placed on the opposite side of the sitter to relieve the shadows. It is quite possible to get good effects with the direct light, but excellent effects may be obtained by shielding the sitter from the direct light, and using large reflectors. The probable cost of fitting up cannot possibly be told without information as to where the studio is situated, and the consequent easy or difficult means of obtaining a supply of electricity or motive power for a complete installation. The electric light is very suitable for the studio. One lamp is quite sufficient, the power is somewhere about 6,000 nominal candles, or two Brockie-Pell lamps each about 2,000 candle-power. It is, however, better to state number of ampères of electric current for the lamp, and this should be about thirty ampères. The best position for light is judged just in the same way as is judged in day time. The arc lamp is generally mounted in a large dead whitened reflector about 3ft. 6in. diameter, and the direct rays of light are screened from the sitter by a small reflector placed in front of the arc. The cost, including lamp and overhead gear, would be about £22. For portraiture work the arc lamp is decidedly the right one to use, as the incandescent light is a much more yellow light than the arc. For a small room one light is sufficient, say of 2,500 candle power. One good system is to enclose a volta arc light in a metal box or semi-globular reflector (sheet iron), about three feet or more in diameter, and to place a small metal reflector in front of the light to prevent the direct rays of light falling upon the sitter, and to reflect them back on to the large semi-spherical reflector, which is coated with a layer of white paint with a matt surface. To further reduce the power of the light, if it is too strong, the open circular front of the metal reflector may be covered with a paper screen. This lamp and reflector combined is suspended by a fork revolving in an axis which is so arranged that it can be moved about in a circle, and raised and lowered to suit requirements. Another form consists of a similar large sheet-metal semi-spherical reflector, towards the top and bottom of which two arc lights are placed behind two smaller reflectors, which are arranged nearly at right angles to each other, and which serve to reflect the light back upon the matt-white hollow of the large reflector, thence on to the front of the opposite small reflector, and thence on to the object to be photographed. Of course, if electric current can be obtained from an outside source, so much the better; otherwise a small Siemens and Halske or Gramm dynamo machine may be used, driven by a small gas engine (Otto). It may be found convenient to supplement the arc light by use of a few incandescent lamps, which can easily be arranged where required. The light should be arranged near the top of the studio and towards the side, and well away from the front of the sitter, with

the supplementary lights where required for each particular case, so that sharpness and angularity may be avoided, and relief, rotundity, and delicacy of half-tones, combined with brilliancy, should be sought. It is impossible to give exact cost, and an amateur (unless a practical electrician) could not fit it up. But any reliable electric light engineer would do so. An arc lamp would cost about £20 to £30; fitting it up, say £10; dynamo and engine, from £80 to £100.

678. Gaslight—To Adapt for Dark Room.—The following is a very useful dark room gas lamp. It has been found to be quite efficient, and, moreover, it has the element of cheapness. In the first place, bore a small hole in the top of the dark room table, through which passes the gas pipe holding the burner (Bray's No. 5). This pipe should project about two and a half inches above the table. Next obtain a long hock bottle, the bottom of which can be knocked out with a hammer. This may sound a more difficult matter than it is, but by using a small hammer and a little care the former, by gently tapping, will soon find where the glass is thinnest. Once get ever so small a hole the rest is easy. Then may be placed a couple of spoilt quarter-plate negatives on each side of the pipe, and upon these stand the bottle, thus allowing a sufficient current of air to pass, without letting any unsafe light out. The light given is exceedingly bright and pleasant, and quite safe to work by. The tap can be placed in the pipe underneath the table, and thus easily regulated. When developing isochromatic plates, the hock bottle must be replaced by a deep ruby lamp glass (bell shape), which can be obtained at the price of 10d. Care must be taken not to turn the gas too high, and in cold weather it should be turned up gradually, so as to avoid cracking the glass. A good lamp can be constructed from the following particulars: Obtain — or preferably make — a box about 18in. high, 12in. wide, and 8in. deep, cut a circular hole in the top, into which fit an elbow piece of stove piping which leads out of the room, and line the exposed part of the woodwork of the top with sheet tin. If the heated air cannot be let out of the room, two sheets of tin may be fixed horizontally at the top of the lamp to allow for the heated air to escape, and prevent light coming out. The bottom of the lamp is cut out all except a frame of, say, half an inch, and a piece of good ruby glass is puttied in from the inside, and similar windows are placed on each side, or they might advantageously be yellow glass with outside blinds of red or yellow fabric, in case of need. Round the inside edges of the two sides and the bottom of the front of the lamp, strips of grooved wood—such as used for negative boxes—are screwed, a piece of felt interposed making the joint quite light tight, and in these grooved slides, made as follows, are placed: Take a piece of tracing linen about 11in. × 19in., and on it paste a piece of orange paper. Now take four pieces of sheet tin, two 21in. long and 1¾in. broad, one about 11in. long and 1¾in. broad, and the other about 10¾in. long and the same width as the others. Fold these strips in the direction of their length, and insert between the folded edges of the two long strips the sides of the orange paper and linen, then clamp the edges firmly—an ordinary letter copying press will do this. Now fix the 11in. piece across the bottom, and finally the top piece, first opening out the sides to insert the ends of the top piece, and finally clamping all together. This gives a threequarter-inch metal frame, with a linen-backed paper window. The second frame is similar, but in this case a ruby paper may be employed. These frames slide up and down in the grooves, and if the grooves are deep enough no light can get round. This light is preferable to glass, besides which there is no chance of breaking on account of the heat from the gas. It is best to use a small Bray burner, screwed into a piece of lead pipe, which is inserted through a hole at the bottom of one of the sides. A piece of rubber tube will connect this to any convenient gas supply.

679. Lamp (Dark Room)—To Make Folding.—A Chinese lantern makes a good temporary dark room lamp. If one cannot be obtained of a non-actinic colour, a red, or red and white one, may be coated with Thomas's liquid ruby solution, or with any suitable dye, according to preference. The lantern may be hung on a nail or a hat-peg; the reflected light from the ceiling may be disregarded if a candle is used. Another: If made *according to these dimensions* it will meet every requirement. Take five pieces of thick pasteboard 14½in. × 5¾in., cut out spaces B in three, and paste red and orange fabric on either side of apertures. Lay the five edge to edge on a table, and glue strips of thin bookbinding leather all the way down on both sides of the joins, in such a way that the pieces forming sides will fold flat, keeping the two pasteboards without apertures for the outsides. Have top and bottom made of tin—top to fit tight over bottom—thereby forming a nice box in which small bottles of developer may be stored on either side of candle-socket for travelling. To use, open folding slides to form a square, with double back, slide square into bottom of box; having previously lighted candle, put on top, and enjoy the result. Inside the bottom there should be a strip of tin, soldered upright to catch the loose end of the inside one of the two backs, so that it may not bend towards the candle. The object of having a double

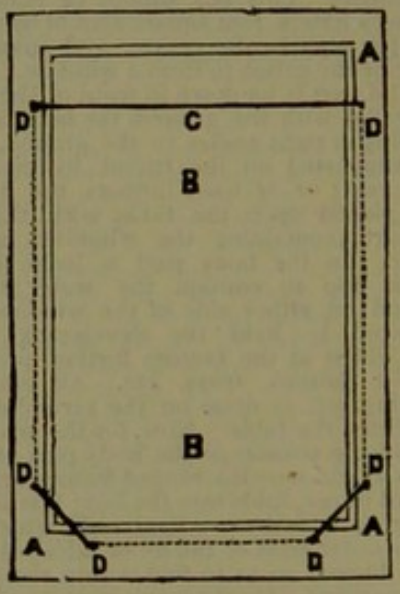


Fig. 1.

back is to prevent the fabric from being cut or bulged by sharp corners when packing among other things. This lamp neither heats, smokes, nor plays any tricks. Another: This can be made either of cardboard or of metal. Taking cardboard first, and supposing the candles to be 6in. long, cut four pieces of stout cardboard 9 × 6, and in each of them (if light is wanted all round) cut a hole 6 × 4. These holes can then be glazed with waste half-plates by drilling small holes as at DDDDDD, and fastening with a long piece of moderately stout copper wire. Each side should then look like fig. 1. Now glue the edges of three of these pieces together with

black twill, and on the end one leave a flap to be fastened by means of small holes and pins. Fig. 2 shows the bottom of the lamp with air holes, the rebate BBBB being about ¼in. deep, and a hole right through to hold the save-all for candle. It should be made of ⅝in. pine, and should be 6½in. square. The top can be made of ¼in. pine lined with tin, and hole made through centre with small tin cone on top, having a circular tin piece suspended by a wire, thus doing away with soldering, cf. fig. 3. Each window in the lamp can be covered with different material; thus, one with orange or ruby fabric, another with two

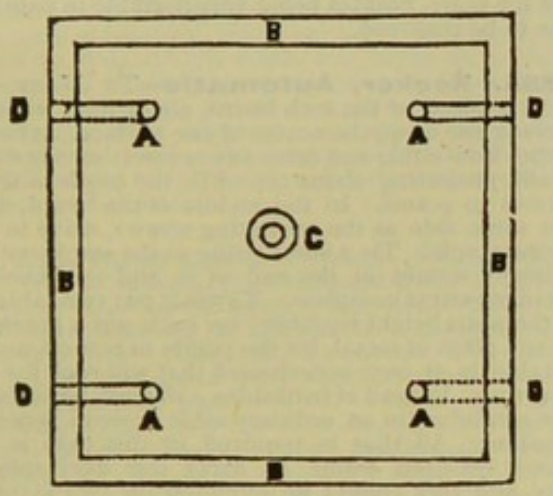


FIG. 2.

thicknesses of *oiled* orange paper, another might be glazed with ruby glass. In fig. 1 the wire goes straight across, and inside, so as to allow the glass to be changed. Of course the measurements can be altered to suit requirements. If metal be employed, two pieces should have edges turned over for ¼in., and the other two pieces, when the

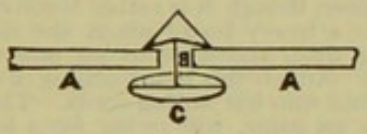


FIG. 3.

lamp is erected, will catch in these, and when top and bottom are fixed in an elastic band round the lamp somewhere near the bottom will hold all securely. The completed lamp is shown roughly in fig. 4.

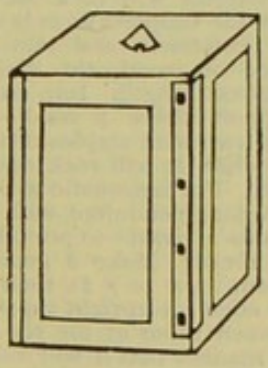
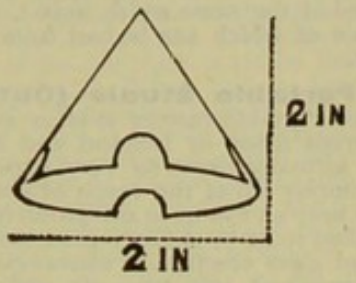


FIG. 4.

Another lamp of home construction—although not a folding one—is just as convenient for travelling, as things can be packed inside it without risk of damage. It is made from two coffee or other tins, one of which is about ¼in. smaller in diameter than the other, and the smaller one is made by cutting small tongues out of the open end, and turning at right angles and punching holes in them to fit on to the base of wood over pins corresponding to the holes. A round hole, about ¾in. diameter of the tin, is now punched out of the bottom, and a rectangular hole is cut out of one side, this hole in breadth being less than the radius of the tin. So far for the inner tin. The larger tin has six or eight holes of about ¼in. in



diameter punched out near the bottom (but in the curved surface), and three rectangular holes same size as in the inner tin at equal distances round the tin. These three holes are now covered with different media and of different opacity. For instance, one covered with double ruby, another with double canary, and the third with one thickness of canary (this for developing lantern plates, etc.). This outer tin is then inverted over the inner tin, and if more light is wanted it can be easily turned round. Sufficient air finds its way in down between the tins, and the only source of light is through the particular window opposite the hole in the inner tin.

680. Limewashing Studio—BEST METHOD OF.—The simplest method for making limewash so that it will not wash off with rain is simply to mix it up with buttermilk instead of water. Boil the chalk and milk with a little glue, and it will stick all right on the glass. Another method: To make limewash to resist rain, take the best newly-burnt lime (Buxton lime if possible), slake it with water in which common salt has been dissolved in the proportion of one pound of salt for every forty pounds of lime, thin it down to the requisite consistency, and apply it as soon as possible after mixing. Whitewash made with size, and containing half-a-pint of boiled linseed oil to every ten gallons of water, is also good, but not so durable. The best plan of all would be to *paint* the roof with two coats of white lead, or, better, oxide of zinc, mixed with turpentine and a *very little* driers. To prevent chalk and milk coming off glass, mix it with size and a little silicate of soda (water glass), say one pound of size and half a dram of silicate to every gallon of wash. Soak the size in cold water first in a jug, pour off water, and melt size by putting jug in hot water, then stir into milk and chalk, and finally add silicate dissolved in a little water. Another and better way is to use sulphate of baryta—the very cheapest will do—and soak it in water for a day, then add fresh glue size (from oil and colourman's) 1 part, boiling water 1 part, and bichromate of soda 1 dram to each quart, and mix until as thick as the "whitewash" is required to be. This will dry hard and insoluble, and any *little* yellow colour will be washed out by the first shower of rain; or it can be washed with a hose pipe if desired, but the colour is very slight, only just off white. There is a patented distemper wash made in all colours and *perfectly* washable, and will not rub off. It is called "Calcarium,"

which has been tested with perfect satisfaction in most exposed places.

681. Paper for Backgrounds—BEST KIND TO USE.—Paper used for laying under carpets can be procured, nearly 60in. in width, at a cheap rate from any furnisher. It is called or known by the name of "carpet paper," and is usually used for laying under carpets, especially when the floor is uneven. It is five feet wide, and is sold by the yard or roll. The *thin kind* (which is useless for the purpose) is about 2d. per yard, and the *thick kind*, which is required, is about 5d. per yard, or thereabouts. Cartridge paper can also be obtained of the same width (60in.), particulars of the price of which can be had from any large stationer's.

682.—Portable Studio (Outdoors)—TO MAKE.—Portable canvas studios can be had from different firms in London and elsewhere: these are in many cases so very expensive that they are entirely out of the reach of such workers as have to keep an eye upon comparative economy. If it is wished to fit up a fairly good substitute for a wood and glass erection, a canvas-covered tent would be required, 18ft. long, 9ft. wide, and end and side walls 6ft. or 7ft. high, roof with a moderate angle, a little under the usual forty-five degree pitch. The first consideration will be a framework of good clean white pine—for a studio above size get made ten standard posts 7½ft. long, 2½in. × 2in. thick, planed up square, sharpened at one end, and painted white. These form the side supports, two end posts of same thickness, but 10½ft. long. These stand at each end of studio to support the ridge. Next make five laths 18ft. long of 2½ × 1½ stuff; four ditto, ditto, 9ft. long, same thickness. These form side rails, top and bottom rail for both sides, ditto, ditto ends, and the fifth, 18ft. length, forms ridge. For roof, five pairs of couples or spars must be made jointed like compasses. Legs 6ft. long, when spread across studio, 9ft., will form a convenient slope for roof. The way to fix these together is by iron thumb-screws, and ¼in. iron wire (galvanised) pins driven into top end of each standard — holes made through laths named for sides and ends slip on to these, and in half-an-hour the whole frame may be set up or dismantled. Let all woodwork be well painted or varnished, and an iron pike like that on the toe of a camera tripod on an enlarged scale, fitted to each standard, would be a great addition. The next requirement is a roll of Dundee or Belfast linen canvas—not as used for ship's sails, but made for certain tailoring purposes, and thirty or thirty-two inches wide. It costs about one shilling a yard, and is exceedingly strong — seventy yards will be required. These seventy yards of canvas must be cut up into a suitable and convenient set of sheets to cover the frame-work. These should be so formed as to leave a doorway and a space at *north side* of wall and roof, which can be covered or uncovered at will, its place to be filled while in use for portraiture by ordinary bleached calico sheeting to act as blinds. Side of studio required opaque must be rendered so by a set of dark blue cotton or woollen curtains. Large sheets of strong brown paper serve the same purpose on a cheaper scale. The judicious use of brass or tinned hooks, rings, staples, and a few yards of good cord and tape will complete a studio which, for ease in working and efficiency as a means of lighting, will compare with the most elaborate and solid structure very favourably indeed. Such a studio, 18ft. × 9ft. × 7ft., side walls, will cost from £5 to £6, if made by oneself. A much cheaper way is to make the studio with a series of light wood frames, covered with Willesden water-proof paper. This is far superior to canvas, and cheaper, as well as perfectly waterproof. It can be made by any amateur who can handle tools at all, or, if not, any local carpenter could do it in a few hours. For the top and side lights use glass in separate lights, or a good substitute can be found in the tracing cloth used by draughtsmen; this could be fixed on frames the same as the paper. Working by this method, a studio 20ft. × 8ft. can be made for about £4 for materials, and it should be put together complete for another fifteen shillings. This does not include a dark-room, which, of course, would cost proportionately more. A studio made as above will not only do for a few months in the summer, but if proper care is taken of it will last for years, besides being very portable in case it has to be removed.

683. Rocker, Automatic—TO MAKE.—Take a piece of flat inch board, about 20in. × 8in. Draw a line down the centre of one surface. At two inches from either end drive two screws, leaving the heads projecting about 1in. File the heads of the screws to points. In the middle of the board, on the same side as the projecting screws, drive in a strong staple. Tie a stout string to the staple with a heavy weight at the end of it, and the whole arrangement is complete. To use it, put two tables of the same height together; on each put a penny, or any piece of metal, for the points to rest on, and a table is at once constructed that will rock for a long time. Instead of two tables, a slot may be cut for the pendulum in an ordinary table or work bench. Another: All that is required in this case is a simple wooden frame to carry the developing tray, and this should be mounted on two pivots near the centre of the frame, so as to practically balance the tray or dish. In addition it is necessary to add a pendulum, which should be fixed near the centre of the frame. A strong piece of galvanised iron wire, bent to the proper curve, will be sufficient for the purpose, and at the lower end of this a piece of lead or other material must be added to give weight. Sufficient play underneath the bench or table must be allowed for the swing of the pendulum. Another simple rocker, though it is rather inconvenient in practice, is a heavy board about the size of the developing dish, and covered on one side with sheet lead. Attach this to the ceiling of the dark room by four thin but strong cords. The rocker, when once set going, will swing for a long time. Another rocker which works very well is due to Dr. Eder. It consists of a small round platform, to which is attached a long iron rod heavily weighted at the end. Near the edge of the developing table an upright knife edge is fixed, and a groove cut in the iron platform, so that the iron swings lightly. If the pendulum be started the platform will rock for a very long time. Perhaps the simplest form is a thin board, 6in. wide for preference, and 16in. long, with a triangular piece of wood, 2in. diameter, nailed across the shortest length. Into each end of the triangular support drive a small French nail. With the aid of two wire staples this can be fixed to the bench, when it will rock easily upon the edge of support. For automatic action all that is needed now is a long pendulum, with heavy weight —fifty-six pounds at least—to provide the motion. An automatic rocker: Make a good solid base-board (say about 12 × 10 × 2), then fix, near the middle of each edge, an upright support about 5in. in height, between these at the top is pivoted a shelf in such a manner that it will move freely like a "see-saw." Then procure an old American clock movement. Remove the escapement, and fit in its place a new arbor with a long pivot projecting half an inch outside the frame; on this is fitted a large fly-wheel to slow the movement. A new pivot is

also put in the arbor which carries the second wheel, the pivot projecting about ¼in. beyond the frame; upon this is fitted a small brass wheel with a screw about ¼in. from the centre to serve as a crank. A shaft is carried from this crank to the top shelf. This shaft should be of such length that when the crank pin is horizontal with its centre the shelf is level. As the crank revolves the required motion is given to the shelf. Another way: Get a block of hard wood 2in. square and about 10in. long, or longer if larger dishes are used. Into centre of this mortise a 1¼in. square rod 30in. long, and on the top of it fix a board a little larger than the largest dish you use. Then on either side rod, and two inches from it, screw into block two screws at least ¼in. thick, cut heads off screws, and file up ends to knife edges, running in direction of length of block. Cut a hole in top of developing table 2in. × 3in., and on two sides fix a flat iron plate for knife edges to rest upon. Then fix a weight of about eight pounds to lower end of rod (this can be cast in lead), and the arrangement will then be complete.

684. Ruby Lamp—To Make.—Procure a piece of stiff cardboard, 18in. × 12in, and divide it by pencil marks into three equal parts, each 12in. × 6in. From the middle portion cut out a piece 8in. long by 6in. wide. Now, with a penknife, score down the lines made, and bend back the sides to form a triangle. Glue a piece of ruby medium inside the middle portion over the aperture, and sew up the ends of the triangle. Place a candle inside, and a triangular piece of tin with a few small holes in it to afford ventilation on the top, and the box of plates can be opened without fear of fogging.

685. Ruby Light—To Protect Eyes from.—It seems necessary to put up with a ruby light for isochromatic plates, but considerable relief may be gained by having a light screen of some opaque substance — cardboard or metal — suspended at about an angle of 45° in front, and at top of ruby glass front of lantern. It is well to hinge this at the top of the lantern, and having a small balance weight, so that it can be lifted easily when it is required to examine the density of the negative. Also after development has proceeded till all fine detail is out a brighter light may be used, so it is well to have the lantern fitted with two ruby fronts, one of which can at this point be thrown back or turned aside, leaving a brighter light for the rest of the operation. Be sure it is a ruby of the proper tone. Some people are more affected than others by the red light of a dark room, but the ill-effects can generally be minimised to a great extent by placing the lamp in the most favourable position. As a rule the injury to the eyesight is caused by having the light directly in front of the operator, so that the light shines directly and most powerfully upon the face. A better position is to have the light to the right or left of the worker, so that its rays are thrown across in front of him, and not directly on to the face; besides which development cannot be watched so well when a stronger light is upon the face than that falling upon the plate. A method of illumination was devised some time ago by Dr. Mitchell (U.S.A.), in order to avoid the light action upon the eyes. His lantern consisted of a square box, with a ruby glass placed in the bottom below the gas flame, the front being opaque, and the lamp being hung above the developing sink. Instead of ruby glass in a lantern, several sheets of thin brown packing paper may be used. Such expedients as colouring the developer with a red aniline dye—though interesting and instructive in certain cases — are outside the domains of practical photography.

686. Shed—To Adapt for Studio.—A great deal depends upon the aspect of the building, and amount of light possible—but supposing it runs north-east and south-west, with roof sloping to north-west, and that it has a window in roof, the best plan would be to place a good window towards the south-west end, so as to get as much available light as possible. Then cover the window in the roof with one thickness of light blue calico. To the other window do the same, but with two thicknesses. But it must not be a fixture, or in dull weather there will not be sufficient light. Have a reflector composed of a clothes-horse, over which is a white sheet or tablecloth. This must be placed at the shaded side of the sitter, to relieve the heavy shadows on the dark side of the face. The walls of the "studio" must be limewashed a light-blue colour. When this is done, and the walls are dry, the studio will be ready. Another writer says: This is rather an awkward light, but with careful arrangement good portraits can be and are taken with it, as studios cannot always be built in the most desirable positions. First of all have *all* the glass covered with tissue paper. By this means a much softer light is produced. The sitter should be placed at a distance of not less than six or seven feet from the south-west window, according to circumstances, and more towards the south-east side, the camera being placed at the south-west end of studio. The background should be hung diagonally across from south to north. The window at south-west end should have the full width of seven feet, and to the top of roof, but not to reach to bottom of floor within about two feet, and the skylight on the north-west should be six or seven feet long, and the full width of the half span of roof. Have blinds to pull up and down the skylight, so as to be able to cut off some of the light when necessary, and so that more light proceeds from the window than the skylight. The first thing in the morning, or the latter part of the afternoon, should be the best times for working, though with the tissue-covered glass the sunlight would be diffused, and should not make much difference. The arrangements of sitter and camera are pretty much as have to be used in an ordinary room with a large window (see No. 534).

687. Studio, Length of, Required—To Calculate.—In a studio of 17ft. the use of a long-focus portrait lens for taking, say, cabinet size pictures is out of the question, as Ross's cabinet lens No. 3 requires twenty feet between camera and sitter for a full-length figure; but there are plenty of medium angle portrait lenses to be obtained by which a fair-sized picture may be obtained, but to cover a whole-plate a very wide angle would have to be used. As a guide, particulars are given below of a few of the best known portrait lenses:

Maker.	Description.	Diameter.	Focus.	Distance between subject and lens.
Burr ...	Cabinets, 8½ x 6½	... 4 in.	... 12 in.	... 25 ft.
Adams ...	8½ x 6½	... 3⅜ ,,	... 10⅜ ,,	... 19 ,,
Dallmeyer	3 B cabinet	... 3½ ,,	... 8 ,,	... 18 ,,
,, ...	4 B 8½ x 6½	... 4½ ,,	... 12 ,,	.. 25 ,,
,, ...	A No. 3, 8½ x 6½	... 4 ,,	... 12 ,,	... 24 ,,
Ross ...	3 A, 8½ x 6½	... 4 ,,	... 12 ,,	... 24 ,,

Cartes-de-visite in any position may be taken with an ordinary carte portrait lens of 4½in., 4⅝in., or, better still, 5in. focus, such as Grubb's A3, but as the size of the picture increases difficulties in connection therewith will increase also. Cabinets in busts, three-quarter figures, or sitting positions, may be taken with a short-focus cabinet lens of 6in.

or 6½in. focus, such as Dallmeyer's 1A, or a similar lens. Whole-plate portraits may also be taken in busts, three-quarter figure, or sitting positions with a portrait lens of 9½in. or 10in. focus, but full-length portraits on a whole-plate should not be attempted in a small studio; they might certainly be taken, but the results would be somewhat unsatisfactory. Of course, much more pleasing results would be obtained with lenses of longer focus, but if only 17ft. is available, there is no other alternative but to use lenses of short focus. It is always desirable, both in and out of the studio, to use lenses of as long focus as circumstances will permit. If a large volume of light is at command, unobstructed by buildings, etc., then perhaps lenses of the rectilinear type may give better results, possessing, as they do, greater covering power and depth of focus. As some guide, it may be said, a lens of 11in. focus, at a distance of eleven feet from a six foot man, gives an image 7in. long. Of course, for vignette or three-quarter length figure portraits the lens must be brought nearer. With good light and quick plates, ordinary rapid rectilinear and good single lenses are the very best instruments for the studio, and are fast taking the place of large portrait lenses. Short studios are, as a rule, inconvenient, and should be long enough, if at all possible, to enable the user to make all c.-d.-v. portraits with a longer focus lens than is usual with so-called carte lenses. It is found that adding ten feet to the studio takes four or five guineas off the price of the lenses required, *i.e.*, a whole-plate R.R. for cabinets, half-plate R.R. for cartes, and skylights, etc., may be so constructed that double the required light really needed to illuminate sitter can be had. Economy does not include a small amount of glass; it is cheap and, under ordinary circumstances, as durable as wood.

688. Studio—To Build.—A studio can easily be made from inch deal, a strong framework of wood being all that is required. Glass must then be fixed in the exposed side of the studio, with light blue calico curtains, then inside coloured a light blue. A studio may well be constructed after the principle put forth by Mr. A. Pringle, the side rising seven feet, glazed to within two feet of the ground, and the roof going as near horizontal as the wall will allow. The studio should be boarded for three or four feet at each end, so as to be available for working at each end. If it has to be erected with a southern aspect, it should be glazed with ground glass, or a substitute applied to the plain glass, so as to diffuse the direct rays of the sun. Another specification is: Fasten two upright beams twelve feet high against the wall, eighteen feet apart; also two more eight feet high, eight and a half feet from the wall. These must all be joined by beams six inches off the ground, and by others joining the tops; all this framework must be most securely made. The parts of the uprights which go into the ground should be well tarred to prevent rotting. On the framework six inches from the ground the floor must be made; this should be of ¾in. boards. The door-frame comes next, a good substantial one, seven feet high and three feet wide; place this in either end, it does not matter. The walls are built of ½in. flanged boards, which must fit perfectly. Now, the most important question—the glass roof; twelve feet of the roof should be entirely of glass, and the remaining six of wood, protected by galvanised zinc. Anyone who desires to be very economical might buy up some old tops of cucumber frames and make the roof of this. All the flanges in the walls should be covered with Willesden waterproof paper on the outside; it will not show when the studio is painted. A roller blind is absolutely necessary; one should be obtained working on something the same principle as those in railway carriages. A small Rippingill's oil stove should stand in one corner, to warm and keep the place free from damp. The door should fit tightly, and should have a guard at the bottom. As to ventilation there are many plans from which a selection could be made.

689. Studio—To Light.—In order to be able to take groups of about twenty persons it is desirable to have the studio 19ft. wide at all events, wider if convenient, and 30ft. long, or thereabouts. It should be built thus: Make 4ft. to 6ft. of each side, and the roof of the background end opaque, and have, say, 16ft. of glass at each side and in the roof also. An A-shaped roof will be the best to use, and give it a good slope or pitch. The sides should be 8ft. high, and the glass should come to within 18in. to 2ft. of the floor. The roof and side on which most sun is likely to shine might be glazed with ground glass, the ground side being inside. Or a double set of blinds could be had for this side instead of ground glass — one set muslin and the other calico of medium thickness. If these are made to run upon wires, using rings similar to curtain rings, only of brass, about one inch in diameter, they will be found much more convenient to use, and will keep in good working order much longer than roller blinds do, as by the aid of a few screw eyes and some thick string pulleys can be formed, and the strings fastened in a suitable manner to the rings of the blinds. When one string is pulled the blinds slide quickly along the wire towards one end of the studio, and when the other is pulled they slide back again. Four to six strings at each side, if fixed properly, will work the top and side blinds easily. The above will make the quickest possible light. If glass cannot be put into both sides it can be arranged to do with it in one side only, but have the A roof all the same, and both sides of it glazed as above stated, as then when a reflector is used upon the shaded side there will be good light coming in at the top to reflect, which will make a very great difference to the quality of the pictures possible. All experience teaches *to let in light at both sides and the top, and regulate its quantity and direction by properly arranged blinds on wires*, and trust as little as possible to reflectors of any kind, as they are not very effective, take up much room, generally in the way, and require a good deal of shifting about before the desired effect is obtained. The quantity of glass or wood required to cover any given space is got by multiplying the width by the height to be covered—for example, 16ft. × 8ft. = 128ft. superficial will be required for each of the above side lights, and if this total is multiplied by four it will give roughly that wanted for the roof.

690. Temporary Studio—To Construct.—An extemporised lawn studio may be arranged as follows: It is not necessary that the camera should be inside, but it is desirable that the lens should be shaded during the exposure either with the hand or by means of a sky shade made of cardboard. Procure a large three-fold clothes-horse, which should stand about five feet high. If full length portraits are to be taken this horse should be made a foot or eighteen inches higher. Turn the two outside ends so that they stand at right angles with the back. The back then forms the support for any kind of background the operator may fancy. The background, whatever it may be, is best hung on hooks from the top, and slightly weighted with lead at the bottom to prevent it blowing about. One wing of the screen is best covered with a white sheet, or boards painted dead white will answer the same purpose.

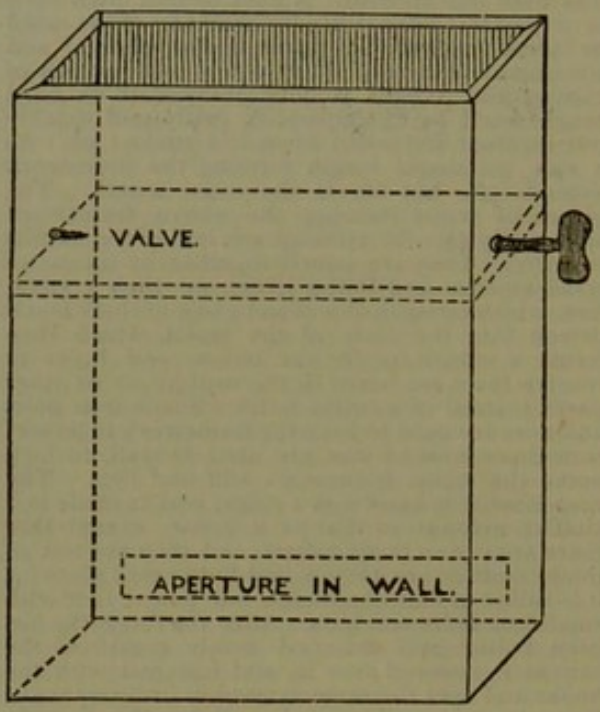
This acts as a reflector to the light which passes through the other side. The other side can either be glazed with ground glass or else covered with tissue paper. The latter method is, of course, the cheaper, but care must be taken that holes are not accidentally made in the paper. Thin calico blinds hung on rollers should be fitted, which aid the effective lighting of the sitter. A cover for the top made this shape ∧ should be glazed with ground glass, and blinds of calico should be added. A studio so made will fold up and put away very easily when not wanted, and the total cost will not exceed 10s. In case the worker would like to glaze the wing himself, the simplest way to do so is to procure some paling nails 2in. × 1in.. that is to say, two inches of spike and one inch of turn ⌐. These should be placed at intervals of about four inches all round the glass, and will hold it perfectly satisfactorily. Another one is made as follows: Make three trusses of the shape of an expanded letter **A**, the two legs to be about six or seven feet long, and fixed together so as to form a right angle; the cross piece will act as a brace to hold them firm. One leg of each of these can then be fixed to the wall upright, keeping them wide enough apart to give the width the studio is required to be, and the middle one of the three about two feet higher than the others (midway between them, of course). Then suspend a curtain from each outside horizontal piece, and throw another curtain over the middle one, resting on the outsides, when a studio is constructed any desirable width, and six or seven feet long, according to the length of the legs of trusses. The cost of above will be a mere trifle, as the curtains might be borrowed from the household department. To make it more portable, the trusses might be fixed to the wall by bolts, and the three members of each can be hinged at the joints so that they will fold up. The only disadvantage of the short studio is, it is usable in fine weather only, and at certain times of the day the sun would be shining into the lens, otherwise it answers fairly well.

691. Tent Studio—Portable, To Make.—A very useful tent may be constructed after the following plan: Four wooden uprights with spikes in the bottom are placed six feet apart, and joined by light iron rods. It is well to have the side irons to project a foot or two over the uprights, so that in cases of emergency the top curtains of white calico which they support may be drawn more to the front. The curtains on the one side must be white calico, and on the other dark grey or some neutral tint. Do not have black, as they cast unpleasant reflections. The uprights should be fastened to the ground by cords; they can also be made jointed for convenience of packing. Two or three rings should be put in the uprights in order to secure the curtains by tapes to the sides should there be any wind. The white or light side of the tent should be placed towards a north light if possible. A very good background suitable for a tent of this description can be purchased for a few shillings. This, if attached to a roller, can be fixed to the back of tent, and helps to secure greater rigidity, as well as being the best method of keeping it free from creases. When not in use the uprights may be stowed away in a small space, and the curtains folded up.

692. Travelling Tent—To Make.—Take six posts about 2in. square and 8ft. high for the uprights. About two inches from the top and the bottom make holes right through, 1in. square in two of them, and half-way through on two adjoining sides in the other four. Into these sockets fit twelve poles or laths, 1in. square, and put a bolt at each socket to keep the poles in place. Take two ten-foot laths, and fasten by screw bolts upright in the centre of the two end laths. This gives the framework of the studio (size 20 × 10). Cover with unbleached calico, cut and sewn to fit the sides, and fastened on with rings and large-headed nails in the same way as shop blinds often are. For the top have the calico sewn on a stout cord, fastening this on to the top of the centre pole. The whole affair can be set up in less than half an hour. A kind of tent often seen is a *portable canvas studio*, such as those used by photographers at fairs, flower shows, and sometimes at races. They are a combination of canvas and a light wooden framework (a hard tough wood being employed), easily and quickly put together and taken down and packed up. As a rule, no single length forming the framework exceeds 9ft., but 6ft. is the usual length. The pieces of wood forming the above framework are usually 1¼in. to 2½in. square, and of the lengths required. They are joined together by means of small mortise and tenon joints, or their equivalent, which consists of a round piece of thick metal driven into the ends of the wood, which then forms a substitute for the tenon, and holes to receive them are bored in the wall plates or other parts, instead of mortise holes. Small iron bolts and nuts are used to keep the framework together; sometimes rods of iron are used as well, to help make the whole framework stiff and firm. The roof is what is known as a ridge, and is made in a similar manner to that of a house, except that there are not so many rafters, and they are not so thick, neither are they nailed to the wall plate (as it is called in housebuilding), but bolted to it with small iron bolts and nuts. After the foregoing has been bolted and fastened firmly together, the canvas is covered over it, and fastened with the hooks and eyes the same as used in ordinary tents. Sometimes no roof is fitted at all, but if it is to be used in England all the year a roof had better be provided, because the weather is so changeable. When it is not raining it is usual to have the canvas forming the roof removed temporarily from just over where the sitter is placed, and for a little distance in front of him or her. It may be on one side only if the sun shines brightly and is high up in the sky, but on dull or dark days and towards evening it is usually necessary to open at least half the top light right across, as it must be borne in mind that the light coming through the canvas usually used is very poor in chemical power, so the only real light to work with is that coming through the open roof. Probably for the roof Forfar sheeting would be better than canvas, as it is thinner, and when wet with rain would let in a fair amount of chemical light from the top even when the whole was closed in.

693. Ventilation of Studio—To Arrange.—The simplest way to ventilate a studio is to insert grates or make apertures covered with perforated zinc in the sides or bottom, and connect a flue to the top, with turn-cap to protect it. The expired air, by virtue of its greater rarity, rises and passes away by the flue. One good principle is, whatever style or design the studio may be, be sure and have plenty of ventilation under the floor to prevent dry rot. A very good way of ventilating a studio is to have a grating in the floor at one end to admit cool air, and a trap-door in the end of studio, as near the top as possible, through which the hot air can escape. This door should work easily on a pivot, so that when necessary it may be closed; the grating should also have a cover, which can be placed over it when not required. If the studio is raised a little off the ground on bricks, it is surprising

the volume of cold air that rises through a grating twelve inches square. Another good plan is to have a rising frame in the roof, with an iron support, so that it can be adjusted to any height. Annexed is a diagram of a ventilator, very easy and simple to make, and well adapted to the purpose. Make a box 12in. × 8in. and 4in. deep, leaving one end open. Cut a hole about 6in. × 3in. near the closed end of the box in the wide side,



and cover this with a piece of fine gauze. Now make a valve—a board to fit, but so that it can be easily turned in the inside of the box about four inches from the open end. This must be secured by a screw at one end and a handle at the other, the screw and handle being fixed in the centre of the ends, so that it will turn both ways. It would be best to tack a thin strip of velvet round the edges of the valve to prevent a draught when closed. Now a hole corresponding to the one in the side of the box must be cut in the wall wherever desired, and the whole thing fastened to the wall so that the two holes fall together. It would be best to place it where not easily seen, being rather an uncomely-looking object.

694. Vignettes (Bromide)—To Make Background for.—The professional method is to well grind the portion to be "vignetted" with pumice powder applied with a tuft of cotton wool. Dust it off, and then go over the parts desired with a mixture equal portions of pumice and the stumping chalk. Again dust off, and insert bolder effects with the black chalk alone. After these powder applications prove satisfactory, cross-hatch the entire background with a charcoal pencil (Couté crayon No. 2). The artistic white spaces, which add to the effect of these grounds, can be wiped out with a piece of bread. Another method, which demands some experience of colouring, is to make a good wash of Indian ink, and apply with a bold touch just where the lighter portions of ground appear, and leave a sharp outline to the "clouds." When dry, work in the deeper shadows with the crayon, as in previous description, which might be said to be the easiest for a novice, for any blunders can be removed by grinding them away with the pumice, which will also be found useful for reducing any portions of the picture that may be too dark. Backgrounds can also be inserted with good effect in oil colours, but dry with a gloss that detracts from the admired delicacy of the bromide.

695. Washer for Plates—To Make.—A barrel or receptacle of some kind will be necessary to hold the washing water, with a tap close to the bottom. Then place the negatives to be washed in another receptacle containing a stretcher of some kind to receive them a few inches from the bottom. This will allow the hypo to fall, and by having a tap in the bottom the water can be thoroughly drained off. Of course, there must be a tub or something of the kind to receive the water after it leaves the tank. Another plan: Get a tin box, such as a biscuit tin, about two inches deeper than the length of the plates to be washed, and about an inch wider. Cut some pieces of small cane the required length, and fix them across the box two and a half inches from the top, leaving enough space between the canes to admit two plates. The canes are fixed in position by driving through the tin from the outside some small nails called gimp tacks. When fixed, an indiarubber band about half an inch wide is placed round the tin, covering the heads of the tacks; this will prevent any leakage. One or two coats of Brunswick black, or Bates's black varnish, inside and outside, complete the tank, which is used as follows: A bucket is placed on a high table or shelf, the tank on a chair or stool, and another bucket on the floor; a piece of gas tubing is bent into the form of a syphon, the shorter arm reaching to the bottom of the bucket on the shelf, and the longer arm to the bottom of the tank, another syphon, the short arm hanging about an inch over the top of the tank, the long arm reaching below the bottom of the tank outside, complete the arrangement. The plates, in pairs back to back, are placed in the tank, which is filled with water; the upper bucket and the two syphons are also filled with water. A stream of water is thus set up (which will continue as long as any water remains in the upper bucket), and passes through the tank, and is eventually received into the lower bucket. This is a good and cheap washing apparatus. The simplest of all plate-washing arrangements is to use a portable rack, somewhat after Tylar's make, and use either two tanks or a tank and a pail. Fill one with water about 85° or 90° F., and the other with cold water; the plates should be soaked in alum after a good rinsing, and then put into the warm water and allow to remain for ten minutes, then take out, and place in the cold water; by repeating this three times all hypo may be considered as taken out. Another arrangement may be used by having a stout shelf placed about one foot from the bottom of a window at one side; on this shelf place a two gallon stone bottle with a tap at the bottom—this could be obtained from almost any china dealer, or a chemist; to the tap affix some indiarubber tubing of small bore—this can also be obtained from a chemist; underneath place the tank containing the plates in a rack. If the tank is fitted with a tap at the bottom, the inlet of water may be regulated to equal the outlet; to prevent any chance of overflow, a hole may be made in one side of the tank about half an inch from the top, a cork fitted in the same, and a piece of glass tubing passed through the cork, and a piece of indiarubber tubing fitted on the glass; it is only necessary to place underneath the whole arrangement a pail or tin which will hold two gallons, or, if preferred, the tubing may be carried out of the window, and the waste water allowed to run outside.

CHAPTER XVIII.

TONING.

696. Acetate Toning Bath—To Keep.—The worker should add gold to acetate solution, and not, as beginners often do, acetate to gold solution. Again, the whole theory of toning rests on the fact that certain salts (acetate of soda, for instance) reduce metallic gold from its neutral chloride in the presence of a disturbing cause, notably *organic* matter (*vide* Abney, "Treatise on Photography," p. 138). Now, if one uses *pump* or *rain* water, the chances are that it is literally crowded with minute organic impurities, and is far worse than ordinary tap water for his purpose. If there is difficulty in getting distilled water it is advisable to use boiled and filtered tap water. The following is a simple formula for acetate toning bath. Dissolve two drams acetate of soda in twenty ounces of water, and when quite dissolved add four grains of gold chloride. Shake and leave it in a dark place for a day or two before using. When it is wanted for use neutralise the quantity required by adding a pinch of prepared chalk or whitening, and filter into the toning dish. After using render it again slightly acid with hydrochloric acid, and pour back into the bottle, and when next used neutralise the quantity required as before. The reasons for this method are—(1.) If the toning bath is acid, the prints will not tone. (2.) If the bath is neutral, the gold is liable to be precipitated by organic matter (dust, etc.) It is a good way to make the stock solution of gold chloride by adding fifteen drams of water to fifteen grains of gold chloride, and neutralise with a little chalk. Any blue-green colour may arise from the presence of proto salts of iron in the water, which would at once precipitate the gold.

697. Acetate Toning Bath—To Make.—A fifteen-grain tube of gold chloride is dissolved in fifteen drams of water and tested for acidity; if found to be acid, neutralise with a pinch of chalk. A few hours before toning, add to the stock acetate bath three-quarter drams of gold solution for each sheet of paper to be toned. Wash thoroughly before toning when using an acetate bath. An acetate bath gives purple or brown tones according to the length of time the print is immersed in it. Another way: If the acetate bath be made as under it will be found to keep well, and to give excellent results. Into a perfectly clean glass flask put 150 grains of sodium acetate in ten ounces of cold water, shake up, and when dissolved place the flask over a spirit lamp and raise the temperature of the solution to boiling point; allow it to cool, and after standing two or three hours filter it into a clean sixteen-ounce bottle, then add fifteen grains of chloride of gold dissolved in five ounces of distilled water, finally add half-an-ounce of prepared chalk, shake, and allow the solution to remain until the chalk has subsided; do not filter after adding the chloride of gold. To use the above stock solution take one ounce of solution and nine ounces of water at a temperature not under sixty degrees. The stock solution should be made a few days before using; it improves by keeping. Add a grain of gold in solution for every sheet of paper toned.

698. Albumenised Paper—To Tone.—For ordinary work one cannot do better than use the acetate toning bath. Acetate of soda 30 grains, water 8 to 12 ounces, gold 1 grain, or chloride of lime 2 grains, chalk teaspoonful, water 16 ounces, gold 2 grains. If these baths are made up with hot water, they can be used as soon as cold, but if made with cold water they should be left for a day before using. They will keep indefinitely, being replenished occasionally as required. When toning is over filter the bath back into the stock bottle, as if any organic matter finds its way into it, it is liable to cause precipitation of gold. It is also advisable to keep the stock bottle in the dark, as light is liable to cause a deposition, and consequent loss of gold. The following will tone albumenised prints in from eight to ten minutes, and is ready for use immediately it is made, but it must be used with care: Sodic phosphate 50 grains, water 18 ounces, auric chloride 3 grains. The soda is first of all dissolved in the water, and then the gold is added. This bath should be kept in the dark. This other bath is one which has been found very successful: A solution—Borax 100 grains, hot water 12 ounces, when cold add auric chloride 2 grains. B solution—Potash chloroplatinite 24 grains, acid citric 60 grains, sodic chloride 96 grains, water 12 ounces. After washing soak the print in A until it has turned a light brown, and then wash and place in B until toned to the desired shade. The tones in this bath range from a rich brown to purple black. It is, moreover, ready as soon as made, but does not keep well after once a batch of prints have been toned with it. A combined bath has by some been found the most satisfactory in use of all the endless formulæ put forth. It is made as follows: First prepare a stock solution containing in every pint of water 330 grains of borax, 180 grains of acetate of soda, and ninety grains bicarbonate of soda. This solution keeps indefinitely. If, after compounding it, there should be any sediment, it should be allowed to settle, and the clear liquid poured off. The toning bath is prepared by taking ten fluid drams of this stock solution, one grain chloride of gold, and diluting, preferably, with distilled water to ten ounces. It is advised that the bath should be made two hours before using, but it will probably be found that it is sufficient to make it up before proceeding to wash the prints preparatory to toning. With ordinary negatives the bath gives a rich brown

tone which is very pleasing, and with strong negatives and the addition of a little more gold, a fine photographic purple is obtained. The old bath should be kept, and is most advantageously utilised by employing it instead of water in making up a second toning solution. In this way all gold is utilised, but unless the bath is fairly free from organic matter it is cheaper in the end to discard it. If, however, care be taken to keep dust and dirt from it as much as possible, it tones even more easily than a freshly-prepared solution. It should be kept in a dark place prior to its further employment.

699. Alkali—Use of in Toning.—The use of the alkali is to prevent the acid formed during toning from attacking the silver image, and so reducing its intensity. An alkali is not, however, a necessity when the salt of a weak acid, like acetic acid, is employed. The greater the quantity of gold present, and the higher the temperature, the more rapid the toning. In the case in point the precise quantity of acetate, etc., provided enough is present, does not appear to exert much influence on the final result. Too rapid toning is not desirable, as in such case *blue* gold is thrown down, and a cold tone results. Too slow toning is also to be avoided, or little *visible* toning takes place, the gold being deposited as *red* gold. In practice the quantity of gold is adjusted to give a pleasant colour in a reasonable time and at a moderate temperature, and the acetate, etc., mixed with it in considerable excess to avoid reducing the depth of the print as much as possible. The action of the alkali in gold toning is twofold: (1) To neutralise the acidity of the gold chloride (the gold chloride of commerce is always acid), and (2) to absorb the chlorine liberated when the gold is deposited upon the silver print. Thus, with acetate of soda the action is represented by the following equation:

$$2AuCl_3 + NaC_2H_3O_2 = 2Au + NaC_2Cl_3O_2 + 3HCl.$$

Gold chloride + soda acetate = gold + soda trichloracetate + hydrochloric acid.

The effect of varying the constituents of the toning bath will be as follows: *Gold.*—By decreasing the quantity of gold, toning takes place more and more slowly, and will eventually cease. Increasing the quantity of gold causes the opposite effect. The toning takes place more rapidly, and, if the gold is much increased, the toning will be irregular, very superficial, and the print will lose much tone in fixing. *Acetate of Soda.*—Increasing this within reasonable limits does not appear to alter the toning; decreasing leads to lower toning, and the prints are bleached to a greater extent. *Water.*—Increasing the water makes the toning slower and more regular, and the prints lose less tone in fixing; decreasing it will have just the opposite effect. *Action of Heat.*—Heat usually increases chemical action, and if the toning bath is heated, the toning takes place more rapidly. It is always advisable to *warm* the toning bath *slightly* in winter, and also at other times when the toning does not take place with sufficient rapidity. *Too much heat will precipitate the gold.*

700. Aristotypes—To Tone with Platinum.—The bath for aristotype prints requires to be double the strength than if used for albumenised paper, or only the bare surface is toned, and when fixed, being so thin, the untoned image shows through. Wash the prints well before toning, use a fixing bath of hypo 1lb., water 6 pints, and fix for about twenty-five minutes, and the prints will be satisfactory in tone. (1) Neutral oxalate of potash 2 parts, phosphate of soda 1 part, water 1 litre = 1 pint, 15 fluid ounces, 1 fluid dram, 43·69 minims; (2) potassium chloroplatinite 1 part, water 20 parts. Just before using, six parts of No. 1 are mixed with one part of No. 2; the prints are washed as usual, and then toned. If black tints are required the prints are placed for from twenty-five to forty minutes in the solution, which should not be shaken, when they will acquire a blue-violet tone, which will turn black in the fixing bath. Fixing and washing takes place in the usual manner.

Ed. Liesegang gives the following: To obtain black tones, it is necessary to keep the prints for a long time in the toning bath. The following bath can be recommended: *(a)* Water 100 parts, oxalate of potassium 11 parts, phosphate of potassium 5 parts; *(b)* water 20 parts, chloroplatinite of potassium 1 part. Before using, mix six parts of *a* with one part of *b*. Wash the prints well, and leave them from twenty-five to forty minutes in the toning bath. Then wash in salt water, and fix as usual (ten per cent.)

701. Bicarbonate Toning Bath—To Make.—Take

Chloride of gold	1 grain.
Bicarbonate of soda	30 ,,
Distilled water	10 ounces.

This gives warm brown tones, inclining to purple. It can be used as soon as made, but will not keep.

702. Black Tones—To Obtain.—"How can I get black tones?" is frequently asked by the beginner, or "brown tones," or "purple tones?" and he is frequently choked off by giving him some formula or other. The tone, strange as it may seem, depends almost entirely upon the quality of the negative, so the beginner should learn that with a bad negative, no matter what is done with the prints, they will never yield anything but an indifferent tone. To get a good deep tone of the black or dark purple type requires a negative with a considerable contrast, and no clouded parts. All the shadows or clear parts of the negative should be as near clear glass as possible, clear and bright, and not in any way clouded, and the tones of the negative should range from dense opacity to all points between these two extremes. The printer can then print until his densest shadows are bronzed without the high lights getting clouded over, and with well printed pictures from negatives such as this there is no difficulty in getting the tones which are so desirable. A flat, thin, or weak negative will only give washy-brown pictures, and no amount of dodging or modification of bath will alter it. In some cases, however, a considerable improvement in tone results from printing through green, or even yellow, glass. Really good black tones have been obtained on albumenised paper by using the chloride of lime toning bath. It is made up as follows:

Chloride of gold	1 grain.
Acetate of lime	10 ,,
Chloride of lime	1 ,,
Water	8 ounces.

Mix the gold with the water, neutralise with prepared chalk, and allow to settle. Then filter off the clear liquid and add the other ingredients. The bath keeps well and improves with age; it should always smell faintly of chloride of lime.

703. Blue-black Tones—To Obtain.—The tone of the print does not depend upon the paper, but upon the negative. A flat or thin negative will not give purple prints, no matter how it is dodged. The following bath gives rich purple tones, with suitable negatives:

Acetate of soda	...	...	30 grains.
Bicarbonate of soda	...	...	3 ,,
Chloride of gold	...	...	1 ,,
Water ...	...	...	4 ounces.

Allow to stand twenty-four hours, and then use (always filter the toning bath after using, and preserve till required again), after toning, transfer into salt and water, and fix in the usual way; continue toning until the print, when examined by transmitted light, exhibits little or no trace of red in the deep shadows. Another bath is as follows:

Chloride of lime	...	...	4 grains.
,, ,, gold	...	...	3 ,,
Water ...	...	...	30 ounces.

This bath gives purplish black tones. The following gives warm purple tones:

Chloride of gold	...	...	1 grain.
Phosphate of soda	...	...	20 ,,
Water ...	...	...	8 ounces.

Should be used directly after making, as it will not keep.

These tones are very difficult to obtain with certainty, but some of the conditions under which they can be obtained are given below. A rather dense (or at all events, a non-actinic coloured) negative gives the best results with the greatest ease, and, in the long run, with the most speed as well. No doubt a great deal depends upon the exact formula used for the salting of the albumen, as well as the strength of and the composition of the sensitising, toning, and fixing baths, all of which have a great influence upon the tone. The amount of moisture in the air and paper while printing may also have some effect on the tone. A thin negative is best intensified; if this is impossible, or is not desired, stretch a piece of yellow or green tissue paper all over the outside of the frame, and print in the sun; or a piece of white ground glass may be used instead of or as well as the foregoing. It is no use to try to get black tones from thin or bluish-toned negatives as a rule, even when printing in the shade without the coloured tissue paper, ground glass, or both. Fuming the sensitive paper with liquid ammonia for twenty minutes also helps to get a black tone. The blacker or more non-actinic the colour of the deposit forming the negative image, the easier and quicker the black tone is obtained. But thin pyro-developed and stained negatives generally give black tones easily; the prints from them also tone much faster than from rather thin hydroquinone or eikonogen developed negatives. Fumed paper and white ground glass with all negatives should be used when printing in a strong light as well as if the sun shines brightly. When in the shade printing in this manner also improves the tone, but usually takes too long. The stronger the light the better. It is advised to use Durand's paper, and his acetate toning bath, doubled in strength, which then tones quicker and blacker—

Acetate of soda	...	...	1 dram.
Chloride of gold	...	...	2 grains.
Water ...	...	...	6 ounces.

In ten to thirty minutes the tone desired is usually obtained. Other toning baths might answer as well or better. Print much more deeply than usual, and tone until quite black. Fix in

Hypo ...	...	...	4 ounces.
Liquid ammonia	...	...	1 dram.
Water ...	...	...	1 pint.

for fifteen to twenty minutes. If after fixing the prints are too dark, well wash and reduce them in Adam Soloman's solution:

Cyanide of potassium	...	...	5 grains.
Liquid ammonia	...	...	5 drops.
Water ...	...	...	20 ounces.

Immerse prints, one at a time, for from two to five minutes, watching and moving them carefully all the time; well wash afterwards. This solution tends towards a black tone also. If the prints are burnished, do not have the bar very hot, or else the tone will be made redder in tint. Another way to get purple tones is to sensitise one's own paper. The best blue-black that can be obtained is on plain salted paper, sensitised on a fifty-grain bath. This gives a strong printing paper, and the tone is agreeable; this, of course, gives a matt surface, but if this is objected to it can easily be got rid of by coating a talced glass plate with gelatine; when this is set squeegee down on it the wet print, allow to dry, and strip from the glass. The quality of the negative has a great influence on the tone of the print.

704. Blue Prints (Cyanotype) — To Tone.—The only available tones are a bluey black or indigo, brown, brownish purple, slaty blue, and blue violet, and they are produced by immersing the washed print in the following baths:

Blue Black.

Immerse in

Ammonia	...	...	1 per cent. solution

or

Bicarbonate of soda (sat. sol.)	...		1 part
Water	...	...	80 ,,

until the desired colour is reached. The whites will be found to be bleached, however, and if the bath is too strong the whole image will be bleached.

For Brown.

Washing soda ... ... 10 per cent. solution.

until bleached, and then in

Tannin ... 10 grains to the ounce of water.

For Brownish Purple.

First into tannin, twenty grains to ounce, to which three drops of hydrochloric acid are added. Rinse, and treat with ten minims of liquor potassæ to two ounces of water until it turns rusty red. Rinse, and immerse in a bath of hydrochloric acid, one drop to the ounce.

For Blue Violet.

Carbonate of ammonia ... 2 per cent. solution.

In all cases print rather deep.

705. Blue Tones on Silver Prints—To Obtain.—These can be obtained with an osmium bath. The following is very satisfactory:

Osmium ammonium chloride	...	1·5 grains	= 23 grains.
Osmiate of potash	...	0·1 ,,	= 1½ ,,
Acetic acid	...	15·0 ,,	= ½ ounce.
Water ...	...	1 litre	= 36 ,,

Osmium is one of the rarer metals of the platinum group, and is worth about £7 per ounce, so that the osmium ammonium chloride for the above recipe will cost probably 7s. 6d. One of the principal reasons we hear so little of osmium is the extreme rareness of the metal. The general quoted price is a guinea per dram. The salt is not offered, but the cost is easily estimated. It seems doubtful whether ammonium osmium chloride is obtainable commercially, but it can be made as follows: Obtain some pulverised osmium (price about twenty shillings per dram) and heat it with pure salt in an atmosphere of chlorine gas. This will produce a mixture of sodium chlorosmite and chlorosmate. Dissolve these in water (small quantity), and add ammonium chloride and alcohol. Filter off the precipitated ammonium osmium chloride, and wash it with alcohol. To tone with the salt dissolve about one and a half grains in ten ounces of water, and add acetic acid until the liquid, after stirring well, reddens blue litmus paper faintly.

706 Borax and Acetate Toning Bath—To Make.—First dissolve fifteen grains of gold chloride in two ounces of water, and add ten grains of bicarbonate of soda to neutralise; next

dissolve three-quarters of an ounce of borax and one and a quarter ounces acetate of soda in twenty ounces boiling water; stir well, and add the gold solution; make up to fifty ounces with cold water, and use when about seventy degrees of heat. This bath keeps a fair length of time, and gives a good solid black tone; and if a "touch" of purple is desired, omit the sodium bicarbonate, and make the sodium acetate into one and a half ounces. Another: Soda acetate 15 grains, borax 30 grains, gold chloride 1 grain, water 8 ounces. Dissolve the acetate in four ounces of the water, and add the gold at least twenty-four hours before use. Just before using add the borax dissolved in the other half of the water. The prints must be rather deeply printed, and well washed before toning, and if ready sensitised paper is used a little soda carbonate should be dissolved in the first wash water. It should be remembered that black tones can only readily be obtained from perfect negatives with plenty of contrast. The following also is a capital formula for an acetate-borax toning bath, and, moreover, will produce splendid black tones:

Gold chloride	15 grains.
Soda acetate	150 ,,
Borax	15 ,,
Water	16 ounces.

Mix the gold with the acetate in four ounces of the water, and the borax with the remaining twelve ounces. Keep these two solutions for seven hours, and then mix them and use straight away. This bath keeps fairly well. Here is another acetate-borax bath, but this contains a little soda bicarbonate. It is a splendid bath, and will give black tones:

Gold chloride	1 grain.
Borax	20 ,,
Sodium acetate	12 ,,
Sodium bicarb.	6 ,,
Water (distilled)	6 ounces.

707. Borax Toning Bath—To Make.—Make a stock solution of borax ½ ounce, water 40 ounces. When required for use take eight ounces of solution and add one grain of chloride of gold. It can be used immediately, and keeps fairly well, but it is better to mix only quantity required for use. Gives warm brown tones, and is one of the easiest to make and use. All silver nitrate should be washed out before using.

708. Bromide Prints—To Secure Pure Whites in.—If the whites of bromide prints are found on completion to be yellowed, the stain can be completely removed by immersing the print, after fixing and thorough washing, in a strong solution of tartaric acid, keeping it in the solution for an hour or more if necessary, and finally washing in clean water.

709. Bromide Prints—To Tone.—Fine browns may be obtained on bromide paper by proceeding as follows *after fixing*:

A.

Potassium ferricyanide	100 grains.
Water	24 ounces.

B.

Uranium nitrate	100 grains.
Water	24 ounces.

These solutions will keep separately, but must be mixed only for immediate use. Take equal parts of A and B, and immerse the print therein until it begins to turn, then immerse in a weak solution of common alum, wash thoroughly, and then immerse for five minutes in a fresh fixing bath:

Hyposulphite soda	3 ounces.
Water	16 ,,

Wash thoroughly. As this process intensifies the print, medium light prints give the best results. With this toning bath a *necessary* condition of success is to use distilled water for the final washing. Water having the slightest trace of hardness will cause the print to fade. Another way of toning prints after fixing is the following. The prints should be very much over-printed, and then soaked in following bath till *desired* tone is obtained:

Platinum perchloride	8 grains.
Distilled water	30 ounces.
Hydrochloric acid	½ ,,

Another: After fixing and well washing immerse in a mixture of bichromate of potash 1 part, hydrochloric acid 3 parts, water 150 parts. When bleached wash thoroughly and develop with dilute ferrous oxalate in ordinary daylight, or with the following developer:

No. 1.

Citric acid	120 grains.
Ammonium carbonate	88 ,,
Water	1 ounce.

No. 2.

Sulphate of iron	140 grains.
Sulphuric acid	1 drop.
Water	1 ounce.

To three parts of No. 1 add one part of No. 2; this will give a reddish or pink coloured image, which may be toned in any of the ordinary toning baths, or with one of the sulphocyanide baths, the following being good:

Chloride of gold	1 grain.
Acetate of soda	25 ,,
Sulphocyanide of ammonium	3 ,,
Water	1 ounce.

After toning the print should be fixed and washed afresh, or else the print, after fixing and washing, is placed in either of the following baths: (*a*) Saturated solution cupric sulphate mixed with saturated solution calcium chloride, and filtering off the calcium sulphate; or (*b*) saturated solution mercuric chloride. After thoroughly washing again expose to light, and develop with a very weak ferrous oxalate developer, or with diluted quinol and carbonate of ammonia. The resulting image should be more or less warm, and can be toned with either of the following baths:

(1.)

Acetate of soda	3 grammes.
Chloride of lime	2 ,,
Chloride of gold	1 ,,
Hot water	500 c.c.

Add the gold after the other salts are dissolved, and allow to stand three hours before using.

(2.) Solution 1.

Chloride of gold	1 gramme.
Distilled water	500 c.c.

Solution 2.

Ammonium sulphocyanide	30 grammes.
Ammonium carbonate	25 ,,
Distilled water	500 c.c.

Mix one part of solution 1 with three parts of solution 2, and dilute with equal quantity of water for warm browns. (3.) The "tungstate" bath (No. 748). Or by treating the developed, fixed, and washed print with a solution of Schlippe's salt of strength one to fifty of water, to which a drop or two of ammonia has been added, a rich, warm brown can be obtained on bromide paper. Another way of toning bromide prints is as follows. Immerse prints in a bath composed of

Platinum perchloride	15 grains.
Hydrochloric acid	1 ounce.
Distilled water	70 ,,

This gives prints of a pretty sepia tint. When the desired tone is obtained, remove from the bath, wash well, and dry. This requires to over-develop, as the bath reduces as well as tones.

Red and green tones may also be easily produced on bromide paper. The *red* tone may be obtained by using the uranium toning solution thus: Having made and fixed the prints, *wash thoroughly*. Make solutions

No. 1.

Potassium ferricyanide	10 grains.
Acetic acid (thirty-three per cent.)	2 ounces.
Water	8 „

No. 2.

Uranium nitrate	10 grains.
Water	10 ounces.

Mix Nos. 1 and 2 in equal quantities, and if not *perfectly clear*, filter. Put the mixture in a dish, and immerse the well-washed print therein; keep it moving, and watch closely. The print will pass through various tints, first brown, then chocolate, and finally reach the red chalk tone required. When it reaches this stage, remove and wash twenty-five minutes in running water. Rather weak prints answer best. For the *green tones*, treat as before, until the red colour is obtained, and then wash and immerse in a solution of

Ferric chloride	60 grains.
Water	10 ounces.

The paper will in this become first green, and finally a bright blue will be obtained. Remove when the required tint is reached, and soak in clean hypo solution (four ounces to the pint) for a few minutes, when again wash thoroughly. Other directions are: Use any good developer excepting the *ferrous oxalate*, which is found most unsuitable, for unless the most scrupulous care is taken to get rid of every trace of iron from the print, it will be found that the whole of the picture will have a more or less blue tone, owing to Prussian blue being formed during toning. For red tones, obtain a somewhat brilliant print, wash most thoroughly to eliminate hypo, and to make more sure give an alum bath. Now dry the print, then prepare the toning bath as follows:

No. 1.

Potassium ferridcyanide	10 grains.
Acid, acetic	2½ drams.
Water to	8 ounces.

No. 2.

Uranium nitrate	12 grains.
Acid, acetic	2½ drams.
Water...	8 ounces.

Mix equal parts at time of using, as the mixed solution will not keep. Wet print first, then immerse in toning bath or lay on a piece of glass and apply with a piece of cotton wool or a Buckle's brush. Continue this until the required tone is obtained. Then well wash for as short a time as will clear the high lights satisfactorily. Then dry, and if necessary spot the print with red chalk or Indian red modified to suit the tone. To obtain pleasing green and blue tones proceed as follows: The tone and character of the green is dependent upon the depth of plain print, and more particularly upon the nature of tone obtained in the preliminary bath. Immerse the print in the uranium bath given above, and tone only to a sepia tone, noting particularly that the warmer or redder the tone now obtained, the more the resulting tone will be a blue instead of green. Having obtained, say, a good sepia tone, well wash the print, then immerse in this bath; a one per cent. solution of iron perchloride, to which three or four minims per ounce of hydrochloric acid has been added. The print will steadily change to a green, somewhat resembling the delightful tones of the sea studies of the Autotype Company's printing in carbon.

710. Cheap Toning Bath—To Make.—The following bath gives very good tones with Eastman's sollo paper:

Acetate of lead	½ ounce.
Hypo	4 „
Water	20 „

It gives brown tones with albumen paper. The following is a cheap bath:

Chloride of gold	1 grain.
Carbonate of soda	15 „
Distilled water	10 ounces.

Mix half-an-hour before use. Will not keep. Tone to purplish blue and fix. The resulting colour is a good brown, free from any purplish tinge. But to get a true sepia tone, use water at 170° F., add the gold, and use the bath in ten minutes. It is to be regretted that the fierce competition and resultant cut prices of materials tend not only to injure the photographer, but also his productions. Photographs are now supplied by some people at such an exceedingly low rate that there can be scarcely any profit at all attached to the work, and if a cheaper way of printing can be found it will be used on account of the few pence saved, and without a thought as to the diminished chance of permanence of the work. On this latter head, lead toning is to be deprecated, as it is undoubtedly less permanent than the nobler metals, gold and platinum, though, of course, it is cheaper. Chloride papers toned in the single or combined baths use a considerable quantity of gold, and are to that extent expensive, and on that account the prints are more permanent. Those who use albumenised paper are advised to stick to the old acetate of soda bath, as good tones are obtained in it. It will keep (thus being a cheaper bath, as it can be used over and over again until all the gold in it is exhausted, whereas a bath such as the bicarbonate of soda is useless soon after it is made up, no matter how few prints may have been toned in it), and it is easily prepared. For cheapness the borax bath is recommended as follows: Borax (pure) six to eight grains to each ounce of water; chloride of gold one grain to each eight ounces of solution. This quantity is supposed to tone one sheet of paper, and when using good wet plate negatives, or dry plate ones of the highest class, viz., those pyro and ammonia developed but not cleared, or those with perfectly clear shadows, such as are obtained with hydroquinone, eikonogen, rodinal, amidol, or metol, it will suffice. But if any negative is fogged, or, rather, over-exposed and over-developed, and much denser all over (or thick negatives, some photographers call them), the gold must be increased to one and a half or even two grains, instead of one grain as given, otherwise the toning of the prints from them will take one hour or more instead of five to fifteen minutes, as used to be the case in the wet collodion days. It is surprising how the colour of the deposit of the negative, and clearness or mistiness of the transparent parts of it, favours or not the quick toning of the prints from them. Hence to secure cheapness in tone, secure negatives of wet plate quality.

711. Chloride of Calcium Toning Bath—To Make.—Take

Gold chloride	2 grains.
Calcium chloride	2 „
Powdered chalk	1 teaspoonful.
Water	16 ounces.

Neutralise the gold with the chalk, and add the water in which is dissolved the calcium chloride. This bath works best after it has been made some time.

712. Chloride of Lime Toning Bath—To Make.—Take

Chloride of gold	15 grains.
Common chalk (precipitated) ...	150 „
Chloride of lime	24 „
Lime water	15 ounces.

Add the gold to the chalk, and mix into a paste with a little lime water, and leave for one hour; filter, and wash the filter with the remainder of the lime water, in which is dissolved the chloride of lime. Add one ounce of above stock solution to ten ounces of water for each sheet of paper to be toned. When old, and the bath refuses to tone, add a little chloride of gold and leave for fifteen minutes, or, if it ceases to smell of chlorine, add a grain of chloride of lime. This gives purplish black tones, and keeps well. It does not require the last traces of silver nitrate to be washed out of the paper. A mixture of this with an equal proportion of the acetate bath works very well, and gives warm, black tones.

713. Chloride Prints — To Tone.—The bath recommended by the makers undoubtedly gives the finest results, and works with far more certainty and evenness than any other. Make a toning bath strictly according to the formula sent out with the paper. Guesswork will *not* do. Also remember to add the gold *last*. and let stand for twenty-four hours or more Having printed rather deeply, well wash the prints in rain water, warm the toning bath up to 60° Fahr., and commence toning with two or three prints. Be most careful not to overtone, and take them from the bath while there is still considerable warmth in the shadows, for when the paper prints purple the tone of the finished print becomes *bluer than when taken from the toning*. Fix for ten minutes in hypo 3 ounces, water 20 ounces. Be sure the hypo is not an inferior quality (perhaps very full of sulphur). In conclusion, the paper must not be kept too long, or it becomes yellow and the lights degraded, and if required for burnishing use the *alum after toning*, and before *fixing*. The colour produced depends on the quality of the negative from which the prints are made, whether it be thin or dense, also the nautre or actinic power of the light at the time of printing. The colour of the image is influenced by the condition of the paper as to dryness, also by moisture in the air; it is therefore best to store the paper in a dry place, and to use a thin sheet of rubber behind the paper in the frame. A thin negative printed in a weak light gives a purple shade, at first all the detail coming out, but on further exposure the proper red colour appears, and the detail is clouded over and lost. A good negative, printed in the shade, first gives the purple colour, which gradually turns to a warm red colour, with slight bronzing of the shadows remaining clear and distinct. The best toning bath is the simple sulphocyanide one recommended in the instructions sent out with the paper, and there is no difficulty in getting any desired colour from sepia brown to a cold purple, depending on the time the prints are allowed to remain in the bath. The tone is best judged by transmitted light, which requires a little practice, as the prints always dry a little colder than they appear wet. It is found that an old toning bath works best, adding fresh quantities of gold as it becomes exhausted, and may be worked for a long time if allowed to settle after use, and the clear liquid decanted. The instructions sent out with the paper must be strictly observed, and on no account must the washings before and after toning be forgotten or disregarded. If the prints tone too quickly and in blotches, it points to insufficient washing, and the bath must be diluted (see No. 745). To insure freedom from acid and lower sulphur compounds, dissolve the hypo in cold water, and add half a dram of strong ammonia, allow the solution to stand at least five hours, then filter through cloth or paper, when the clear solution is ready for use.

714. Collodion Transparencies—To Tone.—After fixing and well washing, immerse the transparency, until *thoroughly bleached*, in a solution of ten grains each of mercuric and ammonium chlorides to the ounce of water. After another thorough washing in running water, place it in a fifty-grain to the ounce solution of potassium sulphide (liver of sulphur), in which it is to remain until the desired colour is reached. Care should be taken not to *over-tone*, as when dry the transparencies toned by this process are considerably bluer than they appear in the potassium sulphide. These can be toned a pretty purple if not developed too cold in tone, and this can be avoided by giving them a full exposure and a weak slow development, and tone in a bath as follows:

Gold chloride	2 grains.
Soda acetate	30 ,,
Water	8 ounces.
Ammonium sulphocyanide	10 to 50 grains.

The quantity of this salt decides the tone—less used, warmer the tone; more used, deeper and colder. Sometimes a transparency will not tone, however coaxed. In this case transfer it to

Water	4 ounces.
Acid hydrochloric	4 drops.

for a few minutes, and place in the toning bath without washing. This will cure it in most cases. If the tone be too red or warm it can be modified to purple or black by immersion in a very weak solution of platinum bichloride, say one grain to ten ounces water. The required tone can be thus obtained, only it must be stopped short of the exact tone required, as in drying it gets blacker. If, however, the transparency was cold to start with, the toning solution will not make it warm, for nothing but full exposure will do this. Should the toning with platinum be carried too far, wash well, and flood with cyanide fixing solution, when the image returns to its original colour, and can again be retoned. There is one point of great importance as to the platinum bichloride. Sometimes when a new supply has been got in, and the toning solution made up, when the transparency is immersed in it, to one's horror, the image, instead of assuming the much-desired tone, begins to bleach, and soon becomes white. This is owing to hydrochloric acid in the salt. Wherefore, to prepare the stock solution, carefully neutralise with a small quantity of solution of carbonate of *soda*, shake up well, and test with litmus paper. When the acid is neutralised, then add nitric acid until the liquid just reddens litmus paper. It is then ready for toning, for it must be acid to tone at all.

715. Combined Toning and Fixing Bath—To Make.—The following is one formula, but will not keep long: Dissolve six ounces hypo in a pint of water, and mix with it fifteen grains gold chloride dissolved in a second pint of water. Print deeply. Another—Take the following:

A.

Hyposulphite of soda	30 ounces.
Water	30 ,,

B.

Gold chloride	15 grains.
Water	20 ounces.

To solution A add, slowly and well stirring, four ounces of B. The bath is then ready for use. It improves by keeping, and when necessary is replenished by the addition of fresh hypo and of gold solution. Keep the print in this bath ten minutes or a quarter of an hour. The two following baths are recommended for the production of a good purplish black tone:

Hyposulphite of soda	...	...	6 ounces.
Sulphocyanide of potassium		...	1 ,,
Acetate of soda	...	...	1½ ,,
Alum	...	...	96 grains.
Distilled water	...	...	21 ounces.

Fill the bottle containing this solution with clippings of paper or bad prints, or add hundred grains of chloride of silver, and leave for twenty-four hours, filter, and add

Chloride of gold	...	...	15 grains.
Ammonium chloride	...	...	30 ,,
Distilled water	...	...	6 ounces.

The prints should be rather deeply printed, washed in weak carbonate of soda, toned face downwards, dipped in soda, and then, to ensure complete fixation, they should be immersed in fresh hypo. No. 2 is

Gold chloride	...	...	15 grains.
Sodium tungstate	...	...	3 drams.
Sodium thiosulphate	...	...	6 ounces.
Ammonium sulphocyanide	...	...	5 drams.
Water	...	...	24 ounces.

Dissolve the last three salts in twenty ounces of water, the gold in the remaining four ounces, and mix the solutions. If the bath tones too quickly, add more water. With a negative of good contrast and detail, purple tones are easily obtained. With a weak, thin negative it is vain to expect them.

716. Combined Toning and Fixing Bath—To Use.—A fresh bath takes certainly an hour for toning; the more it is used, the quicker it will work. A mixture of three parts of fresh bath with one part of old exhausted bath will tone in about one quarter of an hour. After use, the bath must be filtered; it will always become dirty, but this cannot be avoided. If four ounces of boiling water are used, and the solids added, the gold solution, which should be neutralised with chalk first, may be added, and then the bulk made up to eight ounces. The bath should be allowed to remain for at least twelve hours before use, and better results are obtained if the bottle is filled with chippings of wash prints, or forty grains of pure chloride of silver be added to it before it is allowed to ripen. The reason a bath sometimes refuses to tone is because it is acid. Test it with a piece of red litmus paper, and if in proper condition the paper will be changed to a slightly blue tone. Should the paper refuse to turn colour, carefully add drop by drop a little ammonia till the bath is slightly alkaline. The prints should not be washed at all, but immersed straight into the fixing bath. The bath changes colour after use, but should not turn "very dirty." This is probably caused from some contamination. The gold should also be tested before mixing it with the toning bath, as the chloride of gold is sometimes very acid. If the instructions are carefully carried out this bath works perfectly, but, of course, rather slowly, but it should be remembered that fixing as well as toning has to be accomplished.

717. Concentrated Toning Bath—To Make.—The following method may be adopted, as to fifteen grains of gold about one ounce (480 grains) acetate is necessary, and one ounce acetate soda is soluble in 2·86 ounces of water, say three ounces:

Gold chloride	...	...	15 grains.
Acetate of soda	...	...	480 ,,
Water (distilled) to make		...	7½ ounces.

Half an ounce of this contains one grain of gold, which is generally allowed as sufficient to tone a sheet of paper (about fifteen cabinet size pieces or thirty carte size). In using this, take therefore of this solution half an ounce, and add half a pint or ten ounces water. After use, this may be used to dilute the next toning bath, instead of water. Filter after use, and then, when required to use again, add another half ounce of the concentrated solution. Of course, another way is to keep the gold in solution, the plan being to smash the tube in beaker, and add water to make fifteen drams, then each dram contains one grain gold, or near enough for practical purposes. Another method: Dissolve the gold in two ounces of distilled water, and neutralise the acidity by adding a good pinch of carbonate of soda or common chalk, shake thoroughly and allow to stand for half an hour, pour off the clear solution, and add one ounce of acetate of soda, and make the solution measure four fluid ounces. Two drams of this will represent about a grain of chloride of gold, and should be added to half a pint of water to form the toning bath, which works best at about 90° F. After using, the dilute bath may be filtered and kept to dilute the next bath instead of plain water. The stock solution must be kept for twenty-four hours before use, and should be preserved in a non-actinic light.

718. Difficulties in Toning—To Avoid.—A good many difficulties are apt to occur in toning, but the way to avoid some of them may be pointed out as follows: Either impure chemicals are used, or, most likely, the toning bath is used too cold, in which case slow toning would take place. The remedy is obvious. A new bath will not work as well as an old one, or a new one to which part of an old bath has been added. Schölzig recommends that prints should be made *very* deep, bronzed in the shadows, and the toning bath made up as follows:

A.—Sulphocyanide Bath.

Water	...	...	10 ounces.
Hypo	...	...	2½ ,,
Sulphocyanide of ammonium		...	2½ drams.
Acetate of soda	...	...	1½ ,,
Alum solution, ten per cent.		...	½ ounce.

To which add (1) some unfixed ordinary sensitised paper clipping, or (2) twelve grains nitrate of silver in one ounce of water, or (3) three ounces of an old toning and fixing bath. Let it rest for a day, filter, and add—

Water	...	...	2½ ounces.
Gold chloride	...	...	6 grains.
Chloride of ammonium	...	...	12 ,,

and mix well. Finally, do not use an acid bath. Always neutralise the gold solution before use.

B.—Toning baths for albumenised papers. Be careful (1) before using the bath to make it neutral or even slightly alkaline by adding whiting; (2) to thoroughly wash out the excess of silver nitrate from the prints, as its presence decomposes the sodium acetate, and forms sodium nitrate, which will not absorb the chlorine, and hence the latter will attack the image on the paper; (3) to be liberal with the gold in the bath, as brown tones after fixing are generally to be traced to insufficient deposit of gold; (4) to wash thoroughly between toning and fixing; and (5) to make the fixing bath alkaline with ammonia, and use it freshly made. If, however, the chloride of lime bath be used, the second point may be omitted, as the presence of silver nitrate in this case helps the toning. Another recommendation is—Test hypo bath, or put a lump of carb. ammonia in hypo bath some time before using bath, and see if that will not be a cure. Most makes of ready sensitised paper require to be thoroughly washed in four changes of water; to the third washing water add saturated solution of washing soda, about one in twenty, the paper will then be found to tone readily; it should not be toned any deeper than the required shade, as what tone it loses in the hypo dries back again. Fix the prints in a hypo bath of six pints to the pound, made slightly alkaline with carbonate of soda. Do

not neglect this, and do not use a hot hypo bath (above seventy degrees), as this will ruin the tone.

719. Ferro-prussiate Paper—To TONE.—(1.) *Black Tones.*—Immerse the prints in a solution of tannin 1 dram, water 4 ounces, for five minutes; then in a solution of carbonate of soda 1 dram, in five ounces of water, for about a minute; wash well, and place in the tannin solution again for a minute or two. Another way is a solution of caustic potash, followed by a four per cent. solution of tannin. Also ammonia or bicarbonate of soda alone will give blue-black tones.

Use of sat. sol. bicarbonate of soda... 1 part.
Water ... ... 80 ,,

Again :

Chloride of lime sat. sol. ... ... 1 part.
Water to ... ... 120 ,,

will give a nearly black tone, and strong solution of sat. soda (half saturated), followed by tannin, will give a pretty brown tone resembling a silver print; while bleaching in ammonia and bathing in a solution of gum catechu and borax will give a slaty-blue colour. (2.) *Green Tones.*—A *fairly* green tone can be got by printing deep, and, after washing, immersing in ammonia 2 drams, and water 20 ounces, then, *without rinsing*, transferring to a solution composed of sulphuric acid 1 dram, and water 16 ounces. A very pronounced green appears, however, impossible. (3.) *Platinotype Tones.*—Sepia tones may be obtained on this paper as follows: Immerse the prints in a dilute solution of potassium hydrate until they turn orange, when they must be washed in plain water, and then placed in a solution of tannin five grains to the ounce, till a dark brown tone; wash them in water again, and again put them in the potash solution until the desired tone is obtained, when they must be at once taken out and washed. Brown tones may be obtained by omitting the last potash bath. To obtain a black tone float the blue print on a bath of nitrate of silver till the image is nearly gone, wash well, and develop with ferrous oxalate. (4.) *Purple Tones.*—Take a cyanotype print, printed rather deep, wash well, and then place in a bath of twenty grains of tannic acid and three drops of hydrochloric acid, in which the print lies for a few minutes. Then rinse, and treat the print with ten drops of liquor potassæ in two ounces of water, which turns it a rusty red colour all over, and after rinsing again, give it a bath of hydrochloric acid, one drop to the ounce, and when it has reached the desired tone, wash and dry. This gives the print a fine purple tone.

720. Gelatino-chloride Print, Black and White—To TONE.—The necessary conditions for success are common to all solutions in photography, and one is that the chemicals must be pure, the dishes perfectly cleansed from any old chemicals, and the ingredients carefully weighed to within a few grains either way, though the strength of this bath is the essential condition of its working satisfactorily. The solution being quite freshly made, the next thing to consider is the print, which should be at least three shades darker than the finished picture is required to be. The print should be rinsed or soaked for five minutes at least, to prevent the toning solution getting into a thick milky condition, as with unwashed prints. The formula is—Gold 4 grains, bicarbonate of soda 90 grains, water 6 ounces, the old bath containing only 16 grains of soda. The prints should be immersed singly, and will tone in about five seconds. It is easy to get black and white tones on gelatino-chloride paper by development. For instance the following formula: A.—Metol 1 part, sodium sulphite 10 parts, water 100 parts. B.—Carbonate of soda 10 parts, water 100 parts. C.—Bromide of potassium 10 parts, water 100 parts. Take 1 ounce A, 80 minims B, and 2 to 4 drops C. Give very short exposures to the paper till a very faint image appears, and by using the above developer and modifying it to suit the taste, a very good black tone will be obtained. Another method is to fill printing frame in dark room, expose twenty or thirty *seconds* only to sunlight, or to eight inches magnesium wire, and develop in yellow light by amidol (half negative strength), with small quantity bromide of potassium added. Fix, rinse, and tone in daylight with Ilford Company's Alpha toning bath. Toning with a platinum toning bath—say one made from Powell's compressed platinum—and then "finishing" in an ordinary gold bath, will produce a splendid purple black tone, and really repays for the expense, but that it is rather expensive no one will doubt. Very good black tones can be got on mezzotype paper by the use of the platinum bath, but this, of course, is a rough surface paper, and best suited to broad and artistic effects.

721. Gelatino-chloride Prints — To TONE.—Toning gelatino-chloride prints is an easier process than with albumenised paper, and a greater evenness of tone can be obtained. The ordinary sulphocyanide bath as recommended by the Ilford people works well *if* the prints are thoroughly washed first, and this is an important point. *These papers require thorough washing*, in that the silver takes a long time to wash out of the emulsion. Moreover, do not allow the prints to soak long in the first two changes of washing water, as this degrades the whites. The following formula works as satisfactorily as can be wished:

Ammonium sulphocyanide ... 140 grains.
Sodium phosphate... ... ... 140 ,,
Sodium tungstate ... ... 100 ,,
Water ... ... 24 ounces.

Saturate this with silver chloride by soaking in it scraps of unfixed or spoilt paper, etc., then filter and add

Gold chloride ... ... 15 grains.
Water ... ... 4 ounces.

The fixing bath must be weak, ten per cent. is the strongest.

A combined fixing and toning bath is a great convenience, and if proper precautions are taken the results are as permanent as with the separate baths. A good formula is as follows:

Water ... ... 20 ounces.
Hypo ... ... 4 ,,
Amm. sulphocyanide ... ... ½ ,,
Lead acetate ... ... 60 grains.
Lead nitrate ... ... 60 ,,
Gold chloride (neutralised) ... 4 ,,

The substances are to be dissolved in the order named, and each to be added only after the previous one is quite dissolved. The liquid will be turbid, and is ready for use when it has settled and is clear. The prints are placed in it without washing, which is a great saving, and if extra care as regards permanency is required, they can, after toning and washing, be fixed in a separate hypo bath of ten per cent. strength. Another bath recommended for gelatino-chloride papers is—

Gold chloride ... ... 4 grains.
Bicarbonate of soda ... ... 1½ drams.
Water ... ... 6 ounces.

There is another method of toning gelatino-chloride prints, viz., by development. Liesegan recommends to make a *weak* print, and then to plunge it without washing into

Gallic acid ... ... 5 grammes : 5 grains.
Acetate of soda ... 5 ,, : 5 ,,
Tannic acid ... ... 3 ,, : 3 ,,
Water... ... ... 500 c.c. : 1 ounce.

It will develop entirely of a warm black, which

turns green in hyposulphite of soda, whilst in a mixed toning bath it will acquire a warm tone.

722. Grainy Prints—To Avoid in Toning.—Mealiness in prints may be caused by too strong or by too warm a toning bath, that is, even when the paper is all right; but this can hardly be the cause of some of the prints in a batch going wrong, and not others. This may be due to some of the prints being on old pieces of paper, or very probably to some of the prints getting more washing than others before going into the toner. When using a lime chloride (bleaching powder) bath, or any of those made up with sodium carbonate or phosphate, a little of the free silver nitrate should be left in the print. If it is all washed out, it is almost a certain case of measles, though the spots may be so small as not to be noticed. With the acetate of sodium bath, on the contrary, all the free silver nitrate *must* be removed. The peculiar mottled appearance of the surface of a print known as mealiness is generally due to the weakness of the silver bath. Nothing can be done with mealy prints caused by the weakness of the silver bath. There is, however, another cause, and that is too much washing before toning. The prints are put in the water, and some are taken out and put in the toning bath, and the rest are left in the washing water. If there is a large number of prints to tone, no doubt this is done again, still leaving more in the water. By that time the prints will have had too much washing, and will cause mealiness to a certain extent, though not so great as that caused by the weakness of the silver bath. This, no doubt, will solve the mystery of some of the prints of the same batch proving all right, while others turn out mealy. Another says this fault may be caused by several things. In the first place, the toning bath may be too new, or contain too much gold. This would not necessarily affect all the prints, though it might be supposed so. The remedy in either of these cases is obvious. Secondly, the prints may be overtoned; much of the paper at present in the market will not stand toning beyond brown, which brings on the third cause, unsuitable negatives; flat or foggy negatives give prints which are generally liable to mealiness, if the toning is carried far. Fourth cause, bad paper; this is not a likely one, if a good brand is used and obtained *direct from the maker*. Still another cause is washing the prints in hard water before toning. This often leaves a white scum on the surface, which is very difficult to remove, and which will give the prints a mealy appearance after fixing and drying. This can be remedied by adding a little lime water, or milk of lime, to the water—just enough to render it soft—before putting the prints in. It will not harm them, and is better than rain-water, which may have been conveyed to the cistern through rusty pipes.

723. Gold, Precipitation of, in Toning Bath—To Prevent.—Gold in the toning bath will precipitate if exposed to light. The solution must be kept in the dark, or in a blue bottle. The light affects it, and makes the gold fall down. It is also due to decomposition of the gold chloride caused by organic matter in the solution. To prevent it the solution should be kept acid until required, when it can be neutralised as wanted. The best and most convenient way to keep gold chloride is to dissolve fifteen grains in fifteen drams of distilled water, put it into a glass-stoppered bottle, and add a little chalk. One dram will then contain a grain of gold chloride, and the solution will keep well if protected from light.

724. Jaudaurek's Toning Bath—To Make.—All amateurs will hail with welcome a bath invented by M. Jaudaurek, of Vienna, which will tone albumen prints, no matter how long they have been printed, nor how faded and yellow they may be. The following is the process, which is of great value:

Solution A.

Distilled water	17 ounces.
Tungstate of soda	154 grains.

Solution B.

Precipitated chalk	60 grains.
Chloride of lime	15 ,,
Chloride of gold	60 ,,
Distilled water	15 ounces.

This solution should be made in a yellow glass bottle, well shaken, and allowed to stand for twenty-four hours, then filtered into another yellow glass bottle, and kept well stoppered. When the prints have been washed they should be placed in the following bath:

Solution A	5 ounces.
Solution B	70—140 minims.

They should not tone too quickly—about ten minutes in summer should be the shortest time. If they tone too quickly, reduce the quantity of solution B. After washing fix in

Solution A...	5 ounces.
Sodium hyposulphite ...	230 grains, or 1 in 10.

They must be left in this until the yellow colour has quite disappeared.

725. Lead Toning Bath—To Prepare.—One is the following:

Lead acetate	280 grains.
Hyposulphite of soda	4 ounces.
Distilled water	20 ,,

Print deeply, and do not wash before toning.

Another: The lead bath should be composed of half an ounce of acetate of lead in ten ounces of a one in ten solution of hypo. Immerse the prints for twenty minutes in any old gold toning bath, and then transfer for a quarter of an hour to the lead toning bath. The results, however, are not as good as can be achieved with an ordinary toning bath, and possibly the prints so toned would be anything but permanent. Another formula, given below, is not very much in favour, principally, no doubt, because it will not keep. It gives rich black tones, but they are seldom permanent: Nitrate of lead 60 grains, chloride of sodium 80 grains, hypo 1 ounce, chloride of gold 2 grains, water 1 pint. Mix in hot water, and use at once. Prints to be fixed in fresh hypo. On the other hand, the following solution has been used for aristotype papers with great success. It forms a combined toning and fixing bath: Hyposulphite of soda 4 ounces, distilled water 20 ounces, lead nitrate 3 grains, gold chloride 6 grains. Dissolve in the order given. The lead nitrate is added to preserve perfect whites, which it does. Make up the bath two or three days before use. Tones are from sepia brown to black. Washing and aluming must be carefully attended to.

726. Loss of Tone in Fixing—To Prevent.—This annoying defect appears to occur more frequently with some samples of gold chloride than others. It has been accounted for by an accidental contamination with chloride of copper, probably derived from the use of old jewellery or English sovereigns in preparing the gold salt. If copper be present part of the image would be toned by a coloured compound of copper, which would dissolve in the hypo. The addition of alkaline gold to the fixing bath has been recommended to prevent this, and the following formula is given for the purpose and found valuable:

Chloride of gold	1 grain.
Carbonate of soda	20 ,,
Hypo	4 ounces.
Water	20 ,,

Mix the gold and soda, and add to the hypo solution.

727. Matt Surface Paper—To Get Black Tones on.—For matt surface paper either of the following solutions is excellent for yielding fine black velvety tones, far superior to those given by the chloride of lime bath:

Gold chloride	4 grains.
Sodium phosphate	120 ,,
Sodium acetate	200 ,,
Platinum chloride	3½ ,,
Water	35 ounces.

The sodium acetate and phosphate should be dissolved first, and the chlorides of gold and platinum added afterwards. This bath should be made at least twelve hours before use. Or—

Sodium acetate	1½ drams.
Gold chloride	4 grains.
Uranium nitrate	6 ,,
Sodium bicarbonate...	15 ,,
Sodium chloride	½ dram.
Water	30 ounces.

This may be obtained by gold or platinum toning. The following baths are recommended. Gold—

Chloride of gold	1 grain.
Chloride of lime	1 ,,
Chloride of sodium	1 ,,
Distilled water	5 ounces.

In this the salt acts as a restrainer, and prevents an unequal deposition of gold. Print deeply. Platinum—

Platinic chloride	1 grain.
Water	16 ounces.

Neutralise with carbonate of potash, and just before using add half a dram of formic acid. This bath will not keep. Print deeply, and a fine black will be obtained. Mr. Lyonel Clark has obtained a fine black tone with the cold process platinotype developer. Its composition is—

Oxalate of potash	40 grains.
Biphosphate ,, ...	100 ,,
Water	1 ounce.

Just before using, add ten grains of chloroplatinite of potassium. Various other combined baths give a black tone, such as uranium and gold; iron, uranium, and gold; lead and gold. Another formula by Mr. Lyonel Clark—print as usual, *but rather deeply.* Toning solution: Dissolve sixty grains of *chloro-platinite of potassium* in two ounces of distilled water. For use take two drams of this solution, dilute to four ounces with water, and make it freely acid with nitric acid. The toning takes place very quickly, and when the required tone is obtained the print is swilled and fixed in hypo as usual. The chloro-platinite of potassium may be obtained from the Platinotype Co., or their agents. It is the *platinum salts* of their cold bath process. A sixty-grain bottle costs 3s. 6d.

728. Obernetter Paper—To Tone.—The following solution will give warm brown tone to prints on Obernetter paper. It is a combined toning and fixing solution:

Phosphate of soda	60 grains.
Sulphocyanide of ammonium ...	100 ,,
Hyposulphite of sodium	2 ounces.
Water	8 ,,

Dissolve, and after putting into a bottle add some scraps of untoned prints, sensitised paper, or filter paper, through which silver nitrate solution has passed, and let it remain some time. When required for use, filter and add four grains of chloride of gold dissolved in four ounces of water. The following bath will give purple tones:

A.

Chloride of gold	1 grain.
Water	1 ounce.

B.

Hypo	5 grains.
Acetate of soda	10 ,,
Water	1 ounce.

Pour A into B and well shake. Wash prints well before toning. Very fine warm brown tones may be obtained by the same bath by leaving out the hypo. The phosphate bath gives warm purple tones; it can be used as soon as it is made, but it will not keep. The bath is made up as follows:

Chloride of gold	1 grain.
Phosphate of soda	20 ,,
Distilled water	10 ounces.

Warm brown tones can also be obtained with the following:

Chloride of gold	1 grain.
Sulphocyanide of potassium ...	12 ,,
Hyposulphite of soda	½ ,,
Water	4 ounces.

Place the print *face down* in the bath till the desired tone is obtained, which may be as deep as required, as it does not lose in fixing. After toning, the prints should be placed in a solution of carbonate of soda (one in ten), then fixed in fresh hypo three ounces to the pint, then washed thoroughly. The phosphate baths are always conducive to black and the acetate to brown tones. If uniform tone is aimed at, the prints must be washed in water until there is no appearance of milkiness, and the tone judged by looking through, and never on the print. Obernetter's new toning bath, which is as follows, is excellent for brown tones:

No. 1.

Acetate of soda (re-crystallised) ...	1 ounce.
Distilled water	25 ,,

into which pour two ounces of a one per cent. solution of chloride of gold.

No. 2.

Sulphocyanide of ammonium ...	2 drams.
Distilled water	10 ounces.

and add one ounce of a one per cent. solution of chloride of gold. Both solutions should be kept separate. For toning bath take in the proportion of twenty ounces of No. 1 to six ounces of No. 2; mix, if possible, the evening before use. The following bath will be found to give fine warm purple tones:

No. 1.

Dissolve fifteen grains of chloride of gold in eighty ounces of water (which contains no lime).

No. 2.

Saturated solution of acetate of soda, fused (not crystals).

For toning take fifteen good drops of No. 2, and add four ounces of No. 1. Let this stand for one hour before use. This bath will tone between forty and fifty cabinets, but can only be used once.

729. Obernetter Prints—To Tone with Platinum.—The following will work well:

Platinum bichloride	10 grains.
Sodium bicarbonate...	10 ,,
Water (distilled)	10 ounces.

At time of using add one drop of nitric acid for each grain of the platinum salt. The prints must be *very considerably* over-printed, as the reduction of the image is very great. A much more satisfactory way of toning Obernetter prints with platinum is by adopting Lyonel Clark's process, for particulars of which see No. 735. Potassium chloroplatinite tones better than the bichloride. This last is not nearly so satisfactory. The bleaching action is considerable, so that much over-printed proofs are necessary. The following is one of the most satisfactory toning baths with platinum bichloride:

Solution A.

Platinum bichloride	...	...	15 grains.
Distilled water	..	...	2½ ounces.

Solution B.

Hyposulphite of soda	...	...	4¾ ounces.
Acetate of soda	...	...	463 grains.
Distilled water	...	...	30 ounces.

For use take 170 minims A solution, and *carefully neutralise* with carbonate of soda. Add this to three ounces of B solution, and keep the prints in this bath until they acquire the required tone, then wash for several hours. This is a combined toning and fixing bath. An excellent toning bath may be prepared as follows: Boil in the light a solution containing two grammes (thirty grains nearly) of platinic chloride, with one gramme (fifteen grains) of neutral tartrate of soda until the yellow liquid becomes dull grey; then make up the solution to the litre (about thirty-five ounces), and add sulphuric acid in proportion 1:200. Well wash the print and immerse. Toning takes place fairly rapidly. Another bath may be made as follows: A slightly acidulated solution of platinic chloride (say one grain to ten ounces of water) has a fragment (say half grain) of sodium sulphite added to it. This does away with the necessity for the platinous salt, and the print after well washing is placed in it, and after toning is fixed as usual. The following is a formula for the use of platinous salt:

A.

Neutral oxalate of potash...		...	2 grammes.
Phosphate of potash	...	...	1 ,,
Water ...	...	...	1 litre.

B.

Chloro-platinite of potassium		...	1 part.
Water ...	...	...	20 ,,

Just before using, six parts of A are mixed with one of B, and the proofs, after being well washed, are immersed. The toning for black prints should be carried on for from twenty-five to forty minutes in the solution, which should not be shaken, when they will assume a blue violet tone, which becomes black in the fixing bath.

730. Palladium Toning Bath—To MAKE.—Palladium chloride solid can be obtained at 6s. per gramme (of fifteen and a half grains), or the solution at 2s. 9d. per ounce, from any large chemical house. The formula given for platinum toning (Lyonel Clark's) will succeed well, substituting palladous chloride twenty-five grains for the sixty grains of potassium chloro-platinite in stock solution A. Baths the same proportion. The strength of this solution is about sixty grains to the ounce; however, enquiry might be made at the time of purchasing. This, obviously, would be far too concentrated for toning purposes, and the proportions would probably be one grain of palladous chloride to eight to ten ounces of water, made slightly acid, and one to two grains of sodium sulphite added. This is to be brushed over a well-washed silver print on *plain salted* paper. Palladous chloride can be readily made from the commercial palladic chloride by passing sulphur dioxide gas through it, or as sodium chloro-palladite by mixing palladic chloride, or more properly chloro-palladic acid, with sodium sulphite at the time of using. Palladic chloride is obtainable, price £7 4s. an ounce. A solution containing one grain of the chloride and sixty grains of sodium sulphite to ten ounces of water will tone silver prints, giving results very like those got with platinum. Seeing that palladium salts are many times more expensive than those of platinum, it is difficult to understand what special advantage this new method of toning possesses.

731. Phosphate Toning Bath—To MAKE.—Take

Chloride of gold	...	...	1 grain.
Phosphate of soda	...	...	20 ,,
Distilled water	...	...	10 ounces.

Gives warm purplish tones. May be used as soon as mixed, but will not keep.

732. Pink Tint in Toning P.O.P.—To AVOID.—The following appears to be the best way to avoid pink tones: In the first place, the paper itself must be kept quite dry before, during, and after toning. Damp in all these papers is a prolific source of many of the evils that amateurs suffer from in toning. A very useful preventive is to put a piece of cloth indiarubber behind the P.O.P. while in the printing frame. The indiarubber is very cheap, and can be got at most good-class dealers. Another, and usually the principal, cause of unpleasant pink tinges is allowing the gold to be used up in the bath, and then continuing to tone as if it was still rich in gold. This is a misplaced economy which brings its own punishment, for it will certainly spoil a greater number of prints than would suffice in value to replenish the gold. Still another cause of pink tinges is conducting toning operations in too strong a light. A good plan is to get a large piece of orange glass, which can be purchased for a few pence, and fasten it on to a few sticks of wood in the shape of a window glass. Then nailing a piece each side of one end, it will stand upright. The use of this simple device will allow all the toning operations to take place in an ordinary room, and the prints can be lifted for a moment to the full light to test the actual colour. This will be found a great advantage, as judging colour by candlelight is often very deceiving. Given ordinary care in the making of the bath, and following carefully all the instructions issued by the makers, there ought to be no trouble with the pink tones. With the ordinary pink, white, or mauve paper, and with various baths all tones can be obtained. Sulphocyanide of ammonium will give rich black, purple tones; a combined fixing and toning will give chestnut brown tones, while splendid rich colours can be obtained by first toning in platinum and finishing with the sulphocyanide bath. But borax and gold is one of the simplest, and perhaps, after all, is as good as anything, and in careful hands and used with judgment will produce a range of tones equal to almost anything. It may be worth mentioning that occasionally, just as the gold gives out, a rich brown tone can be got out of the cyanide bath, which is superior to anything got in any other way, but it is very uncertain.

733. Platinotypes—To TONE.—The following method of Mr. Fitz-Payne is entirely satisfactory. It needs under-printed prints.

A.

Uranium nitrate	...	...	10 grains.
Glacial acetic acid	...	...	1 dram.
Water to	...	...	5 ounces.

B.

Ferridcyanide of potassium		...	10 grains.
Glacial acetic acid	...	...	1 dram.
Water to	...	...	5 ounces.

For use mix equal parts of A and B. These solutions unmixed will keep indefinitely, but after mixing very soon deteriorate. Prints are developed and fixed in ordinary way, and, after they have been dried, should be inserted one by one in toning solution, and will then, if all the iron has been properly fixed out, tone to any colour, from a nice brown to a Bartolozzi red, according to the time they are left in the solution. In order to make safe of the absence of iron from the paper it is desirable when it is proposed to tone prints to give them an extra bath of double strength hydrochloric acid; the presence of iron is shown in the toning

bath by the presence of stains. The colour in the prints when obtained appears to be permanent, though this is not certain at present. If the paper is developed with addition of a small quantity of mercuric chloride and of sodium carbonate a long range of colour is possible from yellow to red. This also needs under-printed proofs. Also the following developer gives red tones, which, however, approach sepia rather :

Saturated solution oxalate of potassium ... 12·0
Saturated solution of chloride of copper ... 12
Oxalic acid ... ... 1·5

It is employed as the ordinary developer. To obtain a warm sepia red, take a slightly under-printed proof on sepia paper, and intensify it with silver, thus :

Glacial acetic acid ... ... 10 minims.
Water ... ... 1 ounce.

Soak the print for about a minute in this. Then add to it

Silver nitrate solution (sixty grains in one ounce) ... ... 1 to 4 minims.
Dry pyro ... ... 1 grain.

and again pour over the print. If intensification will not start, add very cautiously more dry pyro. When dark enough, wash well for a few minutes. Then put it in the uranium bath, as above, and when toned—the action is rapid—wash for a few minutes, preferably using the squeegee to help. The result is a very good warm sepia red. An improvement on the above method is to intensify with silver, until much too dark, then continue as above; but finally remove all the silver with a hypo bath, to which a few drops of potassium ferricyanide have been added. A minute is ample time for this and a moderate squeegee wash after will suffice, as there is no silver left to fade.

734. Platinum and Gold Toning Bath — To Make. — For the platinum bath (neutralise if acid with whiting) :

Dissolve in fifteen ounces of water

Sodic acetate ... ... 120 grains.
Sodic phosphate ... ... 60 ,,

When dissolved add

Platinum chloride... ... ... 2 grains.
Gold chloride ... ... 2 ,,

Shake well and make up to twenty ounces with water. This combination gives very good results.

735. Platinum Toning Bath — To Make. —It is necessary to use other than albumenised paper, as with that the results are not so satisfactory, and the toning takes place very slowly. If, however, it is wished to try albumenised paper, after washing the prints free from silver, as usual, give a preliminary bath of acetic acid—one dram to six ounces of water. Ordinary matt surface prints only require washing in one or two waters, and then apply the following toning solution with a brush :

Stock Solution P.

Chloroplatinite of potassium 60 grains : 1 grain.
Water ... ... 2 ounces : 16 minims.

To tone, take sixteen minims, and make up with water to half an ounce, and then add one drop of nitric acid, stir up, and tone. To tone gelatine papers (aristotype, alpha, etc.), instead of using nitric acid, use

Stock Solution D.

Oxalate of potash ... ... 8 ounces.
Water ... ... 50 ,,

For use, take of P 1 part, D 3 parts, water 2 parts. After toning with the acid solution, wash in a bath containing a little carbonate of soda before proceeding to fix. The bichloride is too energetic, and reduces the silver in greater proportions than the platinum is deposited, hence its bleaching action. The proper thing, according to Lyonel Clark, is the chloro-platinite of potassium 1 part in 250 of water acidified with nitric acid sufficient to turn litmus paper sharply red. After freeing the prints from free nitrate of silver, by washing, while still wet, apply the toning solution by means of a brush, or by laying the prints face down on a levelled slab, on which a small portion is spread. The solution should be made only when required for use, as it deteriorates by keeping. Another formula is—

Stock Solution A.

Chloro-platinite-potassium ... 60 grains.
Water to ... ... 2 ounces.

Bath for Black Tones.

Stock solution A ... ... 1 dram.
Water up to ... ... 2 ounces.
Nitric acid ... ... 1 to 2 drops.

Bath for Warm Tones.

A ... ... 1 dram.
Water ... ... 8 ounces.
Nitric acid ... ... 1 to 2 drops.

These baths, when made up, do not keep. They give good black tones with albumenised, or, better still, matt surface paper.

736. Purple Tones — To Obtain on Chloride Plates. — Toning with the following baths will yield by No. 1 a purple blue, and by No. 2 a purple black.

No. 1.

1.—Uranic nitrate... ... ... 1 part.
Water ... ... 100 ,,

Filter in case the solution is not clear; this is generally unnecessary.

2.—Ferricyanide potassium ... ... 1 part.
Water ... ... 100 ,,
3.—Ferric chloride ... ... 1 part.
Water ... ...5 to 8 ,,

Take equal parts of Nos. 1 and 2, and tone until it is a very dark colour and very dense. Rinse for three or four minutes, and then plunge into 3. Allow it to remain for five minutes, after which wash and dry.

No. 2.

Chloride of gold ... ... 15 grains.
Acetate of soda ... ... 180 ,,
Lime water ... ... 15 ounces.

It keeps fairly well.

737. Rhodanate of Ammonia Toning Bath — To Make. — The following combined tone fixing bath is recommended by Dr. G. Kreb for use with his palladium printing-out paper, and may work satisfactorily. On gelatino-bromide and chloride papers the formula contains borax as boric acid : Warm water 30 ounces, hypo 7 ounces, rhodanate of ammonia 6½ ounces, boric acid 1 ounce, nitrate of lead ½ ounce, chloride of gold (one per cent. solution) 2 ounces.

738. Salt Bath — To Use for Toning. — The employment of salt or of a soda bath before toning albumenised paper prints has a specific object in view in each case. As the object of these baths is not very generally recognised among photographers, the subject shall be treated somewhat fully. Primarily, the salt bath is used when warm brown tones are desired, although it fulfils other functions. There are two ways of obtaining a brown tone in an albumenised paper print, one of which has much greater claims to permanency than the other. The usual method is make use of an ordinary bath, and to stop the toning process earlier than would be the case if a purple tone were going to be produced. By operating in this way the substitution of the silver by gold is not so great as when a purple tone is attained, and the brown tone produced is most probably the result of the deposition of the blue form of gold upon the red-coloured silver albumenate. The probability

of permanence is, therefore, not so great. The better way is to take advantage of the fact, pointed out long ago by Faraday, that if the deposition of the gold is made to take place very slowly, then the colour of the deposited metal is not blue, but red, the particular colour depending upon the rapidity of the deposition. This method, therefore, permits a larger amount of gold to be deposited without over-toning the print. The toning action of the gold is restrained by the use of a bath of common salt prior to toning, and further by increasing the quantity of borax in the toning bath. For ordinary work, where the toning action does not require to be unduly prolonged, employ a solution of half an ounce of salt in a pint of water. The strength of this solution may be increased if the photographer is prepared to spend a longer time over the toning. The prints should be kept in the salt bath for five or ten minutes. Besides affecting the tone of the print, the salt bath ensures the removal of the last traces of silver nitrate from the paper by converting it into silver chloride. In fact, it was recommended some years ago by Professor W. K. Burton to add two per cent. of salt to the toning bath, by which treatment it was claimed that the prints required no washing previous to toning. It must be mentioned with regard to the use of a salt bath after toning that care should be taken not to have it too strong, since, as Abney has shown, the action of considerable excess of salt on silver albumenate is to convert a little of it into silver chloride, which would be removed on the print being fixed, and, accordingly, would cause a reduction in density. It appears, therefore, that the employment of salt bath gives greater permanency, lengthens toning, and gives brown tones. A bath of sodium carbonate is useful for two purposes: It neutralises and renders harmless the free organic acid with which all ready sensitised papers are prepared. It also tends to produce a purple tone. The bath is generally made up by guess, but a good strength is one part of washing soda in forty parts of water. Some writers have complained that the use of this bath softens the albumen and sizing of the paper, and makes the prints more liable to blister. The prints should receive a few washings in water between the carbonate of soda bath and the toning solution. The rapidity or otherwise of toning is not affected by it to any appreciable extent, and the chief use of the bath lies in the assistance it renders in obtaining purple tones.

739. Sel d'Or Toning Bath—To Make.—Take

Chloride of gold	1 grain.
Hyposulphite of soda	4 ,,
Hydrochloric acid	4 drops.
Water	10 ounces.

Dissolve the gold in half the water and add to the hypo dissolved in the remainder of the water, stirring constantly, and then add the acid. Burton strongly recommends this bath.

740. Sepia Tones—To Obtain.—Sepia tones may be obtained on plain salted paper by using an ordinary gold bath of one half the usual strength; for this purpose the prints should not be printed too darkly. For sepia tones on bromide paper the prints are developed as usual with ferrous oxalate and washed, then immersed in the following:

Ferrocyanide of potassium ...	9 grains.
Uranium nitrate	8 ,,
Glacial acetic acid	5 drams.
Water	16 ounces.

Success depends chiefly upon thoroughly washing all iron and hypo from the prints before toning.

741. Slow Toning—To Avoid.—There are many things which tend to cause this, such as—(1.) Too weak toning solution, perhaps having been used too often, when the gold needs replenishing. (2.) The particular paper used being a slow toner, as some of the papers now on the market are very slow toners. (3.) The toning solution used not being one to suit the paper, so that it is best to try many formulæ with the paper until a suitab e one is found. (4.) Any acidity in the paper would ensure slow toning; it should be washed previous to toning, until the litmus paper (blue) does not turn red when dipped in the water. The following are some causes and remedies of slow toning: (1.) Acid toning bath; add enough sodium carbonate to make alkaline. (2.) Insufficient amount of gold chloride. (3.) Cold bath; use at about blood heat. (4.) Insufficient washing before toning. (5.) Acid present in the silver sensitising solution; add a few drops of ammonia to first washing before toning. (6.) Bad gold solution; get some new, not cheap, but Johnston and Matthey's. (7.) Old paper; get the best brand and stick to it. On slow toning, Burton says: "Preserved paper is much more difficult to tone than that prepared on a neutral bath, and, moreover, double albumenised paper takes longer to tone than single." In a weak bath it may be found *impossible* to tone some brands of double albumenised-sensitised paper. If paper prepared at home refuses to tone, the sensitising bath should be looked to. If this be acid, or be much loaded with organic matter, there is certain to be a difficulty in getting a good tone. If a toning solution used time after time, such as the acetate, refuse to tone, it may be suspected at once that the gold has been thrown down. The bottle should be examined for any black powdery doposit, which is really gold. A bath which is to be used repeatedly should be frequently filtered, as the presence of any organic matter in it is likely to throw down the gold, and when once it is thrown down the bath may be at once rejected. If tone—though it is all that could be desired in the toning bath—vanishes when the prints reach the fixing bath, one cause undoubtedly is insufficient washing before toning. Another is acidity of the fixing bath. Too strong a fixing bath may be another cause of falling off, especially with certain brands of paper,

742. "Solio" Paper—To Obtain Black Tones on.—Warm black tones may be obtained on white solio paper by using the following bath (Welford's):

Chloride of gold	4 grains.
Sodium bicarbonate	1½ drams.
Water	6 ounces.

Print rather deeply, wash fairly well to remove the excess of silver salt, and tone in above bath for, say, three minutes, wash, fix in fresh hypo bath for fifteen minutes, and wash well. This bath must be made up as required. The Eastman Company also give a toning bath for the production of black tones, which is as follows. First tone the prints in the following stock solution:

Acetate Bath.

Sodium acetate	150 grains.
Gold chloride	5 ,,
Water	40 ounces.

till they assume a chestnut brown, then transfer to the combined toning and fixing bath, and tone to the desired colour. Another way is to tone them in the Ilford bath, and by continuing the toning longer than usual, or over-toning them, a beautiful black shade, something like a platinotype, is obtained; in fact, prints toned in this manner that had been squeegeed on to ground glass have been mistaken for platinotypes, so closely did they resemble them.

743. Strength of Toning Bath—To Ascertain.—The method for estimating gold in the exceedingly small quantity in which it occurs, even in an unused toning bath, would be impossible except for someone with a good knowledge and plenty of experience of quantitative chemical analysis. It would also require a very delicate balance, which would cost at least £13 complete. The method would be to precipitate the gold from a measured quantity of bath by means of ferrous sulphate, the liquid would be filtered through a filter paper containing a known weight of ash to catch the gold, it would then be washed several times with clean distilled water to free from soluble salts. Filter paper containing gold would be dried, and then ignited in a weighed crucible, with free access of air to burn the paper completely, and allowed to cool. When cold the crucible would be again weighed, and from this weight would be subtracted the weight of crucible + weight of filter paper ash. The remainder will be the weight of gold in the quantity of solution taken. Now to get a quantity of gold that could be weighed so as to obtain anything like accurate results, at least a gallon of solution would have to be taken, so that it will be seen at once that the method is impracticable. A rough method would be to add to two ounces of the bath half an ounce of saturated solution ferrous sulphate, and notice the amount of dark purple precipitate formed. A similar experiment with a solution containing a known quantity of gold will give some idea as to the approximate amount contained. Or, take forty ounces of the solution, and add one ounce of a saturated solution of iron protosulphate, keep in a bright light for a day, or until the precipitate has quite settled; decant very carefully, and filter the remainder through the very best Swedish paper. Pour a few ounces of water afterwards into the filter paper and allow it to pass through, so as to wash both paper and precipitated gold; burn in a platina crucible, and treat when cold with nitric acid to remove any trace of iron or silver. Wash again and dry; carefully weigh, and the quantitative analysis is complete.

744. Sulphocyanide Bath, Deposit in—To Prevent.—The gold is sometimes precipitated in the form of sulphocyanate. There should be an excess of sulphocyanide in the bath, which will precipitate if over strong in gold. If this occurs, add some more sulphocyanide, and dilute the bath with water to nearly one-half its present strength. If this does not cure it, give it up, as the gold in toning bath is not worth recovering in small quantities. A yellow deposit of sulphur sometimes occurs in this bath from insufficient washing between the clearing solution and the combined toning and fixing bath.

745. Sulphocyanide Toning Bath—To Make.—For print out papers, which are now sold under a great variety of names ("Solio," "Nikko," etc.), no baths give such really beautiful results as the sulphocyanide. The following is a simple formula:

Chloride of gold	1	grain.
Sulphocyanide of potassium ...	12	,,
Hyposulphite of soda	½	,,
Water	4	ounces.

The prints should be rather deeply printed and soaked in a solution of alum (one in ten) for five minutes, then given a dip into a bath of carbonate of soda, and then toned face downwards; afterwards dipped in carbonate of soda and fixed in fresh hypo. The prints should *not* be washed much before toning. Another:

Water	16	ounces.
Sulphocyanide of ammonium ...	30	grains.
Chloride of gold	2	,,

The prints tone in this bath in about six minutes, and dry somewhat darker and much colder than they appear whilst wet. Another:

Stock Solution A.

Sodium acetate	600	grains.
Water	20	ounces.
Gold chloride	15	grains.

Stock Solution B.

Ammonium sulphocyanide ...	50	grains.
Water	20	ounces.

For use, take two parts of A, two parts of B, and four parts of water. The toning may be stopped by a bath of salt and water (see No. 715).

746. Sulphur Toning Bath—To Make.—Sulphur was the method which was used first for toning. It is not satisfactory. Even though the tints are extremely pleasant, they are very liable to fade, and cause the production of the well-known yellow print. Sulphur toning can be effected by simply placing the silver print in the fixing bath of hyposulphite of soda which has been rendered acid. The sulphur is precipitated by the action of the acid, and gives the prints a light chestnut brown colour; if a little gold is added to the hypo bath a dark chestnut tone is obtained. An ordinary strong solution of hyposulphite of sodium should be used.

747. Toning Baths — To Compare in Qualities.—(1.) Borax does not keep well. Gives excellent tones, and is very easy to work. (2.) Tungstate keeps well, although it turns red. A favourite bath. Purple warm tones. (3.) Acetate keeps well. Should not be used till twenty-four hours after making. Gives rich warm tones. (4.) Phosphate keeps fairly well. Gives rich purple tones. Can be used immediately after preparation. (5.) Bicarbonate does not keep. Gives good warm tones. (6.) Chloride of lime keeps fairly well. Gives best results after keeping twenty-four hours. Black and rich dark-purple tones. The above applies when no free silver nitrate gets into the bath through insufficient washing. All toning solutions should be kept in the dark. Of course, all toning solutions have their peculiar advantages and disadvantages, but the following estimates by one who has had some experience with all those mentioned, though briefly worded, will give an idea of their peculiarities. The acetate bath is much used, and is highly recommended. It keeps well if excluded from the light, and gives rich brown and brown-black tones. It should be stored in a stone jar in order to keep out the light, which decomposes it very rapidly, and should be made at least a day before using. The acetate bicarbonate bath is also highly recommended, as it gives fine purple black tones with most papers. It keeps well, if excluded from the light, and should be well corked, and made at least fourteen hours before use. The bicarbonate bath gives from brown to black tones, in accordance with the length of time it is in toning. It is ready for use as soon as made, but its great drawback is that it will not keep more than twenty-four hours, as it rapidly decomposes. The borax bath gives brown and rich bluish black. It can be used a few hours after mixing, but its keeping properties are very bad. The tungstate bath is the one to be most recommended; a great variety of tones can be obtained, and its keeping qualities are good on the whole. It may be used several times, adding a few drops of gold solution when it becomes inactive. It was used and recommended by many experts, including Durand, with whom it was a favourite, as also it is among many American photographers. All the other solutions except this one

should not be used more than once, as the albumen gets dissolved from the surface of the paper, and decomposes the gold when it is exposed to the air and light, when it is deposited in the form of dark flakes, which are insoluble, and, therefore, of no use for toning. Another writer draws the following conclusion: (1.) That with care and practice good results may be obtained from any of these solutions. (2.) That for occasional use it is better to make up just enough toning bath to tone the prints on hand (reckoning one grain gold chloride for each sheet of paper), and when used to throw it away. With the greatest care, small quantities of organic matter and silver chloride will find their way in, and these lead to the precipitation of the gold and cause loss. (3.) If it is preferred to keep it, take care to wash thoroughly the prints before toning, and keep toning dish, etc., scrupulously clean, and keep the toning solution in the dark except when in use. (4.) That to get good purple or sepia tones *good negatives* are essential.

748. Tungstate of Soda Toning Bath—To Make.—The following is Dr. Liesegang's tungstate of soda toning bath:

Boiling water	35 ounces.
Tungstate of soda	5 drams.
Chloride of gold	15 grains.

Dissolve the tungstate in the hot water, then add the gold. The bath is ready for use as soon as cool. The following is another well proved formula for this bath, which keeps fairly well, and gives very fine purplish brown tones:

Chloride of gold	15 grains.
Tungstate of soda	300 ,,
Distilled water at 212° F.	15 ounces.

When cooled it is ready for use. One part of above should be mixed with seven parts of water at 90° F., and used at that temperature. After using, the dilute bath may be filtered and used next time instead of water to dilute the stock solution. Finer tones are thus obtained, and the bath is more economical. The following is another formula:

A.

Water	100 parts.
Chloride of gold	1 ,,

B.

Water	100 parts.
Borax	10 ,,
Tungstate of soda	40 ,,

B will keep for some time. A is mixed as required, and added to an equal part of B for use. Another (by Mr. Tylar): The following formula will be found reliable if due care be taken to use pure chemicals and accurately-weighed quantities:

Tungstate of soda	60 grains.
Sulphocyanide of ammonium ...	100 ,,
Hypo	960 ,,

To be dissolved in six ounces of distilled water.

When *quite* dissolved, add (and this must always be *last*) chloride of gold six grains, or six drams of solution of one grain to one dram. Shake up well, and make up with distilled water to eight ounces. This quantity will tone four sheets, though more can be toned, but it is not advisable. The bath must, before toning, be always tested for alkalinity, and, if acid, ammonia should be added drop by drop until the requisite result is obtained. The prints will not require any washing, and although when first immersed they assume a dirty yellow colour, this is succeeded by the hues so much desired. The great advantage of the above bath is that there is no going back in the fixing, as the one bath both tones and fixes. The following is a formula given by Mr. C. Durand as long ago as 1873, but it will be difficult to improve on even now as a good, simple toning bath:

Tungstate of soda	20 grains.
Chloride of gold	1 ,,
Boiling water	8 ounces.

Use it as soon as it has cooled, and after the first batch of prints are toned pour it into a bottle and keep it as a stock solution, and it can always be used without being again warmed, merely adding sufficient gold for the day's toning a few minutes before required for use, and with each grain of gold a grain or two of tungstate of soda. This bath will become purple in colour, but that does not signify; and it can (by following the above method) be used over and over again indefinitely, and will answer well for ordinary or ready-sensitised paper.

749. Uranium Toning Bath—To Make.—The salt of uranium used for toning is the nitrate, $UO_2(NO_3)_2 + 6H_2O$. For toning silver prints, uranium is generally used in conjunction with gold. The following bath is recommended (1):

Uranium nitrate	1 grain.
Gold chloride	1 ,,
Sodium bicarb.	20 ,,
Distilled water	10 ounces.

This must be used as soon as mixed, and should be distinctly alkaline. It gives purplish black tones. To obtain the best results, the free silver should be eliminated with a solution of common salt. After toning, the prints should again be placed into the salt bath. Other formulæ are (2):

Uranium nitrate	4 grains.
Gold chloride	4 ,,
Chloride sodium	60 ,,
Acetate sodium	60 ,,
Water (preferably distilled) ...	32 ounces.

Dr. E. L. Wilson's formula. Neutralise with soda bicarbonate. Dissolve in fifteen ounces of distilled water (3):

Sodic acetate	60 grains.
Sodic bicarbonate	10 ,,
Sodic chloride	30 ,,

When dissolved add

Uranium nitrate	5 grains.
Gold chloride	4 ,,

Shake well, and make up to twenty ounces with water, and if acid neutralise with chalk. This bath is a favourite in America, and gives rich velvety black tones like an engraving. There are other formulæ in which the same reagents occur in varying proportions, but the above work quite satisfactorily. The following formula is recommended by Schölzig for use with his paper:

For Black Tones.

Borax	1½ drams.
Uranium nitrate	4 grains.
Chloride of gold	3 ,,
Water	24 ounces.

Each sheet of highly albumenised paper must be calculated to take at least two grains of gold. Mix either bath twenty-four hours before it is used, and use at a temperature of from 60° to 70° F. The above bath will suit most of the papers in the market. Another uranium toning bath is made as follows:

A.

Potassium ferricyanide	100 grains.
Water	24 ounces.

B.

Uranium nitrate	100 grains.
Water	24 ounces.

These solutions keep separately, but must be mixed only for immediate use. Take equal parts of A and B, and immerse the image therein until the desired tone is attained. Then wash very thoroughly, and immerse for five minutes in a fresh fixing bath, and finally wash thoroughly. This process intensifies the prints, so that light prints produce the best results. The above formula gives

warm red tones Rich brown sare best obtained by leaving the print in the toning solution until it begins to turn, and then at once immersing it in a weak solution of alum ; then wash and fix as before. The chief feature of these modes of toning is the black tones that can be obtained.

750. Uranium Toning—To Secure Clear Whites. In order to ensure clear whites when toning bromides with uranium, attention must be paid as much to several preliminary operations as to the formula employed. In the first place, the portions of the print which are to remain white in the final result should be quite free from fog The newer developers, such as amidol, metol, etc., are liable to give a trace of fog where no light has acted, particularly with some brands of paper. For this reason, therefore, it is preferable to develop those prints intended for uranium toning with ferrous oxalate, which does not reduce silver bromide which has not been exposed to light. Care must be taken to perfectly fix and work the print, and it is then ready for the toning process. The acetic acid employed is the strongest obtainable commercially. On removal from this bath the whites are yellow, but this stain is quite removed by placing the print in running water for about six or seven minutes. Longer application causes a gradual reduction of tone. In the case of prints already made which have stained whites, a bath may be tried of very dilute hydrochloric acid, or the print might be mounted in a drab or old gold cut-out mount, which destroys by contrast the effect of the stained whites. It has also been recommended to give the prints a bath of from one per cent. to two per cent. sulphuric acid previous to uranium toning, well washing, and then after toning and again washing placing in an alum bath acidulated with sulphuric acid. In this bath prints take a rich tone, ranging from purple to brown, and if the whites were previously stained they become clear. Redder tones, inclining to burnt sienna, were stated to be obtained if a bath of hypo were employed before the alum bath, the prints being well washed between the two. If the whites will not clear by well washing in plain water the prints are probably either insufficiently fixed, washed for too long a time after fixing, or not washed enough to remove all hypo. Always use *two* fixing baths, the second one being fresh and previously unused; wash thoroughly, but not too long. By going to work properly, all the hypo can be removed in twenty minutes. *Pure* whites are not very desirable in a uranium toned print, though, of course, the yellow tint must not be allowed to remain. It can always be removed by washing if there is no hypo about, but this often takes time, as the print must not be put under the tap, but simply soaked in a rocking dish with frequent changes of water. A bath containing about two grains of ammonium sulphocyanide to the ounce will immediately remove the yellow stain, and, at the same time, improve the colour. Very little subsequent washing is necessary to remove the sulphocyanide, which is strongly recommended. The yellow stain seems to be much more readily soluble when the toning bath contains a few drops of acetic acid, but this addition will not prevent its appearance. A small quantity of the sulphocyanide, say about half a grain, added to the toning bath, will to a certain extent prevent it, and also produce a warmer tone, but too much in proportion to the other ingredients will cause a red precipitate while the print is in the bath, which, when the latter is removed, will be immediately dissolved. The following hints may be of use: If the bath stops working and becomes colourless, add uranium, but if it will not work, though still of a yellow colour, add ferricyanide. The mixture of uranium and ferricyanide alone ought to be yellow, but if green, add a very minute quantity of the sulphocyanide, just sufficient to bring it to its proper tint upon stirring or shaking; a much less quantity than half-a-grain will accomplish this. Always filter the bath before use. Soak the print before toning if previously dry, and wipe off superfluous moisture with a damp pad of cotton wool before applying the bath. Rock the dish while toning, and if result is unsatisfactory, wash well with dilute ammonia, followed by plain water and a bath of very dilute acetic acid, and restart toning.

751. Varying Tones in Prints—To Obtain.—Ilford P.O.P. printed deeply, washed well and toned in the bath they recommend will give blue tints in the high lights, and red or reddish brown in the half-tones or shadows, provided care is taken to keep the bath strong enough in gold, and to remove the prints time enough, that is, before the shadows have toned properly. The redder these are when examined by transmitted light the better for the purpose. By adopting the plan of adding some bicarbonate of soda to the first washing, and also some to the solution of gold before adding to the bath, this is prevented, and good purple blacks are obtained with pretty quick toning, and every print alike. The secret, however, is not in the paper, any sample of gelatino-chloride will do—and solio lends itself as readily to the process as P.O.P. All that is necessary is to print the paper until it is just a trifle overdone, and then to tone rapidly in a slightly warm sulphocyanide bath. The solution attacks the high lights, and changes them into a sort of blue before the denser portion of the print gets beyond the red stage. As these tones are not generally admired, the above advice shows equally how to avoid them.

752. "Zenotype" Toning Bath—To Use.—Zenotype is a method of toning by development all makes of gelatino-chloride papers, print-out lantern slides, and transparencies. It is the property of Mr. E. J. Browne, who, for upwards of twenty years, was chief operator, printer, and retoucher to Messrs. Brown, Barnes, and Bell, photographers. It has been in use—privately—for some years, but has only recently been put on the market. Each bottle is capable of developing up, and toning, some two hundred half-plate prints. To use zenotype: Take one dram of the solution, add six ounces of water to it, and it is ready. That is the toning bath, and needs no addition to it. To use the bath print gelatino-chloride to half the usual depth or two-thirds the depth, or for rich tones print fully out, but do not *overprint* as for gold toning. Immerse in the toning bath *dry*, do not wash previous to toning. Rock the bath gently. As soon as the print begins to change colour—which it does in about a minute, the shadows being first acted upon—a second print may be immersed. When that begins to change put in a third, and so on until half-a-dozen or a dozen are toned at once in the bath. Take them out when they have *passed* the colour which is desired. From the toning bath the prints go *direct* into the hypo, which should not exceed two ounces to the pint. In this bath they *apparently* fade, but the colour gradually returns. They are taken out of this bath at any time when the desired tone is reached, always allowing for the print to dry slightly darker with *more* detail showing. Most beautiful tones can be got in the hypo bath. Should a further range of tones be wished for, colder tones ranging down to a black with heavy green shadows, a bath of twenty ounces water and about twenty to thirty drops of nitric acid, can be used after the fixing bath. The tones are practically unlimited, and the whites are pure. In fact, they seem *whiter*

than the paper is before printing. To those who think of trying the process, which for cheapness, splendid results, and ease of working is unsurpassed, the following advice may be given: (1.) Clean hands and dishes. (2.) Do not exceed one dram of zenotype to six ounces of water (soft water). (3.) Print from half to full out, but *don't over-print* —remember that the bath develops as well as tones. (4.) Develop and tone until the whites are discoloured. (5.) Put straight into hypo. (6.) Remember the hypo bath is to be used on paper, and should not exceed two ounces of hypo to twenty ounces of water. (7.) Fixation is complete after about two minutes, but prints can be left in for fifteen minutes without danger. (8.) Wash after fixing for about half-an-hour. (9.) It does not hurt the fixing bath if a little alum is added. Alum gives a pinkish tone to the flesh of portraits. (10.) Clean hands, clean dishes, clean hands, clean dishes, ditto, ditto, ditto.

CHAPTER XIX.

VARNISHES AND CEMENTS.

753. Amber Varnish—To Make.—Amber resin, from which the varnish is made, can be bought from 2s. 6d. per pound from any wholesale dealer in chemicals. The following is a simple, though excellent, formula for amber varnish:

Amber	3 ounces.
Oil of turpentine	20 ,,
Oil of linseed	10 ,,

The only solvent to make it useful for photographic purposes is methylated chloroform. The amber must be picked, and the pieces that are quite clear only used. The "cloudy" will not do. There is no difficulty in obtaining it, for all large drysalters and wholesale chemists keep it, and it can also be obtained from any tobacconist who does his own pipe repairs. Old broken amber pipe mouthpieces will do if just cleaned with soda and water, and then methylated spirit. The formula is—Chloroform 10 ounces, amber 1½ ounces. Pound the amber up, and then add the chloroform (it readily dissolves), filter, and apply cold. It is capital for transparencies. The best varnish extant is made by dissolving amber in its various solvents, such as turpentine, chloroform, etc. This dries beautifully transparent and glossy. To prepare it proceed as follows: Obtain splinters of the cheapest amber (such as you can get from a cigar mouthpiece manufactory), and place in an iron retort. Connect this with a wide metal condenser, and heat till the contents just begin to fuse. Now heat very gently, and when the whole is thoroughly liquid keep the temperature constant until all signs of ebullition and bubbling have disappeared. It is essential to keep the temperature low, as upon this depends the success of later operations. If everything is right the limpid fluid is run into iron moulds, where it solidifies on cooling to a jet black lustrous mass. As copious fumes of succinic acid and ethereal oils are formed during the operation it is advisable to condense these in a flask placed at the end of the condenser. The varnish is made by dissolving the black mass in turpentine. If a thick jet black varnish is required a saturated solution is simply made by adding the black amber to warm turpentine until no more will dissolve. If too thick and dark, thin with more turpentine. A magnificent polish is made by dissolving the fused amber in prepared linseed oil varnish, and then diluting with turpentine. (2.) If the varnish is wanted for photographic use, nothing is better than that used by the early photographers—Crushed yellow amber 1 part, chloroform 8 parts. Dissolve without heating; shake; let stand for twenty-four hours, decant and filter; use cold. This dries very rapidly, and is so durable and transparent that it can hardly be distinguished from glass. (3.) Another good formula is the following: Copaiva balsam 1 ounce, and absolute alcohol 32 ounces (by weight). When dissolved add eight ounces powdered amber mixed with quartz (sand) *quant. suf.* Heat on water bath till dissolved, then pour off from sand and mix with small quantity of oil of turpentine which has been filtered through charcoal.

754 Aquarium Cement—To Make.—This is a waterproof cement that will stand the long-continued action of water, and is used at the Zoological Society's Aquarium. It might probably be useful to photographers in the construction of lantern tanks, large developing trays, etc.

Finely powdered litharge ...	Of each 3 parts.
Fine white dry sand... ...	
Plaster of Paris	
Powdered resin	1 ,,

Mix thoroughly and make into a paste with linseed oil, to which a drier has been added. Beat well and let stand four hours before using. It spoils after about twelve or fifteen hours. Glass thoroughly united with this cement will part in its substance rather than at the joining.

755. Aristotype Paper, Varnish for—To Make.—A varnish for backing aristotype paper may be made as follows:

White shellac (broken small) ...	20 ounces.
Absolute alcohol	40 ,,

Let it stand for three or four days, then add the following solution:

Powdered borax	4 drams.
Curd soap	4 ,,
Warm water	2 ounces.

Mix all well in a tall bottle, and set aside to settle. Pour off when clear, and save the rest by squeezing the varnish out of the residue through a linen bag.

756. Black Varnish—To Make.

No. 1.

Benzene	1,000 parts.
Indiarubber	6 ,,
Asphalt	300 ,,
Lampblack	*quant. suf.*

No. 2.

Another: Black sealing wax varnish—

Shellac	1 ounce.
Black sealing wax	3 ,,
Spirits of wine	10 ,,

757.—Bright Varnish—To Secure.—The proper proportion of gum dammar to benzole is about twenty-five grains of the former to one liquid ounce of the latter. Any failure to obtain a bright varnish is no doubt due to using impure materials. The benzene used must be the pure substance (specific gravity ·878 at 20° C.), having a boiling point of 80° C. not benzoline. The gum dammar should be white or pale yellow, and should exhibit a bright fracture when broken. The melting point of the unadulterated substance is 150° C. With pure materials the gum dissolves readily in the benzene

to a bright solution, and requires no filtration whatever. For negative purposes the film of gum is not sufficiently hard to stand the wear and tear of much printing, but for lantern slides and other transparencies it is all that could be desired, inasmuch as it can be applied cold, and is perfectly colourless. For retouching purposes the varnish is mixed with a small proportion of oil of lavender, the particular formula recommended by Dr. Eder being as follows: Gum dammar 10 parts, benzene and rectified turpentine each 75 parts, oil of lavender about 2½ parts.

758. Brown Transparent Varnish—To MAKE.—Ordinary asphaltum, as sold for microscopic work, will, if used in small quantity, give a warm transparent brown colour to varnish. If the tone is not red enough add a little dragon's blood. However, to be more precise, here are a few formulæ:

No. 1.—Dark Varnish.

Pound up and digest shellac	16 parts.
Gum sandarac	32 ,,
Gum mastic	8 ,,
Gum elemi	8 ,,
Dragon's blood	4 ,,
Annatto	1 ,,
Turpentine	16 ,,
Alcohol	256 ,,

Thin, if necessary, with alcohol.

No. 2.—Brown Hard Spirit Varnish.

Sandarac	4 ounces.
Pale seed lac	2 ,,
Elemi	1 ,,
Alcohol	1 quart.

Digest with agitation till dissolved, and then add Venice turpentine two ounces.

No 3.—Another Brown Varnish.

Gum sandarac	3 pounds.
Shellac	2 ,,
Rectified spirit (65° O.P.)	2 gallons.
Dissolve, and add turpentine varnish	1 quart.

If the colour is not dark enough add dragon's blood and benzoin.

No. 4.

Digest

Shellac	12 parts.
White turpentine	5 ,,
Gum sandarac	2 ,,
Spirits of turpentine	4 ,,
Alcohol	96 ,,

Colour with asphaltum or lampblack.

759. Cold Negative Varnish—To MAKE.

No. 1.

Orange shellac	1½ ounces.
Mastic	¼ ,,
Sandarac	1¼ ,,
Oil of turpentine	¼ ,,
Venice turpentine	¼ ,,
Camphor	10 grains.
Methylated spirits (66 overproof)	20 ounces.

No. 2.

Orange shellac	2 ounces.
Sandarac	2 ,,
Canada balsam	60 grains.
Oil of lavender	1 ounce.
Methylated spirit	16 ,,

Ashman's:

Commercial "japanner's gold size"	1 part.
Refined benzene	1 ,,

The plate should be thoroughly dry, not warm; drain off the excess of varnish, and allow the plate to dry during the night. If benzoline or turpentine is used instead of refined benzene, the result is less satisfactory, and a longer time is required for drying. In warm, dry weather it will dry in half-an-hour.

Another:

Gum mastic	4 ounces.
Refined benzene	3 ,,

Dilute as before.

Another: Take one ounce of Canada balsam, and bake in *cool* oven till brittle, when cold dissolve this in three ounces of benzene, in which sixty grains of gum mastic have been previously dissolved. Cold are quite as satisfactory as hot, but generally take longer to dry. The simplest "cold" varnish is gum dammar 90 grains, and benzole 1 ounce. This dries in a few minutes, but takes a day to harden perfectly, unless the negative is kept hot for a short time *after* varnishing. A modification of the above is made of sandarac 40 grains, dammar 50 grains, and benzole 1 ounce; this is a fairly hard, durable varnish, and gives a good retouching surface. A capital "shellac" cold varnish is: Shellac 1½ ounces, methylated spirit 20 ounces; when dissolved, add gradually ·880 ammonia, a precipitate is formed, keep adding the ammonia until this is redissolved - only *just*, mind—filter, and it forms the hardest cold varnish known, except zapon varnish, which is a new introduction, and is *most highly* spoken of. According to E. Vogel, zapon varnish is composed of three parts collodion cotton to one hundred parts amyl acetate. It has a greater power of resistance against moisture and mechanical damages than all other negative varnishes, and is applied in the cold state.

760. Collodion Lantern Plates, Varnish for—To MAKE.—A good one may be made by dissolving gum dammar twenty grains in pure benzole one ounce; or use the following:

Light amber shellac	2 ounces.
Sandarac	2 ,,
Canada balsam	½ dram.
Alcohol	12 ounces.

Dissolve and filter for use. Or keep a stock bottle of fine white shellac and methylated spirits; decant as required for use, and dilute by adding more spirit until proper thickness is obtained. The two following varnishes are deemed "satisfactory" by Abney:

Seed lac	120 grammes	: 1 ounce.
Methylated spirit	1 litre	: 8¼ fluid ounces.

The lac is allowed to remain in contact with the spirit for two or three days, with occasional shaking, after which the supernatant liquid is decanted off and thinned down to proper fluidity. The other formula is—

Unbleached lac	65 grammes	: 1,001 grains.
Sandarac	65 ,,	: 1,001 ,,
Canada balsam	4 ,,	: 61⅝ ,,
Oil of thyme or lac acetic	32 c.c.	: 544 minims.
Alcohol ·830	500 c.c.	: 17 oz. 4dr. 48m.

Any difficulty probably arises from not warming the plate enough. It should be only just bearable to the back of the hand, otherwise the alcohol evaporates and leaves the water, which causes the resin to separate in minute particles.

761. Collodion Varnish—To MAKE.—A very high temperature soluble cotton is wanted for this purpose, for a tough horny film is required, and the only commercial sample of cotton that succeeds well is Anthony's soluble No. 1. Failing to obtain this, it can be made as follows: Place 240 grains of clean corded cotton in a warm oven to remove all traces of usual moisture (for, if any is present, the high temperature of the acids will allow them to act upon the cotton and dissolve it, and so failure ensue), mix six ounces pure nitric acid with six ounces sulphuric acid, and obtain a temperature of 165° F.; pull the cotton into light tufts, and immerse at once with a strip of glass;

keep the whole immersed for seven minutes, and then pour off the acids, press the cotton against the sides of the vessel with the glass strip to express as much of the acids as possible; plunge the cotton into a large vessel of cold water, then wash until quite free from acid, squeeze as much water out as possible, then pull it into small tufts to assist drying, and when perfectly dry pour on fifteen ounces of methylated alcohol specific gravity ·820, and, when saturated, add fifteen ounces of methylated ether specific gravity ·725, shake well, and the cotton will dissolve in a few minutes, and then add two and a half drams of castor oil, allow it to settle, and decant for use. If too thick for the purpose, it can be thinned with the ether alcohol, and to obtain and maintain the acids at a temperature of 165 an outer vessel may be used with hot water as a bath. The collodion is most excellent for enamelling purposes.

762. Collodion Varnish—To Remove.—The collodion may be dissolved off with a mixture of *equal volumes* of methylated alcohol and ether. Methylated ether will answer very well Flow this over the plate, or, better, put in a dish with the negative. Perform this operation in the daylight, and keep the dish covered as much as possible, as ether gives off an inflammable vapour at a very low temperature, and several dangerous accidents have been known to occur through want of care with it.

763. Coloured Drawings, Varnish for—To Make.—Canada balsam 1 ounce, spirits of turpentine 2 ounces. Mix them together. Before this composition is applied, the drawing or print should be sized with a solution of isinglass in water, and when dry, apply the varnish with a camel-hair brush.

764. Coloured Varnishes—To Make.—One of the most simple ways of forming a transparent varnish colour is to use the transparent oil colours, adding a white copal varnish as a medium. Of course, there are only a few that are suitable for such use, among which may be mentioned crimson lake, gamboge, Prussian blue, Antwerp blue, Hooker's green, bistre, burnt sienna, vandyke brown, and sepia. The following are the methods and materials practically employed by the trade. The tools required will be one marble slab with a flat smooth surface, about a foot square and an inch thick; this is for grinding the colours on preparatory to mixing, also a palette knife, one with a blade 8in. × 1½in. is found most convenient to use. The materials required will be colours—Blue, *Prussian blue;* green, *distilled verdigris;* yellow, *gamboge;* red, *scarlet lake;* turpentine and best pale copal mixing varnish, or Canada balsam. Also several small covered pots to put the mixed colours in and preserve them from dust. A little of the dry colour is placed in the middle of the slab and crushed to powder by means of the palette knife. A few drops of turpentine are dropped on the colour, enough to make it into a stiff paste, and then the knife is taken by the handle in the right hand, and the two fingers of the left pressed on the blade close to the handle; the end of the blade is pressed flat on the stone so that a length of the blade lies flat on the stone, the handle being at an angle, and then with a circular motion the colour is ground till it is perfectly fine and even. A little of the varnish or balsam is dropped on the stone, and by a similar motion it is mixed thoroughly with the colour. One precaution, do not add too much turpentine for mixing the colours, else it will be difficult to grind them fine. For articles in which a quick drying varnish would be advantageous, powdered aurine, in ordinary negative varnish, yields various shades of lake and ruby, according to quantity dissolved. Seed lac gives a bright yellow; asphaltum a good brown, adding dragon's blood to gain depth. As only *transparent* colours are available for dissolving in varnishes, the tints would be limited, and only comprise purple and crimsom lakes, sap green, Prussian, indigo, and ultramarine blues, raw and burnt sienna, and vandyke for browns, dispensing altogether with the various "chromes" and "scarlets." These colours would be, of course, oils, such as are put up in tubes for artists' use, and could be mixed in mastic or copal varnishes. Equal parts of gold size and turpentine also yield a delicate, quick-drying medium for transparency painting. A good transparent varnish may be made as follows:

Oil of turpentine	8 ounces.
Oil of lavender	6 ,,
Camphor	1 dram.
Bruised copal	2 ounces.

And a few directions may help in mixing the colours. It is indispensable that the colouring matters used be ground to an impalpable powder, as above, before mixing with the varnish, and should then be again thoroughly ground with the varnish, or the transparency of the varnish will be lessened. *For blue*, mix half an ounce each of indigo and Prussian blue (very finely pulverised) with twenty ounces of spirits of turpentine, strain, and mix with the above varnish, to intensity required. *For red*, half an ounce of cochineal in ten ounces of turpentine, stand for fifteen hours, then strain, and add to varnish as above. *For yellow*, to twenty ounces of varnish add one ounce of pulverised root of curcuma until the desired colour is reached, stand for a few hours, and strain. King's yellow and Dutch pink also give bright yellows. *For green*, use verdigris, or King's yellow and bright Prussian blue mixed with the varnish. *For orange*, mix a little red with yellow, as given above. *For pink*, use a little red. *For purple*, use a mixture of red and blue. In place of the above varnish shellac dissolved in methylated spirits may be used. Aniline colours are particularly well adapted for making transparent coloured varnishes, and possess great intensity even in very thin films. Prepare an alcoholic solution of lac or sandarac, and a concentrated alcoholic solution of the aniline colouring matter required, and add to the clear varnish before using.

765. Crystal Varnish—To Make.—A very good crystal varnish may be made by dissolving

Gum dammar	25 grains.
in Benzole	1 ounce.

The following is a good recipe:

Sandarac	18 parts
Mastic	4 ,,
Ether	200 ,,
Benzole	80 to 100 ,,

For positives, add one ounce white shellac (pulverised) to three ounces of alcohol, to which has been added three ounces of ammonia. Then add six ounces of water. This gives a very fine colourless varnish when in thin films. See also Cold Varnish (No. 759). Another: One ounce of gum juniper and two ounces of powdered glass are placed in a bottle, six ounces of methylated chloroform added, and the bottle shaken up until the gum is dissolved. It is then filtered through cotton-wool. This is poured on the plate in the usual manner, and dried immediately without heat. It should be used in the open air or near an open window to avoid the inhalation of chloroform. Another: Dissolve one ounce of white lac in ten ounces of warm spirits of wine. Let the varnish settle for several weeks, then carefully decant the clear portion into a bottle for use.

766. Dead Black Varnish—To Make.

No. 1.

Alcohol	8 ounces.
Lampblack	2 ,,
Gum shellac	1 ,,

Dissolve the shellac in seven-eighths of the spirit, and *mix well* the lampblack with the other ounce. Then mix the two. Other formulæ are:

No. 2.—Methylated spirit 10 ounces, in which is dissolved 1 ounce gum sandarac. Rub up in a mortar or dish with fine lampblack (about one ounce) until of the required consistency, and keep in a well-corked bottle. This dries very quickly, and is a good black for wood, etc.

No. 3.—Rub up one ounce gold size in a similar manner, with one ounce lampblack, and add eight ounces turpentine, and half-ounce methylated spirit. A good dead black, suitable for wood, metal lens tubes, shutters, etc.

No. 4.—A dead black may be readily extemporised by stirring up fine drop black with negative varnish, until about as thick as cream Apply all these with a camel-hair brush. Another: Take two grains of lampblack, put it into any smooth shallow dish, such as a saucer or small butter plate, add a little gold size, and thoroughly mix the two together. Just enough gold size should be used as will hold the lampblack together; about three drops of such size as may be had by dipping the point of a lead pencil about half an inch into the gold size will be found right for the above quantity of lampblack; it should be added a drop at a time, however. After the lampblack and size are thoroughly mixed and worked, add twenty-four drops of turpentine, and again mix and work. It is then ready for use. Apply it thin with a camel-hair brush.

767. Electrician's Cement—To Make. —For cementing brass necks on glass jars, etc

Resin	4 parts.
Wax	1 ,,
Finely powdered brick	1 ,,

Melt and mix well together. It must be put on warm, but not so hot as to split the glass. It holds very firmly.

768. Film Varnish—To Make.—Almost any good negative varnish will be suitable for films, but it must neither contain anything that will dissolve the support—such as strong spirit, if the support is celluloid—nor must it be very brittle, or it will crack when the film is bent. The following is a varnish that is suitable for both celluloid and other films:

White hard varnish	10 ounces.
Liquid ammonia ·880	*quant. suf.*
Water	5 ounces.

Add sufficient ammonia to just dissolve the precipitate first formed. Lay the film on a glass plate face upwards, and varnish — *without warming the negative* in the ordinary manner. Another that can be recommended is "water varnish." A saturated (cold) solution of borax is brought to boiling point, and to this is added shellac till it will dissolve no more. It is allowed to stand till cool, and then filtered. This, of course, is used cold, and the negative can be varnished wet as it comes from the washing water by floating it on the varnish. It is then allowed to dry spontaneously. The following also answers very well, and will not warp or affect in any way the film; *no heat* must be used when varnishing, but it requires twenty-four hours to harden, although it is dry in a minute or two:

The very best benzole	12 ounces
Gum dammar	1½ ,,
Gum mastic	½ ,,

Mix and agitate at intervals until dissolved, then allow to stand until it becomes quite clear, and the dark sediment forms quite a distinct layer at the bottom, then decant and filter through cotton wool. It is then ready for use, and can be applied with a flat camel-hair brush, or the film just floated on the varnish, which can be held in a shallow glass or porcelain dish; not vulcanite. The following is another formula, given by Mr. Ashman, which will be found satisfactory:

Commercial japanner's gold size ...	1 part.
Benzole	1 ,,

The film should be quite dry, but not warm. Flow the varnish on, and drain the excess off as usual, and then set up for the night to dry. In fine weather the drying will often be completed in half an hour. Another says: For celluloid films, the best treatment is the homœopathic No doubt under certain circumstances resinous varnishes may be used, but they cannot compare with a plain spirituous *celluloid* varnish besides it is very cheap, for there is scarcely a photographer who has not more spoilt glass or film negatives than he cares for. This is how it is prepared: Take old celluloid negative films, and remove the gelatine coating. Then cut the celluloid into small shavings, and dissolve them in ordinary alcohol, sufficient to make a thinnish varnish. Apply this to the film in a cold state, and put it aside to dry slowly, without the application of heat. This varnish flows smoothly and sets evenly, and is much tougher than any resinous varnish. It is, however, open to the objection of containing spirit, which is, perhaps, more apparent than real, although raised by many writers, inasmuch as it is applied on the *unprotected* side of a film of gelatine, and would probably be dry long before it could penetrate through the gelatine film to the celluloid support. It would, of course, not be wise to *soak* a celluloid film in such a varnish.

769. Filter for Varnish—To Make.—Make a paper funnel of writing paper, gum it up so that it will not come undone, and cut off the point so as to leave an orifice large enough to admit a pencil. Into this hole push from the inside a tuft of cotton wool, and pull it through the opening to such an extent that it is firmly held there. Now prop this extemporised filter above a clean, dry bottle, and pour in the varnish above. It will filter out bright and clear.

770. Flexible Cement—To Make.—Here are two recipes for twill or cloth. (1.) Guttapercha 16 ounces, indiarubber 4 ounces, pitch 2 ounces, shellac 1 ounce, linseed oil 4 ounces. Mix and use hot. (2.) Best fish glue 16 ounces, treacle 1 ounce, water 4 ounces. Steep overnight, melt and add eight ounces of a strong decoction of nut galls, stirring constantly. These are easily applied, and it is only necessary to keep the edges to be joined under pressure for twenty-four hours. With leather it is essential to have absolutely clean edges, best done by paring them with a sharp knife just before gluing. The first recipe will answer for joining twill or cloth to leather but for leather to leather the following answers best: (3.) Carbon disulphide 4 ounces, indiarubber 1 ounce, isinglass 2 drams, guttapercha ½ ounce. Dissolve by gentle heating together (taking care not to do this near a light, as the disulphide is very volatile and inflammable). Coat the two clean surfaces thickly with the mixture, let them dry apart, then place them together and use a hot iron and considerable pressure to melt the cement, and so join them to each other. Lastly, put under pressure for some days. A few more follow—all good ones. (A.) Common glue and isinglass equal parts, soaked for ten hours in just enough water to cover them. Bring gradually to boiling point, and add pure

tannin until the whole becomes soapy, or appears like the white of eggs. Buff off the surfaces to be joined, apply the cement warm, and clamp firmly. This is a recipe given by one of fifteen years' experience. (B.) Mix ten parts disulphide of carbon with one part oil of turpentine, and add enough guttapercha to make a tough, thickly-flowing fluid. Clear the edges of the leather, etc., from grease, with blotting-paper and a hot iron, apply the cement to both surfaces, bring into contact, and clamp until dry. (C.) Dissolve in disulphide of carbon enough guttapercha to make the solution the thickness of syrup. The parts to be joined must be well coated to fill up the pores; then heat the cement, and join the edges, hammering the parts until the cement is cold. (D.) Virgin indiarubber is cut with a wet knife into the thinnest possible slices, which are then divided by shears into threads as small as fine twine. A small quantity of the shreds, say one-tenth the capacity of the bottle, is then put into a wide-mouthed bottle, and the latter is three-quarters filled with good benzine, free from oil. The rubber almost immediately commences to swell, and in a few days, if often shaken, will assume the consistency of honey. Should it not be inclined to dissolve, more benzine is to be added, until it arrives at the proper consistency. A piece of rubber no larger than a walnut will make a pint of the cement. It dries in a few minutes, and three coats should be used. N.B.—Keep B, C, and D in tightly-corked bottles. Carbon disulphide has not only a disgusting smell, but is poisonous if the vapour be breathed for any length of time; in fact, so injurious is it to animal life that it is used to kill insects in grain.

771. Flexible Varnish—To Make.—The varnish known as "balloon varnish" is one of the best flexible varnishes. It is made by boiling, with constant stirring, two gallons of linseed oil with six ounces of copperas, the same weight of sugar of lead, and one pound of litharge; boil until it strings well, and thin, if necessary, when cold with drying oil. A substitute for the above consists of a solution of indiarubber in chloroform, carbon bisulphide or other light spirit, at the rate of one ounce to the pint. Another soft flexible varnish may be made from dammar gum thus: Crush transparent and clear pieces of dammar into small grains, and put into a glass flask, sufficiently large for the purpose, one hundred grains of the gum; over this pour twelve ounces of acetone (a liquid obtained by the distillation of various acetates), and expose the whole to a moderate temperature for twelve or fourteen days, frequently shaking. At the end of this time, pour off the clear saturated solution of dammar in acetone, and add, to every four parts of varnish, three of rather dense collodion; the two solutions are mixed by agitation, the resulting liquid being allowed to settle. Preserve in well-closed bottles. This varnish is best applied by means of a soft beaver hair brush. When applied at first, the surface of the article will become covered, as it were, with a white skin, but as the varnish dries, however, this will disappear, and leave a clear shining surface. Two or three coats may be given. This varnish retains its gloss and elasticity well, and for many purposes is much to be preferred to one made from oil.

772. Liquid Glue—To Make for General Purposes.—Below are given a series of formulæ for liquid glue. Those which contain *glue* are unfit for mounting photos, etc., on account of the acid present, which is essential to prevent the glue setting when cold. Those containing methylated spirit may be kept in well corked or stoppered bottles to prevent evaporation. The freedom from lumps will depend upon the care taken in preparation. (1.) Dilute two to two and a half ounces strong nitric acid, with forty to fifty ounces of water. Soak in this twenty-four ounces glue for twenty-four hours, and then heat until it is homogeneous. Cost, about sixpence per pint. (2.) Pour seven ounces of water upon three ounces of glue, and let it stand for five or six hours. Then add one and a half ounces strong hydrochloric acid and three-quarters of an ounce of zinc sulphate, and heat to 170° to 190° F. for ten or twelve hours. Cost, about same as No. 1. (3.) Dissolve half pound powdered orange shellac in sixteen ounces methylated spirit. Put mixture in a well-corked bottle, and heat gently until dissolved. This forms an admirable cement for wood, etc. Cost, about one shilling a pint. (4.) Dissolve one ounce borax in twelve ounces soft water, then add two ounces finely powdered shellac, and boil with constant stirring till dissolved. Cost, sixpence a pint. The cost in each case is approximate only. All the ordinary dry glues can be kept in a liquid state by the addition of three parts of acetic acid for every one of powdered glue; the acetic will dissolve the glue without the aid of heat, but it would then be rendered useless for mounting purposes.

773. Label Varnish—To Make.—The following is a satisfactory method of varnishing labels. First give the labels a coating of size (made by dissolving one ounce of glue in ten ounces of hot water), taking care to *completely cover* each label. Next day (or as soon as dry proceed to varnish, using either "oak varnish" or "church varnish" with a camel-hair brush about the same width as the label. Endeavour to cover the label with one stroke of the brush, and use as little varnish as possible. Greasy looking marks are due to an imperfect coating of size. The varnish will dry perfectly by next day. Spirit varnish is of little use. It does not resist the action of acids and alkalies, and of moisture like an oil varnish. Another simple method is to melt paraffin wax, and brush while hot over the labels, but this cannot properly be called varnishing, and is not so satisfactory as the method described above. One of the best varnishes for labels is made by treating pale, clear dammar resin with five times its weight of acetone, in a flask or stoppered bottle, allowing it to stand a week or more with occasional shaking. The clear solution is then poured off, and to three parts of it add four parts thick photographic collodion, shake well, and allow to clear by standing, when it is ready for use. Apply to the labels with a broad camel-hair brush, two or three coats being needed. This varnish resists the fumes and damp acid atmosphere of the laboratory, remaining glossy, and does not crack. A cheap and ready varnish is made by dissolving ordinary resin in methylated spirits in a stoppered bottle (two ounces to the pint), allow to settle, and apply with a camel-hair brush. The success attending the preservation of labels depends on the way they are put on the bottle; it is, therefore, essential that the glass should be quite clean, and the label moistened evenly on the gummed side, not by the mouth, but from a wet pad of cloth, applied to the bottle, smoothed with a cloth, and the bottle and label rolled on a soft surface, such as five or six folds of blotting paper. The fixed label should be allowed to dry three or four days before varnishing.

774. Lacquer for Brasswork—To Make.—The lacquering of optical instruments requires great care and patience. If, however, the following instructions are carefully followed, success should be easily attained. If the lens

mount, etc., has been lacquered before, the old lacquer must be removed, and the metal carefully cleaned and polished. To do this, take the mount to pieces, and boil off the old lacquer in a lye made by dissolving one ounce of potash in one pint of water. Allow the mount to remain in this hot solution for twenty minutes, and then plunge into clean cold water, when the whole of the old lacquer will be found to have been removed. Now dip into nitric acid of high specific gravity, and let it remain until quite clean and bright, then plunge quickly into clean cold water, and give two or three rinses in changes of water, transfer to a sawdust box kept heated by any convenient means. When dry, the mount is ready for relacquering. For new work, the best way is to place the mount on a suitable wooden chuck in the lathe, then polish with finer and finer emery cloth powder, and if necessary burnish it. If, however, this is not possible, get the surface as clear as possible with emery, and then place the mount in pickle, *i.e.*, dilute nitric acid for some hours, until clean and bright, rinse, and dry as before Now for the lacquers. Their name is legion, and the general principles as regards colour are that colouring substances, such as red sanders, dragon's blood, and annatto, give richness of colour, while turmeric, gamboge, saffron, sandarac, and Cape aloes lower this tone, and hence, by mixing the two classes various tints can be obtained. The simplest, and, according to Holtzapffel—no mean authority—the very best, for lens mounts is half a pound (or one ounce) of best pale shellac to one gallon (or twenty ounces) of good methylated spirit. This should be dissolved without heat, but by continuous agitation for five or six hours, filtered if not clear, and kept away from the light. It may be coloured for red tints with the first-named class above, and for yellow with the second. English lacquering is generally pale ; Continental very much coloured. To apply the lacquer and to get the exact temperature require considerable skill and experience, and it is here that beginners generally fail. The great secret is to take very little lacquer at a time on the brush ; never go over the same part twice, or ridges will result ; have the work absolutely *clean* ; have no loose hairs in the brush ; *and* do not make the article too hot. Now, suppose the mount *is* clean, and the lacquer ready. The brush should be a fine flat camel-hair, and the mount should be held by a piece of round wood passed through it, and be heated over a charcoal brazier, or other convenient source of heat without moisture or smoke. The degree of heat may be from about 140° to 210° F. Holtzapffel says not warmer than boiling water, but in practice that is an extreme limit. The lacquer is applied by straight strokes of the brush, always in the same direction. When dry the mount is done *outside*. The inside must then be carefully coated with some dead-black lacquer. The following are a few recipes for coloured lacquer :

No. 1.

Seedlac, annatto, gamboge, dragon's blood, each	4	ounces.
Saffron	1	,,
Spirit	10	pints.

No. 2.

Turmeric	1	pound.
Annatto	2	ounces.
Shellac and gum juniper, each	12	,,
Spirit	12	,,

No. 3.

Seedlac	6	ounces.
Dragon's blood	40	grains.
Amber and copal, powdered, each	2	ounces.
Extract of red sanders	½	dram.
Saffron	36	grains.
Powdered glass	4	ounces.
Absolute alcohol	40	,,

Very fine lacquer.

No. 4.

To five ounces of spirits add gamboge enough to give bright yellow colour, and add three ounces seedlac in powder ; dissolve in sand bath.

No. 5.

Hard and good colour ; clear shellac solution 100 parts, picric acid in alcohol to required colour. and add half part of crystallised boracic acid in alcohol.

No. 6.

Seedlac	3	ounces.
Dragon's blood	2	drams.
Turmeric powder	1	ounce.
Rectified spirit	1	pint.

Digest for fortnight and then strain.

775. Lantern Slides, Varnish for—To MAKE.—The following will answer : Sandarac 2 ounces, Venice turpentine ½ ounce, oil of turpentine 1 ounce, methylated spirit 20 ounces. This is suitable for retouching or spotting with pencil or brush with oil colours. The following varnish will be found a very good one for lantern slides :

Orange shellac	2	ounces.
Sandarac	2	,,
Canada balsam	60	grains.
Oil of lavender	1	ounce.
Methylated spirit	16	,,

The gums will take some time to thoroughly dissolve in the spirit—the solution will be accelerated by occasional shaking. The plates should be heated in the usual way before applying the varnish. Or, in place of the above, ordinary negative varnish, with the addition of methylated spirit, may be used. The first requirement for a suitable varnish for lantern slides is extreme clearness and transparency, and next to these qualifications may be mentioned perfect freedom from dust and minute specks of hair, etc. Very many have been tried, but there is nothing to beat the following: Best gum dammar 25 grains, dissolved in one ounce of pure rectified benzole. When the solution is complete decant off into another bottle, then filter twice or three times. After coating a transparency never return the surplus varnish to the same bottle, but to another one, so that when the second one gets full it can be refiltered back to the original bottle. This is suitable either for collodion or gelatine slides. Be sure to use it cold. It is as near being colourless as it is possible to make a varnish.

776. Marine Glue—To MAKE.—This is one of the strongest cements known, will unite wood, metal, glass, leather, etc. There are several recipes—but it will suffice to give one, as it is probably generally much cheaper to buy it than to make it.

Indiarubber (cut very fine)	1	part.
Coal tar naphtha	12	,,

Digest with heat and agitation, and when solution is complete add

Powdered shellac	20	parts.

Continue heat and stirring till quite melted, then pour out on cold metal surface. To use, it should be melted at about 248°—250° F., and applied in the liquid state with a brush. Care should be taken not to heat it too much, as at a few degrees above its melting point, it loses its strength and becomes crumbly.

777. Matt Varnish—To MAKE.—Sandarac 1 ounce, castor oil 80 grains, alcohol 6 ounces. First dissolve the sandarac in the alcohol, and then add the oil. The following is a good formula :

Sandarac	½ ounce.
Canada balsam	1 dram.
Sulphuric ether	7 ounces.
Benzole about	3 ,,

The proportion of benzole added determines the nature of the matt obtained. The varnish is applied cold, as it is really the chilling that causes the matt surface. Another:

Gum mastic	20 grains.
Gum sandarac	90 ,,
Ether	2 ounces.
Benzole	1 ,,

Dissolve and filter. Coat the back of the negative in a cool, airy place. This is most requisite for the production of a fine matt; when set, take it to a clean fire and get it as hot as the hand will bear. When cold it will be found to give a very hard surface for pencil or stumping. The following are also two capital formulæ for matt varnish, either of which will be sure to please:

No. 1.

Amber resin	12 grains.
Benzole	1 ounce.

Dissolve, and allow to stand for twenty-four hours before use.

No. 2.

Sandarac	6 grains.
Shellac	40 ,,
Mastic	40 ,,
Ether	12 drams.

Dissolve and add

Benzole	2 drams.

Another writer suggests that in all these formulæ an important ingredient is omitted, viz., methylated chloroform, for without it it is not possible to *properly* regulate the "matt" surface. Much better results are obtained by the following: Sandarac 2½ ounces, mastic ½ ounce (both picked white samples), ether (specific gravity ·725) 25 ounces, benzol 14 ounces. Mix the benzol and ether, and shake well before adding the gums, and when all is dissolved filter. Try on a piece of glass, and it will be found to give a very coarse matt. Now add one ounce of chloroform, and shake. Try again on a piece of glass, and a beautiful medium matt results, and if required finer still of course add more chloroform, and a surface can be obtained finer than the finest ground glass obtainable. If overdone with chloroform add a little more benzole, and it will rectify it.

778. Negative Varnish—To Make—The best varnish to be obtained is made this way: Two ounces of best orange shellac are dissolved in one pint of methylated spirit, one ounce of whiting well pounded up is added, the whole shaken up and allowed to settle. It is then filtered through a filter made in the following way: A piece of glazed paper is taken, folded into a cone, and the edges are gummed together. The point is then cut off, and a tuft of cotton wool pushed through the hole thus formed, of such a size that it fits tight. The wool is moistened with a few drops of methylated spirit just before use. The advantages of such a filter are that it is quickly, easily, and cheaply made, and when used it can be thrown away and a fresh one used next time; also, there is no troublesome cleaning to do as when using a glass funnel. The above formula gives the varnish of a right consistency for use. The following, also, is a perfectly reliable varnish, very tough and durable; it is much clearer and easier to work than a plain shellac solution, and gum camphor is used in place of castor oil to prevent cracking:

Shellac	2 ounces.
Gum sandarac	1½ ,,
Camphor	10 grains.
Methylated alcohol	20 ounces.

Dissolve the gums and allow to settle for a few days, then filter. Another formula which yields most excellent negative shellac varnish is as follows:

Orange shellac	1 ounce.
Sandarac	1 ,,
Canada balsam	40 grains.
Oil of lavender	250 ,,
Methylated spirit	8 ounces.

The negative must be warmed and dried by heat in the usual way. It will not be at all necessary to add any castor oil, as the expansion of the film may be put down as practically *nil*. Another way: Dissolve half an ounce of orange shellac in one pint of methylated spirit; when dissolved, add about two teaspoonsful of fine ashes from a coke or coal fire, and shake well. The wax of the lac attaches itself to the ashes, and soon settles to the bottom, leaving the varnish quite clear, and it can then be filtered without difficulty; if too thin add lac, if too thick dilute with spirit. This is very hard, does not crack, and will stand any amount of sun-printing without becoming tacky. Varnished gelatine negatives sometimes become strongly pitted from accidental water splashings: for remedy, thoroughly remove the varnish with spirit, then soak the plate for some time in water, dry, and revarnish.

779. Old Films—To Make Varnish from.—To make a negative varnish from old films can be done by cutting up the films in small pieces with scissors, and thoroughly cleansing from all greasy matter. Weigh out one ounce of the films, mix with four ounces of methylated spirits, and shake till dissolved, when it will be ready for use. Apply in the same manner as ordinary varnish. It cannot, however, be used for varnishing celluloid films, as it dissolves the film to be varnished.

780. Opticians' Cement—To Make.—The following cements are used by opticians for the purpose of cementing glass to metal, such as lenses to chucks, etc.:

No. 1.

Beeswax	1 ounce.
Resin	15 ,,

Melt and add five ounces of whiting, previously heated to redness, and still warm.

No. 2.—Shellac, softened with rectified spirit or wood naphtha.

No. 3.

Pitch	5 parts.
Wood ashes	1 ,,
Tallow	1 ,,

Less or more tallow according to temperature.

No. 4.—Very strong for rough purposes.

Resin (melt and add dry)	1 pound.
Plaster (warm)	4 ounces.

For cementing *lenses* use nothing but the purest and whitest Canada balsam, liquefied by heat, and applied to the surface, previously warmed. Press well together, and allow to harden for several days.

781. Positive Varnish—To Make.—A varnish for backing positives is made as follows:

Spirits of turpentine	6 ounces.
Asphaltum	2 ,,
White wax	2 scruples.
Lampblack	1½ ,,

Dissolve in a warm place, and filter through flannel.

782. Residues from Varnish Making—To Utilise.—A very good use can be made of varnish residues in two ways: (1.) Shake up the contents of large jar or bottle, let it settle, draw off a few pints of clear liquid, place in a wide-mouthed stoppered bottle, add enough fine lampblack to make a deep black liquid; thin, if on trial it dries glossy, with methylated spirits, till it dries a deep

black, with a beautiful dead surface. This is a most useful varnish for coating the inside of cameras, dark slides, etc. (2.) Add to remainder, without removing the sediment, ordinary orange shellac 1 pound, mastic 3 ounces, sandarac 3 ounces. Shake up and keep in a warm place for a few days, till all the gums are taken up, and a very excellent and useful French polish is the result, with which every polishable article of wood in the possession of the photographer can be kept in fine order. It may be used as a brush polish or varnish if desired upon studio stands, or any article not easily polished in the French polisher's fashion with rubbers and oil, etc. Another way of utilising the residues of ordinary varnish containing shellac, sandarac, etc., which always contain much useful material that is still capable of being dissolved. For this purpose, add to the sediment two or three times its bulk of the original solvent used, methylated spirit or benzole, preferably the former. Let this stand for a considerable time, shaking repeatedly. Afterwards heat carefully on the water bath. Decant when cold, and filter two or three times. Repeat the process with the residue in the filter, until the filtrate is colourless. This shows that no more has dissolved. Mix the several solutions thus obtained, evaporate on the water bath until the whole has a clear light yellow colour. This will not be strong enough for use with negatives, but it can be applied with advantage to lantern slides, if care be taken to free it from minute particles of dust, hair, etc. The solution if not required for this purpose can be used instead of the ordinary solvents when the next quantity of negative varnish is made up, the proportion of the other ingredients being reduced by, say, fifty per cent. (2.) Most formulæ for varnishes contain excess of shellac, so it is probable that a large proportion of this substance will be found in the residues. Shellac is very easily soluble in alcoholic ammonia; hence, add to the residues a desirable quantity of this liquid made by saturating absolute alcohol with ammonia gas. Shake and let stand, but do not warm. Decant and filter as before. The solution should be of a light yellow colour, and can be used for varnishing cold. It may be, however, that, practically, all the soluble constituents of the gum used for the basis of the varnish have been extracted by the spirit, in which case the best thing to do is to recover the spirit if the quantity is enough to render it worth while. For this purpose allow the sediment to settle as completely as possible, and syphon off the supernatant spirit into a copper retort, which can be connected by means of a bent piece of wide glass tubing fitted through a cork with a metal or glass spiral condenser, round which a current of cold water can be sent. On heating the contents of the retort by means of a circular Fletcher's burner, the spirit will distil over. If it should come over coloured, it may be purified to a great extent by dissolving some crude caustic potash in some methylated spirit, and adding this to the bulk of the liquid in the retort. The mixture should then be boiled for an hour, and the liquid distilling over returned to the retort at intervals. If the whole be then distilled, the majority of the impurities in the spirit will be found to have disappeared. The strength of the spirit may be greatly increased by allowing it to stand for twenty-four hours in contact with enough quicklime to form a stiff paste with it, the mixture being conveniently made in the retort used for distillation. The spirit is then distilled over from the lime, which will have absorbed the greater proportion of water contained in the spirit.

783. Retouching Varnish—To Make.—A good retouching varnish is—

Sandarac	...	...	...	1 ounce.
Castor oil	...	...	...	80 grains.
Alcohol	...	...	...	6 ounces.

First dissolve the sandarac in the alcohol, and then add the oil.

784. Rice Glue—To Make.—This is an elegant cement; very easy to manufacture, and is not only applicable to mounting photographs and all the purposes for which flour paste is used, but when reduced with water to the consistency of clay, it can be employed for models, busts, etc. It is made by mixing rice flour intimately with cold water, and then gently boiling the mixture; it is beautifully white, and when dry is semi-transparent, having the appearance of mother-of-pearl; it will take a high polish, and is very durable. Papers pasted together with this cement will sooner separate in their own substance than at the joining.

785. Ruby Liquid — To Make. — Take equal parts of magenta and aurine; dissolve in methylated spirits; this may be mixed with spirit varnish for coating glass with, or may be used as it is for paper, etc. A splendid method of making a good ruby liquid is to get a small bottle of Judson's concentrated dye, ruby colour, and to dilute this with about a third of the quantity of water that they recommend. This will furnish a good ruby liquid, suitable for photographic purposes. The following answers very well for coating glass or fabric to make it non-actinic: Gelatine 1 ounce, silver nitrate 1 ounce, water 9 ounces. Dissolve the silver nitrate in the water, pour over the gelatine till soaked, and then warm till melted. The glass or fabric is given a good coat of this, and then exposed to light till the desired colour is attained; it is then washed to free it from the excess of silver nitrate. A deeper or lighter colour may be given by adding more or less silver nitrate to the formula above given. Another way of making a ruby liquid would be to dissolve a ruby dye, such as eosine, in a ten per cent. solution of gelatine, or in some negative varnish. For coating glass there is nothing better than collodion mixed with *aurine* (the latter to be had from most photo dealers). If for dyeing fabrics use aurine or metaphenylamine diamine, also procurable from most dealers. These are merely dissolved in spirit and the fabric soaked in the dye. There are several other formulæ. The following are for coating glass: (1.) A mixture of fuchsine and erythrosine, in dilute methylated spirit or negative varnish, is convenient, but requires renewing occasionally. (2.) Take red sandal wood in powder (four ounces), macerate for a week in alcohol (sixteen ounces), filter, and dissolve in the filtered liquid four ounces of best orange shellac; pour off the clear varnish, or else filter it. The glass should be warmed, and the varnish poured on in the usual manner of varnishing negatives. (3.) Another very good ruby liquid is made by emulsifying with gelatine, nitrate of silver and chromate of potassium (two grains silver nitrate to each ounce emulsion give dense film), but will not long stand daylight, which is indeed the fault of most ruby liquids. Another is made by dissolving five grammes of carmine in forty c.c. of ammonia. Then dissolve two grammes picric acid in 450 c.c. of water with seven grammes glycerine. In this last solution soak fifty grammes hard gelatine for an hour, and afterwards dissolve in a water bath. When the gelatine is thoroughly dissolved, add the carmine and apply to the glass with a wide brush. When first coat is dry give second or third according to required density. (4.) A solution of orange lac and dragon's blood in rectified naphtha will answer, but it is not so neat either in application or result as the commercial preparations, which may

be classed as varnishes, and are, like them, difficult and dangerous to prepare on the small scale. If the glass can be removed from the window, it may be coated with a solution of gelatine and colouring matter in water, which gives a very good result, but is not always practicable or convenient. The following is a perfectly non-actinic colour, and can be applied for dyeing fabric or added to shellac varnish for coating glass, etc. It is somewhat complicated, but is reliable in every way. When potassium nitrite is added to a solution of metaphenylene diamine hydrosulphate, a deep chocolate coloured precipitate results. When this is filtered off and dissolved in alcohol, it gives a red solution which transmits only the red rays. For producing this colouration it is unnecessary to have absolutely pure metaphenylene diamine. The following process will suffice:

Nordhausen sulphuric acid	...	...	5 parts.
Strongest nitric acid	...	...	5 ,,
Ordinary nitro benzole	...	...	1 ,,

Place in flask, agitate, boil, allow to stand until cold, pour into a quantity of water, allow to stand to deposit, then filter, and wash the precipitate with cold water, and then with a little cold alcohol (which removes the undecomposed nitro benzole). Crystallise from hot alcohol. These crystals are mainly meta-dinitro benzene, and will yield metaphenylene diamine on reduction with nascent hydrogen. To effect this add iron filings and hydrochloric acid, and put in a warm place for an hour or two. Filter, and *nearly* neutralise the solution with hydrate of potassium, leaving a slight amount of free acid. This will precipitate the greater part of the iron. Now heat and filter. Acidify the filtrate with sulphuric acid, and add a concentrated solution of nitrite of potassium, which throws down a heavy precipitate. Filter again and dissolve in alcohol. If necessary filter this also. The evaporation of the alcohol will leave the colouring matter in the solid state in the form of green crystals. These may either be dissolved in alcohol and used for dyeing fabric or paper, or else dissolved in collodion to be applied to glass. Another method of preparing non-actinic paper is to make a solution of three grains of chrysoidine in one hundred c.c. of alcohol and fifty c.c. of water, and to draw the paper through the mixture.

786. Ruby Varnish—To Make.—For a ruby varnish that will stand heat, take of orange shellac 2 ounces, methylated spirit 20 ounces; agitate until dissolved. When thoroughly dissolved, add one ounce powdered chalk, and set aside to settle for a week; then filter. In one ounce pure alcohol dissolve sufficient good ruby dye (Judson's penny dyes answer very well) to give the required depth of colour, and add to the varnish; shake well and again filter. Gently warm the glass before coating. This will not chip with heat, or rub off. Another way: Dissolve sixty grains finely powdered aurine in a pint of ordinary negative varnish, and apply to the glass in the usual way. The sensibility of various coloured substances for filtering the light rays coming to the plate has been the subject of much experiment at the hands of Vogel, Eder, and, at an earlier period, of Hunt. The practical result is that of the numerous red colouring matters, the two best for dark room illumination are aurine and chrysoidine. Of these two, perhaps chrysoidine is the preferable, although it does not cut off those rays which are chemically active on silver bromide so completely as ruby glass, coloured with cuprous oxide, and although it possesses the further disadvantage of slowly bleaching in dry light. The safest red light for a dark room in which gelatino-bromide plates are to be developed is obtained through glass, the two sides of which have been coated with different "liquid rubies" prepared as follows: One part of gelatine is warmed in eight parts of water and half a part of aurine, previously dissolved in four parts of alcohol and four parts of water added to the solution. The second "ruby" is made in an exactly similar way, except that the aurine has been replaced by roseine (a dye of the triphenyl methane group and bearing the names also of aniline-red and fuchsine). One side of the glass coated with one solution, and the other with the other, forms a combination which allows only red light to pass. Another very efficient light filter consists of a similar preparation to the above, but containing a mixture of chrysoidine and aniline-red. Two and a half grammes of chrysoidine are dissolved in 125 c.c. of warm water, and then successively are added twenty grammes of gelatine, three grammes of glycerine, and forty c.c. of a twenty per cent. solution of alum. This mixture is suitable for coating glass plates.

787. Translucent Varnish—To Make.—A fine, though somewhat expensive, varnish is made by dissolving (for twenty-four hours) pulverised gum tragacanth in white of nine eggs well beaten. Lay a coat of this on the windows, and let it dry.

788. Varnish Drying White—To Prevent.—The reason of this is that the varnish contains too much water, having probably absorbed this from the air through the bottle having been left uncorked. A remedy would be thinning it down cautiously with *absolute* alcohol. Varnishes which dry without heat are never so good as those which are warmed after applying them. Another likely cause of the above is dampness of the negative. The negatives should be quite dry and free from any suspicion of dampness. The varnish may, however, have become thick or dirty, in which case it might be diluted with methylated spirits and filter. Varnishes which dry with heat are, as a rule, better than those which dry cold, if only because the plate *must* be warmed before applying, but it is to a great extent a matter of choice. It is as well, even with so-called "cold varnishes," to slightly warm the plate before varnishing, otherwise it will not dry with such a bright surface, being more or less dull. Those cold varnishes which contain borax after a time become powdery, and should be avoided.

789. Varnishing—Method of.—The best way to varnish with spirit varnish is the following. The room must be about 65° F.; warm the plate as usual, and flow the varnish. Do not rock the plate, but place it as held when draining in a rack. After two or three minutes, the crapiness will disappear; it must then be heated again as usual. This way has two advantages: Firstly, a more glassy surface; and secondly, no chance of "firing" the plate, which often occurs if warmed directly the varnish has run off.

790. Varnish—To Remove.—Place negative in a flat dish, and pour methylated spirit on it which has been previously made distinctly alkaline by the addition of a few drops of strong ammonia solution. Let the plate soak one or two minutes, and then remove by gentle friction with a small pad of cotton wool the remainder of the gum, after which the plate may be flooded two or three times with fresh spirit, and well washed by soaking in three changes of water, face downwards, then dry. To remove varnish from prints begin at the corner of the print by rubbing up the varnish with the fingers. A fine white dust will be produced, which is the dry old varnish. Proceed all over the

print, and wipe off this white dust with a rag. Repeat until the print has lost all the varnish.

791. Waterproof Backing Varnish—To MAKE.—The following are several waterproof varnishes suitable for paper: (1.) Boil Chio turpentine until brittle, powder, and dissolve in oil of turpentine. (2.) Canada balsam and clear white resin, six ounces of each, are dissolved in oil of turpentine one quart. (3.) Digest gum sandarac 20 parts, gum mastic 8 parts, camphor 1 part, alcohol 48 parts. Prints had better receive a coat of gelatine solution before the application of this last varnish. The following is a varnish for backing chloride prints:

White shellac	1 ounce.
Alcohol	20 ,,

Allow to digest for twenty-four hours, and then add—

Powdered borax	2 drams.
Castile soap	2 ,,
Warm water	2 ounces.

Mix well, and allow to settle, when it should be decanted off, and is ready for use.

792. Waterproof Negative Varnish—To MAKE.—A solution of indiarubber in benzole would be the nearest approach to a *waterproof* varnish. None of the gums or lacs would answer the purpose. Of course another coating of, say, collodion would have to be given over the indiarubber to prevent the sensitised paper coming in contact with it. Another:

Very transparent amber	3½ ounces.
Hot clarified linseed oil	1 pint.
Turpentine	2 ,,

Heat the amber in a closed vessel, pour on the linseed oil, boil till it strings very strongly, take it away out of the house and well mix with the turpentine. This will flow well upon any work it is applied to. It becomes very hard, and is the most durable of all varnishes. Spirit varnishes will not stand leaving out in the rain all night. A varnish which will stand wetting is indeed an ideal varnish, and the only safe way is by *double* varnishing, first, while the plate is *cold*, with gum dammar 120 grains, benzole 1 ounce. Allow it to dry, and then warm before a fire and apply another varnish of

Shellac	1½ ounces.
Sandarac	2 ,,
Castor oil	3 drams.
Alcohol	18 ounces.

Retouching can be performed on this, and it will stand a lot of punishing with either heat or water. The gum dammar must be used first always, for it is too soft for the outside, but very waterproof, and will not redissolve when the spirit varnish is applied.

793. Yellow Varnish — To MAKE. — For the inside of dark tents or boxes is easily made by mixing chrome yellow with methylated French polish. It can be applied with a brush, and dries quickly. Stephen's ebony stain is handy for blacking apparatus.

CHAPTER XX.

MISCELLANEOUS.

This chapter contains, besides those entries which did not seem to fall naturally into the heading of either of the preceding chapters, a few which came to hand too late to be classified in their proper place. They will, however, be easily found by consulting the index.

794. Artigues' Process — Mode of Working.—This method of carbon printing, which is comparatively new, bids fair to become a formidable rival of the older method involving either single or double transfer. "Photograms of '95," in its brief review of technical and photo-mechanical progress for the year, says of it, "The Artigues process of carbon printing without transfer, though not new, has only this year become available for British workers through the persistence and enthusiasm of the hon. sec. of the Linked Ring." The process was invented by M. Artigues, of Bordeaux, in 1889, and is now becoming widely known and appreciated in Europe. A thin film of gelatine is coated on paper, and when set is sprinkled with black powder. When dry it is bichromated from the back of the paper. Development is effected by mixing white sawdust with hot water, and applying it to the print (after exposure) while held in a vertical position. The prints obtained by this method have certain peculiar qualities not obtained by older processes, and its application in photo-mechanical processes renders it extremely interesting. Artigues' paper may now be obtained commercially.

795. Baize (Green)—To Line Boxes or Cases with.—The method recommended is the least messy and the most expeditious of any, and in result compares very favourably with more orthodox processes. With fairly stiff cardboard, cut rectangular pieces a shade smaller than the interior sides and top and bottom of the box. Each of these pieces must now be covered on one side with the material. The best way of accomplishing this is to lay the card upon a piece of baize ⅜in. or 1in. wider all round, and then turn over and glue the projecting edges. Take care to have the baize stretched fairly tight. To avoid the extra thickness at the corners, cut off triangular pieces. Paste has been found unsuitable for this work. Le Page's liquid glue, though somewhat expensive, is excellent, and has the advantage of drying quickly. After all the pieces have been covered, and allowed to dry under pressure, it simply remains to fix them to their respective positions in the box. For this purpose glue may be used, or, if the future contents of the box will allow, small nails or screws. In lining developing or chemical cabinets, with their multiplicity of compartments and pigeon holes, this method lends itself to very successful work. Another says that the best treatment for fixing green baize to wood is to let it shrink as much as it likes for about twelve hours in cold water, at the end of which it must be allowed to almost dry, and then use the strongest glue procurable, instead of using paste. For every foot of baize required allow nearly two in the bath to make up for loss in shrinking. It would be difficult to purchase shrunk baize, as the shopkeepers prefer to sell articles which stretch, if anything, like the well-known trick of making two feet of elastic cover one yard on the counter. It would materially assist the gluing to press down the baize by a board with some weights on top of it, as this rough cloth lies very lightly on its surface. Another way: Ordinary carpenters' glue is as good as anything for this purpose. The following is the recipe for mixing: Procure some good Scotch or French glue at the ironmonger's, quantity as required, break it up into small pieces, to do which fold glue in a piece of old cloth and hammer on some solid surface; this prevents it flying about. Put the broken glue into a small earthenware jar, pour in enough water to cover it, and let steep overnight. To dissolve, put jar containing glue into a small pan which has enough water in it to come half-way up the jar and not allowing it to float, boil over a good fire, keep stirring at intervals until dissolved, and if too thick, as it probably will be, thin down with hot water, stirring after each addition of water. Work in a warm room and apply glue to wood, only giving it an even coating. Cut the baize a little larger than the parts to be covered, and do one side at a time. Should the baize still continue to shrink too much, which is very unlikely, tack the edges at moderate intervals with small green gimp pins; a pennyworth procurable at the ironmonger's will do more than serve the purpose.

796. Brush, Handy—To Make.—It consists merely of a sponge, which has, perhaps, one half or three-quarters of its bulk stuffed into a short, wide-mouthed bottle. This brush is very cleanly, and pleasant to handle. It is inexpensive, and can be made in a few moments from materials which are to be found in every laboratory; and it can be quickly and thoroughly cleansed by pulling it apart and washing its component parts. Almost any desired stiffness of touch can be obtained by selecting a sponge more or less harsh in its texture, and by letting it project from the bottle to a greater or less extent. Such a brush is particularly suited for applying paste to the backs of prints when mounting them, inasmuch as it never sheds any

bristles, nor leaves any bristle tracks or ridges in its wake; and when temporarily out of use, it can be stood up erect on the flat end of its handle, and in this position, though fully charged with paste, it collects no dirt on itself, and does no harm to other things. Two or three of these implements standing about in his dark room give a photographer the means of promptly and neatly sopping up any corrosive or staining fluids that may be accidentally spilt, without even soiling his fingers. Another useful brush is a Buckle's brush. It is made by taking a glass tube about three-quarters of an inch long and half an inch diameter, and drawing into it, by means of a silver wire, a tuft of cotton wool, which, when used, is thrown away. It is particularly handy for applying silvering solution, or any chemical which, in ordinary cases, would destroy the substance of a brush.

797. Burnishing Roll—To Brighten.—The best way to polish, and, at the same time, remove scratches, is to hone the bar on Arkansas stone, using sweet oil. Hold the stone flat on the bar, and draw from end to end. A very good polish, and, at the same time, removing surface marks, may be got by folding a piece of No. o emery paper round a flat piece of wood, and using as the hone, taking care always to draw from end to end of the bar. It might also be cleaned by getting some rotten stone, which can be purchased at most oil shops, and mixing it into a paste with some sweet oil. It requires to be used with a lot of elbow grease, and will take some little time, but it will brighten the bar without in any way scratching it, which would be the case if emery powder was used. The price of rotten stone is sixpence a pound. Another way is to use very fine emery powder, rubbing in the direction of the length of bar, not crosswise in any case, or it will leave some ugly scratches, as will also be the case if the powder is too coarse. The finest flour emery only must be used, and a final polish can be given with rotten stone or putty powder.

798. Conundrums, etc., for Lantern—To Prepare.—To rapidly prepare lantern slides of conundrums, illustrated rhymes or jingles, business announcements, or anything which can be written or sketched with pen and ink: Take a slow gelatine dry plate, 3¼ × 4¼, with thick film, develop it with oxalate developer of ordinary strength for the average time, say three or four minutes, without having exposed it to light, then fix, wash a few minutes, soak a minute in alcohol, and in a couple of minutes more it will form a plate with perfectly transparent film, on which anything can be written. India ink is best to write with.

799. Composition for Copying—To Make.—The following is a good firm pad: Gelatine or refined glue 1 ounce, water 2 ounces, glycerine 4 ounces. Dissolve together, and add a few drops of carbolic acid to prevent its turning sour, pour into tray, and place on a perfectly level surface to set. Another chromograph mixture: Gelatine 1 ounce, sugar 1 ounce, barium sulphate (precipitated) 2½ ounces, glycerine 6 ounces, water 4 ounces. To use with this, the ink will have to be thickened by dissolving gum in it, and adding half a teaspoonful to the ounce of glycerine. Do not add gum water, or you will make it too weak; dissolve the solid gum in the ink. Another is glycerine 18 ounces, water 12 ounces, barium sulphate 6 ounces, powdered loaf sugar 3 ounces, Nelson's gelatine 3 ounces. Let the above mixture stand for twenty-four hours, and then heat it over a spirit lamp for two or three hours, and pour out into a shallow dish to set. Take care to avoid air bubbles, which can be pricked with a red-hot needle if they appear. After use, clean the "graph" with a piece of rag dipped in *cold* water, and then dry it. Do not put it away wet. If the surface becomes rough from use, remelt it, stirring all the time, and then pour back again into the dish. Another formula is: Scotch glue 1½ pounds, soaked in water until flaccid, glycerine 6 pounds. Heat for about six hours, to drive off excess of water. Write the notice with an ink make of aniline violet; about 160 grains dissolved in one ounce of hot water is right strength. When dry place it on the "graph," and rub with the palm of the hand, allow it to remain for a minute or two, and take off; then place plain paper on, and rub a few times with the hand, pull off, and a *facsimile* is produced. Fifty or more copies can thus be obtained, the quantity depending upon the strength of ink written with. When cop es enough are printed, sponge the surface of the "graph" until the writing is removed, and when it has worn uneven, remelt and allow it to set again, and it is as good as new.

800. Copies of Photographs—Who has Right to Make?—This matter appears to have never been clearly decided, but the following remarks upon special cases may help to a conclusion: According to well-established precedents, the copyright of a photograph vests in the *author* of it. Now who is the author? Perhaps the nearest approach to a decision on this point is the suggestion of the Master of the Rolls in the case of Nottage *v.* Jackson, that the person who is actually present when the photograph is taken, who superintends the arrangements, places the person to be photographed, and gives the necessary orders, is probably the "author" of the photograph. Of course, in some cases where the whole work is done by one man, the author is easily found, but if the principal and his assistant between them pose the subject, arrange the accessories, etc., it is probable that they should be called joint authors of the photograph. Well, having settled the author of the photograph, the copyright vests in him, and can only be transferred by *writing*, and in the ordinary course, no action for infringement of copyright can be sustained unless the author or proprietor has registered his photograph at Stationers' Hall. However, there seems to be a tacit understanding on either side that the photograph shall not be reproduced by either party for their own benefit. That is to say, the photographer is debarred from printing and exhibiting copies from the negative without the consent or order of the original of the negative, or the person who paid for it being taken, whilst, on the other hand, the sitter is not justified in copying the photograph. Then, again, in cases where a photograph is taken for a "valuable consideration," as in the case of ordinary professional work, the copyright vests in the sitter, but the negative remains the property of the photographer, and any alteration of these conditions must be made in writing at or before the time of sitting. Photography Annual, 1894, gives some further information. (1.) The Photographers' Copyright Union make the following remark in *Photography* for 1894, page 43: "When, however, a person sits to a photographer, and *pays* for his photograph, the copyright does *not* belong to the photographer, and he cannot charge a fee for reproducing." Therefore, a sitter having paid for his photographs, the copyright of them is his property, and he may copy and print more if he chooses. (2.) Photography Annual, 1894, page 222: "It has been held by Justice North, in the case of Pollard *v.* Photographic Co., that a photographer who has taken a negative likeness of a customer to supply copies for money may be restrained from selling or exhibiting copies, both on the ground that there is an implied contract not to use the negative for such

purpose, and also on the ground that such sale or exhibition is a breach of confidence." But to prevent anyone copying a photograph without permission, the person in whom the copyright is vested must register it in the usual way, for on the same page of the ANNUAL, the following remark occurs: "The Act of 1862 (July 29th, 25 and 26 Vic., c. 68) enacts that no proprietor of any copyright shall be entitled to the benefit of the Act until registration."

801. Copyright in Photographs—LAW OF.—It should be noted that it is violating the Engravings Acts to produce by photography a copyright engraving. By the Acts 10 and 15 Vic., c. 12, sec. 14, the powers and liabilities under the Acts of George II., George III., George IV., and William IV.—relating to infringement of copyrighted engravings—were extended to include prints taken by lithography, or *any other* mechanical process, by which prints or impressions of drawings or designs are capable of being multiplied indefinitely, which would include the photographic process. It would therefore be an infringement of the copyright given by the Engravings Acts to copy by photography or sell a photographic copy of a print in which copyright has been acquired. A person who copies, imitates for sale, hire, exhibition, or distribution, is liable, even though he has acted innocently in the matter. Even to exhibit a pirated production constitutes an offence, provided that a knowledge of the piracy can be brought home to the exhibitor. Of course, making a single copy for home adornment is not, in itself, a very great offence; it is none the less an infringement, though perhaps doubtful if proceedings would be taken if discovered. It is of course known that photographs of prints, etc., are often taken by private individuals for private use, but the practice is none the less an infringement on an existing copyright. The penalty by 17 Geo. III., c. 57, for an infringement is the forfeiture of the plate from which the pirated copy was printed, and 5s. for every copy undisposed of. There is no copyright, however, in *subject*. With regard to American copyright, though in the present state of the copyright laws there is nothing to prevent the Americans from copying registered designs and selling them in their own country, they must draw the line at that, as, if they are impudent enough to send them to England for sale, and can find agents unprincipled enough to sell them, and photographers to use them, there is a remedy against both, that is, if it can be proved that they sell and use same knowing them to be registered designs. This can be found out by giving them notice, and seeing how they act. If the Copyright Act could be evaded in this way it would soon be a dead letter, as all the pirates would have to do would be to get the printing, or, in some cases, the painting, done in America, and ship them back here and sell them with impunity. We are bad enough, but not quite so simple as this.

802. Crystoleum—HOW TO WORK.—This process in brief consists of mounting a silver print upon glass, rendering it transparent, and colouring its more prominent features upon the print, finishing off by applying the broader masses of colour upon a second glass, which is bound closely to the first one bearing the print. This painting upon back of second glass imparts that beautiful softness that has brought this simple and effective method of colouring into such favour. There is a similar process, known as "Kartaline," which is done by rendering the print transparent, completely colouring it from behind, and then mounting it upon a canvas or cardboard support. This is a rather more difficult undertaking for an amateur artist than "crystoleum," as every stroke is *en evidence*, not having the softening influence of the second glass; it is worth any extra trouble, though, for the pictures never turn spotty and go "off" in that disheartening manner peculiar to crystoleum, owing to minute air bubbles between the print and the glass. The colours required for either of these pictures are ordinary oils, sold in tubes at threepence each, and, as they are to be viewed through the prints, require to be more vivid than if used upon the surface. The most useful tints will be found in scarlet and crimson lakes, lemon and orange chromes, emerald green, Prussian and indigo blues, vandyke brown, burnt sienna, flake white, and ivory black. A quick-drying medium for mixing them with is equal parts of turpentine and japanners' gold size. Some good brushes are required, either fitch or camel-hair, for the backing up, and fine sables for working upon print, a white china palette, a HB retouching pencil, and clean rags and turpentine complete the list of required materials. Silver prints are generally preferred for crystoleum, as the paper is thin and becomes transparent easier than other processes of printing, but pretty studies can be made from almost any kind of picture or engraving printed upon plain papers. Commence by preparing sufficient gum, starch, or gelatine to quite cover glass and print to be attached, bring them into contact while under the solution, drain carefully, and wipe off superfluous mountant, see that the contact is perfect and free from all air bubbles, and set aside to dry. When quite set, rub as much as possible off the back of the print with fine sandpaper, then place the glass into a pan or saucer which contains melted white wax, allow it to remain until quite transparent, and hold to a fire, so that all the wax possible may run off, wipe clean, and allow it to cool, when it is ready for painting. Should the study be a portrait, commence by defining the eyebrows and lashes, pupils, and nostrils with the lead pencil, touch up any high lights on hair, put patterns on lace, or any other improvement that suggests itself, then colour the eyes and lips, and put just a slight wash over the hair of the required colour. This concludes the requirements of the first glass. When quite dry, place another glass behind, and bind both firmly together with strips of gummed paper or stamp edge. Now mix an extremely vivid flesh tint, using scarlet lake, orange chrome, and white, hold up the painting to the light, and apply the colour. Do not paint quite up to the outlines, and never *over* them. Let the colour be stronger on the cheeks by adding crimson lake. Make no distinction for lips or shadows, as all gradations are supplied by the print, and this is what renders crystoleum one of the easiest modes of colouring photographs. Any tint for hair or drapery must be rendered strong enough to show through both glasses, by the addition of sufficient white, particularly when the subject is rather dark. Concerning the glass supports for crystoleum, although the convex ones sold for the purpose are the favourites, flat ones are quite as effective, and infinitely easier of manipulation. This suggests a very good use to put to any unavoidable waste of the dark room. In "kartaline," the print should be large enough to allow of its being attached to a glass support for convenience during painting, thus: Fold down half an inch or so all round, well gum this edge and attach the print to a piece of clean glass when dry, lay in front of a fire, or insert in the domestic oven, until warm enough to melt a bit of white wax passed briskly over it, absorb all excess of wax with blotting paper or soft cloth, allow it to cool, and it is ready for colouring. As in this method the roughness of the work is not disguised by the second glass, greater care and skill must be

displayed to gain a good effect. When quite hard the prints can be mounted on to canvas stretchers or bevelled panels, as fancy suggests, using a mountant of glue containing a little turpentine. One difficulty, however, of crystoleum work is the presence of white spots, the cause of which is owing to the oxidation or drying up of the oil or medium employed to produce the transparency, and this unfortunate tendency has hitherto prevented a most effective method of colouring from receiving the attention it deserves, as these spots are very uncertain and erratic in the period of their appearance, sometimes showing at once, and in others not until some months have passed since the picture was completed, and it has been observed that those prints that are attached to the regulation "crystoleum" glasses apparently deteriorate in a shorter space of time than those coloured independent of any permanent support. It is therefore presumed that a portion of the transparent medium penetrates the albumen, and, lodging upon the glass, dries up, thus causing the spots. Excellent results, however, have been gained from a simple coat of copal varnish applied upon the back of the print; it dries beautifully clear, though slightly yellow in tone, which is an objection, for delicate subjects. Both the linseed and castor oils are more liable to speedy evaporation than the white wax, the latter being one of the best mediums in use for this work, minus the *camphor;* this only dries up the wax at once, and is a mistaken idea. Another cause of the white flaky spots complained of is the presence of small globules of air between the print and glass, which are caused either by inefficient squeegeeing or by the surface of the glass not being perfectly clean and the print leaving the glass on drying. Another method of mounting photos intended for crystoleum work is given below. Prepare a mountant by taking one teaspoonful of Brown & Polson's cornflour, mixing to the thickness of cream with a little cold water to get rid of lumps, and pouring on to it a quarter of a gill boiling water, then boiling mixture for a few minutes with constant stirring, allow to cool, when it is ready for use. Take the glass on which the photo is to be mounted and rub well with a paste made from whiting and water, allow to dry and wipe off with a dry linen cloth, finally polishing surface with a silk handkerchief, using a little precipitated chalk, *not French chalk*. Soak the photo in lukewarm water for a few minutes till thoroughly wetted, then remove surplus water by draining and wiping with a clean cloth, and lay the print on the glass, the surface of which has been smeared all over with the paste or mountant; on back of photo place a piece of damp parchment to prevent damage, and squeegee well, always working from the centre to the edges, examining the face of glass to see that all air bubbles are removed, which, when accomplished, the glass and print are allowed to dry in a cool room. The best form of squeegee is found to be one made from the wood of a cigar-box, say 1in. wide × 7in. long, the end being cut to the shape of a blunt chisel; in fact, this is the only form allowable in dealing with convex and concave glasses. It now remains to render the photo transparent, and the first operation is to carefully sandpaper the back of the print to remove most of the paper support to the film, and thus help the transparent medium to do its work, also getting rid of any defects which sometimes show, due to the grain in the paper. Now rub the print over with transparent medium or castor oil, using tip of finger, and put the work away for a few days to allow time for the oil to thoroughly soak in, which excess is removed by means of a rag, when the colouring and painting may be proceeded with. In some cases a preservative medium is used after treating with oil, but before painting, and this can be obtained from most colourmen. It is rubbed on allowed to stay a few days, when the excess is wiped off.

803. Developing Dish—To Repair.—Get some marine glue, melt it just as it is without any water, make the dish to be repaired perfectly dry and warm, apply the glue to broken portions, and press into contact. In case, however, of a *papier maché* dish the various layers of paper must be glued thoroughly together with some glue, to which a little potash bichromate has been added. Expose the dish to sunlight afterwards, in order to render the glue insoluble. While the glue is still hot, the dish should be subjected to a good pressure. Either guttapercha or marine glue will resist most photographic chemicals, and will not easily soften or come apart again unless boiling water is used in the dish or it is placed too near a fire, neither of which is likely to be required.

804. Diaphanotype—To Produce.—Produce a good photograph on plain paper, with all the delicate half-tones of the negative well preserved. Let it be deeply printed. Do not attach the print to cardboard; retouch the unmounted print in the shadows of the drapery, but do not interfere with the face. Place the print in contact with a piece of the best white plate glass, using the following solution:

Canada balsam	...	...	...	2 ounces.
Turpentine	...	...	...	1 ,,

Pour this over the glass in much the same manner as collodion, and lay the print down on it, and with the finger or a soft pad, commence from one corner carefully to press out all air bubbles. When the picture is sufficiently set to paint upon, work in the local colours of the face, drapery, and accessories in oil colours, having a careful regard to the general outlines.

805. Ebonite Dishes—To Repair.—Almost any waterproof cement can be employed to mend ebonite or vulcanite dishes when they are broken. Amongst cements obtainable commercially are Prout's elastic glue, marine glue, James's impregnable cement, and others. First of all, thoroughly clean the parts to be repaired, either by scraping gently with a penknife, or, if greasy, washing thoroughly in strong soda water. Having got the surface in the best condition, take a little of the cement (made liquid by heat if necessary) on the point of a penknife or a brush, and apply a thin coating to the parts to be joined, then, if possible, clamp the parts together for some hours until the cement is quite dry. A cement which has been well recommended for cementing vulcanite is made as follows: Take one part of sulphur, and mix with three parts of pure rubber, and dissolve in six parts of alcohol, and one hundred parts of bisulphide of carbon. Then evaporate to a consistency of thin paste. Apply a little of this to the edges to be joined, and heat to about 310° F. for about four hours. (See also No. 111.)

806. Exposure Meters—How to Use.—An exposure meter differs from an exposure table in this, that it measures *something*, viz., the actinic power of the light at the time of using. It is therefore a *combination* of an actinometer and an exposure table. The calculation, once the actinicity of the light is determined, is generally effected by a modification of the slide rule; hence it saves much trouble and some chances of error, and is so far better than an exposure table that the former ascertains positively what the light actually *is*,

whereas the latter only tells us what it ought to be. The same remarks and precautions apply to the meter, as are pointed out in directions, How to Use an Exposure Table, No. 807 (*q.v.*) The light, however, being ascertained by an actinometer, requires no particular precautions as to estimating, as in para. 1 of the article on Tables, but the estimation of Subject is still left to the judgment as in 807 (para. 4), also the remarks on Development apply, viz., either to alter the mode of development or the speed number of plate until a few trial exposures come out right. It would be invidious to attempt a comparison of exposure meters, as many are constructed with great care and yield good results to those who once learn the use of them; but of *one*, Watkins's, a well-known writer on photography, and one whose name is well known to all readers of *Photography*, says, "I have found Watkins's (meter) simply invaluable." The only real difficulty in using a meter seems to be the determination of the precise moment when the sensitive paper reaches the standard tint, because (with albumenised paper particularly) the colour of a piece freshly exposed to sunlight differs rather from what it ultimately becomes. The judging may be very much facilitated by keeping a little piece of gelatine film tinted yellow (a film stained with picric acid answers perfectly), and viewing the tints through that; this seems to filter out the slight element of "*nuance*," as the French call it, and reduces the estimation to one of relative darkening. One point should be noted. Several instruments are on the market calling themselves "exposure meters" which are not *meters* at all—they measure nothing, having no actinometer and no means of measuring light. They are simply "slide rules," intended to facilitate the calculation involved in using "tables." They are useful in their way, but not *meters*. The photographer who desires an "exposure meter" should see that he gets it.

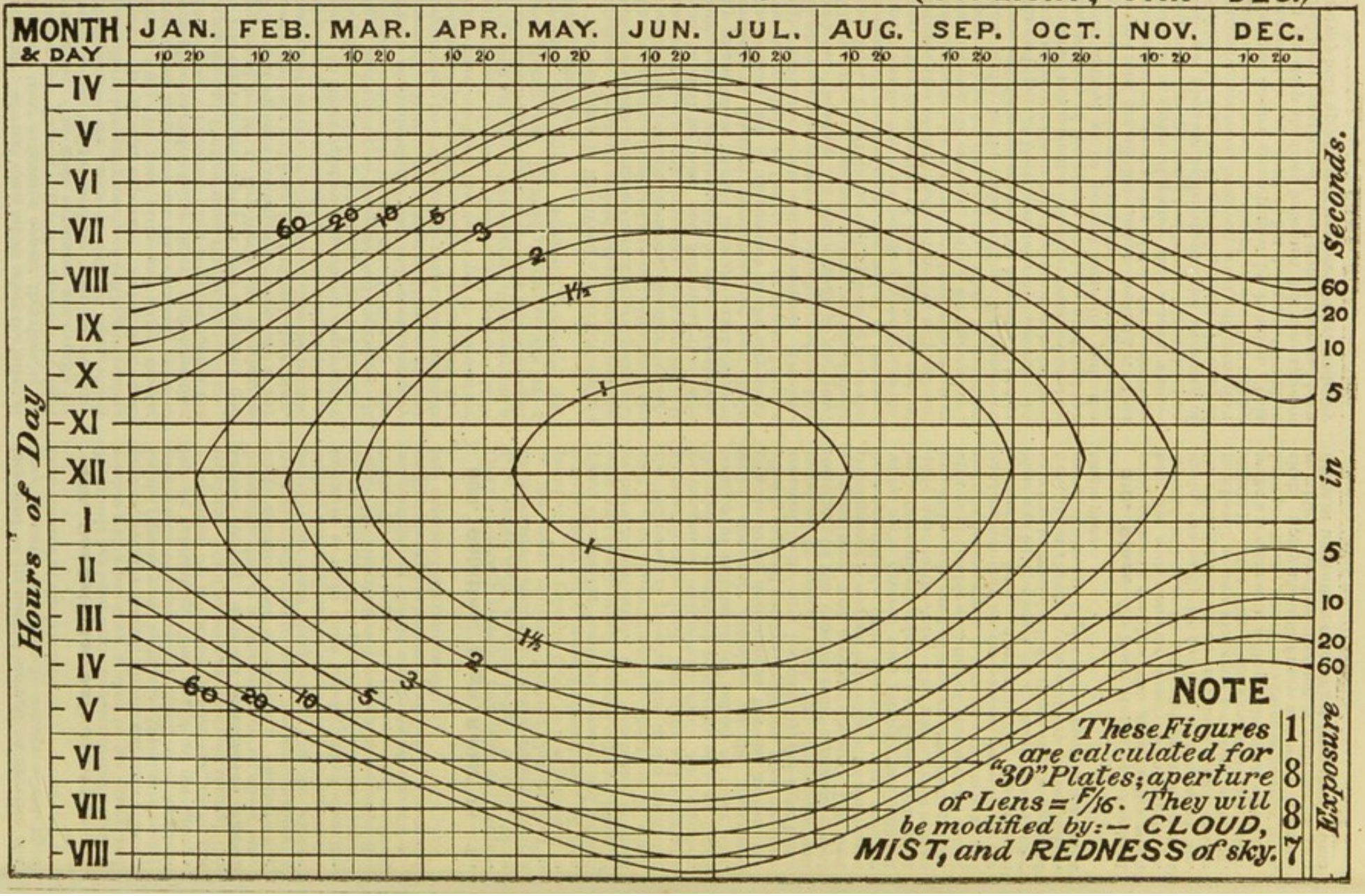
807. Exposure Tables—How to Use.—Although decried by a great many experienced workers there is no doubt that some such form of assistance in determining the exposure necessary at any given time, or for any given light, as is rendered by exposure meters and exposure tables, is welcomed by most beginners. Nor does this seem an illegitimate form of assistance, for it must be remembered they are *only to guide the judgment, not to supersede it*, and, fortunately, the density of judgment, which induced one budding photographer to give a ten minutes exposure in the open ruins of Tintern Abbey, because it was an "interior view," and his tables gave ten minutes for interiors, is probably rare; and, indeed, the gentleman in question would have been likely to go more hopelessly wrong without his tables than with them. At all events, he was *trying* to form an intelligent judgment, and although he had not taken *all* the factors into consideration, he was more likely to do better next time than one who worked entirely by rule of thumb. The experienced worker who despises tables forms his own judgment from a rapid mental comparison of all the factors (light, subject, stop, and sensitiveness of plate) which go to determine exposure, based upon the results of *his own lengthened experience;* the beginner, who necessarily has not that experience, but who adopts an exposure table or meter, has before him the results of other people's experience to aid him in forming a judgment. True, his judgment may sometimes be erroneous, but so may the experienced worker's, and every time he *thinks* out an exposure he acquires confidence and experience, and becomes better able to dispense with aids, when he is sufficiently advanced. One great advantage of tables seems to be that by not having to worry his mind about the light and exposure, he can concentrate his attention on the artistic aspect of his subject, the composition upon the focussing screen, and the focussing and best stop to use, which are so apt to be overlooked in the hurry of the moment, when there are too many points to occupy the mind at once.

In the use of "tables" and "meters," the following points should be borne in mind: (1.) A meter on the whole is better than a table, for the meter determines what the light *actually is*, and calculates the exposure from that, whilst the table can only show what the light *ought to be*, at the particular time of day and date, and it is necessary to make allowance for any variation from that standard light such as "dull," "cloudy," "diffused light," etc. (2.) As the "tables" unfortunately do not agree among themselves, to adopt one and stick to it, modifying the developer and the plate number until the right exposure is hit upon, then with same developer and plate, all future exposures will be nearly right, and the table will be found of great assistance in deciding the judgment in difficult cases. (3.) To remember that the "table" depends greatly upon development. It only represents the experience of one or two individuals, and is based upon the methods of development adopted by them. A table, for instance, based upon development by metol, would have numbers very different to one based upon ferrous oxalate. It is necessary for the photographer either to adapt his developer to the "tables" he is using, or to adapt his tables to his developer. In the first instance, if a few trial plates appear over-exposed, weaken the developer (preferably in accelerator, as that can be added afterwards as it appears to be required); if under-exposed, use a stronger developer. In the second instance, if plates are regularly over-exposed, assume that the plate used is a faster one than the numerical exposures correspond to. Thus many tables are based upon a so-called "thirty-times plate," a term which has no meaning, but is usually assumed to be an Ilford Ordinary, and to correspond to about 10° on the actinograph. Well, if the plates turn out over-exposed, call them forty-five times or sixty times, and either take three-quarter or half the exposures until the ratio is properly settled, and *vice versâ*. (4.) To exercise great judgment in appraising the "subject." It is here that room for judgment exists, and here that it commonly fails. The ratios usually advised for subject are as follow (modified from Burton's tables):

Sea and sky	½
Open landscape...	1
View with thick foliage, or strong foreground or light buildings ...	2
Dark buildings	3
Heavy foliage foreground	4
Woods and badly lit river banks ...	10
Living objects outdoors (near) ...	4
Interiors...	100-1,000
Copying same size	6

Great care is required as to which category a subject really comes under—especially in interiors and badly-lit river views, where it is very easy to under-estimate the actinic value of the light. The table quoted above gives for "portrait near window"=8, which appears a mistake, as Hurter and Driffield, who have experimented very carefully, assign for portrait in studio 50, and in sitting room 120, ordinary landscape being 1, and this is much nearer the average time required for well-exposed portraits. It is necessary to note *what kind of subject* is taken as unit—the table already quoted gives open landscape, which is supposed to mean distant view with no near object—and a "cottage with trees," for example, would require double

A TABLE OF PHOTOGRAPHIC EXPOSURES. (SUNLIGHT; JAN – DEC.)



exposure; whereas some tables select the latter as unit, and their exposures appear, therefore, to be double the former. (5.) To practise in light estimation. The table exposures are usually set down as for "bright sunlight," but the majority of exposures are taken in diffused light, which generally yields better results—but if bright requires double the tabular exposure; and if dull, three times. (6.) To note plate and stop; tabular exposures, as printed out above, usually refer to slow plate (so called thirty times), and stop either f/8 or f/16. Of course, f/11·2 requires double the exposure, and f 16 four times that of f/8.

The diagram annexed is a very ingenious one published by Mr. C. Ray Wood, and showing, as it does, at a glance the exposure necessary at any day of the year and hour, for f/16 and slow plate, may be of service to some who dislike the trouble of referring to a table and making a slight calculation. An Ilford rapid would probably require only half these exposures, which are intended for sunlight, and appear to be quite *full* exposures. It would be desirable, using this diagram, to begin with a weak developer and add accelerator *very* carefully. With metol, at least half these exposures might safely be given, and perhaps some workers might find their negatives over-exposed until they had either modified the developer or allowed for extra speed of plate. Taking, for example, April 20th, nine a.m., when the diagram shows one and a half seconds, Wormald gives only half a second, and Hurter and Driffield three-quarters of a second. The former apparently requires very strong developer.

The following is Mr. Wood's description of his diagram: The curves embodied in the accompanying table have been in constant use for several years, and have at all times furnished an exact estimate of the duration of exposures, rendering the after development a matter of ease, certainty, and rapidity. It will be well to point out first what the table indicates, and how it should be read. It indicates by means of the curved lines the exact value of *sunlight* in England throughout the year—from the brilliant sun of midsummer to the very much weaker sunlight of December, or the still fainter light when the sun is near the horizon. The left-hand column corresponds to the hours of the day, and the "heading" to the months of the year. The months are subdivided into periods of about ten days. The table is used by looking *down* the column corresponding to the period of the year, and *across* the line corresponding to the time of the day. The intersection of these either *on* one or *between* two of the numbered curves will indicate the exposure—for instance, on March 10th at ten in the morning, the exposure will be, for a given lens, stop, and plate, two seconds; while at the same time of day in the middle of June the same lens, stop, and plate will require but one second, and in the early part of December fully five seconds. In nearly every case in which exposures have been timed by this table the developer recommended by the makers of the plates has been used, and has been applied at its normal strength, with the pleasant consciousness that the resulting negative would turn out all that could be looked for. This meant a very great saving of time in the development of a series of plates after a tour, when—although copious notes had been made at the time—it was pleasant to be spared the necessity of feeling the way in the development. In cases of excessive contrast, however, a very different plan had to be followed, or the plate would be lost by reversed action accompanied by halation. This occurred on one occasion, but the state of the plate in the deep shadows indicated that the exposure had been exactly right, and if the image had been slowly built up by a very *weak* developer, gradually increased to its normal strength, a negative of a very beautiful but difficult subject would have been secured at the first trial.

808. Gas Cylinder, Safe Joint for—To MAKE.—It has been found in practice that a leather washer which has been soaked in hot water and pressed, suitably shaped, affords sufficient packing for the regulator and cylinder. Anything of an oily nature must be rigorously avoided, either for packing or lubricating. The gas does not always escape from the top of the cylinder—*i.e.*, round the regulator—but it sometimes comes out through the key-pin opening. This can sometimes be stopped by turning the key a little more on or off—a very slight distance will often suffice. Another—For washers which have to resist pressure, nothing is better than thick sheet lead. Cut the washer slightly too small on the outside and too big on the inside, so as to fit quite loosely, and so when the pressure is applied to give room for lateral expansion. Mr. Beard himself states that he soaks the leather in warm water and presses out as much oil as possible. It should not be found that any excessive pressure is necessary, especially if cone and bull nose are both gun-metal.

809. Gelatine, High Relief in—To OBTAIN.—Prof. J. Husnik's Leimtypie or Gelatinotype yields high gelatine relief. A thick plate of chromatised gelatine is exposed under a negative in the usual manner, but the development is peculiar. The gelatine tissue is first cemented to a metal (zinc) plate in the following way. A zinc plate, after having been well cleaned and rubbed over with emery paper, is coated with a solution of guttapercha and dried. It is then heated to about 200° F., and allowed to cool to about 100° F., when the bichromated gelatine film is laid on it, the guttapercha film finally hardening and securing a perfect contact with the zinc plate. After exposure the plate is developed by means of a saturated solution of bichromate of potash or other salt, which not only dissolves all the unexposed gelatine during development, but also hardens the already exposed parts of the picture, the impression received in the first instance by the light being increased by contact with the bichromate salt solution. In this way the relief can be developed a longer time, and become deeper. This first development is stopped before the finer parts have been injured, the plate allowed to dry, and the white parts covered with printer's ink (diluted with turpentine), using a fine brush, and going quite near to the lines. The whole relief is then exposed to light, and on account of its having taken up a considerable quantity of chromic salt during the first development, is very sensitive to light, and hardens not only on the surface, but also on the sides of the lines. After removing the ink, the plate can be developed for a second time in order to get an increased relief. Prints can be obtained from these *clichés* in an ordinary press, and as many as 50,000 copies have been struck off a single plate.

810. Glass—To BORE HOLES IN.—Any hard steel tooth will cut glass with great facility when kept wet with camphor dissolved in turpentine. A hand-drill may be used, and when the hole is made, can easily be enlarged with a round file. Or a small archimedean drill stock, which can be purchased at any tool shop for about a shilling, should be fitted with a clock-maker's "bit," then make a scratch with a file on the glass, which has been previously placed on a piece of baize or thick cloth. Apply the drill firmly, and when it begins to "bite" the glass, moisten it with one or two drops of turpentine, renewing it from time to time

as the boring proceeds. Keep the drill-stock upright, and the hole required is soon produced. The great danger is of breaking the glass when the point of the drill passes through, and a good plan is to drill from both sides, and finish hole with a small square rimer. Do not press too hard on the drill, and make a few trials on scraps of glass before attempting to drill transparencies. The drill may, with advantage, be left "dead hard," and not tempered at all, as it wears away very fast. This is done by heating the drill red hot, and plunging it vertically into cold water.

811. Glass—To Paint and Gild.—Probably the best way for an amateur to do this (especially if not skilled in the use of the brush) will be to first roughly paint a black line with Brunswick black, allow to dry, and then trim the inside edge with a knife, assisted with a pointed piece of wood dipped in turpentine. When this has been done satisfactorily, roughly paint the line where the gold is to be with thin mastic varnish, overlapping the black a little, and when this has got tacky gild with gold leaf and dry. Then another coat of varnish, or a strip of thin dark paper glued over both black and gold, dry, and then trim the inside edge carefully all round. The work is, of course, done on the inside of the glass. Gold paint is no use for the purpose, but gold powder can be used, and, if this is dusted on, and then carefully stippled with a brush before drying, the gilding will be more or less of a "frosted" appearance.

812. Imperfections—To Remedy.—(1.) Imperfections on collodion negatives. These are *fogging* (see No. 135); *spots of various kinds*, which are caused by the use of collodion holding small particles in suspension; turbidity of the nitrate bath; dust on the surface of the glass at the time of pouring on the collodion; from small holes in the slide admitting a pencil of light; insoluble particles in the pyrogallic acid; causes which render the iodide of silver insensible to light at particular points, making a transparent spot; concentration of the nitrate of silver on the surface of the film by evaporation; small particles of undissolved iodide in the collodion; the alcohol or the ether containing too much water; and the use of glass improperly cleansed. *Markings*, which are also divided into a variety of kinds, viz., a *reticulated appearance on the film after developing*, often caused by using collodion containing water, or by immersing the plate too quickly in the bath, partially precipitating the soluble pyroxyline; *oily spots or lines*, from raising the plate out of the nitrate bath before it has been immersed sufficiently long to become sufficiently wetted, or from removing it before the ether on the surface has been washed away, or from redipping the plate after exposure to light, and pouring the developer on immediately, or from the nitrate bath being covered by an oily scum; *straight lines traversing the film horizontally*, from a check having been made in immersing the plate in the bath; *curved lines*, from employing the developer too strong, or not pouring it over sufficiently quick, or by using too little acetic acid and omitting the alcohol; *stains*, from too small a quantity of fluid having been employed to develop the image; *irregular striæ*, from fragments of dried collodion accumulating in the neck of the bottle, and being washed on the film; *wave-like markings*, caused by using an inferior pyroxyline, and most seen when using an old bath; *stains on the upper part of the plate*, from using a dirty slide; *wavy marks at the lower part of the plate*, from the collodion being too thick and glutinous, from reversing the direction of the plate after its removal from the bath, or from impurities on the woodwork of the frame ascending the film from capillary attraction; *marks*, from the developer not running up to the edge of the film, from the film not having set sufficiently; *a want of intensity*, from the development not having been sufficiently pushed, from the collodion film being too blue and transparent, or the collodion being too new, or the plate having been kept too long between sensitising and development, or the bath having been newly prepared from impure nitrate, or the light was too feeble; *inferior half-tones with great intensity of the high lights*, from the plate being insufficiently exposed, the collodion of inferior quality, the nitrate bath old and partially decomposed, or the light is reflected too strongly from the object; *the image pale and misty*, from over-exposure, or there is diffused light in the camera or developing room, or from the presence of bromides or chlorides in the collodion; *the high lights of the image are solarised* from over-exposure of the plate, organic decomposition of the collodion, or from acetate of silver and other organic bodies in the bath; *the image dissolves off on applying the fixing agent*, from the collodion being over-iodised; *the developer does not run up to the edge of the plate*, from using collodion nearly anhydrous, and the nitrate bath is new and contains very little alcohol; *the film peels off*, from the glass not being clean and the collodion too thick.

(2.) Imperfections in collodion positives. Besides those common to both negative and positive, as above described, there are several peculiar to the latter. *The shadows are dark and heavy*, from the plate not having received sufficient exposure in the camera, or from the film being very transparent, and the silver solution weak, or nitric acid is present in the bath, or the collodion is brown from free iodine; *the shadows good, but the lights overdone*, in consequence of the developer having been kept too long, or the object is not properly illuminated, or the collodion is not adapted for positives; *the high lights are pale and flat; the shadows misty*, from over-exposure in the camera; *the picture develops slowly, and spangles of metallic silver are formed*, from too much nitric acid being present, in proportion to the strength of the bath, to the amount of iodine in the film, and to the quantity of protosalt in the developer; *circular black spots after backing up with the varnish*, caused by lifting the plate too quickly out of the bath, or by pouring on the developer at one spot, or by the use of the glasses imperfectly cleaned, *the image becomes metallic on drying*, from the developer (of iron) being too weak, or free nitric acid has been added in excess, or the proportion of nitric acid is too great in the (pyrogallic) developer; *green or blue tints in certain parts of the image*, from the deposit of silver being too scanty, in consequence of the over-action of light, or the film of pyroxyline being too thin; *vertical lines and mistiness on the image*, from using an old bath much reduced in strength by the loss of nitrate of silver and want of alcohol in the developer.

(3.) Imperfections in paper prints. These are: *Markings of the brush*, from an excess of ammonia in the nitrate solution; *the prints are marbled and spotty*, from inferior quality of paper, which does not imbibe the liquids evenly, or the amount of nitrate of silver in the sensitising solution is not sufficient; *the prints are clean on the surface, but spotted when held up to the light*, owing to imperfect fixation; *the print is pale, cold, and faded in appearance*, from the chloride of silver in the paper being in excess with regard to the free nitrate of silver, or from using a too weak solution of nitrate of silver, or from the paper having been kept too long after sensitising; *the high lights are of a yellowish cast*, from acidity of the toning bath, from over-toning, from allowing the bath to remain idle too long and decomposing, or the paper is kept too long, or the washing is imperfectly done or too

prolonged, from exposing the print to light during toning and fixing, or from too long a time being allowed to elapse between printing and fixing; *intense bronzing of the deep shadows*, from too great transparency in the negative, and the paper being salted too strong to correspond with the weakness of the negative; *imperfect definition*, from bad paper if the negative is a good one; *yellow markings over the shadows*, from carelessness in handling the paper, washing in unclean dishes, or laying them down or together while damp; *small specks and spots of different kinds*, from black spots or pin-holes in the negative, from metallic specks in the paper, from insoluble particles floating in the bath, or from coming in contact with cyanide of potassium, or sulphuret, or ammonia, etc.; *marbled stains on the surface of the print*, from allowing the silver solution to stand in the dish unused some time without filtering; *streaks on albumen paper*, from uneven coating with silver solution, and the albumen does not wet readily; *the albumen flakes off the paper*, from the bath being alkaline.

813. Incombustible—To Render Paper or Fabric.—To render paper non-combustible to a certain extent soak the material in either: (1) Tungstate of soda 1 part to borax 2 parts, dissolve in water 30 parts; or (2)

Sulphate of ammonia	... ...	8 parts.
Carbonate of ammonia	... ...	2½ ,,
Boracic acid	... ...	3 ,,
Borax	... ...	1 7/10 ,,
Starch	... ...	2 ,,
Water	... .	100 ,,

To be used hot, and the fabric dried and ironed.

814. Invisible, The—How to Photograph.—That certain invisible things or emanations may be detected by means of photography is well known, but that a visible object may be covered by a substance so as to be perfectly invisible to the eye, and then copied in the camera just as if it were not covered at all, if not incredible, is not generally understood; this, however, can be easily done. A photograph, for example, which is not too strong in contrasts of light and shade, may be wholly obscured by washing it over with a solution of aniline violet, such as is sometimes used for writing ink; it may then be placed before the camera, and a negative of the unseen image taken precisely the same as if it could be distinctly seen on the ground glass.

815. Labels—To Attach to Bottles.—Nothing rouses such feelings of disgust as having a bottle full of something and not knowing what the something is. One does not like to taste it, as pyro and other photo chemicals are violent poisons, and yet one does not care to throw it down the sink. Possibly the solution, etc., was duly labelled when made up, bought, etc., but that confounded label has come off! If they must be labelled at all use the following gum, which does not chip off:

Gum arabic	... ...	2 ounces
Water	... ...	2 ,,

Dissolve and add

Soaked gelatine	... ...	¼ ounce.
Glycerine	... ...	30 drops

and small lump of camphor. Dissolve with heat. When the labels are attached with this, give them a coat of copal varnish, or else coat both label and the glass surrounding it two or three times with the following varnish, by means of a camel-hair brush, first sizing the label with a solution of isinglass in water:

Canada balsam	... ...	1 ounce.
Spirits of turpentine	... ...	2 ,,

For non-corrosive ink see also No. 51.

But the best practice is not to use labels at all, but to keep separate ten, twenty, or forty ounce bottles each for their single solution. Thus, ten ounce for pyro, eiko caustic, alkalies, bromides, etc.; twenty ounce for carbonates, hydroquinone, etc.; forty ounce for hypo, oxalate, eiko stock solution, ferrous sulphate, etc. Now as these bottles are only used for the one solution, it is obvious that their labels would soon become most unseemly in appearance. Procure, therefore, a small tin of Aspinall's white bath enamel and a small brush (which, however, may be conveniently discarded in favour of a wax vesta which is lit and the head knocked off), and proceed to paint in letters about half an inch high abbreviated titles for the solutions. Thus—Pyro, Hypo, Eiko, Quinol, Am. Br., Pot. Br., Pot. Carb. Though for most their chemical formula is more useful. The enamel dries quickly, is easily seen in a dark room against the blue glass of the bottles, does not wash or fall off, and will stand boiling water.

816. Line Drawings—To Convert Photographs into.—There are two methods by which a photograph can be prepared for this purpose. The first consists in printing the photograph in the usual way on either plain or albumenised paper, and fixing it, care being taken not to tone it with gold. When washed and dried, the image is of a brown colour. This must be gone over with a steel pen charged with very black ink, so as to ensure the chief features in the photograph being translated into lines more or less thick. When the drawing is completed, the paper is floated upon a solution of bichloride of mercury, by which the photograph disappears in consequence of its bleaching, leaving the ink lines. From this drawing a negative is made. The second method consists in sensitising the paper by sponging it over with ammonio-oxalate or citrate of iron, exposing under the negative, and developing with a wash of potassium ferridcyanide. This gives an image in a blue colour, which does not require to be removed in the after process of producing a negative from the pen and ink drawing.

817. Magic Mirrors—To Make.—The method of producing these pictures is based on the carbon process, which it is not necessary to describe. It consists in the following: If the negative to be printed be rather a dense one, tissue of the ordinary transparency kind may be chosen, and one less loaded with colouring matter; if the negative be weaker in character, the bichromate bath should not exceed the strength of five per cent. The tissue is immersed for a short time in the solution, squeegeed off, dried quickly, and used speedily. It is exposed as usual beneath a negative, and then coated with a collodion composed of five grains pyroxyline dissolved in an ounce of a mixture of equal parts of methylated spirits and methylated ether, and allowed to partially dry. A clean glass (preferably plate glass) is then taken and coated with the same, and washed in clean water until the greasiness has disappeared, when it is ready to receive the tissue. This may now be plunged into the water and left for a minute or so, but not until it begins to curl outwards: when ready it is lifted out of the water, squeegeed in the usual way, covered with two or three layers of blotting paper, and placed under a weight for an hour or two, after which the glass is taken, placed in boiling soda water, then the tissue is pulled away from the layer of collodion and placed to dry. When the plate has become quite dry its surface will have a glossy appearance, which will not exhibit any peculiarity until it is breathed on, when it will be found that the picture will appear possessing all the delicate detail of the original. The important points to remember are first, that the layer of

collodion should not be too horny and dried; second, that the tissue should not be allowed to absorb much water. Another method: Take some fluor spar and dissolve in sulphuric acid; when dissolved sufficiently to flow easily in a quill pen trace the required design or picture upon a piece of glass which has been cleaned thoroughly and dried. Leave it for a short time, say, five or ten minutes (if the acid is left too long the drawing will be visible on the dry glass, a few trials will determine the length of time the acid should be allowed to remain upon the glass). Wash the glass with water and dry perfectly. As soon as the glass is dry the picture will appear whenever the glass is breathed upon.

818. Magic Photographs—To Make.—Make a print on albumen paper in the usual way, fix and wash thoroughly without toning, immerse the print in a saturated solution of bichloride of mercury until the image disappears; wash and dry. To make the invisible image appear, place the picture in contact with a moistened sheet of absorbent paper which has been previously soaked in a saturated solution of hypo soda, when the image will reappear with all its pristine vigour, as if by magic.

819. Metallic Spots—To Remedy.—Spots of zinc, copper, etc., frequently appear in paper from the imperfect condition of the rollers by which it is calendered. These spots give the photographer much trouble in his printing operations. Such paper should be treated in the following manner: Dissolve twenty parts citric acid in two hundred parts distilled water. Pour the solution into an earthen or porcelain dish (the bath should be abundant, so that the paper may swim freely in it; the action is hastened by the application of gentle heat); allow several sheets to remain in it for an hour or two, then remove them and place them in another dish containing water rendered alkaline by five per cent. of ammonia; wash finally in pure water, and suspend by one corner to dry, thoroughly protected from the dust.

820. Metrical Measures—To Convert into English and Vice Versa.—Owing to the almost universal prevalence of the metric system in foreign countries, and its partial adoption by scientific writers even in our own, many (and an increasing number of) formulæ are expressed in the metrical weights and measures. These, although really simpler to use and make up than our English formulæ, are often a vexation of spirit to those who are unfamiliar with them, whereas a very simple calculation would suffice to make them easily intelligible. To begin with, these measures are expressed in grammes (grm.) and cubic centimetres (c.c.), the very simple relation which connects these two being that one c.c. of water weighs one gramme. It must also be borne in mind that 1,000 c.c. is sometimes called a litre. Now since a gramme equals 15·4 grains and a c.c. of water weighs 15·4 grains, it suffices to express all English weights (drams, ounces, etc.) in grains, and fluid ounces or drams in fluid grains, and to divide these by 15·4 (15$\frac{2}{5}$), when the result is at once reduced to grammes and c.c. To perform the reverse operation, multiply grammes and c.c. alike by 15·4, and the result is expressed in grains which for the fluid measures is easily reduced to drams or ounces, as may be most convenient. For all practical purposes the ·4 may be omitted, so that all that is necessary is to divide or multiply by fifteen, as the case may be. Even this simple process may be still farther simplified, at least so far as concerns turning metrical measures to English, which is the operation most frequently needing to be performed by the English photographer. One method is to note that in most formulæ the quantities of water are in multiples of 500 c.c., *i.e.*, either 500, 1,000, 1,500 c.c. Now 500 is so nearly 480 that each 500 may be taken as an ounce, and the grammes as grains to the ounce (two ounces, or three ounces) as the case may be. Thus a formula reading

A	8 grammes.
B	3 ,,
Water...	500 c.c.

might be taken as

A	8 grains.
B	3 ,,
Water	1 ounce.

whilst the corresponding quantities for

A	15 grammes	would be	15 grains.
B	7 ,,	,,	7 ,,
Water ...	1,500 c.c.	,,	3 ounces.

This method, of course, only gives an approximation to the *proportions* and not to the *bulk*, for 1,500 c.c. is a great deal more than three ounces (about forty-eight ounces). The following method gives a close approximation to the original bulk, and does not alter the proportions. Divide the grammes by four, and call them drams; divide the c.c. by four, and call them fluid drams. Thus, by this rule, the first formula above would work out—

A	2 drams = 120 grains.
B	$\frac{3}{4}$,, = 45 ,,
Water	125 fluid drams = 15 ounces 5 drams.

and the second one

A	$3\frac{3}{4}$ drams = 225 grains.
B	$1\frac{3}{4}$,, = 105 ,,
Water	375 ,, = $46\frac{7}{8}$ ounces.

For the less common operation of converting an English formula into a metric one, the easiest method is to express solids in grains and *divide by fifteen*; liquids in fluid ounces, and *multiply by thirty-two*. Thus, a developing formula as follows:

Pyro	1 ounce =	$437\frac{1}{2}$ grains.
Sulphite of sodium	4 ,, =	1,750 ,,
Citric acid	120 grains =	120 ,,
Water up to ...	20 ounces.	

would appear

Pyro...	29·2 grammes.
Sulphite	117 ,, (nearly)
Citric acid	8 ,,
Water	640 c.c.

It is hoped these simple methods may facilitate the comparison of formulæ expressed in different measures. Although it is much to be wished that until England can agree with every civilised country in the world in the matter of weights and measures, all photographers would help to simplify the present confusion worse confounded by agreeing to express all formulæ in *parts*.

821. Mezzotint Photographs—To Make.—Touching up paper prints in light and shade requires care and some knowledge of drawing. The colours to be used must somewhat depend upon the tone of the photograph. Brown madder and Indian ink, in the required proportions, will very nearly approximate to the tone of many photographs, whilst others will require these colours with the addition of a little neutral tint, and others a little sepia. The chief point is to use very little colour at a time, and, in touching up the half-tones especially, to work with a tolerably dry brush; it will be found that thus it will be easier to see the exact tint produced than in working with a pencil fully charged with colour. A little Chinese white may sometimes be used if the photograph be very heavy and wanting in drawing in the shadows, especially in the hair. But it must be remembered that Chinese white is very cold compared with the

tone of most photographs, and will require modifying to harmonise. It may also be used for putting the point of light in the eye. Avoid gum and anything that does not accord with the surface of the print.

822. Mirrors—How to Silver.—For silvering the glass one cannot do better than to quote the directions for working Common's process given by Major Waterhouse. The solutions recommended by Mr. Common are three:

	No. 1.	
Nitrate of silver	... ...	1 ounce.
Distilled water	... ...	10 ,,
	No. 2.	
Caustic potash	... ...	1 ounce.
Distilled water	... ...	10 ,,
	No. 3.	
Glucose ...	... ...	½ ounce.
Distilled water	... ...	10 ,,

The above quantities are sufficient for 250 square inches; consequently an ordinary copying mirror 8 × 6 would require rather more than two ounces of each solution, and other sizes in proportion. The caustic potash and distilled water must be quite pure. Ordinary caustic potash will not answer at all. The best to use is known as "Pure by alcohol." The glass surface to be silvered is cleaned with strong nitric acid, applied as recommended by Mr. Browning with a Buckle's brush, then well washed in clean water, and after rinsing with distilled water, laid face downward in a dish of distilled water till wanted. Before cleaning the glass it will be necessary to arrange for supporting it face downwards in the depositing dish, so that the surface to be silvered may be quite horizontal, and just below the level of the fluid, which should be about half an inch above the bottom of the dish. It is best to use a large cork, about four inches in diameter, cemented to the back of the plate and fitted with three strings, by which it could be suspended in a level position, and adjusted to any height by winding the string over a roller placed at a convenient height above the dish. To prepare the silvering solution: A sufficient quantity of the silver solution No. 1 (two ounces) is put into a perfectly clean glass. Ammonia is dropped in till the precipitate first formed is just redissolved. The same quantity of potash solution No. 2 as of silver is now mixed in, and the precipitate again dissolved by ammonia. A little more silver solution is then added to produce a distinct turbidity, and distilled water to make up the quantity necessary to fill the depositing dish to about three-eighths or half an inch, and the mixture is then filtered through cotton into another clean glass vessel. The same quantity (two ounces) of filtered solution of glucose No. 3 as was taken of silver and potash is now mixed in, and the whole poured into a depositing dish, which should be preferably of glass, well cleaned with nitric acid. The glass plate is then taken out of the distilled water and laid face downward on the silvering solution, being supported, as before described, just above the surface, so that the solution does not cover its back. Mr. Common places the requisite quantity of distilled water in the dish in which the mirror has been remaining face downwards, and then, having lifted the mirror up, pours in the undiluted silvering solution, together with the glucose solution, stirs well together, and then carefully lowers the mirror again into the dish. Almost immediately after the immersion of the plate the silvering action begins, and, if things are going on well, a brilliant reflecting surface will be seen at the back of the plate, and in forty minutes, or even less, a good deposit of silver will be obtained. It is usually recommended to stop the action as soon as the silvering fluid appears clear and free from turbidity, but it is not always easy to see this. After silvering, the plate is well washed, finished with distilled water, and dried off quickly. A slight cloudiness of the surface may appear, and must be removed by polishing before the mirror can be used. It is better to allow the mirror to remain a day or so before polishing, in order to harden the coating. To polish the plate it should be slightly warmed, and be perfectly dry, then rubbed gently in small circles with a piece of very soft and dry chamois leather, afterwards using a little jeweller's rouge. Mirrors should always be kept in a dry place, and will require repolishing from time to time.

823. Oak Frames—To Darken.—There are various methods by which this may be accomplished, and one of the following may be tried, though any of them, if the instructions are attended to, will give good results: (A.) The frame is thoroughly dried and warmed slightly; when still warm it is coated once or twice with a stain composed of one ounce extract of walnut peel dissolved in six ounces of water, by heating to boiling and stirring well. After the frame has been treated thus, and is still only half dry, it is brushed over with the following solution: One ounce bichromate potash, five ounces of boiling water. After this treatment, if the frame is dark enough, it is carefully dried and polished, or oiled if desired. (B.) Oak may be darkened by rubbing on it, by means of a rag or brush, a strong solution of liquid ammonia. The colour deepens immediately, and does not fade; by this means an artificial production of "ancient oak" is obtained. (C.) A walnut stain nearly suitable for all kinds of woods may be prepared as follows: Water 1 quart, washing soda 1½ ounces, vandyke brown 2½ ounces, potash bichromate ¼ ounce. Boil for ten minutes, then apply with a brush. This stain may be used either hot or cold. Other methods are: Very strong coffee will darken wood considerably, or a mixture of iron filings and sulphuric acid has the same effect. A solution of bichromate of potash may be used in a similar way to ammonia. A brown stain can be imparted to wood by painting it over with a solution made by boiling one part of catechu, cutch, or gambier, in thirty parts of water, to which a little soda is added. The wood should be dried in the air, and then painted over with a solution of bichromate of potash 1 part, water 30 parts. By slightly varying the proportions of the solutions and length of treatment, various shades of colours can be obtained with the above materials. Light oak can be darkened by applying oil with a piece of cotton wool, and afterwards with a clean piece of flannel, bnt to appear like walnut it should be stained with a strong solution of potassium permanganate, or with Condy's fluid. The stronger the solution the darker the frame will be dyed; half an ounce of potassium permanganate to two ounces of water is a good strength. If after staining with the above solution the frame be rubbed with an oiled rag, very fine colour may be obtained.

824. Opal Plates—To Clean.—If the spoilt opals are placed in a bath of fresh hypo, to which a saturated solution of ferricyanide of potassium (*red* prussiate of potash) has been added, until the mixture is orange in colour, all deposit due to silver will be cleared away. In case all stain is not removed by this treatment, rinse the opals, and immerse them in a strong solution of bichromate of potash, to which some strong sulphuric acid has been added. This ought to remove anything. In some cases it is easier to remove a stain by mechanical than by chemical means. Rubbing the plate with rouge or tripoli, moistened with spirits of wine, will effect this, and

will not scratch the plate. Films may be detached from spoilt opals, lantern plates, etc., either with a strong hot solution of washing soda, or with glacial acetic acid, and neither of these reagents leaves anything behind in the form of stain. Another simple method for removing the stains remaining in the darker parts of an opal print, after washing the film off as much as possible, is to steep the opal in a solution of chloride of lime to which a little acetic acid has been added until the stain is entirely bleached. Then wash thoroughly in running water, and afterwards in a warm solution of nitrate of barium, using a hard nailbrush. A final brushing with soap and water will give a perfectly clean opal. Another method: After removing the film, soak the plate in a strong alkaline solution, carbonate of soda, or, what is still better, caustic potash; allow it to remain in this for some time, and during its immersion rub the solution over the discoloured portions of the plate by means of a piece of cork or such like. In ordinary cases this treatment will most likely prove successful, but if it should fail, the following may be tried with better results: Cover the plate with a solution of nitric acid (strength about twenty-five drops of the acid to the ounce of water); to this solution add a quantity of tripoli powder, and rub the mixture over the surface of the plate until the stains have disappeared, and it resumes its original white surface.

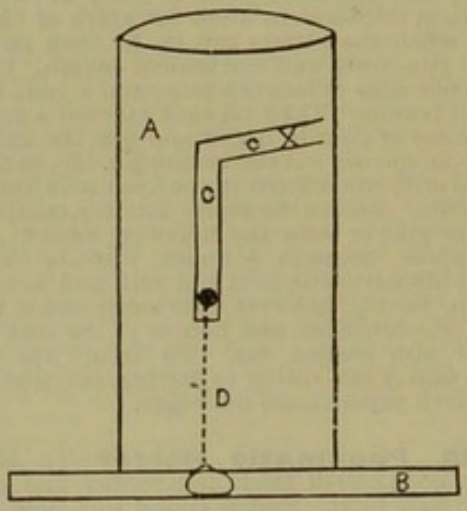
825. Parchment—To Restore.—When parchment documents are wrinkled and creased the evil may be remedied, without injury to the writing, in the following manner: Place the document, face downwards, upon a clean piece of blotting paper. Beat up to a clear froth, with a few drops of clove oil, the whites of several fresh eggs, then with the fingers spread this over the back of the sheet, and rub it in until the parchment becomes uniformly soft and yielding. Then spread it out as smoothly as possible, cover it with a piece of oiled silk or paper, put it on a piece of smooth board, and set it aside in a cool place, with a weight on the board for twenty-four hours. Then remove the board and silk, cover with a piece of fine linen cloth, and press with a hot smoothing iron (not too hot) until all signs of wrinkles have disappeared. The heat renders the albumen insoluble, and not liable to change.

826. Plate Boxes—To Utilise.—Cheap and useful trays may be made from plate boxes by giving them a coating of stearine and driving it into the cardboard by means of a hot iron. If the stearine is not handy, a good wax candle might be used instead. Some store their negatives in plate boxes with a sheet of paper between each and the front edge of the box cut at the corners to allow it to be folded down, and thus give better access to the negatives. The cardboards from lids and bottoms of boxes are also useful for vignetting, etc. Another practical use is for storing of negatives, when a list of the contents should be pasted on each box lid outside, or at one end, so as to obviate the necessity of opening each box for a particular negative. They can also be used for keeping cut sensitised paper, and should then have some loose sheets of blotting-paper, soaked in solution of carbonate of soda, placed alternately with the paper. Untoned, unmounted, and loose prints may also be kept in them. Having removed one end of the boxes, glue the lids on, and then glue the boxes together—the top of one to the bottom of the next one. This forms a very convenient set of pigeon-holes for negatives when placed on a shelf of convenient width, each box containing nine or ten negatives in their envelopes. Any negative may be removed without disturbing the whole row. A cabinet may also be made of Thomas's plate boxes by gluing the outer cases together—four wide and three deep—and using the inner boxes as drawers. This is very convenient for prints, pencils, test papers, etc. If they are the ordinary top and bottom boxes, such as the Ilford, Castle, etc., they can by the following means be made into strong, light-tight boxes. Take two boxes, same size, separate the in from the outsides, and bring the two insides together, edge to edge, and paste a band of brown paper round three of the sides. Do the same with the outer lids, and then let them dry. When dry, take a penknife and cut out the unfastened sides; then take a piece of grooved cardboard, and glue it inside the box to separate the plates; if the grooves are made wide enough to pass two glasses back to back, the box will easily hold a dozen plates.

827. Plates Waste—To Make into Tanks.—A piece of rubber tubing may be placed between the plates, it being arranged in the shape of a V, and the plates held together by two extra strong indiarubber bands. An easy method would be to make a frame of deal or mahogany with grooves to receive the plates, cement them in with fine plaster of Paris, and then, when dry, run melted paraffin wax over the cement. With care a tank might be formed by means of plaster of Paris without the frame, but the plaster would have to be enamelled or coated with wax to prevent absorption of the liquids. Another way: Take a piece of quarter or half-inch board, according to the capacity of tank required, cut it same size as the plates, and then out of the middle of it cut a piece the size and shape of the opening required to be transparent in the tank. Give the edges of the board, which will come in the interior of the tank, a coating or two of black varnish, so as to waterproof the wood. Take a couple of quarter-plates, and cement one on to each side of the wood—in other words, "sandwich" the piece of wood between two glass plates. The hollow place left by cutting out the piece of board will form a suitable tank for various liquids. A cement for fixing the glass to the wood may be made as follows: Oyster shells ground to the finest powder mixed to a paste, with whites of eggs, or Prout's elastic glue might do. Another: Take a piece of wood (of sufficient thickness to allow for width of chemical tank when the glasses are let in flush on either side) 3½in. wide and convenient length. Cut out from one edge of length a piece 4in. × 3in., leaving ½in. at bottom. Then on each *side* cut a rebate of thickness of glass in depth and ⅛in. lap, and from the bottom strip cut the rebate ¼in. lap, so that the plates will, when fitted in, be flush with the top of the slide. Secure the plates into the rebates with marine glue or with the following cement: Resin 2½ ounces, beeswax ½ ounce, Canada balsam 1 dram (dissolve with heat and mix, and heat when using), having, however, previously made the inside, wooden sides, and bottom of the tank waterproof with shellac, etc. To secure the glasses from falling out, owing to jarring, etc., glue strips of brown paper round the edges.

828. Pneumatic Holder—To Make.—Get a good ball of thick indiarubber, and pierce a small hole in it. Fasten round this hole a thick ring of the same material with some rubber solution. Let it dry, and it forms a very simple article for holding plates when coating, etc. Press the ball, put the ring against the glass, release the pressure on the ball, and the plate will stick. A holder may be made with a small cotton or silk reel and an indiarubber ball about 2in. in diameter. Shave down the reel as small as possible, leaving the flange at one end only. Cut a nick all round the

stem close up to the flange, and force into the hole of the ball till the nick is grasped. Cut a small piece of rubber cloth, and fix on the top, with a hole in it. A very useful substitute for a pneumatic holder is a bottle with a cork in it rounded on the top, on which the plate may be held and manipulated. Another way: Purchase a chisel handle, which can be obtained from an ironmonger for 2d. or 3d. Make a circular disc of well-seasoned wood, about a quarter of an inch in thickness and 1½in. to 2in. in diameter, and bore a hole in the centre and countersink it. Bore a hole in the ferruled end of the handle and screw the disc on to the handle, driving the screw well home. Cement a piece of rubber fabric, with the rubber side outwards, on to the disc with shellac. Obtain a soft red rubber washer of the diameter required, $\frac{3}{16}$ths of an inch thick, with an aperture of about $\frac{3}{8}$ths of an inch in diameter, and cement it on to the rubber fabric, round the inner edge, with rubber solution. When the cementing is thoroughly dry, the holder will be ready for use. Having cleaned the glass plate to be held, wet the rubber washer and press it firmly on to the plate and it will retain its hold. This is similar in principle to the pneumatic railway carriage candle lamps. Another: This is easily managed by detaching the ball of a release to shutter. If not, the ball of an old ear syringe will do. Now get a piece of 1in. wood, 2in. square, and either cut or turn it so that it may be of shallow cup shape, with rim ¼in. wide, and shank ½in deep, to fit the aperture of the ball. Now bore a hole through the centre of the shank into the bottom of the cup, give a coat inside and out of shellac varnish, and with indiarubber solution cement a 2in. elastic band to the rim, insert the cup into the ball, and the holder is made. Another: This is a simple apparatus to make, the material required being a disc of $\frac{3}{16}$ sheet rubber, a hollow wooden tube about 3in. in length, and a piece of stiff wire. Failing a wooden tube, a piece of stout millboard roller, such as is used for the packing of pictures, will do, though, unless the wearing parts are protected with a tin clip, they will soon fray. A is the hollow tube, B the disc of sheet rubber in its normal position; C CX is a slot cut in one side of the tube, and within which works



a small arm or lever attached to the wire rod shown by the dotted line D, the said wire being secured to B by passing through and riveting on to a thin brass plate. To bring the apparatus into use, place it in the position as sketch on the back of a glass plate, raise the lever up slot C and slip it along the slot CX. The indiarubber disc should be about 2½in. or 3in. in diameter, and the hollow of the tube about an inch less.

829. Public Parks, etc.—How to Photograph in.—Applications to photograph (views only) in the provinces and the various London parks, etc., must be made as under, enclosing in all cases a stamped addressed envelope for reply:

In the Provinces.—The cathedrals: Upon application to the deans. The churches: Upon application to the vicars. Ruins of abbeys and castles: Upon application to the stewards. As a rule, no objection is made to amateurs taking views in cathedrals and churches, between the hours of Divine service; but it is always better to ascertain whether permission is necessary—of the person in charge—at all of the above places.

In London and Vicinity.—Battersea Park: Of the County Council (address the London County Council, The Chief Officer, Spring Gardens, London, S.W.; permissions to photograph available for twelve months are granted). British Museum: Of the principal librarian; amateurs are allowed to photograph exhibited objects only; leave is not granted to photograph objects indiscriminately; the object to be photographed must be distinctly specified, and a separate application submitted to each department (stating the photographer to be employed—if a special object *not exhibited* is desired). Burnham Beeches: No restriction. Bushey Park: H.M. Board of Works (address H.M. Board of Works, H. W. Primrose, Whitehall, London, S.W.; permissions to photograph available for twelve months are granted). Epping Forest, Wanstead Park, and Highgate Woods: The Town Clerk, Guildhall, E.C. Embankment Gardens and Finsbury Park: Of the County Council (as above). Green Park: H.M. Board of Works (as above). Greenwich Park: H.M. Board of Works. Hampton Court: H.M. Board of Works. Hyde Park: H.M. Board of Works. Imperial Institute: Of the Secretary. Kensington Gardens: H.M. Board of Works. Kew, Royal Gardens: Of the Director (the privilege is not available on Sundays, Christmas Day, Good Friday, or Bank Holidays). Richmond Park: H.M. Board of Works. St. James's Park: H.M. Board of Works. St. Paul's Cathedral: Of the Dean. South Kensington Museum: The Secretary, Department of Science and Art, London, S.W. Victoria Park: Of the County Council. Virginia Water: Of Capt. Walter Campbell, Holly Grove, Windsor Park. Wanstead Park: Of the Town Clerk, Guildhall, London, E.C. Windsor Green Park: Of Capt. Walter Campbell, Holly Grove, Windsor Park. Westminster Abbey: The Dean. Zoological Gardens: The Secretary, Zoological Society, 3, Hanover Square, London, W. To photograph in the City it is usual to make application to John Whalley, Esq., 26, Old Jewry; and for those districts under the metropolitan police to the Commissioner of Police, 4, Whitehall Place, S.W. Direct permission will not be given; but a letter stating that no objection will be made, providing the photographs are taken in the early morning and no obstruction is caused. These letters are extremely useful to show to any officious policeman who may interfere, and as there are many such it is as well to have them. No one should attempt photography in any of the places mentioned without being in possession of a permit, as in many cases there are penalties attached for so doing, and there are always over-officious keepers who are ever on the alert to catch the unwary.

830. Room—How to Darken.—Procure an ordinary blind roller fitted with cord, rack, and pulley, or other means of drawing up and down, and fit the roller at the top of the window. For the remaining three sides of the window-frame, cut some strips of "carpet" or other strong brown paper about six or eight inches wide, crease these

down the centre lengthwise, and glue together with thin glue. While the glue is still moist, fold the strips again down the centre, and put on one side to dry. These will form grooves one and a half or two inches in width, and should be tacked on the two sides and the bottom of the window-frame, open side inwards. The blind is made of one thickness of black calico or linen and one thickness of carpet paper, tacked on the roller in the usual way. The blind is made just wide enough to work in the paper grooves which have been fixed round the window. A close-fitting valance of black material is fixed up over the roller, and the arrangement is complete. Where it is considered desirable, the whole or part of the blind might consist of some translucent red or yellow fabric.

831. Stoppers—To Remove when Fixed.—(1.) Heat the neck of the bottle in the flame of a common wooden match, turning the bottle round and round so as to warm the glass evenly, and before the neck has had time to cool press the stopper right and left several times with the thumb. This manœuvre is rarely known to fail. A spirit lamp, if available, is more convenient than a match. An ordinary lamp or gas jet is practically useless, as the heat is not sufficiently concentrated. Take care in any case not to crack the neck of the bottle by overheating, and be sure to use the thumb as directed before the neck has had time to cool. (2.) A fixed stopper can often be removed by means of a string passed once round the neck of the bottle and drawn rapidly backwards and forwards, the bottle being held fast meanwhile; and if this fails take a block of wood three inches square and two inches thick, and cut a hole in its centre large enough to receive the head of the stopper. This piece of wood is placed over the stopper and grasped firmly in one hand, while the neck of the bottle is held by the other. A gentle steady twist is then given, taking care not to wrench, but give a steady, firm turn. This will remove the most refractory stopper. (3.) Put two or three drops of paraffin oil in the recess between stopper and bottle. This will in a short time insinuate itself through the "sticking" place. In the meantime, prepare two pieces of hard wood, say ash, about 9in. long by 1in. wide and $\frac{3}{4}$in. thick. Bind them at one end with a leather hinge (a bit of good thick "upper" off an old shoe will do well), nail it very securely, and glue a strip along the inner edges, say 5in. long. There is then an instrument somewhat like a pair of crude nut-cracks. Put this on the stopper, grip it tight with the hand, give a few wriggles, and then a firm, slow turn, and the stopper is certain to give way to this persuasion. The leather lining is to soften the pressure and prevent slipping, and the length is for leverage. Wipe the oil out of the neck before it can run into the contents of the bottle. (4.) The best way to remove a tight glass stopper is by tapping it gently on one side with a light wooden handle, at the same time as bottle is held in the other hand, press the stopper with the thumb and first finger on the other side, upwards. This method, if persevered in long enough, is sure to succeed, but requires patience. Or sometimes a quicker way is to warm the neck of the bottle by wrapping a cloth round it dipped in boiling water, which usually succeeds. The last method is one which must only be resorted to in very extreme cases, and is: A drawer is opened slightly, the stopper—which must have a flat top, not those that cover over the mouth of the bottle—is inserted in the nick, and then the body is twisted forcibly with the hands. Care must be taken, or else, if the stopper is in very tight, the neck of the bottle may come off with it, and the bottle be irretrievably spoiled. And now for prevention, which is said to be better than cure. Wipe the neck of the bottle and the stopper dry, and anoint with a little vaseline, and it will never stick. The vaseline will not hurt the contents, as it is unacted upon by ammonia.

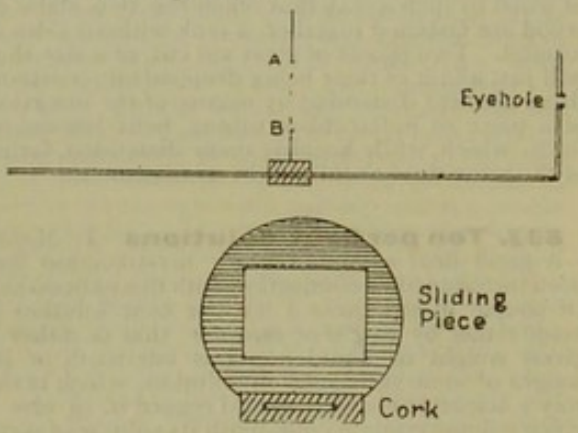
832. Tank for Lantern—To Make.—Various interesting experiments may be shown by means of a tank. To make one, select two pieces of wood, 8in. long, 4in. wide, $\frac{5}{16}$in. thick; and at the middle of each cut a hole 3in. in diameter; after which cut away the wood surrounding this hole for a distance of about a $\frac{1}{4}$in., so that the borders of the first-mentioned one will form a shoulder for the part afterwards cut away, the larger aperture being cut to the edge of the piece of wood in such a way that when the two slabs of wood are fastened together, a tank without sides is formed. Two pieces of glass are cut, of a size that will just admit of their being dropped into position; these are kept distended by means of the insertion of a piece of indiarubber tubing, bent horseshoe form, which, while keeping them distended, forms at the same time a water-tight compartment.

833. Ten per Cent. Solutions—To Make.—A good deal of unnecessary mystification has been introduced in connection with this expression. Of course in strictness a ten per cent. solution is made either by *weight* or *measure*; that is, either a given weight of liquid contains one-tenth of its weight of some substance in solution, which is the way a scientific chemist would regard it, or else a given volume contains one-tenth its volume of some other liquid. What a photographer wants, however, and means by a ten per cent. solution, is that a fluid ounce of 480 minims should contain forty-eight grains of the soluble ingredient, and the whole confusion has arisen out of our custom of measuring liquids and weighing solids, coupled with the existence of two ounces—a troy ounce and an avoirdupois ounce, the avoirdupois ounce weighing 437½ grains, whilst the fluid ounce contains 480 minims. To get, therefore, a solution in which every ten minims should contain one grain of, say, pyro, or the dram six grains, it is necessary to take an ounce avoirdupois of pyro, which is the weight by which it is sold, and add enough water to make up *not ten ounces* but 4,375 minims, that is nine ounces one dram *nearly*. The same of potassium bromide or any other solid of which a ten per cent. solution is desired. The great advantage of a ten per cent. solution is that it affords such an easy method of measuring out any desired weight and saves so much weighing. Suppose for any purpose seventeen grains of potassium bromide are required, it is only necessary to *measure* out 170 minims of a ten per cent. solution, or two drams fifty minims, which is done in two seconds. For a ten per cent. solution of ammonia (or any liquid) measure out a fluid ounce and make up to *ten* ounces.

834. View Meter—To Make.—A view meter must not be confounded with a view finder. The latter is used merely to see when a moving object is on the centre of the field of view, and therefore on the centre of the plate; whilst the former is employed as a convenient little instrument for ascertaining the amount of view included by the lens upon any given size plate without the trouble of setting up the camera, and also, incidentally, of looking at any subject and noting its composition, and whether it is likely to make an artistic picture. Many view finders can be used also as view meters, when they show the view upon a rectangular piece of ground glass which is of the right proportions, and includes the same amount of subject as the plate does for a

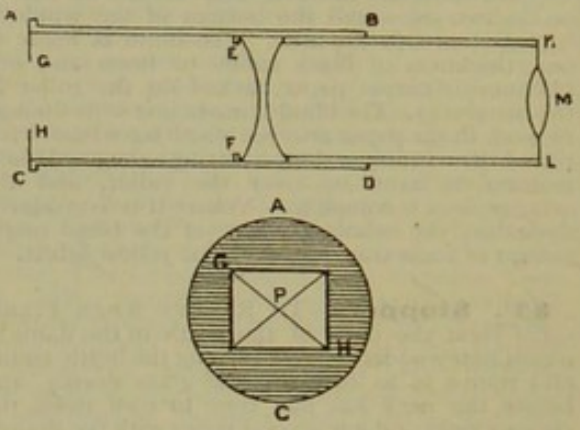
given lens, but they are usually incapable of adjustment, and hence a properly constructed view meter is preferable.

There are two forms of view meter which are within the power of an amateur to construct. The first consists merely of a strip of metal, such as brass (or even wood), to one end of which is attached a piece at right angles, preferably made folding by a little hinge, and pierced with a small round hole for the eye, whilst along the strip slides another piece carrying a circular disc, in which is cut a rectangle bearing the same proportions as the plate, say 1in. × ⅝in. The sliding piece may be merely a flat piece of cork, in which is stuck transversely to the axis of the instrument a circular piece of ferrotype plate cut in the centre in rectangular shape thus:



The eyepiece, which folds flat when the meter is not in use, is set up at right-angles to the strip, and the sliding-piece traversed backwards and forwards until the eye at the opening of the eyepiece sees exactly the same amount of subject the ground glass of the camera shows with any particular lens. The strip is then marked with number and focus of that lens, and the sliding-piece only requires setting against that mark and the landscape looking at through the eyepiece when the rectangular opening frames just so much as the plate will take in from same point of view. If too much or too little, the correct point of view can easily be found by altering the position of the observer, or, if the strip is marked for several lenses, by altering the sliding-piece the proper lens is found to cover the plate at the selected point of view. Another may be constructed as in the next column.

A B C D is a brass tube, carrying at one end a cap A C, in which is a rectangular hole G H, bearing a proportionate size to the plate used (as for quarter-plates, $\frac{17}{16}$in. × $\frac{13}{16}$in.; half-plate, a shade wider), E F is a concave lens of 1½in. *negative* focus, and M a double convex lens of 3in. focus, both carried by an inner brass tube E F L K, which slides in the outer



one. When the eye is applied to the convex lens, the picture will show in miniature. A C is also a front view of the cap, with opening G H crossed by two fine wires showing centre of view at P. To use this it must be adjusted by sliding the inner tube until the rectangular opening just frames the view on focussing screen of camera. This is best done by noting two prominent objects at edge of screen, and seeing that the opening of meter just includes them. Then make a mark on the sliding tube of meter, so that it can be again set in exactly the same position.

835. Water-developed Plates — To Make.—A process has been invented by Dr. Blacklandt by which plates may be developed by simple immersion in water. The dry plates, prior to exposure, are immersed in a solution as follows:

Pyrogallic acid	10	parts.
Salicylic acid	1	,,
Dextrine	10	,,
Alcohol	4	,,
Water	20	,,

and allowed to dry at ordinary temperature. After exposure they may be developed by immersing the plates in pure water, to which has been added a small quantity of liquor ammonia, or a few grains of carbonate of soda. Such plates might prove very useful to tourists who desire to develop plates on tour without carrying a formidable amount of impedimenta with them.

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USEFUL TABLES.

Mr. W. K. Burton's Table of Comparative Exposures.*

Aperture of lens. U.S. No. = f/A	Sea and sky.	Open landscape.	Landscape with heavy foliage in foreground.	Under trees. Up to	Fairly lighted interiors.	Badly lighted interiors. Up to	Portraits in good studio light.	Portraits (outdoor) in bright diffused light.	Portraits in well-lighted ordinary room.
	sec.	sec.	sec.	m. s.	m. s.	h. m.	m. s.	sec.	m. s.
No. 1 = f/4	1/150	1/50	1/25	0 10	0 10	0 2	0 1	1/2	0 4
No. 2 = f/5·6	1/50	1/25	1/12	0 20	0 20	0 4	0 2	1	0 8
No. 4 = f/8	1/25	1/12	1/6	0 40	0 40	0 8	0 4	2	0 16
No. 8 = f/11·3	1/12	1/6	1/3	1 20	1 20	0 16	0 8	4	0 32
No. 16 = f/16	1/6	1/3	2/3	2 40	2 40	0 32	0 16	8	1 4
No. 32 = f/22·6	1/3	2/3	1 1/3	5 20	5 20	1 4	0 32	16	2 8
No. 64 = f/32	2/3	1 1/3	2 2/3	10 40	10 40	2 8	1 4	32	4 16
No. 128 = f/45·2	1 1/3	2 2/3	5 1/3	21 20	21 20	4 16	2 8	64	8 32
No. 256 = f/64	2 2/3	5 1/3	10 2/3	42 40	42 40	8 32	4 16	128	17 4
Or calling	1/3	1	6	*Up to* 480	480	*Up to* 5,760	48	8	192

*These are for bright sunlight in May, June, or July, slow plate.

Platt's Tables.

Table I.—Subject and Light.

Compiled and slightly altered from Eder and Burton.	Sunshine.	Diffused light.	Dull.	Very dull.	Gloomy.
Sea and sky	1/4				
Panoramic view (open landscape)	1	2	3	4	5
,, with thick foliage or strong foreground	2	4	6	8	10
Dark buildings	3	6	9	12	15
Heavy foliage, foreground	4	8	12	16	20
Woods and badly-lit river banks	10	20	30	40	50
Living objects outdoors	4	8	12	20	30
Portrait near window	8*	16*	24*	40*	60*
Interiors (according to light). *Upwards of*	100	200	300	400	500
Copying same size	6	12	20		

*This seems *much* too small. (See Burton above.)
is ratio for outdoor portraits. *In room*, 120 is about right.

Table II.—Time of Day and Month (Dr. J. A. Scott).

Hour of day.		June.	May. July.	April. August.	March. September.	February. October.	January. November.	December.
a m.	p m.							
12		1	1	1 1/4	1 1/2	2	3 1/2	4
11	1	1	1	1 1/4	1 1/2	2 1/2	4	5
10	2	1	1	1 1/4	1 1/2	3	5	6
9	3	1	1 1/2	1 1/2	2	4	12	16
8	4	1 1/2	1 1/2	2	3	10		
7	5	2	2 1/2	3	6			
6	6	2 1/2	3	6				
5	7	3	6					
4	8	6						

Yellow sunset or fog affects these figures.

Platt's Tables *(Continued)*.

TABLE III. — LENS AND STOP.

U.S. No.	1	2	4	8	16	32	64	128	256
Ratio...	f/4	f/5·6	f/8	f/11·2	f/16	f/22·6	f/32	f/45	f/64
Factor	¼	½	1	2	4	8	16	32	64

In practice the factors taken from Tables Nos. I., II., and III. are multiplied together, and divided by a number representing the speed of the plate, which with an "Ordinary" plate (*so-called thirty times*) or about 16° Warnerke, may be taken as 20. Thus, October 15th, bright sunlight—cottage with foliage, 10 am. $F/16 = \frac{2 \times 3 \times 4}{20} = 1\frac{1}{5}$th sec.

Cadett's Table, showing the relative Rapidity of Sensitomer Numbers W°.

Number of times more sensitive than	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°
25 is	16	12	9	7	5	4	3	2⅓	1¾	1⅓	1
24 ,, ...	12	9	7	5	4	3	2⅓	1¾	1⅓	1	
23 ,, ...	9	7	5	4	3	2¼	1¾	1⅓	1		
22 ,, ...	7	5	4	3	2⅓	1¾	1⅓	1			
21 ,, ...	5	4	3	2⅓	1¾	1⅓	1				
20 ,, ...	4	3	2¼	1¾	1⅓	1					
19 ,, ...	3	2⅓	1¾	1⅓	1						
18 ,, ...	2⅓	1¾	1⅓	1							
17 ,, ...	1¾	1⅓	1								
16 ,, ...	1⅓	1									
15 ,, ...	1										

To use this table to compare the rapidity of two plates, the sensitometer numbers of which are known, find the higher number in the first column, and run the eye along until it reaches the column headed by the lower number. Thus 23° is *four* times more rapid than 18°.

E. Ferrero's Table of Exposures for Enlarging.

Stanley's actinometer. *	f/16	f/22	f/26	f/32	f/40	f/48	f/72	f/100
	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
10 seconds	0 9	0 17	0 23	0 36	0 55	1 20	3 0	5 47
15 ,, ...	0 13	0 25	0 34	0 54	1 23	2 0	4 30	8 40
20 ,, ...	0 18	0 32	0 46	1 12	1 51	2 40	6 0	11 34
25 ,, ...	0 22	0 42	0 57	1 30	2 18	3 20	7 30	14 27
30 ,, ...	0 27	0 49	1 9	1 48	2 46	4 9	9 0	17 21
40 ,, ...	0 36	1 5	1 34	2 24	3 42	5 20	12 0	23 8
50 ,, ...	0 45	1 24	1 54	3 0	4 36	6 40	15 0	28 54
60 ,, ...	0 54	1 38	2 18	3 36	5 32	8 0	18 0	34 42
70 ,, ...	1 3	1 54	2 42	4 12	6 28	9 20	21 0	40 29
80 ,, ...	1 12	2 10	3 7	4 48	7 24	10 40	24 0	46 15
90 ,, ...	1 21	2 29	3 28	5 24	8 18	12 0	27 0	52 0
100 ,, ...	1 30	2 48	3 48	6 0	9 12	13 20	30 0	57 48
120 ,, ...	1 48	3 16	4 36	7 12	11 5	16 0	36 0	69 24

* Stanley's actinometer is bromide paper soaked in potassium nitrite.

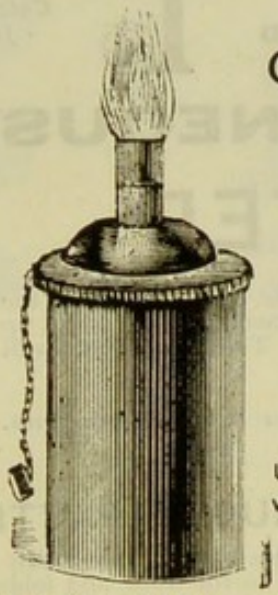
These exposures are for Eastman and Ilford slow bromide paper. Britannia rapid requires one-fiftieth and ordinary gelatino-bromide plates one-twentieth these exposures. F/45 would require $\frac{9}{10}$th exposure of f/48, and f/64 would require $\frac{1}{8}$th of f/72.

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From "THE PRACTICAL PHOTOGRAPHER," July, 1895.—"All the objectionable features of candles and oil are overcome by the 'Moonlight' Pocket Lamp, a little affair which can be stowed in the waistcoat pocket."

From "THE OPTICAL MAGIC LANTERN JOURNAL," July, 1895.—"Placed inside of a ruby lantern, it is excellent when developing photographic plates, and as a reading lamp at lantern lectures it cannot be surpassed for ease of lighting and general convenience."

From "PHOTOGRAPHY," June 27th, 1895.—"It is useful in numberless ways in photographic practice. It is compact in shape, and gives a light of good colour. For the travelling photographer the lamp is likely to be a useful bit of apparatus, as its size involves no inconvenience in carriage, and if need arose might be used for reading in a railway carriage."

From "THE PHOTOGRAPHIC REVIEW OF REVIEWS," July 15th, 1895.—"It is cheap, very cleanly, and with a roll of ruby paper round it, or used in one of the folding patterns of dark room lamps instead of the night lamp, forms an efficient light for changing or developing. It is exceedingly neat in its dimensions."

From "THE OPTICIAN," July 18th, 1895.—"Photographers have cordially welcomed the 'Moonlight' Vapour Pocket Lamp, whose universal utility, however, likewise commends it for household and railway travelling purposes. Among other articles manufactured by the company on the same principle are cycle, night, boudoir, carriage, piano, taper, and workshop lamps, lanterns, etc., all of which are commanding a large sale."

From "THE AMATEUR PHOTOGRAPHER," June 21st, 1895.—It is perfectly safe, gives off no smell, and lights instantly, and there being no liquid left in the lamp, it does not leak, and gives a very good light. For the dark-room at home, and for touring, it will be found extremely convenient, safe, and economical for railway travelling and other purposes."

From "THE BRITISH JOURNAL OF PHOTOGRAPHY," June 21st, 1895.—"It is compact, cylindrical in shape. It burns at the top with a steady flame, powerful enough to enable plates to be changed or developed by."

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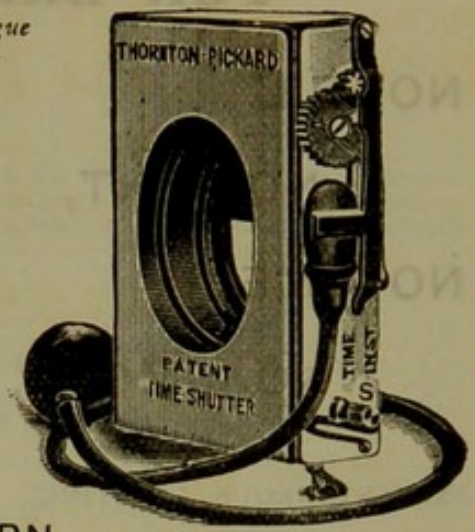
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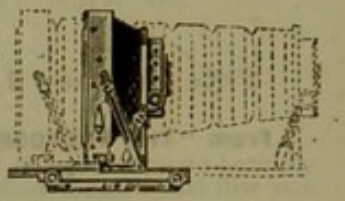
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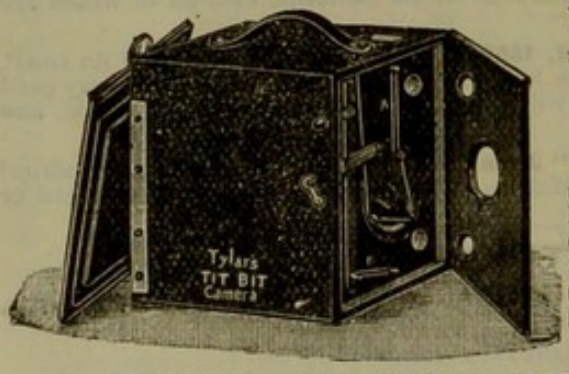
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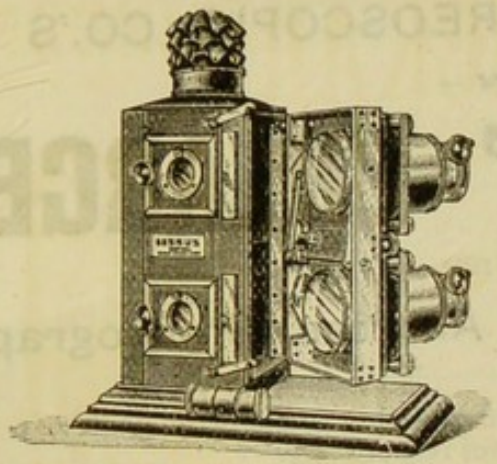
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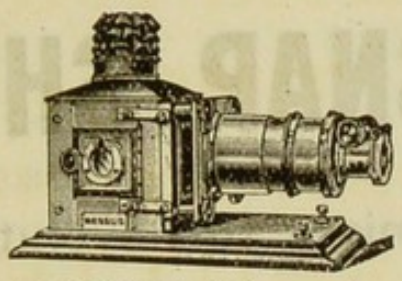
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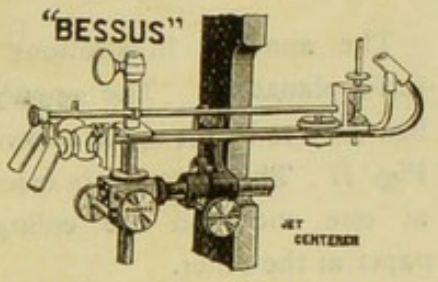
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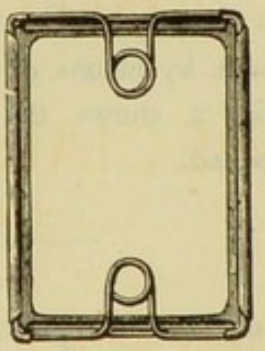


FIG. 22.
With handles cut down.
FOR ROLLABLE FILMS.

	Per doz.
¼-plate ..	**12/-**
5 × 4 ..	**15/-**
½-plate ..	**18/-**
7 × 5 ..	**21/-**
¼-plate ..	**21/-**

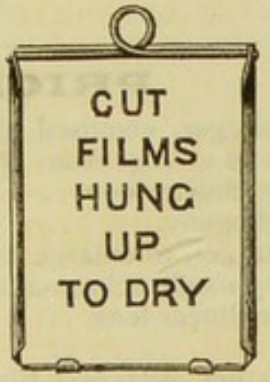


FIG. 25.
FOR CUT FILMS.

	Per doz.
¼-plate	**8/-**
5 × 4	**10/-**
½-plate	**12/-**
7 × 5	**14/-**
¼-plate	**16/-**

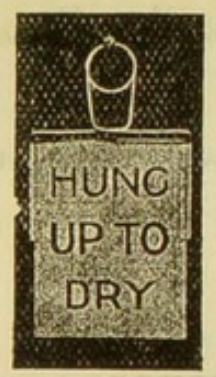


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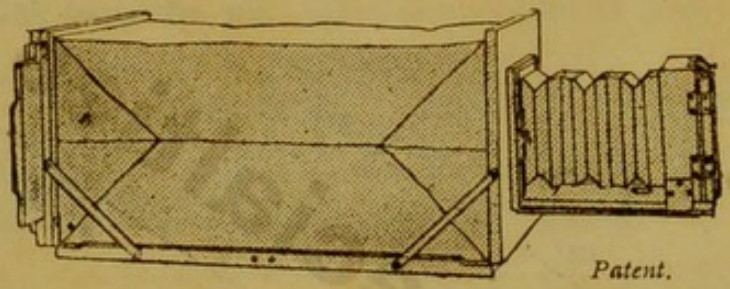
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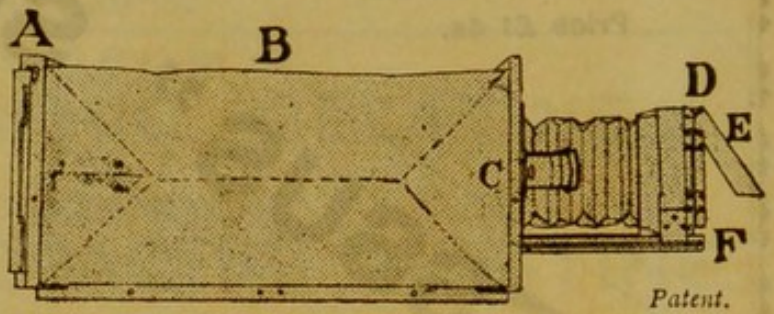


Patent.

FIG. 1.

The annexed illustrations are self-explanatory. The apparatus has only to be set up as shown in Fig. 1. The negative is inserted at one end and the enlarging paper at the other.

The Shutter is then drawn and the apparatus pointed up to the sky. The exposure is made by means of the flap E. Fig. 2 shows the apparatus opened.



Patent.

FIG. 2.

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	In best mahogany	6	16	6
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