BACK FOCUS

Journal of the Australian Photographic Collectors' Society Inc
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Contents

LAVERNE magic lantern - circa 1870

The Australian Photographic Collectors' Society Inc.

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The Australian Photographic Collectors' Society Inc is incorporated in Victoria Australia, and has as its members, people with similar interests in photography. Its Rules of Association contain its aims and purposes as "To foster the collection, restoration and conservation of the apparatus, images and literature of photography from its beginning until recent times, and to encourage the exchange of information about such items."

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Meetings are held at Australian Model Railway Association Hall. 92 Wills Street, Glen Iris, VICTORIA - Details of meetings, markets, auctions and other event may be found on the APCS website: www.apcsociety.com.au

Society membership includes subscription to Back Focus: $50.00 per annum. See the APCS website for details.

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BACK FOCUS No 118 CONTENTS

The ADLAKE SPECIAL - an auction tale...

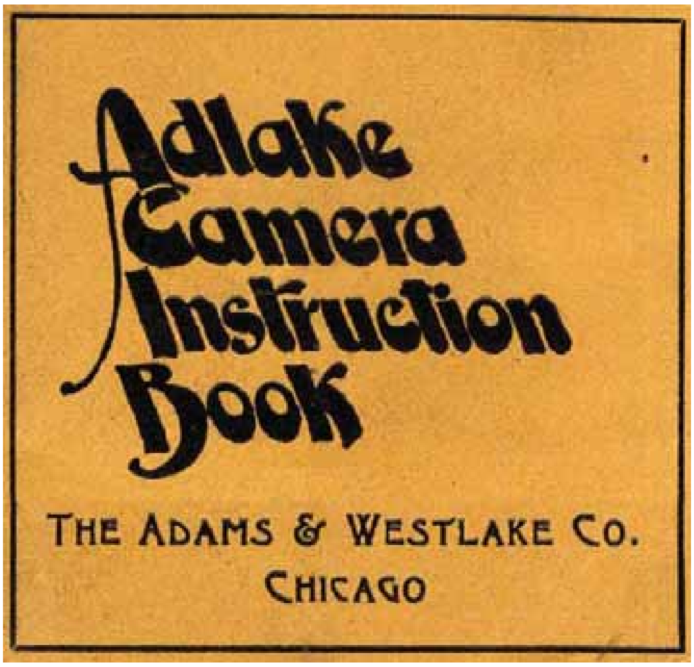
Collectable cameras turn up in the most unlikely places – but occasionally an item turns up in a camera auction or at a camera market that might be overlooked as it does not appear to be anything special – until some research is done.

The APCS April auction this year listed lot 118 as a "falling plate 5x4 box camera in poor condition" and its photograph did not highlight anything in particular. It was purchased on a whim with the idea of adding it to a small collection of falling plate cameras.

After the auction, an inspection showed that this was not a falling plate but some other mechanism. The camera looked very primitive and was not very attractive. It had lost its nameplate and identification took a while. It turned out to be an Adams and Westlake "ADLAKE SPECIAL" made in Chicago USA in 1898 or 1899 . It was very nearly complete with 10 of the original 12 plate holders, and was contained in a leather carrying case that was an original "extra" .

So what was this "thing"? It turned out to be a unique design where dry plates (film would not have been satisfactory) were in individual lightproof holders that when inserted into the film plane were "opened" by a lever on the side of the camera. It was a simple camera optically: the lens was an achromatic doublet of about 5½" focal length and about f:8 aperture but restricted to about f:15 to ensure good coverage in the corners and probably significantly improved resolution. The slightly odd shutter provided about 1/20" Instantaneous and a Time setting and a simple sector knob (strangely placed around a viewing window!) allowed apertures of f:15, f:20, and f:35 – (by measurement and calculation – the instructions only indicate "small – medium – large"). The rest of the camera was predictable – two viewfinders, sealskin covering, etc. A general tidy-up and repair to a crack in the case was all that was needed to bring the camera back to a presentable working condition.

Adams and Westlake (which still trades!) had been around for quite a while in 1897 when this camera was introduced. They were a major manufacturer of bicycles, lamps etc from a large factory in Chicago. An American patent of 1898 shows English inventers H & C Gamwell as the inventers of this odd plate changer and while there is a considerable level of advertising around 1897-1899, the prices were dropped in 1899 and the camera was being given away to amateurs as an advertising ploy at the end of 1900. There are references to the camera being available into the 1920s but supporting indormation cannot be found and it seems that the camera did not continue beyond 1900. In Australia Baker and Rouse were agents in 1899, but later advertisements by that firm do not list the ADLAKE. Adams and Westlake extended this initiative to the whole business of supporting amateurs and wrote that up in a booklet called the "Adlake Camera Instruction Book". This gives a detailed overview of what an amateur needed to produce prints in that short period at the end of the wet-plate era as the first dry plates became available. This instruction is now reproduced below for your entertainment – slightly edited – with a few comments in italics to highlight issues that many of us will have never known. Processes would become much simpler with the much higher speed films and dry-plates produced by Eastman Kodak and others, and the popularisation of photography in general. Some photographs included here are of the auction item. At the end of the article, the ADLAKE lens is used on a modern digital camera to assess its capability.



READ THE INSTRUCTIONS BEFORE LOADING THE CAMERA! BEFORE taking any pictures read the instructions carefully, and thoroughly familiarize yourself with the construction and working of every part of the instrument.

Learn how to operate the shutter for both time and instantaneous exposures; how to place the proper stop before the lens; load a plateholder with a piece of cardboard or common glass, and insert, open and close the plate-holder in the camera.

Provide a box of dry plates and a ruby lamp. As the Adlake takes a 4x5 inch plate, which is a universal size, you are not limited to the use of any particular make of plate, but can use the product of all makers. For general use we recommend extra rapid or instantaneous plates.

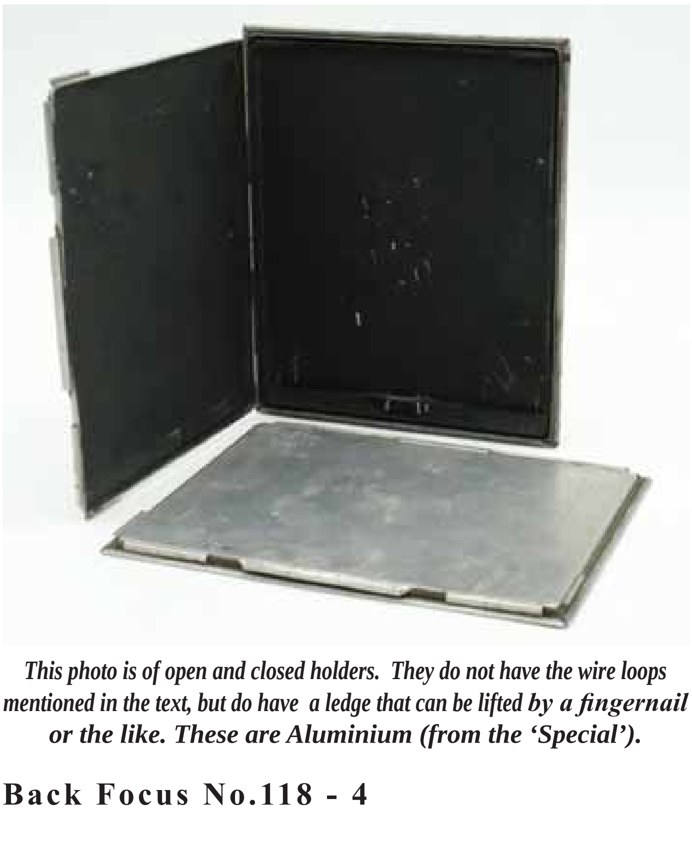
Orthochromatic plates render color values more correctly than the ordinary plates, but are usually sold at a higher price. Stick to one make and speed of plate until you have fully learned its capabilities; after that it will be time enough to experiment with others.

Comment: In the 1890s, what we know as Orthochromatic plates were a novelty – these covered the full human visual spectrum EXCEPT for the RED end. However the first of the dry plates and almost all of the wet plates were strongly blue and UV-sensitive, posing all sorts of problems especially in artificial light, but due to their narrow spectrum sensitivity could produce high resolution images.

You must have a ruby lamp, and to be on the safe side it is best to avoid the cheap makeshifts with which the market is flooded, for many of them leak some white light. To be sure of having a perfectly safe light, purchase a lamp that gives absolutely no white light and has a ground ruby glass, tested by the spectroscope to insure the color being perfect. The Adlake oil lamp has all these requirements. Then if your plates get fogged you will know it was not caused by your ruby light.

LOADING THE CAMERA. Take your plate-holders, box of dry plates and lighted ruby lamp into a closet or room that is absolutely dark. Examine carefully to see if any light is admitted from the outside. If so it must be excluded. The only light must come from the ruby lamp. This is very important. When you are satisfied that your light is safe, open the box of plates by running a knife blade under the sides. The cover can then be lifted off. Open a plate-holder and take a plate from the box. Handle the plate by the edges and do not touch the surface. It is well to brush the film or emulsion side (the dull, not the shiny side) with a very soft camel's-hair brush, slowly and lightly, to remove any particles of dust that may adhere to the plate. Place the plate, film side up, in the plate-holder; tilt holder up, press thumb on spring, and the plate will slide into place. Release spring; see that both ends of plate are under the projecting strips and shut the cover. The plate-holder is loaded. Continue until all the plate-holders are filled.

Load camera by placing plateholders behind the metal partition. Have the loops on plate-holders in front (towards the metal partition and at the top).



This photo is of open and closed holders. They do not have the wire loops mentioned in the text, but do have a ledge that can be lifted by a fingernail or the like. These are Aluminium (from the 'Special').

OPERATING THE PLATE-HOLDER. To place a plate-holder in position, raise the metal arms inside the camera as high as they will go by turning the lever on outside of camera to the top of the slide; lift out plate-holder by putting finger under the wire loop and slide it down in the grooves on the front of the metal partition, making sure that the projections at the sides of the plate-holder cover engage in the metal arms. Close the camera. The plate-holder is now ready to be opened for the exposure of the plate. To open the plate-holder, press downward and forward on the projecting lever on the outside of the camera.

MAKING THE EXPOSURES. Before making an exposure be sure of three things:

FIRST. - That the shutter is set properly. (For time or instantaneous exposures, as desired.)

SECOND. - That the proper stop is in position before the lens.

THIRD. - That the unexposed plate is in position, and the cover of the plate-holder is open.

INSTANTANEOUS EXPOSURES OR SNAP-SHOTS. To take instantaneous pictures the object must be in the full, open sunlight, and the camera must be held so rays of the sun will not fall on the lens. In other words, have the object in the sunlight and the lens in the shade. As the lens is of the "fixed focus " type, careful judging of distances and accurate focusing is dispensed with. Everything is in focus at ten feet and beyond.

Use the largest stop for snap-shots. The milled metal ring directly over the lens controls the stops, and by turning the ring either of the three stops can be brought into place.

Always use the largest stop for snap-shots, except where the sunlight is unusually strong and there are no heavy shadows, such as views on the water or in tropical climes, when the middle stop may be used. Never use the smallest stop for snap-shots, because the light will not be sufficient to impress the image on the emulsion, and the plate will be spoiled.

USE THE FINDER. Point the camera at the object to be photographed and find the image in the finder. For a horizontal picture (5 inches wide by 4 inches high), hold the camera as correctly indicated in the viewfinder. For a vertical picture (4 inches wide by 5 inches high), hold the camera with the handle up. The finders show a correct but reduced fac-simile of the photographic image. Objects not shown in the finder will not show in the picture.

HOLD THE CAMERA LEVEL. Hold the camera level and never point it up or down at an object. If you do, the object will have the appearance of falling over.

To photograph a tall object, such as a building, monument, etc., the operator should, if possible, take the picture from an elevation of half the height of the object to be photographed, and at such a distance from the subject that the entire object can be seen in the finder, holding the camera level. Usually such pictures can be taken successfully from the window of an adjoining building.

When photographing a small object, hold the camera level with the center of the object.

PUSH THE BUTTON. The shutter is always set and is operated by pushing the button marked I, alternately to right or left. If the button is at the right hand of slot, simply push it to the left and vice versa.

To make the exposure, see that the cover of the camera is closed, open the plate-holder, hold the camera level and steady, and push the button.

After the exposure is made, close the plate-holder by raising the lever as far as it will go. Be sure the plate-holder is tightly closed before you open the camera. Open the camera, lift out plate-holder containing the exposed plate, and place it back of the partition with the flat side forward and with the loop side (or extraction lip) at the bottom. By doing this you can readily distinguish the unexposed from the exposed plates and avoid making double exposures.

Clean the lens occasionally by rubbing carefully with very soft tissue paper. The lens can be easily removed by taking out the metal partition and plate-holders, and giving the lens-holder wings a quarter turn.

Comment: This, the removable lens, has to be almost unique in this type of camera, and enabled some testing of the performance of the lens using a modern digital camera! (See towards the end of this article.)

TIME EXPOSURES. Place the camera on a firm support like a tripod or table in such a position that the finder will show the view desired. Should you want to photograph a window, picture or anything in a glare of light, it will be necessary to use non-halation plates, otherwise the picture will be blurred. If you use ordinary plates, do not point the camera at a window or the photograph will show halation. Carefully arrange the window shades to secure the best lighting of the subject.

When you have placed the camera in a secure place (we recommend the use of a tripod for time exposures), push the button marked T to the other end of the slot. The shutter is then set for time. Turn the proper stop before the lens. Push the button marked I to open the shutter and reverse to close the shutter. Avoid jarring the camera during the exposure, or the picture will be blurred. When through making time exposures, push button marked T to other end of slide and shutter will be set for instantaneous exposures.

Comment: The emphasis and detail concerning time exposures was a feature of the era. A reverse analysis of the exposure chart shows that the emulsion speed of standard dry-plates of the day must have been about 5ASA for extra-rapid plates and maybe as low as 1ASA for standard plates in direct sunlight that would have contained a lot of UV, and considerably slower than that under artificial light. Thus even outdoors, exposures of seconds were needed. Indoors with only one window and a dull day and 3 to 10 minutes were needed! Instantaneous exposures were a novelty at this time and there was little uniformity in what the duration should be. In the case of the ADLAKE SPECIAL that seems to be about 1/20th of a second.

INDOOR EXPOSURES can be read from the chart in the next column and all will require time exposures.

OUTDOOR TIME EXPOSURE For time exposures out of doors use the smallest stop in the lens, place the camera on a firm support, set shutter for time and expose as follows:

TIME NEEDED FOR INTERIOR EXPOSURES

	Large Stop f:15	Medium Stop f:20	Small Stop f:35
2 or more windows, white or light coloured walls	Exposures in seconds		
Sunlight - bright	2	3	8
Sunlight - hazy	4	6	16
Cloudy - bright	10	15	40
Cloudy - dull	18	30	75
1 window, white or light coloured walls			
Sunlight - bright	3	5	12
Sunlight - hazy	8	12	35
Cloudy - bright	15	23	60
Cloudy -dull	30	45	120
2 or more windows, medium coloured walls			
Sunlight - bright	4	6	16
Sunlight - hazy	10	15	40
Cloudy - bright	20	30	80
Cloudy - dull	40	60	100
1 window, white medium coloured walls			
Sunlight - bright	6	9	25
Sunlight - hazy	15	25	60
Cloudy - bright	30	45	120
Cloudy - dull	60	90	240
2 or more windows, dark coloured walls			
Sunlight - bright	10	15	40
Sunlight - hazy	20	30	80
Cloudy - bright	40	60	160
Cloudy - dull	75	120	300
1 window, white dark coloured walls			
Sunlight - bright	20	30	80
Sunlight - hazy	40	60	160
Cloudy - bright	60	90	240
Cloudy - dull	150	225	600

- With sunshine - Open and close the shutter quickly as possible to avoid over-exposure.
- With light clouds - From one-half to one second will be sufficient.
- With heavy clouds - From two to five seconds will be necessary.

The time given above applies to the hours between ten and three. For other hours or for objects in the shadow, accurate directions cannot be given; you must learn by experience. " Expose for the shadows and let the high lights take care of themselves."

STOPS. Use the stops as follows:

The Largest - For instantaneous exposures in bright sunlight.

The Middle - For instantaneous exposures when the sunlight is extremely strong and there are no heavy shadows, such as views on the water or in tropical climates; also for interior time exposures.

The Smallest - For time exposures outdoors in cloudy weather, never for instantaneous exposures. Read preceding chapter entitled " Outdoor Time Exposures " for time required.

The smaller the stop the sharper the picture. When setting the stops, see that the one to be used is brought to the center of the lens where it catches.

FLASH-LIGHTS. In many instances it will be found impossible to take satisfactory interiors or portraits on account of poor lighting. By using the Adlake Flash-Light Pistol and Powder this difficulty is removed, and it is possible to obtain interesting souvenirs of card parties, dinner parties, etc., which will become more highly prized with the flight of time.

The camera should be placed on a tripod or a firm support. Compose the picture by the aid of a lighted lamp which can be moved from side to side, and the flame of which can be readily seen on the finder. There should be an abundance of electric, gas or lamp light in the room, so arranged that it will light up the subject well. Avoid reflections. Use the large stop and see that no light shines directly in the lens. For an ordinary sized room, place one teaspoonful of Adlake Flash-Light Powder in the Adlake Pistol; see that the match is in place; hold pistol about two feet above and back of camera; set the shutter for time exposures; open the shutter, expose, fire and close the shutter. Plenty of light in the room serves to illuminate the dark shadows caused by the flash. *Comment: The potential for fire was real and was a major risk – setting Magnesium on fire in an enclosed space is not a good idea!*

DEVELOPMENT. Do not be a mere button-pusher. The most fascinating part of photography is the developing of the negatives. We urge everyone to do his own developing; but when this is inconvenient, the plates may be sent to us and we will develop and print at a nominal charge. Careful attention will be given all orders, as it is to our interest to get the best results possible from every negative.

For developing, provide an Adlake Developing and Printing Outfit. The outfit contains:

- An Adlake Oil Lamp.
- 4 Trays.
- A 4-ounce Graduate.
- A 4x5 Printing Frame.
- Adlake Developer Powder (for 20-oz. solution).
- Adlake Fixing Powder (for 8-oz.)
- Adlake Combined Toning and Fixing (for 8-oz.)
- A Dozen sheets 4x5 Adlake Printing Out Paper.
- A Dozen Card Mounts.

Price, complete, neatly packed, $3.00.

Prepare your dark room and light the ruby lamp. Also provide plenty of clear water and a receptacle for water that has been used. Have a small table or shelf of convenient height in dark room upon which to place the trays. Put five ounces of clear water into one of the trays, and pour in the contents of one capsule of the developer powder and stir until dissolved.

Into another tray pour four ounces of water and the contents of two capsules of the fixing powder. Fill the third tray with clear water. Provide an old towel and place it where it will be handy. Close the door of the dark room and wait a few minutes to see if any outside light gets in. When you are satisfied that the light is safe, place the ruby lamp about two feet from the developer, open a plateholder and carefully take out the plate. Always handle the plate by the edges and do not touch the surface.

Place the plate, sensitized side up, in the developing tray. Rock the tray back and forth to prevent streaks and air bubbles. In about a minute the plate will begin to darken in spots representing the " high lights," and then the detail will come up so that objects in the -picture can be distinguished. The progress of development may be watched by holding the negative from time to time up to the lamp. When the details come out strongly and the dark spots show on the back of the negative, which may take from five to ten minutes, the development is complete and the plate must be taken out. Wash the plate thoroughly in two changes of fresh water: After washing completely, immerse the negative in the fixing bath until it is entirely clear of white spots and the plate is transparent instead of milky. This operation will require from ten to fifteen minutes. After the fixing, light will not injure the negative and you can now examine the plate in daylight.

When the negative is fixed, wash it thoroughly in running water for half an hour or in several changes of water. Rinse the plate and set on edge in a dry place free from dust until thoroughly dry. When dry, the negatives are ready for printing. Wash your fingers after you have placed them in the solutions, and do not get even a drop of the fixing solution in the developer, or your negative will be spoiled.

When through with the development, pour the developer into a clean bottle, labeled “Developer”, and keep the bottle tightly corked. You can continue using the developer until its colour changes to a muddy brown. Pour the fixing solution into a bottle marked “Fixing Solution”, and keep tightly corked. The fixing solution may be used for weeks before it loses its strength.

Rapid and sensitive plates should be kept in the dark as much as possible, and it is wise to cover the tray with a clean piece of cardboard while waiting for the developer to act. Good development requires a moderate coolness. Warm solutions or an overwarm room may bring about an organic change in the gelatine film of the plate that will cause it to pucker or frill. In very warm weather ice water and ice in the developer and fixing solution may be necessary.

Order and cleanliness are positively necessary in photography. Use separate trays for developing, fixing and toning, and mark them so you can readily distinguish for what purpose each is intended. Never use the developing tray for the fixing solution, nor the fixing tray for the developing solution. Wash the trays and graduates thoroughly after using, but do not use soap or any cleansing compound.

SUGGESTIONS ON DEVELOPING. Do not try to develop more than one negative at a time; but you can develop a number of negatives without leaving the dark room. As soon as one plate is developed and rinsed, put it in the fixing tray. If the least particle of the fixing solution gets on your fingers, wash and wipe them before again touching a plate or the developer.

Too much intensity is caused by over-development.

Small transparent spots of irregular shape are caused by dust. Keep the inside of the camera free from dust by occasionally wiping it out with a slightly damp cloth.

Crystallization on the negative and fading of image is caused by imperfect washing of negative. The final washing should be thorough.

Foggy negatives are caused by over-exposure; by white light entering the dark room; by too much light during development; or by too warm a developer; or by hypo getting into developing solution.

Weak negatives with clear shadows are caused by under-development.

The plates should have been in developing solution longer.

Too strong negatives with clear shadows are caused by under-exposure.

Weak negatives with plenty of detail in the shadows are caused by overexposure or too weak a developer.

An ADLAKE drying frame that just happened to be in the writer's collection!

PRINTING. Open the printing frame and place the negative, with the shiny side down, in the frame. Place the paper, sensitized side down, on the negative. Replace the back of the frame and secure the springs.

The operation of putting in the sensitive paper must be performed in a subdued light, and the unused paper must be kept in its envelope. Paper should be kept in a dark, cool place, free from moisture.

The printing frame, when filled, is to be placed, glass side up, in sunlight until the light, passing through the negative into the sensitive paper, has impressed the image sufficiently upon it. The printing can be examined from time to time, in a subdued light, by opening one-half of the hinged back of the frame, keeping the other half fastened to hold the paper from shifting.

Print a trifle darker than the color desired in the finished photograph. Do not handle the sensitized side of the paper. Keep the prints in a dark place until ready to tone. A handy way is to place them between the leaves of a book.

TONING AND FIXING. Prepare the toning and fixing solution by dissolving the contents of one capsule of Adlake Combined Toning and Fixing Powder in eight ounces of water. After using keep this solution in a tightly corked bottle, as it can be used repeatedly. Immerse the prints, face up, one at a time, in the solution. Keep the prints in motion and see that no air bubbles are on the surface of the prints.

The prints will almost immediately change to a reddish-yellow color, then to a brown. Continue the toning until the prints get the shade desired.

When the proper shade has been attained, remove the prints from the toning solution and immerse for five minutes in the following salt solution to stop the toning:

- Salt …… ½ ounce.
- Water ….16 ounces

Then wash the prints in running water for half an hour, or in twelve changes of water.

After washing, place the prints, picture side up, on a sheet of plain white or manilla paper until dry.

SQUEEGEE PRINTS. A beautiful finish can be given the prints by the squeegee process as follows : Take a ferrotype plate especially made for the purpose and wash it thoroughly clean with hot water. Dry with a soft, clean cloth and coat with the following solution: A piece of parafin the size of pea dissolved in four ounces of benzine. Coat the clean plate thoroughly with this solution and polish it off with a clean, dry cloth. After the prints have been washed, take them directly from the water and lay on ferrotype plate, face down, rubbing the print in contact with a clean blotter or rubber squeegee. Set the plates in a cool place to allow the prints to dry. Let them dry thoroughly, and when removed a beautiful glace finish will result. The plates should be thoroughly washed and treated as directed each time before using, otherwise the prints will stick to the plate.

For mounting, provide a bottle of photo-paste. Ordinary paste is apt to discolor the print. Apply a thin coat to the back of the print and place carefully on the card. Put a blotter over the print and run a squeegee roller over the print, or rub with the palm of the hand until the print lies perfectly smooth.

BLUE PRINTS. Blue prints are quickly and easily made and yield satisfactory results.

Print until the deepest shadows are a slightly bronze color, but not until the whole picture shows out clearly in bronze, as this will spoil the half tones and lose detail.

Remove the paper from the frame and place it in clear, fresh water in subdued light. Change the first water after five minutes, and wash in frequent changes of water for twenty minutes more, and then hang up to dry if prints are not to be mounted. When prints are to be mounted, place them between clean blotters until surface is dry, and mount while still damp.

Don't wash the prints for less than twenty minutes, and avoid over-printing, as the paper does not gain its full depth and brilliancy until the prints are thoroughly dry.

If the paper washes down too light after being twenty minutes in water, the exposure must be lengthened. Do not reduce the amount of washing, as the water does not bleach the print, but makes it more permanent if the exposure has been correct.

Store your paper in a dry place, under pressure, if possible.

Don't handle the paper in white light. Even subdued light will injure its tones and keeping qualities.

Don't be afraid of using too much care because it is "only Blue Print Paper."

CHEMICALS The quality of our chemicals will be found very satisfactory. We carry a large variety and can supply at short notice any chemicals not found in the list. Prices include containers:

Acid, Acetic, No. 8, 8-ounce bottle.	$0.15
Acid, Citric, ounce.	.20
Acid, Pyrogallic, Schering's, ounce.	.35
Amidol, ounce.	.75
Alum, Chrome, pound.	.25
Alum, Powdered, pound.	.15
Ammonia, Liq. Conc., pound	.40
Ammonia, Sulpho-Cyanide, ounce.	.20
Borax, ounce.	.05
Eikonogen, ounce.	.40
Glycin, ounce.	.75
Gold Chloride, C. P. 15 grain vial.	.50
Hydrochinon, ounce.	.40
Iron, Citrate of Ammonia, per ounce.	.10
Iron, Proto. Sulph. per pound.	.20
Lead, Acetate, ounce.	.15
Metol, ounce	.75
Potassium, Bromide, ounce	.20
Potassium, Carbonate, pound.	.30
Potassium, Oxalate, Neutral, per ½ 1b.	.40
Potassium, Red Prussiate, ounce.	.10
Platinite.....	
Chloro-Platinite of Potassium, 15-grain vial.	.50
Rodinal, 3 ounce bottle	.60
Sodium, Acetate, Cryst., 4-ounce bottle	.20
Sodium, Bi-carbonate, 4-ounce.	.15
Sodium, Carbonate, pound.	.15
Sodium, Hyposulphite, pound	.10
Sodium, Hyposulphite, 5 pounds.	.40
Sodium, Sulphite...	
Cryst. pound, corked bottle.	.30
Sodium, Sulphite...	
Granular, pound, corked bottle.	.35
Sodium. Tribasic, Phosphate, 4-ounce bottle	.25

CATALOGUE. The instruction book includes an extensive catalogue of items ranging from cameras right through to the mounting hardware and instruction books – a few of them are recorded here:

Adlake Camera...	
5x4 with 12 metal plaet-holders	$12.00
Adlake Special Camera...	
5x4 with 12 Aluminium holders	15.00
Extra plate holders – steel – each	.50
Extra plate holders – Aluminium – each	.65
Adlake leather carrying case	2.00
Adlake extra rapid dry plates – per dozen	.50
Cramer's Crown dry plates – per dozen	.65
Seed's non-halation plates – per dozen	.80
Cramer's Orthochromatic plates – per dozen	.65
Adlake dark room lamp – ruby glass	1.00
Duranoid 5x4 trays – each	.20
Hand-scales – 6-inch – each	.75
Adlake sliding tripod	2.00
Adlake folding tripod	1.50
Adlake developer powder for 20oz solution	.25
Adlake fixer powder for 8 oz solution	.15
Adlake flashlight pistol including igniter	1.00
Adlake printout paper 5x4 – per dozen	.20
Velox printout paper 5x4 – per dozen	.25
Negative rack	.40
Develop print and mount service – each	.15
Develop only service – each	.10

A cross-section of the ADLAKE cameras...
From an advertisement in 1899

GENERAL COMMENTARY *A lot can be gathered from the Adams and Westlake booklet. It gives insight into just how difficult it was to take and process photographs in that era, and there are a few implications that we can draw from it. Photography was a dangerous business… We regularly hear about the dangers of working with sublimed Mercury in an earlier era but some of those chemicals in the above catalogue are also pretty dangerous. There are some practical aspects too. Mention is made of "clean water" but just how clean was the available water? Reticulated tap water was far from clear and contained many mineral salts which could upset the photographic chemistry. Even rain water contained dissolved gases and was fairly acidic, - and remember that the air was far from pure in most built-up areas. This all contributed to uncertainty and almost always to the degradation of the pictures.*

The prices in these lists are in US$ as at 1898, and to bring them to modern equivalence multiply them by 50 to get the Australian dollar equivalent as at 2023. Thus the purchase price of an ADLAKE SPECIAL with a leather *carrying case would be equivalent to $850 today, and a dozen ortho plates with processing would be near enough to $125 plus mounting all based on published inflation. But in addition, the average annual wages in the USA have risen by a further factor of 3.7 over the same period, so the "real" cost of an ADLAKE SPECIAL camera would be about $3,145 in terms of disposable income today and those photos were effectively $39 each assuming that they all came out!.. Advanced amateur cameras were much more expensive – was it any wonder that George Eastman's products aimed at the simple amateur market at very low costs were so successful?*

Taken with an ADLAKE — Negative by H. T. Lockwood, New York

Comrades Three

Taken with an ADLAKE — Negative by J. A. Mosher, Chicago

Manhattan Beach

Another book published by Adams and Westlake in about 1899 observes that photographs taken with the ADLAKE cameras were of a very high quality and the above examples are scans of some printed examples. In general, they are good but we are limited to looking at 5x4 reproductions that have suffered reproduction degradation. And we can't ignore that the photographic printing procedures of the day were far less accurate than they are now. The booklet that is the source of these was produced by a Chicago firm that promoted "photo-engraving" presumably some process that might have involved screening and that is not capable of accurate reproduction. Typical screens are only 100 dots per inch and these may also have been photo-lithographs. But time for some testing to see how good this camera could be…

A feature of the ADLAKE SPECIAL is that the lens can be removed easily for cleaning. The lens is an Achromatic Doublet – ie two elements that might be either air-spaced or cemented, not easily evident, with a probable flint/crown pairing to achieve the Achromatic performance, and basically a 5½" lens native at f:8. This is arranged behind an aperture restricted to about f:15 at its widest probably to ensure the necessary coverage but as it turns out also to avoid serious aberrations at the wider aperture. It did not take too much work to fix the lens in a modern mount and take some photographs using a modern digital camera – a Sony A7R(II) in this case. This of course does not test over the whole 5x4 but does allow the performance to be analysed in the central third of the full 5x4 image..

In the era of the ADLAKE camera, the plates were either blue sensitive (the same as most wet-plates), or orthochromatic (where the whole spectrum is sensitized but without the red end). The lenses that were used around 1900 were already being developed with the full spectrum in mind - we sometimes forget that accurate colour separation prints using filters were already in use by 1900, but in this case, there was no expectation that the red end needed to be good as none of the regularly available dry plates were red-sensitive and amateur colour was still a long way off.

Using a modern camera with red, green and blue sensors allowes a level of simulation for the two types of plate that were used then and of course also allowes the red end to be investigated as well. Those analysis tools are within the capability of the tools in Photoshop, although some experience might be necessary. For these tests an aperture was made that was equal to the "middle" aperture on the camera – ie about f:25. (The aperture control and unit in the camera is part of the front of the case and not part of the physical lens.) Now that is going to allow good depth of field but is also going to introduce loss of resolution that comes with diffraction limitations at small apertures. The resulting images show that with the exception of the red end, the lens is remarkably good. So it is not a surprise that the ADLAKE camera lived up to the hope of its makers for both standard and Orthochromatic plates.

Inspection of the test image in its full colour and blue channel frames and the detail around the red traffic light shows that the red channel is significantly out of focus or suffers from some other dispersion defect (like spherical aberration) but also shows just how good the blue image forming convergence is (no calculations here but it is essentially diffraction limited at f:25 – ie no lens at that aperture can do any better). But analysis teaches more about this camera… To get 5x4" coverage with a lens that has a focal length of 5½" you need a field of view of 63° which is quite a bit wider than a standard lens today. Wide angle lenses have been known since the beginning of photography but they were little more than pinholes with correction, so a lens that could actually achieve an instantaneous photo in daylight and be wide angle with good resolution was a novelty.

Arouund the end of the 19th Century, competing lenses like the Zeiss Protar, and similar multi-element lenses were uncoated – sometimes with up to a dozen lens surfaces making them lossy and prone to internal reflections etc, giving this ADLAKE lens with only 3 actual surfaces a significant advantage. The slightly more professional lenses like the Rapid Rectilinear and the Double Anastigmat had double the number of internal reflections, and although they were several times as fast as this ADLAKE lens, they had only about 60% of the coverage.

Further, if we are happy with the images of the street scene shown here, that is effectively the image that you will get with a 135mm tele-lens – and a lens that is only 7mm in diameter! And before we get too critical about the comparative colour/blue channel images, that sample section is a field that is only 5.5mm wide – about the size of a frame on a super 8 movie film using the same lens!

The proof of the pudding… This ADLAKE camera was aimed at the amateur market at the beginning of the dry-plate era! Thus we arrive at an uncomfortable reality that the quality of photographs at the amateur level has not changed all that much in the last 125 years, but has become a lot more convenient and is now at almost no cost, where it was once a very expensive pastime.

The lens was not a cheap single element that was to be common on most box cameras, but it was not an expensive lens either like the exotic prducts from Zeiss etc.

This untouched photograph taken with the 1898 ADLAKE SPECIAL lens fitted to a Sony A7R(II) is reproduced at the limit of printing - ie at 300 dpi - the original is 7,592 by 5,304 pixels - ie about twice the resolution that you can see here.

This comparison shows a small section of the above original on the left and the isolated BLUE channel on the right, demonstrating the inferior RED performance on many early lenses designed for pre-panchromatic films and plates. Attention is drawn to the red traffic light and the rear red lights on the cars - which are clearly inferior on the left image but in the blue image on the right are sufficiently clear that you can see the individual LEDs in the case of the traffic light. That level of resolution does not continue across the whole 5x4 frame but even modern lenses are not perfect in the corners!

Doppel Anastigmat Componar- Satz

Paul Ewins

Sometimes as a collector you take a chance on something that looks interesting but you know nothing about. As far as I knew Schneider had never made a casket set and it was labelled Componar which is usually associated with enlarging lenses. It sat on eBay for months, part of a package that included another even more obscure set of lenses. Eventually curiosity got the better of me, and I bought it just so that I could work out exactly what it was.

Casket sets were mostly sold in the latter part of the nineteenth and early part of the twentieth century. In essence it consists of a number of lens elements of different focal lengths and a barrel or shutter into which they can be mounted. By changing the front or rear elements you could have a variety of combinations with different focal lengths rather than having the expense of buying a separate lens for each focal length. A little chart would tell you which combination of elements would provide the desired focal length. This idea was simplified in the twentieth century with the convertible lens where you removed the front or rear groups to alter the focal length.

While it was clearly designed as a casket set rather than being assembled from parts salvaged from other lenses there were quite a few questions to be answered. It consisted of three cells and three yellow filters of different intensities all housed in a nice velvet lined case. There was no barrel included as you would expect and the cells had lug attachments rather than the usual thread so they couldn't be attached to a regular shutter. There was what looked to be a primary cell (13.5cm f6) to be mounted at the front and two other cells that look like they were to be mounted at the rear. These bear the inscriptions "Komb. I f16 F=10,5cm" and "Komb. III f7.7 F=16,5cm". While 10.5cm f16 is what I would expect from a single cell, 16.5cm f7.7 sounds more like what I would expect from a pair of cells as does 13.5cm f6. By comparison the triple convertible Symmars would combine two single cells of longer focal lengths, like a 210mm/f12 and a 260mm/f13 for a shorter, faster lens of 135mm/f6.8. The fact that two of the cells are marked Komb I and III suggests that there is a missing Komb. II, but no place for it in the box.

I had never seen Schneider advertise a casket set. Although their early advertising does mention the possibility of multiple lenses sharing the same shutter, this was about saving costs by moving both front and rear cells into the shutter from a barrel mount rather than mixing and matching cells from multiple lenses. A quick look at the earliest production lists showed a few Claron Satz listings, so maybe there was something to it after all.

As there was no serial number on any of the pieces it was difficult to determine the age of the lens. However when I had a closer look I was struck by the art-deco style of engraving which was dissimilar to all of my Symmar lenses but still looked familiar somehow. After dragging all of my lenses out I eventually found a Xenar with matching engraving that dated to 1921, however lenses just a few years later have a different type-face, which indicates a fairly narrow time period. This time a hunt through the early 1920s yielded success in the form of a single entry dated to August 1920 "Componar-Satz, 135mm, f6, batch of 1, s/n 43644, Muster Objektiv".

Muster Objektiv indicates a prototype lens, so the lack of catalogue entries makes sense. My best guess is that originally there would have been a barrel or shutter with a front and rear cell (since it is a Doppel Anastigmat) and this case held extra cells that could be exchanged to create new combinations. Somewhere along the way the front cell (marked 135 f6) has been swapped out, presumably for the one marked Komb. II, and put in the box and then the lens and box have parted company forever.

The final question is what was its intended purpose. The Componar brand was registered in 1914, yet apart from this set and one other prototype in the same month there is no record of any Componars produced for retail sale between 1918 and 1934, when they started to appear as enlarging lenses. The yellow filters suggest it was meant to be a camera lens, so perhaps it was intended to sit between the Isconar and Symmar as a more flexible and cost effective option. The primary focal length of 13.5cm suggest 9x12 folding plate cameras as a possibility.

In the turbulent period following the end of the WW1 business appears to have been very slow and Schneider was producing a lot of prototypes. Obviously this idea went nowhere, but the presentation in its own little case suggests that Schneider had invested more time and thought in it than just throwing together a set of cells. Their only OEM customer at that time was Contessa so it is reasonable to think that this may have been an attempt to persuade Contessa to produce a folding camera with its own custom set of interchangeable elements, hence the reason why there was no space for a barrel or shutter in the case as this would stay attached to the camera. The little lugs would have made for a fast and hopefully secure way of swapping lens elements.

For something that was a dead end this was a surprisingly fascinating little set from the early days of Jos. Schneider & Co.

Wet-plate Chemistry - the reprographic industry

We tend to associate wet-plate chemistry with the early days of photography. However it remained in common use when very large accurate images were needed and the dimensional stability of film was not good enough. In the reprographic industry the art developed and reached maturity in the 1950s and was a subject taught in the trade schools. A set of lecture notes from that era has emerged from the photographic trade school in Adelaide - prepared by a lecturer known as "Soapy" Burford - and we are endebted to reader Mike Leupold who brought it to our attention. We cannot overstate that the chemistry here has many dangerous elements and should only be attempted under strict safety provisions and procedures to deal with medical emergencies.

THE CHEMISTRY OF PLATE PHOTOGRAPHY

The procedure to be adopted in this study will be to follow the sequence of operations as adopted in the trade practice and to apply the chemistry, etc. associated with one operation before proceeding with the next.

Operation 1:

Coat a thoroughly clean plate with albumen solution:

What is albumen? What are its properties and purpose?

The albumen used in photo-process engraving is egg-white and is generally purchased in the powder form. The dry form is obtained by diluting the egg-white and then beating to a froth. The fluid is then filtered and the filtered liquid evaporated to dryness.

Albumen is soluble in cold water but it coagulates in hot water. Alcohol and most mineral salts coagulate albumen. If albumen is mixed with silver nitrate it forms silver-albumenate. When solutions of potassium or ammonium bi-chromate are used as an addition to albumen, and the mixture exposed to light the albumen is rendered insoluble.

Albumen is used to clarify gelatine and as a substratum for the glass plates in the wet plate process.

The dilute albumen solution used as a substratum for wet plates will not keep longer than two days. Any degree of decomposition of the albumin will cause a fogging of the plate. The solution consists of:

Water 1000 cc.
Ammonia 0.660 2 cc.
Dried Albumen. 10 grams.

Operation 2:

After the albumen coating is thoroughly dry an iodised collodion coating is applied.

The composition of the iodised collodion consists of a 2% Ether-alcohol solution of Pyroxylin to which has been added Cadmium Iodide, Ammonium Iodide, Calcium Chloride, Calcium Bromide and at times a little Iodine.

What is Collodion? What are the properties of the metallic and other salts? Why the mixture of salts?

Collodion is a solution of Pyroxylin in a mixture of Ether and alcohol. What is Pyroxylin?

Pyroxylin is a mixture of the tri-nitrate and tetra-nitrate of Cellulose. Cellulose is pure wood fibre, cotton being an example.

To prepare Pyroxylin, pure cotton is treated with 4 volumes of Nitric acid SG. 1.38, and 5 volumes of Sulphuric acid SG. 1.84 at a temperature of 65°F to 70°F for approximately 10 minutes.

Chemically, cellulose is made up of Carbon, Hydrogen and Oxygen - the Hydrogen and Oxygen being present in the same ratio as they exist in water. It is a complex Carbohydrate and the formula may be typically written as $(C_6H_{10}O_5)_n$

Under the treatment with the acid mixture, it is found that the Nitric acid enters the cellulose molecule while the Sulphuric acid withdraws an equivalent quantity of water from the cellulose molecule. Example:

$C_{12}((H_2O)_{10} + 3HNO_3)$ + Sulphuric acid =
$C_{12}((N_2O)_7(HNO_3)_3) + 3H_20$ + Sulphuric acid.

The Pyroxylin formed in the above reaction is the tri-nitrate. Had 4 molecules of nitric acid been absorbed at the expense of 4 water molecules the tetra-nitrate would have resulted.

The method adopted for writing the formula for Pyroxylin is not standard but is used to show more clearly the nature of the reaction.

If the Nitric acid - Sulphuric acid treatment had been carried out in the cold there would have been a replacement of 6 water molecules, i.e. the Hexa-nitrate (Gun-cotton) would have been produced which is not soluble in the Ether-alcohol mixture and therefore of no value in plate making.

Pyroxylin is a solid substance which after being torn to threads is converted into collodion by dissolving in equal parts of Ether-alcohol.

Note: Ordinary methylated spirits cannot be used as a solvent owing to the fact ordinary spirits has a petroleum content. Pure alcohol or Industrial Spirit which consists of 95% pure Ethyl alcohol plus 5% methyl alcohol is necessary.

In all cases the alcohol should be tested by adding a small quantity of water to a test sample. when if any turbidity occurs the alcohol must be rejected.

Method for preparing 2% plain collodion: Take 500 cc. industrial spirit and add 20 grams threaded Pyroxylin. Shake well and add 500 cc. Ether Meth. SG. 0.72. Finally filter through cotton wool.

The purpose of the chemical salts is to sensitise the collodion. They may be added in the dry state or they may be first made into a stock solution. Example:- Take 1000 cc. Industrial Spirit, 80 grams of Cadmium Iodide, 40 grams of Ammonium Iodide, 10 grams of Cadmium Bromide, 10 grams of Calcium Chloride, 2 grams of Iodine flakes. Each salt being completely dissolved in the order stated. When dissolved, 1 part of the salt solution is added to 10 parts of 2% plain Collodion solution.

Note: If the solution method is used it is necessary to make up the plain collodion with the Industrial Spirit reduced by the amount which will be added with the metallic salt.

The ability of the salts to sensitise the collodion is based upon the fact that they are readily converted to light sensitive Silver salts when treated with Silver Nitrate solution.

The mixture of the salts is necessary because of characteristics peculiar to each. e.g. Iodides are more sensitive than bromides and are "faster" in the silver nitrate bath. Iodides however tend to produce strong contrasts while the Iodide-Bromide mixture gives more shadow detail. The Cadmium increases viscosity and produces a very durable film while the Ammonium decreases viscosity. Calcium salts have a tendency to make the collodion glutinous. The nature of the iodides and bromides taken also affect the sensitivity and speed. e.g. the various iodides are hygroscopically different and on evaporation the collodion containing them remains for longer or shorter periods in the moist state. Ammonium and Cadmium salts remain moist for the longest periods and by keeping their moisture in the collodion film they render the film more permeable to the action of the Silver Nitrate bath.

Free Iodine when used changes the color of the collodion to blood red. It affects the sensitivity of the plate but gives greater clearness and decreases any tendency to fog. Therefore, if a silver nitrate bath has a tendency to fog a few drops of tincture of Iodine added to the collodion will reduce this tendency by keeping the bath acid in the neighborhood of the film.

The reaction being:

Iodine + Silver Nitrate + Water = Silver Iodide + Silver Iodate + Nitric acid.

$6I + 6AgNO_3 + 5H_2O = 5AgI + AgIO_3\ 6HNO_3$

Operation 3:

The collodion coated plate is placed in a bath consisting of an 8% - 10% solution of Silver Nitrate.

When a plate coated with collodion and containing an Iodide - for example Cadmium Iodide is immersed in a solution of Silver Nitrate the Cadmium Iodide combines with the Silver Nitrate to form light sensitive Silver Iodide.

Cadmium Iodide + Silver Nitrate = Silver Iodide + Cadmium Nitrate

$CdI_2 + 2AgNO_3 = 2AgI + Cd(NO_3)_2$

The Silver iodide remains on the plate as an insoluble salt while the soluble Cadmium Nitrate passes into the Silver Nitrate bath.

In making up the Silver Nitrate bath distilled water must be used because of the dissolved mineral matter contained in tap water. Again any organic matter present in the water will on exposing the bath to light become oxidised at the expense of the Silver Nitrate. Before a new bath of silver nitrate can be used some Silver Iodide must be added to it otherwise as Silver Iodide is formed on the plate it will be "taken up" by the Silver Nitrate solution in which it is somewhat soluble. Consequently, it is necessary for the bath to be saturated with Silver Iodide before being used as a sensitizer. This may be accomplished by adding a small quantity of a 10% solution of Potassium Iodide. It is also necessary that the bath be made just acid with Nitric acid which by acting as a restrainer prevents fog. The quantity of acid used should be just sufficient to turn blue litmus paper red, as any excess will tend to soften the collodion. Silver Nitrate solutions should be allowed to stand 8 hours before use.

With continued use the Silver Nitrate bath becomes contaminated with alcohol and other impurities. The removal of these impurities may be accomplished by exposing the bath to sunlight after neutrallising by adding about ½ oz. chemically pure Bi-carbonate-soda to each 20 ozs. of Nitrate solution. The time of exposure varies with the intensity of the sunlight - usually 2 to 5 days. After exposure the solution is filtered and tested by the use of an Argentometer or by Titration (Titration method will be explained later).

Organic impurities could also be removed by adding carefully a little of a 1% solution of Potassium Permanganate solution, as the Permanganate oxidises the impurities a brown precipitate forms. The addition of Permanganate must cease immediately the faintest pink colour persists on standing for minute or two. After treatment the bath must be carefully filtered and made up to strength by adding fresh Silver Nitrate and acidifying with Nitric acid.

That the Silver Nitrate bath has become unduly contaminated and requires treatment is shown by fog in the film which cannot be wiped away as can surface fog due to unripe collodion, new Silver bath, or warm temperatures. It is possible for a Silver Nitrate bath to become supersaturated with Silver Iodide. i.e. the Silver Nitrate may become so depleted that it cannot hold all the Iodide in solution.

When this occurs a fine precipitate of Silver Iodide develops and the Nitrate bath takes upon itself a milky appearance. The addition of further Silver Nitrate eliminates the trouble. If the precipitate of Silver Iodide were allowed to persist, it would settle upon the plate as fine dust, with ruinous results. The best method for treating an over saturated bath is to dilute the bath with water and expose to sunlight for a few days (as previously described) since this method has an all-round cleansing effect.

Estimation of Silver Content of Nitrate bath: The Argentometer method simply consists of floating the meter in a quantity of the bath solution and reading the strength of the solution off the scale.

The Argentometer method can be relied upon when the bath is comparatively new but an old bath will give incorrect readings, because of the contaminating salts in solution.

Titration Method.

The titration method gives accurate results.

Apparatus required:

1 only 5O cc. Burette.

1 only 250 cc. Conical flask.

1 each 10 cc. 2O cc. and 25 cc. Pipettes.

Solutions required:

(1) N/20 (2.925 grams per litre) Sodium Chloride.

(2) 5% solution of pure potassium chromate (Indicator).

(5) A small quantity of magnesia (pure).

Procedure.

(a) Take 25 cc. of the bath solution and make up to 250 cc. with distilled water. Mix thoroughly and pour into the 50 cc. burette. Bring the liquid in the burette to the zero mark.

(b) Pipette 20 cc. of the Sodium Chloride solution into the 250 cc. conical flask, and add a few drops of the Chromate indicator, which will turn the salt solution faintly yellow. As the Silver bath contains free Nitric acid, it is necessary that this should be neutralised, as otherwise the red Silver Chromate, (which will be later formed) will be destroyed as rapidly as it is produced. The neutralisation is effected by adding an excess of magnesia to the Sodium Chloride solution in the flask. (An amount which could be piled upon a shilling (10 cent piece) should be sufficient). Place the flask under the burette and run in drop by drop the Silver Nitrate solution. The flask must be constantly shaken and the procedure continued until the yellow solution just turns scarlet. This is the end point. Take the reading of the burette and divide it into 1699 and the answer will be the number of grams of Silver Nitrate per litre of bath solution or divide the reading into 743.5 and the answer will be the number of grains per fluid oz. of Silver Nitrate in the bath,

Specific Gravity Method.

The specific gravity method as with the Argentometer method is only reliable for use with a new bath. The following table gives the grains of Silver Nitrate per fluid ounce of solution in respect to specific gravity readings.

30 grains per ounce of solution 1.05.

35 grains per ounce of solution 1.055'

40 grains per ounce of solution 1.06.

i.e. for every increase of 5 grains per ounce of solution there is an increase of .005 in SG. Reading.

The above table is for readings taken at 60°F. For every degree rise in temperature there is a decrease of .0007 in the specific gravity reading for any fixed solution concentration.

Note: If it is required to convert percentages to grains per fluid oz., multiply the percentage figure by 4.4. e.g. 10% Solution - 10 x 4.4 = 44 grains per oz.

Operation 4:

After the wet plate is exposed it is developed in an acid solution of Ferrous Sulphate to which is also added industrial spirits.

What is the action of the Ferrous Sulphate? Why the acid and the spirits?

The development of the wet plate differs from that of the dry plate in that in the wet plate the developer reacts with the free Silver Nitrate on the surface of the film and reduces it to metallic Silver. This Silver deposits itself upon the Silver Halide salts contained in the collodion film which have been affected by the light. The amount of Silver deposited varies according to the extent to which the light sensitive Silver salts have been affected during the exposure. In the dry plate process where the light sensitive Silver salts are held in a gelatine film the light affected salts themselves are reduced to the metallic state by an alkaline developer. In the wet plate process Ferrous Sulphate is the developer. It has the power of reacting with the free Silver Nitrate, reducing it to metallic Silver, and depositing it on those portions of the film which have been light affected.

Silver Nitrate + Ferrous Sulphate = Ferric Sulphate + Ferric Nitrate + Silver.

$6AgN0_3 + 6FeSO_4 = 2Fe_2(SO_4)_3 + Fe_2(NO_3)_6 + 6Ag$

Only the pure apple green crystals of Ferrous Sulphate must be used. Should any brown crust exist on the crystals it must be removed by washing. It is further necessary to keep the mixed developer well stoppered otherwise Oxygen will be absorbed from the air and the solution will become Oxidised and its action considerably decreased.

The composition of the developing solution is approximately as follows:

Water. 1000 cc., Glacial Acetic acid. 50 cc., Ferrous Sulphate. 50 grams, Industrial Spirits. 50 cc.

The Acetic acid content is necessary as it acts as a restrainer and without it the plate would fog due to traces of metallic Silver settling upon unaffected Silver salts. The only purpose for the spirits addition is to enable the developer to flow more smoothly over the film. This it can do by reason of its superior wetting properties.

Operation 5:

After washing, the developed plate is "fixed" by a solution of Potassium Cyanide.

What are the reactions?

Potassium Cyanide has the power to dissolve the unaffected Silver salts but its action on metallic Silver is very slow. 0rdinary Hypo could be used but it is too slow in its action, even though it may give more delicate detail. The reaction can be shown as follows:~

Silver Iodide + Potassium Cyanide = Double Silver Potassium Cyanide + Potassium Iodide

$AgI + 2KCN = KAg(CN)_2 + KI$

The metallic Silver deposited during development remains on the plate while the Double Potassium-Silver Cyanide and Potassium Iodide are dissolved away. It is necessary to leave the plate in the fixing bath for as long again as it takes the creamy appearance to disappear. This is necessary to give the soluble salts an opportunity to diffuse out of the film otherwise a brown stain will be produced. Again, if the plate is exposed to air with Potassium Cyanide still adhering, a compound termed Potassium Cyanate will be produced which will attack the Silver image.

Potassium Cyanide + Oxygen = Potassium Cyanate.

$2KCN + O_2 = 2KCNO$

Or:

Potassium Cyanide + Oxygen + Water + Silver = Silver Cyanate + Potassium Hydroxide.

$2KCN + O + H_20 + 2Ag = 2AgCNO + 2KOH$

The above reaction shows that if the fixed negative is not thoroughly washed the silver image will be reduced.

When using a new bath the total time for fixing (not including washing) is approximately 30 seconds.

It is advisable to save all used up solutions as they are rich in Silver, which can be recovered by making the solution acid with glacial Acetic acid, and adding metallic Zinc, preferably in the form of powder. Under these conditions the metallic Zinc enters solution and the Silver is precipitated in the metallic state.

It does not pay to use "used up" fixing solutions as they will cause brown stains to appear on the plate.

Operation 6:

The fixed and washed plate is bleached in a solution consisting of Copper Sulphate and Potassium Bromide. The approximate composition of this bath being:

Water.	1000 cc.
Copper Sulphate.	100 grms.
Potassium.Bromide.	50 grms.

What is the necessity for this bath and what are the reactions?

For photo-engraving purposes all negatives must possess great opacity associated with complete transparency. To obtain these results it is necessary to remove all scattered Silver from those portions representing the blacks of the original and to build on further Silver to those portions of the film which represent the whites. Several methods are available but the Copper Sulphate - Potassium Bromide method appears to be most generally used.

When Copper Sulphate is mixed with Potassium Bromide a reaction takes place and Copper Bromide is formed.

Copper Sulphate + Potassium Bromide : Copper Bromide + Potassium Sulphate.

$CuSO_4 + 2KBr = CuBr_2 + K_2SO_4$

When the Copper Bromide comes in contact with the metallic Silver deposited upon the films, Cuprous Bromide and Silver Bromide are formed.

Cupric Bromide + Silver = Cuprous Bromide + Silver Bromide.

$CuBr_2 + Ag = CuBr + AgBr$

Since the Silver deposit is now converted to Bromide the plate takes upon itself a bleached appearance.

Operation 7:

After bleaching, the plate is washed, (the washing must not be taken too far or the precipitated Cuprous Bromide will be washed away) and a solution containing 1000 cc water, 50 grams Silver Nitrate, and 10 cc. pure Nitric acid is poured over the plate.

Why?

The purpose of this operation is to convert the Cuprous Bromide and Silver Nitrate to Silver Bromide, Copper Nitrate and metallic Silver.

Cuprous Bromide + Silver Nitrate = Silver Bromide + Copper Nitrate + Silver.

$CuBr + 2AgNO_3 = AgBr + Cu(N0_3)_2 + Ag$

Operation 8:

The plate is again bleached in a solution of Potassium Iodide and Iodine, the concentration being 50 grams Potassium Iodide, 10 grams of Iodine, 1000 cc water.

Why should this second bleach be necessary?

The first flash exposure as adopted in screen work, slightly affects the light sensitive Silver salts of the transparencies, so that a thin veil of metallic Silver is deposited on development. This veil is further deepened by the Copper Sulphate - Potassium Bromide treatment. While Potassium Cyanide can rapidly dissolve unaffected Silver salts, its attack on metallic Silver is very slow. Potassium Cyanide therefore cannot fully "clear" the transparencies. However the Potassium Iodide - Iodine solution in conjunction with Potassium Cyanide forms a powerful reducer and effectively removes the metallic Silver veil from the transparencies.

Silver + Silver Bromide + Potassium Iodide + Iodine = Silver Iodide + Potassium Bromide.

$Ag + AgBr + KI + I = AgI + KBr$

Operation 9:

After the Potassium Iodide Iodine bleach, the plate is flowed over with Potassium Cyanide solution of the following strength: Potassium Cyanide 25 grams water 1000 cc.

In this operation the silver Iodide which has replaced the veil of metallic Silver existing over the transparencies is converted into a Double Cyanide of Potassium and Silver which being soluble passes into the Cyanide solution and is washed away.

Silver Iodide + Potassium Cyanide = Potassium-Silver Cyanide + Potassium Iodide.

$Ag I + 2KCN = KAg(CN)_2 + KI$

It must be understood that while this treatment removes the Silver from the transparencies, it also reduces to a like extent the Silver of the opacities.

Note: If the Silver of the opacities has been reduced to too great an extent, the plate may be again treated with the Copper Sulphate - Potassium Bromide solution (Operation 6) followed by Silver Nitrate treatment (Operation 7).

By this means the depth of Silver deposit is increased on the opacities without interfering with the transparencies.

Qperation 10:

After washing the plate following operation (9) the plate is flowed over with a 5% solution of Sodium Sulphide.

In this operation the Silver Iodide of the image is converted to Silver Sulphide which being a black compound adds to the intensity of the opacities.

Silver Iodide + Sodium Sulphate = Silver Sulphide + Sodium Iodide.

$2AgI + Na_2S = Ag_2S + 2NaI$

WET COLLODION FAULTS.

Care of the Silver Bath: This solution is the most important of those used in the process, and too much stress cannot be laid upon the necessity of absolute cleanliness of everything with which it is brought into contact. While various methods of more or less elaboration have been recommended for "restoring" or purifying an old bath, it has been found by practical experience that, providing proper care has been taken throughout, a bath can be used almost indefinitely by the simplest treatment.

It must be realized that each ounce of collodion takes approximately 15 grains of Silver Nitrate from the bath by chemical change and surface adhesion. (This loss must be made good by the addition of Silver Nitrate and distilled water as necessary.) At the same time other Nitrates are formed in the bath, and after a period of use it becomes over-iodized and pin-holes are caused in the film. The bath should then be diluted with about a third or half its bulk of water, neutralized with a few grains of Sodium Carbonate and allowed to stand in all available sunlight of strong daylight for two or three days. The excess Iodides will be precipitated and the solution can then be filtered and made up to strength and acidified.

If the above treatment results in an unwanted quantity the bath may be boiled down to the required bulk in an evaporating basin before filtering. This operation also disposes of any alcohol which has not evaporated while the bath has been standing idle.

There is still a general practice of continued boiling down of a Silver bath until a paste and then a liquid is formed to which is added distilled water. In the author's experience this has always been of doubtful value, and assuming that correct treatment is given throughout in disposing of alcohol (by evaporating from a shallow dish), exposure to daylight, making up to strength and careful filtering, a bath can be employed almost indefinitely; in cases of excessive contamination the bath may be treated with a strong filtered solution of Potassium Permanganate.

When added gradually this turns the Silver solution pink, but it rapidly turns to a muddy brown colour and then slightly clears again. The treatment should be continued until the pink colour is retained for about 15 minutes. The solution is placed in daylight for two or three days and carefully filtered.

General Faults: The described operations in the production of a wet collodion negative appear reasonably straight-forward and free from trouble. If due precautions are taken, and extreme climatic conditions do not have to be contended with, the process should in fact be of the desired simplicity. However, troubles certainly do arise through adverse temporary conditions, negligence, misjudgment, or impure chemicals, etc.

We will attempt to explain as many such faults as have come to our knowledge and are likely to occur with average conditions. Certain additional faults with obscure causes occasionally arise, however, but after careful examination of all factors the trouble is invariably traced to either direct or indirect effects of injurious fumes, dirt or impurities at some period.

The film becomes loose while in the Silver bath: Incomplete or too thin coating of albumen substratum; dirty glass; too much acid in the Silver bath or too prolonged immersion; use of old collodion.

Wavy or "crazy" marks on the sensitized film: Insufficient setting of the collodion before immersion.

Curved line of lighter coloured film, probably graded on one side: Uneven flowing of the bath over the film surface upon immersing.

Splash Marks on the film: As above, or interrupted immersion of part of the surface during the early stages of sensitizing.

Gritty surface of the film when taken from the bath: Possibly too much Iodide in the bath; bath requires reconditioning.

Uneven spreading of the developer over the plate surface: Use of an old bath and a developer short of or lacking alcohol. (The developer formula given in the list of solutions included spirit as a standard component, but it is not essential with a new bath.)

Black uneven marks or "fog" appearing after application of the developer; and spreading and increasing in density over the whole surface: Badly ventilated dark-room; impure Acetic acid in the developer. If the former, the effect will probably not occur when starting work in the morning, but the trouble will gradually increase. A rough test for acetic acid is to add a few drops of pure silver nitrate solution to ¼ oz. of the acid in a perfectly clean measure or test tube. Resulting cloudiness or turbidity indicates impurities reacting with the Silver. (Chemicals should always be obtained from a reputable supply house specializing in photographic materials in order to avoid the above and numerous other troubles which frequently occur following the use of locally purchased chemicals).

“Veiling” or slight fog over the whole or part of the film: Action of light in the camera or dark-room. The portions of film protected by the plate-stops in the dark-slide afford a rough indication of the cause of the trouble. If these portions remain perfectly clear, examine the camera for light leakage through holes or cracks in the bellows, a badly fitting rising front board, strong reflections from some outside source, internal reflections, etc. If the fog occurs on the portion of the film protected while in the dark-slide, the fault lies in the use of an unsuitable safe-light; allowing direct rays to fall on the film while in the Silver bath or at any time while in the sensitive condition; allowing the film to be exposed for too long a period to light which for all practical purposes is quite "safe"; or light leakage through the sides of doors or windows. A similar fogging of the plate might be caused by a too warm or insufficiently restrained developer; an insufficiently acidified bath; or use of an unsuitable albumen or a decomposed substratum solution.

Fine Lines fogged: Reflection from copy due to wrong position of arc lamps. Over-exposure, particularly if original is an impression from an engraved plate.

Film of scum formed during development: This is a light grey deposit which can be washed away under a flow of water by lightly rubbing with a wad of cotton wool. If the scum is heavy the image will appear weak and under-exposed and it is better to locate and rectify the cause and start afresh. Any of the following might be the source of the trouble: Dark-room at a higher temperature than the camera room; fumes of paint, turpentine, gas, Ammonia, Sulphides, etc., smoke or fumes from burning arcs; insufficient acid in the Silver bath, or too long a period between sensitizing and developing, in which case it might be advantageous to re-immerse the plate in a separate Silver bath before developing. In cases of doubt a cure can often be effected by the addition of a few drops of a filtered solution of Potassium Permanganate.

Heavy tree-like growth of scum starting from the edge of the plate: Aptly termed "oysters", these are caused by dirt or dried Silver solution on the dark-slide sticks, which upon contact with the wet surface of the film has spread inwards by capillary attraction.

Dirty marks and streaks: Insufficiently cleaned glass; use of a dirty dusting brush.

Grain in clear portions of the film: Prolonged development as an attempt to correct under-exposure.

Uneven density: Uneven illumination; partial drying of the film before immersion in the bath or during exposure; uneven coating of collodion; uneven distribution of the developer; local application of reducing or intensifying solutions; or too much washing after Copper intensification.

Irregular blackening of the image on applying the blackening Silver: Too much surface water on the film; impurities or insufficient acid in the blackening solution; or solution too weak.

White markings on application of the blackening Silver: Insufficient washing after Copper intensification. It will be noted that too much or too little washing at this stage is liable to cause trouble. As there is no visual indication of the correct amount, the operator will have to judge by experience.

Weak image when exposure and other factors are known to be correct: Old collodion; over-acidified bath; or bath too weak.

Small transparent spots "pin-holes" and "comets" of different sizes scattered irregularly over the film: Floor and chemical dust (particularly hypo) in the camera body or dark-room; insufficiently filtered Silver bath or substratum.

Regular distribution of small pin-holes over the whole surface: An over-iodized Silver bath.

Black spots and marks: Insufficiently filtered substratum; chemical dust falling on the plate before or during coating with collodion; dust or specks of dried collodion in the pouring bottle.

Fine black lines: Scratches on the glass surface; glass imperfectly cleaned.

Film cracking: Over-intensification, particularly with Lead. Contributing factors: albumen coating too thin; collodion too thick; prolonged drying before immersion; or uneven drying by heat. Excess ether in the collodion while perhaps giving a harder film might render it subject to cracking.

Denser portions of film adjacent to large areas of clear film: The fault is more likely to occur with a new Silver bath in conjunction with a weak and insufficiently restrained developer or when there is only a small amount of Silver solution left on the surface of the film prior to development or during development. The developer acts on the free Silver solution, depositing metallic silver on the light-acted parts. If the developer is not well restrained this action will occur more quickly following the flow of the developer over those portions where there has been no light action and consequently no deposition.

Brown deposit when finally blackened: Over-exposure and under-development with consequent low deposit of metallic Silver; Sulphide too strong or too old.

Stains: Insufficient washing at some stage. Insufficient fixation. Stains can sometimes be removed after final blackening with a weak Cyanide solution.

The completed image appears loose and "flaky":

Use of too strong intensifying solutions, particularly Iodine and Sulphide.

Opalescent appearance of the film after varnishing:

Plate too cold. (If the plate is too hot or not rocked during draining a streaky effect might result).

DRY PLATES In the wet plate process metallic Silver is precipitated upon the light affected Silver Halides held in the collodion film. The metallic Silver resulting from the interaction between the surface layer of Silver Nitrate and the Ferrous Sulphate developer.

In the dry plate process the developer actually reduces the light affected Halides (largely Silver Bromide) to metallic Silver, in an amount which is dependent upon the extent to which the Silver salts have been affected by light.

Dry plates are of three distinct types, Ordinary, Orthochromatic and Panchromatic.

The ordinary plates are sensitive to the ultra violet and the blue energy waves of light, while the orthochromatic plates are sensitive to the blue-green and yellow waves. Panchromatic plates are sensitive to all the energy waves associated with light.

Operation 1:

Chemical development of the exposed plate: For the development of the latent image reducing agents are necessary, hut only s few reducing agents have the power of selective action, so that the reduction of the Silver Halide to metallic Silver occurs only in respect to those portions which have become light affected,

Developers in general use are Hydro-quinone and Metol. They are used singly or in pairs according to requirements, These organic compounds are somewhat complex, but by their action the effected Silver salts are reduced to the metallic state. Taking Hydro-quinone for an example the reduction takes place as follows:

Hydro-quinone + Silver Bromide = Quinone + Hydro-Bromic acid + Silver

$C_6H_4(OH)_2$ '+ 2Ag Br = $C_6H_4O_2$ + 2HBr + 2Ag

The physical properties of the Silver produced vary with and are dependent upon the reducing agent (developer) employed. It is for this reason that the separate types of work call for the use of different reducing agents.

Hydro-quinone gives a silver deposit of extreme opacity in association with clear transparencies. (The clearness of the transparencies is largely dependent upon the presence in the developer of Potassium Bromide, without which fogging would occur).

Because the Silver deposited in the middle and lower tones by Hydro-quinone has but little light resisting properties, the Hydro-quinone developer is not suited to continuous tone work. However, because it produces strong contrasts, it is very suited to line and screen work.

Hydro-quinone is very sensitive to temperature and for best results the temperature should be maintained at 65°F. With falls in temperature, the developing powers of Hydro-quinone rapidly decrease to almost nil at 57°F.

Metol is a soft working developer which produces a Silver deposit which is very responsive to gradation of tone. It is rapid in action, and has very little tendency to fog. Metol possesses a long life, and will develop a larger quantity of sensitive material than most developers, At times, it is impossible to obtain sufficient contrast when using Metol alone; hence it is usually used in conjunction with Hydro-quinone, and when used with Hydro-quinone the working temperature should be maintained.at 65 deg.F otherwise the benefits to be derived from the Hydro-quinone addition will be considerably reduced.

Sulphite additions to developers: Organic developers have e strong affinity for oxygen, consequently it is necessary that the reducing agents have added to them substances which have a still greater affinity for oxygen to act as preservatives. Substances used for this purpose are Sodium Sulphite (Na_2SO_3), Sodium-Bisulphite ($NaHSO_3$) and Potassium-meta-Bisulphite ($K_2S_2O_5$).

Sodium Sulphite: Sodium Sulphite may be obtained in two forms (a) the desiccated form (No_2SO_3) and (b) the hydrated form ($Na_2SO_37H_2O$). By preventing serial oxidation, Sodium Sulphite helps to prevent the formation of staining products.

Sodium Sulphite has a slight solvent on the Silver Halides of the film. This action is greatest for Silver Chloride but almost nil for Silver Iodide. The action on Silver Chloride and Silver Bromide is however, sufficient to prevent the growth of the surface grains of Halides held in the film, thereby preventing them from emerging into large aggregates of metallic Silver when reduced.

Sodium Sulphite therefore assists in the production of fine grain negatives.

Sodium Bi-sulphite (Acid Sodium Sulphite)

When Sodium Bi-sulphite (Acid Sodium Sulphite) is used, it reacts in the alkaline solution to form Sodium Sulphite and Bicarbonate of Soda.

Sodium Bi-sulphite + Carbonate of Soda = Sodium Sulphite + Bicarbonate of Soda.

$NaHSO_3 + Na_2CO_3 = Na_2SO_3 + NaHCO_3$

Potassium meta-Bi-sulphite ($N_2S_2O_5$) In the crystal form Potassium-meta-Bi-sulphite oxidises more slowly than other Sulphite, i.e. it has better keeping qualities. When dissolved in water it yields a solution of Potessium-bi-Sulphite (acid Potassium Sulphite) e.g.

Potassium-meta-Bi-sulphite + Water = 2 x Potassium-Bi-sulphite.

$K_2S_2O_5 + H_20 = 2KHSO_3$

The equation shows that one molecule of the meta-Bi-sulphite produces two molecules of the Bi-sulphite. The meta-Bi-sulphite is therefore the most effective of the Sulphites used.

As with the Sodium-Bi-sulphite, Potassium-Bi-sulphite reacts in the alkaline developer solution to form the normal Sulphite.

Potassium-Bi-sulphite + Potassium Carbonate = = Potassium Sulphite + Potassiun-Bi-carbonate

$2KHSO_3 + 2K_2CO_3 = 2K_2SO_3 + 2KHCO_3$

Alkali additions to developers: During development an acid reaction is produced which must be countered by alkalis. These alkalis are termed accelerators. Those in general use are Sodium Carbonate, Potassium Carbonate and Potassium Hydroxide. Each developer has its own pH requirement, and the alkalis are added to maintain the required pH of the developer. Actually it is immaterial what alkali is used so long as the necessary pH is maintained.

Bromide additions to developers: Alkali Bromide in the form of Potassium Bromide, when added to a developer acts as a restrainer. It prevents "development fog" by reason of the fact that it retards the reduction of the light-affected Silver salts in reverse proportion to the extent to which the salts have been affected. i.e. The restraining effect of Potassium Bromide is greatest on the "fog" areas. Some developers are very sensitive to free Bromide. Any excess of Bromide giving an underexposed appearance to a normally exposed plate. Consequently, the amount of Bromide present in the developing Solution must be kept within the prescribed limits.

Effects of Temperature: Warm solutions increase the receptibility of the gelatine for water, consequently the film becomes softened and swollen. To obviate the softening of the gelatine the plate may be immersed in a bath of an alkaline solution of 40% Formalin prior to developing. Formalin has a tanning effect on the gelatine which reduces its water receptive properties.

A second method whereby the water receptive properties of the Gelatine film may be reduced is to increase the concentration of the developer by adding to it an inert substance such as Sodium Sulphate. ($Na_2SO_4 + 10\ H_2O$).

After development and before fixing the plate is agitated for approximately 3 minutes in a Sodium Sulphate-chrome-alum "stop bath". This bath permanently hardens the gelatine film. When hardened the film is transferred to the usual fixing and hardening bath.

Except in extreme cases the Sulphate-alum "stop bath" could be eliminated and the plate transferred from the developer to the usual alum hardening and fixing bath. However, the intermediate step of hardening the film in a Sulphate concentrated bath will prevent any swelling of the gelatine which is likely to occur in the more dilute regular alum fixing bath by reason of the action of the water of the fixing solution upon the gelatine before the alum component of the solution can exert its influence.

Operation 2:

Fixing of Dry Plates: After development the unaffected Silver salts must be removed from the plate. This is effected by treating the plate in a solution of Sodium-thio-sulphate (Hypo), The interaction which takes place is not simple for a range of complex reactions are possible,

Example:

Sodium-thio-Sulphate + Silver Bromide = Silver-Sodium-thio-Sulphate + Sodium Bromide

(1) $5Na_2S_2O_3 + AgBr = Na_5Ag(S_2O_3)_3 + NaBr$

(2) $2Na_2S_2O_3 + AgBr = Na_3Ag(S_2O_3)_2 + NaBr$

Other complexes are possible.

It is necessary that the reaction salts be thoroughly washed out of the film since they are unstable. They will, if left in the film, decompose and form Silver Sulphide which shows as a brown stain on the negative.

Sulphite additions to fixing solutions: Sodium-thio-Sulphate, when used alone, is not entirely satisfactory since it is readily oxidised. To counter oxidation Sodium Sulphite is added to the thio-Sulphate solution.

It is further necessary to maintain a slight acid reaction to neutralise the alkali carried over on the plate from the developer. Except where Alum is a component of the fixing solution, the acid condition is maintained by an addition of Sodium-bi-sulphite. The reserve acidity possessed by the bi-sulphite is however, soon neutralised by the carry-over of alkali from the developer, consequently it is necessary to occasionally add a small quantity of a 25% solution of Sodium-bi-sulphite to correct the depleted acidity.

Acid additions to fixing solutions: At times a weak acid (e.g. Acetic acid) is used to maintain the acid reaction, but it must be remembered that acids decompose hypo and liberate Sulphur. To prevent the precipitation of Sulphur Sodiom Sulphite must be present. Sodium Sulphite has the power to combine with Sulphur to form additional hypo.

Sodium Sulphite + Sulphur = Sodium-thio-sulphate

$Na_2SO_3 + S = NaS_2O_3$

Strong acids cannot he used as they precipitate Sulphur more rapidly than it can be "taken up" by the Sodium Sulphite.

Alum additions to fixing solutions: When the negative is to be subjected to after treatments such as Reduction and Intensification it is necessary to harden the gelatine film. For this purpose Alums are largely used. The hardening produced by Alum is due to the fact that when Alum is dissolved in water, hydrolysis takes place. This reaction results in the formation of the hydrated oxide of

Aluminium which is absorbed into the gelatine and retained even after prolonged washing.

The hydrolysis is accelerated in the presence of alkalis and since the negative is alkaline when placed in the fixing bath considerable surface action takes place,

Potassium Alum + Alkali = Aluminium Sulphate + Potassium Sulphate + Aluminium Hydroxide + Sodium Sulphate

$2Al_2(SO_4)3K_2SO_4$ + NaOH = $Al_2(SO_4)_3$ + $2K_2SO_4$ + $Al_2(OH)_6$ + $3Na_2SO_4$

Chrome-alum could be used, however, (except when working at elevated temperatures) the Potassium-alum is more satisfactory, owing to the fact that the hardening properties of Chrome-alum fall off rapidly.

When alum is used the bath must possess an acid reaction. Should the bath fall to near neutrality a sludge of Aluminium Sulphite is formed and the hardening properties of the Alum destroyed. Since the acid Sulphites (Sodium-bi-sulphite and Potassium-meta-bi-sulphite) do not possess sufficient reserve of acidity to prevent the formation of the Aluminium Sulphite sludge, an addition of Acetic acid becomes necessary, Citric or Oxalic acids must not be used as they form complex Aluminium salts which have not the power to harden gelatine.

Actually the hardening of the gelatine is dependent upon the pH of the solution. This in turn, is dependent upon the relative proportions of acid-sulphite and Alum present. It is also dependent upon the degree of alkalinity of the film when placed in the fixing solution.

Operation 3:

Reduction: If the exposure has been correct, "Line" negatives may not require further treatment. However, when working screen negatives, reduction etc. becomes necessary in order to clear the transparencies and control the dot formation.

Reducing agents are of 3 types (a) Subtractive (b) Proportional (c) Super-proportional,

Subtractive. reducing agents remove an equal quantity of Silver from all sections of the negative.

Proportional. reducing agents remove Silver in an amount which is proportional to each density.

Super-proportional. reducing agents increase in activity as the densities increase.

The reducing agent in general use for "Clearing" Screen and Line work is the Potassium-ferri-cyanide-Hypo reducer. (Farmer's reducer). This reducer is in the main subtractive in action, consequently the "clearing" is effected without unduly affecting the opacities.

(a) Silver + Potassium-ferri-cyanide = Silver-ferro-cyanide + Potassium-ferro-cyanide.

$4Ag + 4K_3Fe(CN)_6 = Ag_4Fe(CN)_6 + 3K_4Fe(CN)_6$

(b) Silver-ferro-cyanide+-Sodium-thio-sulphate = Sodium-silver-thio-sulphate + Sodium-ferro-cyanide

$3Ag_4Fe(CN)_6 + 16Na_2S_2O_3 = 4Na_5Ag_3(S_2O_3)_4 + 3Na_4Fe(CN)_6$

The equations show that the Silver image is oxidised to Silver-ferro-cyanide, which is dissolved in the hypo.

Note As Farmer's reducer is unstable it must be freshly prepared or kept in separate stock solutions. e.g.

Solution (a) Hypo 200 grams, water 1,000 cc,

Solution (b) Potassium-ferri-cyanide 100 grams, Water. 1,000 cc.

Tor use dilute the required quantity of hypo solution with an equal quantity of water and add just sufficient of the ferri-cyanide solution to turn the hypo solution a lemon yellow color. Stronger solutions tend to cause stain.

After the necessary reduction has been accomplished the plate must be thoroughly washed to remove all ferri-cyanide from the film.

The Iodine Cyanide reducer (usually used in the wet plate process) could be used in place of the ferri-cyanide reducer. However, the Cyanide reducer has very strong cutting properties, while the ferri-cyanide reducer is milder in its cutting action and is therefore more easily controlled especially when it is required to clear the veil surrounding the dots, rather than reduce dot size.

Whereas in the ease of continuous tone negatives, it is required to reduce contrast, a super-proportional reducer is necessary, as this type of reducer attacks the high lights more rapidly than the shadows. The super-proportional reducer most generally used is the Ammonium-persulphate reducer.

As this reducer is very sensitive to impurities, it is essential that only chemically pure Ammonium-persulphate and pure Sulphuric acid be used, and that the water used be distilled water. This is necessary since small traces of Iron in the persulphate or small traces of soluble Chlorides, Bromides, Sulphates er Nitrates in the water will cause the reducer to be erratic in action. In general the composition of the persulphate solution is:

Ammonium-persulphate 60grams. Sulphuric acid 3cc. Water 1,000cc

For use dilute one part of the mixture with two parts of water.

Ammonium persulphate is a powerful reducer. It oxidises the Silver of the image into soluble Silver Sulphate.

The super-proportional action of persulphate is supposed to be due to a catalytic effect of Silver ions formed during the reaction. Since these ions are more concentrated at the higher densities it is obvious that reduction will be greater in the higher densities. If the reducer becomes milky in use it must be replaced by a fresh supply. To stop the reaction the negative is placed in an acid fixing bath and after fixing for about 5 minutes thoroughly washed.

Operation 4:

After reduction (cutting) whereby the transparencies are cleared, the image is intensified by building up by (a) the addition of further metallic Silver, (b) by the addition of a metallic compound. (c) by producing a colored compound of Silver.

Because of its non-staining properties, Mercuric Chloride is generally favoured for building up intensities when operating dry plates. However, all traces of Hypo must be previously removed by thorough washing, otherwise brown stains will occur on intensification.

The composition Mercuric Chloride intensifiers varies according to the degree of intensification required. The following is a general formula for screen and line work:

Water 1,000cc, Ammonium Chloride 50 grams, Mercuric Chloride 100 grams.

The Ammonium Chloride is added to increase the solubility of the Mercuric Chloride.

As the solution is decomposed by light, it must be kept in brown glass bottles.

After bleaching in this solution. the plate should be washed for at least 15 minutes.

During the bleach the following reaction takes place.

Silver + Mercuric Chloride = Silver-Mercurous chloride.

$Ag + HgCl_2 = AgHgCl_2$

Whey bleached the negative must be thoroughly washed prior to redevelopment (blackening) which may be carried out by either of the following methods.

(a) Redeveloping with a non-staining developer.

(b) Blackening by the use of Sodium Sulphide.

(c) Blackening by the use of Ammonium Hydroxide.

Ammonia as a blackener produces the greatest density but the "blackening" is not so stable as that produced by Sulphide.

After reduction with the ferricyanide solution the plate could be intensified in a solution of Lead ferricyanide.

The Lead ferricyanide is prepared by adding a solution of Lead Nitrate to a solution of Potassium ferricyanide. e.g. Dissolve 40 grams of Lead Nitrate in 500 cc water and add to this solution 60 grams of Potassium ferricyanide previously dissolved in 500 cc water. Allow the mixture to stand for 12 hours before use.

Potassium ferricyanide + Lead Nitrate = Lead ferricyanide + Potassium Nitrate.

$2K_3Fe(CN)_6 + 3Pb(NO_3)_2 = Pb_3Fe_2(CN)_{12} + 6KNO_3$

When the negative to be intensified is treated with the solution of Lead ferricyanide solution the metallic Silver of the image reacts with the Lead ferricyanide to form ferrocyanides.

Lead ferricyanide + Silver = Silver ferrocyanide + Lead ferrocyanide

$2Pb_3Fe_2(CN)_{12} + 4Ag = Ag_4Fe(CN)_6 + 3Pb_2Fe(CN)_6$

After treatment in the Lead ferricyanide solution the image is "blackened" by treatment with Sodium Sulphide which converts the ferrocyanides to Sulphides,

Sodium Sulphide + Silver ferrocyanide + Lead ferrocyanide = Silver Sulphide + Lead Sulphide + Sodium ferrocyanide.

$4Na_2S + Ag_4Fe(CN)_6 + Pb_2Fe(CN)_6 + 2Ag_2S + 2PbS + 2Na_4Fe(CN)_6$

Other Reducing, Intensifying and Blackening agents have been developed, each of which has its own application. Books dealing with the technique of dry-plate photography are available should a student desire a further knowledge of dry-plate reactions.

Water for photographic purposes. Impurities found in tap waters are in the main Chlorides, Bicarbonates and Sulphates of Potassium, Sodium, Magnesium and Calcium.

Calcium salts when present, will react with the acid-sulphites to form Calcium Sulphite which will precipitate as a sludge on standing. This precipitate is harmless if it is allowed to settle and filtered off, but the developer, or fixing solution, is robbed of a proportion of its Sulphite preservative. Chlorides present in the water will simply act as added restrainer, but if Iron salts are present to any extent the water should be discarded. Soluble bicarbonates can be converted to insoluble carbonates by boiling the water. Boiling will also coagulate any colloidal matter present and will drive off any harmful dissolved gases such as Sulphuretted Hydrogen, which if left in the water would produce chemical fog.

Distilled water is the best for use and is essential when it is to be used with Silver Nitrate.

Colloidal matter may be removed from water by adding about 15 grains of Alum per gallon of water, and finally removing the precipitated slime by filtering. Alum will not remove dissolved salts, but is in itself harmless to the developer.

An addition of Sodium Oxalate until no further precipitate forms, will remove Calcium and Magnesium salts, but not Sodium or Potassium, which are left in solution.

Dissolved salts may cause trouble by crystallising onto the emulsion of the negative during drying, and although almost invisible they fog the transparencies.

Weights and Mesures:

1 cc of water	= l gram
15.4 Grains.	= l gram
1 oz.	= 28.4 grams
l oz. water	= 28,4 cc
l oz.	= 437.5 grains
l6 ozs	= 7000 grains
1 oz	= 480 minims
20 ozs.	= 1 pint
40 ozs	= 1 quart
80 ozs = ½ gall	= 1 Winchester quart
160 ozs	= 1 gallon

These lecture notes are from the Adelaide Photographic Trade School and date from about 1952. This was at a time when the reprographic industry needed very large images - up around 40 by 40 inches in the form of separation negatives etc., where image alignment was critically important. Further the quality demands on those images were very high and extreme measures were needed to achive the necessary standards - far more so than in conventional photography.

Those images were on large glass plates and there would have been associated recovery processes that supported the industry.

Many of the dangerous procedures of the historical photographic methods were retained and some of the chemicals included in this record are no longer permitted to be used. Even at the time of this lecture series there would have been associated courses in dealing with hazardous materials. Some of the chemicals are now banned entirely and their use should not be contemplated.

Inclusion of these notes in BackFocus will serve as a historical archive for the future.

From Magic Lanterns to Enlargers

One of the products of early photography was the magic lantern. It, and its variant projectors were to become a common method of displaying images to groups of viewers and also morphed to become enlargers. The early units are collectable and some are particularly attractive. The illuminating sources have evolved over time but have also been the source of a lot of heat that has caused damage. Modern technology has produced some cold emitters and this article looks at the general principles of the magic lanterns and provides a modern cold solution that allows the old lanterns to be used safely – and provides some solutions for lighting all projectors – eliminating the classic bulbs, and gaining brighter illumination than previously, but maybe surprisingly, introducing new problems when the light intensity gets too high. A chance for a couple of restorations too....

PART 1 – Restoration of a LAVERNE Magic Lantern

An "unloved and unwanted" projector in poor cosmetic condition had suffered over the last 150 years. Its history was totally unknown other than it had been languishing in a collection for quite some time, and there was no indication of any changes to it in the last Century. The original light source and the slide carrier were gone, but the unit was fairly complete. A casual observation suggested that this was an early unit and should be restored. The usual searches of the Internet did not provide any easy identification and it was starting to look like a rare item as evidence of another one with the same details has not been found.

Someone had fitted a 250Watt ES lamp typical of the post-WW1 era screwed into a brass and paper light fitting that was typical of the pre-WW1 era made into an assembly utilising part of an "Arnotts Christmas Cake Tin" that might have dated from around 1918. Someone had also liberally painted it with silver-frost – inside and out.

The unrestored LAVERNE magic lantern

It was maybe tempting to connect the lamp to the mains and turn it on, but there are downsides to that. There was a very good chance that the lamp would burn out. But more importantly, those units were never earthed and such is the insulation in the old wire and the lamp sockets that the danger of electrocution is high. In any case, we already know what it would be like – a dull, rather yellow image, associated with the smell of hot rubber and insulation and after a few minutes maybe a broken condenser lens. Interesting to look at but not worth the risks.

Eventually the Internet searching proved successful and this unit proved to be an early French LAVERNE projector that had suffered from at least one attempt to restore it. Fortunately, the original projection lens was still there – so often these "go missing" – and in this case it was an important Petzval which analysis showed was made fairly early and probably by Clement et Gilmer. After some cleaning an identification mark was found on the projector housing which after a bit of restoration is shown here. An analysis of the evidence and comparing the item with a verified model from 1879 which included some significant changes, puts the manufacturing date of this unit sometime in the early 1870s. At this stage a complete disassembly and clean, and some thought into replacing the slide stage was needed. A few repairs would also be needed and where screws etc could be retained they were cleaned up and reused. Silver-frost from an early restoration was removed with paint remover revealing blue passivation of the original iron parts – fortunately with no significant rust. The brass was all cleaned and polished, the lenses were disassembled and cleaned, the polished wooden front and base were simply cleaned and oiled, and the bellows were repaired in a couple of places and reglued into the frame. The front timber holding the lens was fundamentally unstable – being held by only a couple of screws on the adjustable rails, so this was reinforced by a couple of brass pieces.

We can't be certain about the slide carrier but a photograph of a later model from 1879 did include an image of a carrier that looked appropriate and that also turned out to be almost identical to an Ensign Butcher carrier of half a Century later which fitted almost exactly. Using that as a pattern, a couple of hours' work made a new one which was stained black – even though the original might have been polished mahogany – the same as the other wooden parts of the projector and the appearance of the carrier in the 1879 version found on the web. The carrier is held in place by a couple of springs and washers – four assemblies – one on each corner. These were rusty, broken, and a couple were incomplete. New springs and washers were fitted and the new carrier – with dimensions adjusted to fit the mountings – completed the unit. An interesting detail is that while there are a lot of metal-thread screws in this unit, there are no modern-style threaded nuts. These are all cut from scraps of metal – very uneven sizes, then punched and threaded – indicative of manufacturing processes before the work of Whitworth etc and the centralised manufacture of such hardware. The story of the lamphouse is story in its own right – see Part 3.

Almost unbelievably a carrying case still existed but was significantly damaged – cracks – distorted hinges – missing handle – but there was sufficient evidence that it was the original one – the hinges on the lid were very similar to the hinges on the lamp inspection doors on the projector. Again, disassembly, patching cracks and missing bits of wood, straightening hinges, reassembly and black paint were probably the right approach. The original seems to have been painted in a redish colour – largely worn away, and the black covered over a lot of the repair work.

The restored LAVERNE magic lantern

A brief history of Arthur-Léon Laverne and Clement & Gilmer is relevant. It seems that Clement & Gilmer was an established firm in Paris from at least 1860 and that Laverne was apprenticed there. Apparently in 1877 Laverne took over the firm of Gasc et Charconnet, and in April 1890 sold the resulting firm to Clement et Gilmer. C&G were renowned as lens makers and dealers, but Laverne emerged as an inventor – particularly of magic lanterns – and an advertisement marked “A Laverne” and “Gasc et Charconnet” in 1879 show that his products were at the leading edge and features on even the very early examples were to survive on all later designs by other manufacturers. By 1890 the “Laverne” name had disappeared from Clement & Gilmer advertisements that were offering items with the “GLEGIL” name but were clearly influenced by Laverne’s earlier work and were probably indistinguishable from it. An advertisement from 1893 shows their premium projector that included a 500 Watt electric arc source promising “up to 3,000 candlepower” or in modern terms 36,000 lumens. That is seriously bright, and questions just how accurate the advertisement was! A modern projector fitted with a 250 Watt QI lamp and aspheric condenser with a NA >0.5 is only about a quarter of that claim.

An analysis of the above suggests that this particular projector with both the “CetG” and LAVERNE markings must date from sometime before 1877. It does not appear in any available catalogue but a later version with several significant changes is shown with the same name “Universelle” in the Gasc et Charconnet catalogue of 1879. It is a standard 3¼” by 3¼” unit incorporating a double condenser of 4¼” diameter arranged as a symmetrical plano-convex pair. There is no evidence of a reflector in this unit or in advertisements by Laverne in that era. The projector lens is a Petzval portrait camera lens made by Clement and Gilmer – probably some time before 1870, typical both mechanically and optically of C&G lenses made in the 1860s. It does not have a maker’s name on it but one of the elements is signed “TB” on the edge, and the housing is similar to other lenses known to be made by C&G. The lens is marked “4inch” but has an actual focal length of about 6½ inches – the “4inch” label refers to the distance of the image plane from the back element – a practice of the day in the 1860s. By the time of the later advertisements, actual lens focal lengths were listed. In other words – this is a very early example of a fairly standard magic lantern that one would encounter for the next half century.

PART 2 Magic Lanterns – Photographic Projectors:

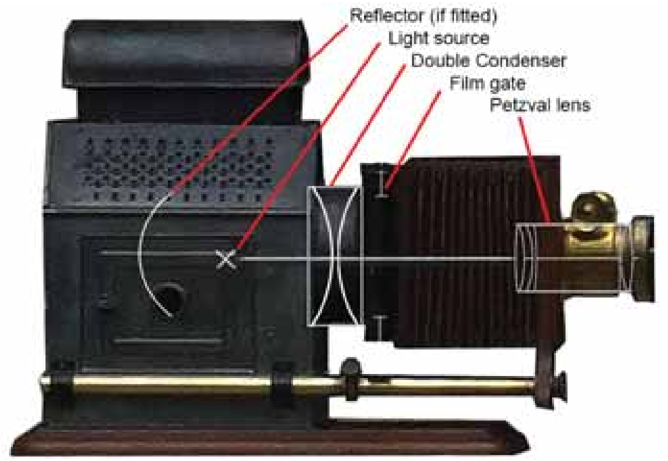
The idea of a magic lantern seems to have come out of the demand for entertainment at least from the 17th Century, and may even have been as early as the 5th century in the form of Camera Obscura. Very early examples are impossible to find and evidence is often only in a written account of some event in diaries etc at least up until the middle of the 18th Century. The device that we call a “magic lantern” today came of age around 1870, by which time artificial light sources were maturing and the necessary optics to create bright images were evolving.

Like a lot of technology, we have to look further afield to discover how the magic lantern developed over the years – a development that is probably not over yet as we now migrate from physical images like the original hand-drawn images, then photography towards digital solutions. But even from the very beginnings of the 19th Century form of the magic lantern, the designs were founded on very good principles, and only a few changes have occurred, most notably the source of the illumination and some consequent changes in the lamphouse optics. This article looks at the designs, particularly in the context of the illumination changes over the years, and how some updates to those early magic lanterns show significant improvements when modern illumination sources are fitted. Some of the more technical aspects have been included in Part 5 at the end of this article. The images that were viewed are a subject all of their own, but it was the invention of photography that prompted an explosion in the use of the lantern technique to view those images. Part 6 provides an overview but only as an introduction to what the magic lanterns were used for.

Magic Lanterns – an overview: The magic lanterns that emerged from the latter part of the 19th Century are simple enough, and comprise a light source, a transparency, a projecting lens, and a screen that an audience can view. Each of these items has its own history but there is a considerable level of coincidence as new designs emerged and sometimes you have to look for the source of various innovations and sometimes even the basic theory involved to understand what it is all about, and to facilitate updating if that is what is needed.

Back in the 1850s light sources were not very bright although sunlight via a hole in a wall and a mirror in an otherwise blackened room was used. Primitive lighting such as Kerosene and wicks were common but already there was evidence of lime-light and attempts to brighten the burners. High-performance gas lamps, electric lamps, and ultimately solid-state emitters were yet to come. It was realised by some inventers that brighter illumination could be achieved by placing optical lenses – generally called

"Condenser Lenses" – between the source and the object frame. At the time there had been already a lot of development of such devices in microscopy – particularly it seems in France – and early developers of magic lanterns almost certainly adopted the theory and practices from that technology. Single element condensers having the necessary aperture and focal length were not realised at the time and the "double condenser" was the way forward. Just when those doubles were introduced seems not to be known with any certainty as the surviving lanterns from that era not only used them but also had standardised a diameter of 4¼ inches, indicating some maturity. Aspherics that could do the job in a single element had to wait, but even then, they were often only an adjunct to a modification of the classical double condenser…



The general optical layout of a magic lantern shown in conjunction with the LAVERNE example. (The reflector is a feature of later projectors.)

Analysis of the lamphouses over the years shows that their designers knew what they were doing, and there was more to it than just experimentation. The performance of double condensers was right at the limit of what they could do with spherical elements, and while the performance of aspherics was well understood as far back as the early 17th Century, the manufacturing techniques had yet to come for all but low levels of aspherics such as were found in telescope objectives. However the refinements linking the condenser optics and the projecting optics did develop throughout the 19th Century with some further modifications in the middle of the 20th Century. Although not relevant to magic lanterns, the same issues have now been taken to exceptional extremes in the production of integrated circuits for computing etc and many of the limiting factors are the ability to project images onto Silicon chips in that industry, and some of the results that have been achieved deserve the title of "magic"!

Early magic lanterns supported transparencies that were drawn by hand on glass and it was probably only convenience that 3¼ by 4¼ and 3¼ by 3¼ inch plates were adopted – sizes that were to survive for over a century – and maybe a great coincidence that the 3¼ by 4¼ (quarter-plate) became a common photographic size – again surviving for a century. A subject in its own right, those plate sizes arose from the need to be efficient in cutting the glass that was available.

The projecting lens had to be appropriate for the transparency and the projection screen. The Petzval Portrait lens that was invented in the 1840s was the premium lens of the day, and fitted that requirement very well – and indeed would stay as the most common projection lens design of quality until the emergence of faster lenses nearly a century later. Several features of the Petzval made it very suitable as a projection lens: They have only one cemented surface and that is at the front where heat is less likely to be a problem, the back principal plane is vey close to being the physical back element minimising an illumination issue, the field angle is limited to about 35° which is adequate for most projection work, an economic aperture was about f3.3 which is quite fast, and it was fairly cheap to make, and eventually was mass produced in large quantities specifically for projection applications.

By about 1890 several things had happened – the basic design of the magic lantern had emerged and there was very little to differentiate between the various forms. The demand for entertainment via this means – particularly the results of photography – and the adoption of this form of display as an aid to religious instruction for example – had exploded. So much so that the technology was well within the reach of amateurs, and the more demanding users. They were prepared to pay for innovations like arc-lamps, faders and multiple projectors for special effects.

Parallel with the magic lantern were other projector forms – smaller transparency standards and movie films, and those parallels occurred throughout the development to the present day. Features of the original magic lanterns can be found even in the most modern digital projectors. With so much similarity, some of the modern developments can also be applied to earlier designs to produce significant improvements!

This article looks at some of the changes, and in particular looks to very modern developments to achieve very significant improvements in image brightness while avoiding some of the short-falls of earlier attempts.

But before going into the area of improvements there are some fundamental concepts behind the designs that explain how the lanterns worked and can also be part of the decision processes when recent innovation emerges. Often those details only arise if a totally new design is occurring, but they can be very useful when existing designs are modified and can even be a guide to what changes are needed:

Lenses, Efficiency and Resolution: The design and eventually manufacture of lens systems is complex and for high performance demands technology that is beyond other than the most dedicated scholarship and practice. This article is not the place to go into that level of detail but some appreciation of the results is helpful when one might want to change the arrangement in an existing projector. The design of the lens system in a projector takes many parameters into account and the following gives some idea on what it is all about. A key parameter for lenses where efficiency is demanded is known as the Numerical Aperture (NA) and that needs to be dealt with especially when modifications are made. For an overview and some of the fundamental arithmetic see Part 5 which defines the NA approximately and links it to the system resolution. Note that NA in this context has equivalence in the more familiar photography parameter – the f-number – when dealing with projection lenses.

The best designs will probably take those theoretical aspects like NA into consideration, but nearly every magic lantern uses a condenser system that is the same as was being used as far back as about 1870. In all cases, alignment and arrangement is paramount. So why worry about issues like Numerical Aperture? When we are modifying designs and attempting new approaches, some understanding of the fundamentals assists in arranging the beam angles etc between the elements. The NA found in the condenser lenses of most magic lanterns is around 0.5, so in theory at least, that can be improved. However there are complications when high and uniform illumination is sought and matters other than just high NA have to be dealt with.

There are good reasons for using large condensers and matched collimator / projector lens pairs, and when experimenting with these systems it is usually sufficient to ensure that the illumination beams just fill the available apertures in the condenser and the projection lens. In practice, the position of the light source relative to the condenser lens(es) gives enough control but particularly on more modern projectors that incorporate a collimating element just behind the transparency, it is industry practice to choose an element that is suited to the projection lens, so if changes are made then those final collimators may need to be adjusted or even changed. Many projectors do have an adjustment for the lamp filament that ensures that it is on the optical axis of the projector. Ultimately, the appearance of the frame on the projection screen is the best measure. However if we make a change to the illumination source – say from a filament to a point source – then other details like the cones of illumination also change and that impacts on where the point source should be compared with the original. Other changes impacting on the numerical aperture can also be changed for the better if we also change the design of the condenser systems – but more about that under the discussion of modifications.

In general photography the lens aperture and its relation to the depth of field is very important but in projectors both the transparency and the screen are flat and depth of field is no so important. But skip forward to the common use of 35mm slides when those transparencies have a bit of a curve, and the complication of flattening with glass mounts introduces other problems like moiré patterns and reflections within the glass mounts leading to fringing. A smaller projector lens does at least partly overcome the curved field issue at the cost of brightness, but at least one manufacturer (Leitz) went so far as to modify the lens design to accommodate the curved field – the Colorplan CF projector lens found on their late model slide projectors and as accessories. More generally, better results were obtained with faster projector lenses and great attention to the design of the condenser and matching it to the projector lens.

Fundamental lighting issues: The light source has to be bright and uniform over the object field. In a magic lantern that field is large – most commonly 3¼ by 3¼ inches. With the lens designs of the day, a double condenser of diameter around 4¼ inches was needed – usually a pair of plano-convex elements. The early light sources were flames from Kerosene and gas lime-lights, then the incandescent bulbs. Heat was an issue and heat filters became essential as the lamp powers increased. But to get brighter light you increased the lamp power but that needed more heat filtering which then reduced the brightness – not an ideal situation. Until recently, lamp powers and electric arcs up to kilowatts were used and even Xenon arcs for large venue applications, but it is emerging that the new solid-state LEDs etc are likely to take over for all designs.

The older light sources are all "isotropic" – that is – they radiate more or less evenly in all directions, although for the last Century special projector globes were produced that were at least partly matched to lamphouse designs that were based on a "reflector-condenser" arrangement. But those reflectors and condensers were also designed to match the available globes which had relatively large filament areas – a bit of a chicken and egg situation. As will become more obvious later, a major change to the projector globe will affect the rest of the optics and that will result in a design change – particularly in the case of an old magic lantern where the original design is clearly around a large isotropic illuminator, forcing change when we do something like using an emitter with a very different illumination pattern.

A very logical issue is that the light from the source via the transparency should all get to the projecting lens, and there are a couple of approaches to achieve that… Each stage of the optical path can be optimised, and anyone looking for improvements or a new design must address each stage in turn. There are probably no hard and fast rules but there are a few logical steps. It is evident that from the beginning of the magic lanterns right up until recently, more and more of the theoretical limits have been sought, and even after the first half Century of development, innovation was still evident on fundamental issues. The light from the source must get to the first condenser – whatever its form, and it emerges that the smaller the light source the better the performance of the condenser will be. Physically small globes originally designed for Cine projectors emerged before WW2 and were quickly adopted for general projectors. The condenser "set" – as we must include all elements – needs to get that light to the transparency stage and also ensure that the resulting beam gets to the projecting lens. However the design of the projecting lens is not as simple as might be immediately thought, but a lens that is designed for projection will probably work well when the beam from the final condenser through the transparency just fills the area of the back element of the projecting lens.

Special note: There is a parameter in lens design called the "back principal aperture (or pupil)" that also has to be illuminated properly but once designed and manufactured, there is little that can be done to modify it. A practical outcome is that some premium projector manufacturers will match the projector lens with the final collimating condenser lens and they may even be supplied as matching pairs. Instructions will often advise on exactly what condenser is to be used with each lens. But there is a key issue: If the incident light cone reaches the edges of the projection lens elements (externally or internally), then local heating can cause damage to the lens, especially if cemented elements are present. This is an issue that has to be dealt with when any projector is modified to the extent that the illumination cones are changed.

Explaining that practice, a common method summary employs a "light gathering" condenser (or pair) followed by a convergent element that matches the parallel collimated beam to the projection lens. Most modern projectors have abandoned the idea of the early "double condenser" and moved to parabolic reflectors and/or aspheric primary condensers, often combined with dichroic surfaces to manage the heat that is generated by the high-power filaments, at the same time using lamps that depart from the older isotropic designs, all aimed at brightness and an even illumination. Those aspheric primary condensers have effectively raised the NA to a high number from the perspective of collecting light and pointing it in the right direction.

Most of the later projectors (after about 1965) utilised modern Quartz Iodide globes that achieve high brightness in a very small package while a few special applications use Xenon Arc tubes. With small light sources there is the opportunity to employ the idea of point source illumination that leads to low dispersion and very uniform illumination when decent optics are also used. A lamphouse that uses a carbon arc or an Xenon arc (HID) is still isotropic and that requires a different set of optics, and the more advanced units use a parabolic reflector to achieve a higher NA – rather better than the 0.5 that is typical of the better double condensers. Much can be written about this part of the subject but is glossed over now as we turn our attention to solid state sources… The idea of using solid-state light sources has been around for a while but very new developments are producing tiny emitters with exceptional power and it is logical that we should concentrate on those new devices – much more later.

So fundamentally, the lamphouse has to be designed to get as much light as possible to the primary condenser – often using reflectors – and a consequence of using aspheric primary condensers is that more light from the source can be utilised especially when the light source is small and the lens can be placed very close to it – a valuable feature when using QI globes. Further gains were achieved by using filaments having special shapes.

A common lamp design found in modern 16mm movie projectors involves a QI bulb permanently set in a dichroic parabolic reflector with a collimated beam that matches the 16mm film gate and thence to usually a fast projecting lens with a focal length of 50mm or 2 inches. With only minor variation, that sort of design works with 8mm home movies. With a different reflector design and usually with the addition of a final collimating lens, those integrated parabolic designs work for 35mm slides as well. It soon becomes evident that there are compromises everywhere as the features of newer modified isotropic globes are allowed to interact with optical design.

A further major issue emerges in the case of movie films. Classical lamps run at very high temperatures and there is sufficient heating to destroy the film if it stops. Heat filters in the beam path and dichroic reflectors can help but it will emerge with the advent of solid state illumination that there is a rather different issue when extreme brightness is achieved – more about that later.

Projection lenses: From the beginning of projectors, the Petzval portrait lens was the fastest that was around – about f3.3 – and it was a practical (but maybe unwise) solution to use your camera lens to project. There was an issue about heat, but in a Petzval lens the only cemented element was the front element – not so much of a problem as most of the heat would be absorbed by the condenser, slide and rear elements. As the production of projectors increased, lower grade Petzval designs were used right through to the 1930s. The 35 degree or so angular limit of a Petzval was OK for projection whereas later "standard" camera lenses were more like 55 degrees which could be achieved by the Planars and Tessars of the day – necessary for wide-angle projection but that introduces additional complexity that is not fixed by considering the projection lens alone. By about the end of WW1, 3-element Anastigmats without any cemented surfaces and with speeds around f:5.6 were the lenses of choice – producing images that were bright enough with the new 500 Watt electric globes with filament shapes made specifically for projection. Amongst the faster lenses, the Leitz Hektor from the 1930s and more modern derivatives should be mentioned. These were up around f2.5 – about double the brightness that could be achieved using a Petzval. For miniature projection even faster lenses are used. However it is unwise to use Tessars etc for this purpose as the heat from the lamphouse is high enough to damage the cemented elements – ruining the lens. Special "projecting versions" were made without cemented surfaces to address the heating problem.

The design of projection lenses used in very high power units involves the heating iuuse again to the extent that temperatures can get so high as to destroy the elements as a result of heating the mountings. This highlights the importance of arranging things so that does not happen, and as will be suggested later, may even mandate that the brightness of new sources needs to be limited to safe values. Projecting lenses used in magic lanterns and modern slide projectors have NA values that are very low – mostly less than 0.1 – unlike microscopes where the objectives are very large compared with their focal lengths for the highest magnifications. However such was the search for brightness in many cine projectors that higher NA values were achieved – but still nowhere near microscopy limits. But change the scene to those huge lenses used for photolithography in the semiconductor industry and you are back in the realm of high NA values and deliberate matching of the lenses to the lamphouses with the result that the resolution of such systems reaches atomic levels.

Viewing screens: Projection screens exist with a wide range of reflectance and have been subject to a lot of experimentation over the years. An important issue is the viewing angle and in general the brighter screens will only be at that high brightness when the viewing angle is on what is called the specular direction. But that is not the only major issue, and when screens are made with for example micro-reflectors in a rectangular pattern – such as the lenticular screen – then interference patterns can be generated. This can be seen with some digital projectors, and the effect is so bad as to rule out the lenticular screen as a good option. A lot of effort has gone into producing screens as the brightness of commonly used screens can be over a range of about three to one – a significant range when high brightness is sought.

The earliest screens were white painted, almost certainly with a flat (or matte) finish, and they were used in a darkened room. That produced probably the best contrast that was possible, and the reflectance from such a painted surface was satisfactory with a viewing angle that was about the widest possible. But experimenters abound and just about every likely surface has been tried at some time. A popular standard is Titanium Oxide paint – very white – but only suitable in a darkened area. For higher ambient light levels a slightly grey surface will provide better contrast. Amongst the brightest screens are the glass bead screens that were introduced a Century ago mostly for movie theatres, but these have a narrow viewing angle which is a distinct disadvantage for large audiences. Silver screens, Aluminised screens, and Lenticular screens incorporating micro-reflectors in an ordered array or maybe at random have all been available at some time.

Many sub-variants emerged, with some interesting design features. Magic Lantern sizes were used in picture theatres and the adopted screens could be perforated so that the image could also be viewed from behind the screen by a person speaking or playing a piano as part of the entertainment. When sound movies emerged, those perforations got bigger as the sound system loudspeakers were generally behind the screens. In the larger theatres, those screens were very solid and definitely not sound transparent. If they had been made of lighter material the natural movement of air in a large theatre would move a flimsy screen. Further, such screens were commonly sloped to improve the brightness and viewing conditions – optimising the keystone effect at the same time.

Jumping forward to the present day as we now experiment with super-bright light sources, the additional brightness can affect what we choose to project onto, and it turns out that the original idea of a matte white screen in a darkened room or a light grey screen when the ambient light level is significant is probably the easiest way to go. The size of the screen can also influence the decision. In the end it is all a matter of compromise – you choose the screen that works.

PART 3 – Solid-state light sources:

Light emitting diodes (LEDs) have been around for a long time but have had light outputs in milliwatts rather than the watts needed for projection. Early attempts to use solid-state devices had only large emitters to play with and the results were not as good as might have been hoped, and quite logically as those emitters were larger than the QI globes that they were replacing. The technology is probably still at an experimental stage, and just exchanging solid state devices for the historical globes may not be the best that can be done. If you have followed the commentary on isotropics and Numerical Apertures, it gives some clues on further positive modifications. It is possible to arrange a light source for a magic lantern that is brighter than almost any filament lamp – and almost cold – at least from an infrared point of view, using an emitter with a dimension of only a few millimetres, and as that emitter is rather anisotropic (ie has a directed emission) then a change to the optics that effectively raises the Numerical Aperture will bring significant improvement. But that means changing the optics in ways that may not be all that obvious. The cost of the solid-state devices is low, and you can get a white source with an output of 15 watts for only a few dollars – giving the equivalent of at least a 250W QI lamp. Other options exist – and work at least to some extent. But there are some electrical, thermal and mechanical issues to deal with.

Probably the reason for the experiments with solid-state sources was the restoration of the LAVERNE magic lantern in Part 1. The original LAVERNE lighting unit was missing entirely, there was no reflector and a new approach was logical. LAVERNE was renowned as an inventor, so this attempt at a novel illumination was not out of place. Originally this would have had a Kerosene lamp source, or maybe a limelight (an invention from 1790), but that was long since gone – replaced by a 250 Watt incandescent lamp made in about 1918, discovered from the details in the rest of the conversion – the lamp socket and mounting.

An inspection of the condenser pair showed that it was very well made and had a good focus for infinity. Logic would suggest that it would perform well with a point source for the lamp and that proved to be the case. In addition, with the lamp source placed a bit further back from the focal point, the "cone of light" arriving at the rear element of the projection lens was uniform and well centred.

All sorts of options then emerged for a lamp source. A traditional 150 or 250 Watt QI mounted with a spherical reflector would have been a strong contender a few years ago, but there were new options:

An HID lamp ("High Intensity Discharge" – usually an Xenon arc lamp) such as is used in automotive service as a headlight can now be purchased for as little as $35 complete with the necessary high voltage pack – nominally a 55 Watt unit that would run on 12Volts. To be effective this would need to be mounted coaxially in a parabolic reflector with a diameter of at least 4 inches. Recall that the parabolic reflector can also be appropriate from a Numerical Aperture point of view? Such a unit was to hand – salvaged from a failed digital projector. However this proved to be unsatisfactory as while the resulting beam did have the appropriate illumination, it was uneven and would have needed a diffuser of some sort introducing unacceptable losses. A similarly mounted LED for automotive use was bright but also needed a parabolic reflector and the available samples failed to impress, largely because those available reflectors were far from being accurate optical devices.

Of the alternative LEDs, one that stands out is from CREE – part number XHP70.2. A bit of technical stuff is now necessary. This device had an emission area of 7x7mm and consisted of 4 cells in series, was mounted on a copper substrate, and all the light radiates in a 180 degree arc. The LED surface was fitted with a permanent hemispherical "lens" which effectively concentrated the beam to about 120 degrees – rather more than the area of the LAVERNE condenser lens when the source was placed at the focus point. The unit is marked 12 Volt and was rated for a maximum current of 2.4 Amps. 6 Volt units are also manufactured.

Now those numbers are absolute maximums and don't mean much by themselves. More importantly, the unit needs to be at a moderate operating temperature and to achieve that, it has to be mounted on a heat sink with a bit of forced cooling. Experimentation showed that a more reasonable set of conditions was 11.3 Volts and 1.3 Amperes achieving 15 Watts, and on the chosen heatsink fitted with a small fan, the surface temperature could be held to 45 deg C, about 25 Deg C above the ambient.

The device is very non-linear and careful control of the voltage and current is essential. Thus a proper supply was needed with fine adjustment capability. Even a couple of years ago, the design and construction of such a supply was not trivial, but today there are modules available on the Internet that do an excellent job and cost very little.

The XHP70.2 chip is not an isotropic radiator and even though its designers have already fitted a tiny highly positive spherical integrated lens that had a beam spread of more than 120 degrees, there was a lot of light that did not get directed into the LAVERNE condenser. Placing the LED chip closer to the LAVERNE condenser to capture more of the light is not a solution as the rest of the focus etc is wrong. So a modification to increase the NA of the condenser by adding an additional element was probably the only solution. A few converging lenses were tried between the chip and the double condenser, but the best experimental result borrowed from the modern designs. A plano-parabolic primary condenser designed to produce a 60 degree beam from a point source was placed right up against the CREE chip. This produced an almost exact fit of the light cone to the LAVERNE condenser, and after a bit of further adjustment to the position, achieved a considerable light increase in the projected image – a factor of about three, and at least comparable to a 250W QI in an efficient modern projector. An observation suggested a NA that is rather better than 0.5 as the subtended half angle was close to 90°. The exact NA would be obscure due to the presence of the aspheric element. A further important point is that the low radiated heat produced by the chip meant that no cooling would be needed in the optical path. However a different heating scenario emerged as the illumination was so bright as to heat any dark surface that it hit – including any dark slides and even the edges of the projecting lens. But this only emerged as a problem when a similar solid-state illuminator was fitted to a 35mm projector and the light intensity was so high that it destroyed a dark transparency – but see a later discussion on that issue. Of course, a small emitting area like the XHP70.2 does need to be adjusted onto the optical axis and in the “trial example” that was achieved using a couple of screw adjustments.

Commonly, a device like the XHP70 is said to require a “driver” – an electronic circuit that controls the power to the device. Several options are available but most have very little information about them and what there is can be very confusing and is often optimistic. The following is a block diagram of a suitable solution to drive a current-limited XHP70 chip with the ability to control and measure the electrical drive. An easy solution utilises an industry standard power pack that is common on laptop computers. This has a significant safety feature as such power packs are fully isolated removing the possibility of dangerous exposure to the power mains. Such units are very commonly available after the laptop computer has become redundant through age. Virtually all of them are able to supply the current needed. Any terminal voltage from 15Volts to 30Volts will be satisfactory as long as it can deliver at least 1.5 Amps.

Block diagram of a suitable driver ensuring safe operation of an XHP70.2. A driving current of about 1.3 Amps results in a terminal voltage just over 11 Volts.

The procedure for setting the regulator will depend on the chosen driver. This one is a high efficiency switch-mode regulator with two controls – voltage and current. A reasonable procedure would be to start with the XHP70 (12V version) not connected and wind the voltage and current control fully anti-clockwise then apply power and adjust the voltage control to about 10.5 volts. Then connect the chip, and increase the current control until the chip lights and then raise the voltage and current to achieve about 1.3 Amps. The voltage will need to be about 11.0-11.3 volts, and the final setting will allow the voltage screw to be moved a bit in either direction without changing the current, and the current control then sets the final current exactly. If the current is accidentally raised up around 2 Amps, then the chip will overheat and probably fail. Of course the chip has to be on a heatsink for all of this. The cooling fan is not in the metered part of the circuit and its voltage can be anywhere near 12 Volts. The metering unit does not have to be present but the current must be monitored when setting up as some sort of meter is needed – if only temporarily.

Another option presents itself to smaller projectors. Chip assemblies with a much larger area, about the size of the projected transparency, but also needing higher voltages are available. Such a chip could be mounted right up against the transparency without any condenser lens at all, and in the case of a movie projector could even be pulsed at the frame rate doing away with the need to have a rotating gate! However the efficiency of such a system is not likely to be high compared with a properly designed condenser and a point source.

The completed lamp unit that was used in the LAVERNE magic lantern. This is clearly an experimental version and needs a bit of “tidying up”. The metering unit on the left is not essential. This version is far from unique, but provides for X, Y, and Z alignment. High voltage options exist too but with significantly increased safety risks.

Using a large emitter also works with a unit like the LAVERNE but retaining the condenser lens – in that case the source is far from being a point source and the efficiency is well down, and even a 100W COB chip is not as bright as the XHP70.2 (at 15 Watts) with the additional refinement of adjustment etc. However the illumination uniformity was very good and if the precision of using a point source is not considered as important then the large COB unit has to be an easy option. The latest versions of these will run from unregulated 220VAC as they have the regulation on-board, but they do have to be cooled and a heatsink fitted with a small computer fan is essential. In Australia most power supplies are 230-240 Volts and that is probably a bit high. A small transformer fixes that and also allows for a little bit of circuitry to arrange a 12 VDC supply for the computer fan. For 110VAC working, suitable COB units are available, and a fan can be sourced that also runs from 110VAC.

Safety Note: While some specific instructions would allow a non-technical person to build high voltage units, there are huge safety issues and this is probably better left to those with experience in electrical engineering and making heat management systems.

Astute readers might notice that the heatsinks and blowers in these illustrations are sourced from scrap Pentium II and Pentium III desktop computer processors. If you don't have a "junk box" that contains such items then a call to a few friends should discover some options. A couple of tricks from the computer industry are appropriate – such as Silicone heat conductive paste between the LED chip and the heatsink. Many cooling fans have speed monitoring wires and you may need to experiment to discover which wires need a 12 Volt source for example – ignoring the rest.

The LEDs that are available can be found in various colour temperatures – for photographic work, cold or daylight LEDs are needed – and "warm" LEDs tend to be so yellow that they are reminiscent of very old incandescent lamps. On a technical point, the spectrum from these new solid-state devices is quite flat, but slight colour fringing is possible on beam edges where the chromatic performance of condensers also falls down a bit:

Even casual observations of the photographed light source indicates some workshop effort and both mechanical and electrical engineering, and "final products" will be affected by the ability and experience of the builder. The examples shown fit into the LAVERNE in a way that allows the focus point to be set easily, and in the case of the tiny XHP70.2 chips, the alignment adjustment is via a couple of spring-loaded screws. Thermal paste between the LED units and the heatsink is essential, and some knowledge of general electrical principles is needed – if only to avoid damaging the components. Assuming that there was a scrap source for the heatsink, surplus laptop supply etc, the total cost of the XHP70.2, the constant current regulator and the metering unit was well under $20. However that was at the end of 2022…. The price of an XHP70.2 or the newer XHP70.3 has tripled in the first few weeks of 2023, and it may be that there is a world-wide shortage as the demand probably outstrips the supply. These devices are also used in super-performance torches, stage lighting, automotive lighting etc .

And on safety, there are some final words of warning. A feature of this approach is that the light intensity of the LEDs and the XHP70.2 CREE units in particular is high enough to cause permanent eye damage if viewed directly. Back in the days of QI lamps it was common to align the filaments using a test card in the slide holder and adjusting the position screws while viewing the projected image directly. That should not be attempted under any circumstances with solid state sources and the only adjustments that are needed for this single emitter approach can be achieved by looking at the projected image for full frame coverage and for maximum intensity – experience shows that this is very easy. And to repeat – you are dealing with dangerous voltages with some solid-state sources and with any HID lamps – extreme care is needed – and there are regulations about unqualified practices which may also affect your insurance policies. Years ago, experimenters would try anything but today we are risk-averse and should not attempt anything like this that could be dangerous without the appropriate care.

The XHP70 version utilising a 19VDC pack from a laptop computer is a very safe option from an electrical viewpoint. The maximum voltage after the power pack is only 19VDC and there is no consequent shock risk. Even under fault conditions like a wiring short circuit, internal protection takes over. This safety aspect alone was the reason for adopting the solutions presented here over other options that would involve working with exposed supply voltages.

PART 4: Conversion of a Leitz Prado 300 Projector.

As the work that went into the project had a level of experimentation in it, some of the above is maybe more complex than is necessary, so a fresh mini-project converting a very common Leitz Prado 300 projector from the mid-1950s was started. These projectors are almost being given away, but it turns out that they are ideal for conversion as they incorporate aspheric primary condensers, correctly matched collimating condensers, often a Leitz Hektor f2.5 100mm or 120mm projector lens, and as can be quickly realised, are very suited to conversion requiring virtually no modification other than the removal of the lamp, reflector and power socket assembly (simply unplug!) the heat filter (simply unplug!) and one of those computer heatsinks fits perfectly.

Prado 300 projector from the 1950-60 era. Maybe the most popular projector ever and a good case for conversion.

Now that old 300W Prado does not have any forced cooling – but the heatsink in the conversion does need a small fan. Sure, Leitz also made a higher power unit with a forced cooling fan that cooled the lamphouse and the slides, but if one of those is going to be converted then maybe remove the Leitz fan and motor as in the conversion, the small computer-type fan directly on the heatsink takes over. There is no need to cool the transparency stage, and it is pointless to retain the heat filters in the condenser assembly.

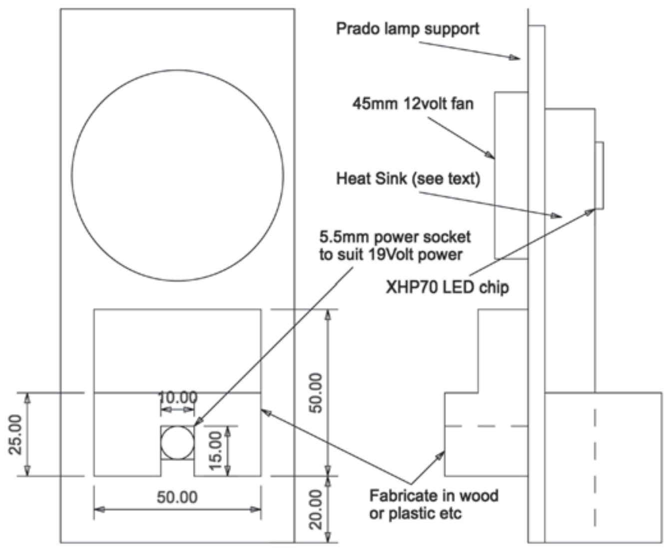
It also turns out that a simplified power supply is all that is needed. If the scrap laptop power supply "19VDC and at least a couple of Amps" is used, a simple dropping resistor of about 6 ohms in series will supply both the lamp and the 12V fan. But it does need to have a power rating of at least 10 Watts and needs to be included in the internal cooling arrangement. However such a resistor is about the same cost as a constant current switching power supply that can be sourced from eBay and the latter is much more efficient, and adjustable – so that is the logical way to proceed.

A little bit of mechanical work is needed to hold the solid-state device in the right place but it turns out that the module that holds the original lamp, reflector and power connector is ideal as a mounting frame for the new heatsink and some minor bits. The photographs of the new solid-state unit and an original P28 incandescent unit side by side sums it up pretty well – and no modifications to the projector itself are needed. These units are so common that a special drawing has been produced that shows the details of the conversion, and allows a bit of bespoke woodwork to be made. That does not give exact details of the screw holes etc, and they may be a tiny bit different for each unit.

Left: the original P28 lamp assembly from a Prado, and Right, the XHP70.2 chip unit with the regualtor - all mounted on a salvaged Prado plate, and the astute will note that the two plates shown here are from slightly different models. (Late Prado 500 on the left and an early 300 on the right).

The result is a projector that is brighter than the most modern of the Leitz projectors – the rather costly "Prado Universal" that is normally fitted with a 250 Watt QI lamp – and of course, even that old Prado 300 will support a huge range of accessories! Leitz got the design of those Prado projectors just right back in the 1950s!

And of course, there are huge advantages in converting to solid-state light sources. An incandescent lamp or a QI lamp has a working life of 25-50 hours. But those lamps are now quite expensive and relatively hard to find. The new solid-state device has a working life of maybe 30,000 hours and with normal use should never need to be replaced. The colour temperature and spectrum of the new solid-state devices is much closer to daylight and there are sufficient variations in the devices that are available that you can choose whatever colour temperature you want. And the total power consumption of the new devices is only about 10% of that of the equivalent filament sources, and as little as 5% when other aspects like the need for large blowers to cool the lamps are considered. But if you update one of those older magic lanterns with a 500 or 750 Watt ES or P28 lamp then the total power saving might be as much as 98%!



A drawing of the layout for converting the Prado lamp unit. All of the removable bits are not needed but a block of wood or plastic to hold the regulator and connector is needed and these dimenseions will ensure correct clearances in the rest of the housing. The heatsink and fan are recovered from a scrap Pentium III processor. The exact location of the XHP70.2 chip will be the centre of the hole in the Prado plate that originally held the reflector. Experiment showed that with the correct collimator lens that matched the Hektor projection lens, the distance between the front of the XHP70.2 chip and the Prado plate was 28mm.

However, even in this mini-project, a few issues arose that do need comment and did change the outcome, but also raised a couple of issues concerning the use of these super-bright devices in general:

Lamphouse design when using a high energy point source – new problems: It turned out that the condensers in the Leitz Prado 300 (and probably all of the related devices) are excellent and the parabolic condenser has quite good performance when the LED is placed optimally. However that position is a few millimetres further away from the lens than the original incandescent lamp, although the front of the micro lens on the chip is about the same position as a P28 filament.

But a detail remains – and raises a problem… Just as in the case of the LAVERNE conversion, a lot of light is lost between the XHP70 chip and the Leitz aspheric condenser.

The effective NA of that system is also too low and taking it to the next stage of refinement, an additional condenser lens matching the XHP70 divergence angle (remember that it is not isotropic) and the entrance aperture of the Leitz condenser increases the projector brightness by a factor of about 3, just as in the LAVERNE example. Recall that the XHP70 does incorporate a tiny hemispherical lens on the front to the chip giving nominally a 120° beam, and that is about as narrow as could be achieved with a single element. The Leitz aspheric needs about 90° when the condenser is mounted in "position 1" relative to the position of the chip. (Those positions are explained in the Leitz operation instructions – as those projectors can also be set up for 6x6 transparencies as well.)

However with all that glass in the path the assembly is a long way from a simple thin lens and the actual beam angles are not particularly relevant, nor are they easy to judge, and the entrance pupils (apertures) become the governing entities as these can be observed directly. In this case absolute design is not going to add much to the understanding of what is going on – observation of the beam cones and the result on the screen is really all that matters. In the case of the conversion of the Leitz projector we end up with 4 elements in the lighthouse – the hemispherical lens on the chip, two aspheric parabolics and the collimating lens matching the projection lens - if maximum brightness is sought..

These are all elements with very high Numerical Apertures, and such numbers are not unusual in high performance lamphouses. Lamphouses used in photolithography in the semiconductor industry can have upwards of a dozen elements – chasing extreme resolutions – and in those machines the projecting lens can have up around 36-elements.

But that is getting off the track a bit. Adding the extra lens just in front of the XHP70 chip does increase the brightness by a factor of about 3 – yes – THREE, but the field coverage is only just wide enough for a 35mm slide when the same aspheric is used as was also used in the LAVERNE example. The additional brightness oversteps a practical limit – it is too bright for an under-exposed, ie dark, slide and it will cook the slide. There is a bit more about this below on heating, but the upshot is that the conversion is better WITHOUT the additional aspheric lens as it just reaches the limit for the light intensity on a 35mm slide and fills the frame for the larger 4x4cm format that those projectors can be adjusted for.

XHP70 operating voltage and current: The voltage and current applied to the XHP70 does vary from device to device and the voltage is typically around 11.3 Volts for the 15 Watt operating point. However the Voltage-Current curve is very non-linear, and even a few millivolts too high will raise the current and cause the XHP70 to fail. The safest approach is to control the current using a constant current electronic device or a simple limiting series resistor – a chip current of 1.2 Amps is about right.

When making those measurements, the effect of the metering circuit has to be taken into account and probably justifies the additional metering circuit shown in the lamp that was made for the LAVERNE projector. The 12 Volt cooling fan will take about 100mA – and that number is usually printed on the fan somewhere .

Heating issues for very bright images: There are heat and radiated energy issues. At one point in the workshop, the "Leitz conversion unit" was operating with the XHP70 pointed toward the bench and about 10-15mm away from it. However even though the XHP70 was cold, there was so much energy in the light beam that it burned a hole in the bench after only a minute. But an analysis of the spectrum showed that there was virtually no IR (heat) radiation in the beam! And there is the further oddity that the XHP70 diode was running at about 45°C but the "hole" in the bench was smoking and was up around 400° C. Thus the burning process must have been an energy conversion as the bench surface absorbed the light output. In the case of a large transparency projector like a Magic Lantern, that is not likely to be an issue, but if and XHP70 is used to light, say, an 8mm movie projector and the chip is up close to the film gate then the film is certain to be burned if viewed statically. Even a 35mm projector is going to suffer from burned transparencies if the beam is adjusted to just fill the 24x36mm frame, and the transparencies are darker than usual.

That suggests that a totally new approach is needed and as there is energy conversion involved then a heat filter (common in most movie projectors) is NOT the right answer. In fact, there may not be a workable solution when the energy in the light beam is as high as can be obtained from an XHP70 and it will be necessary to limit the light to a much lower level – for example put a limit of about 1 Watt on the light beam which means limiting the chip current to about 100mA when the film is not moving in the case of 8 or 16mm cine film – it is still very bright at that level.

This issue does not challenge any laws of physics, but it is only now with the super energies that can be obtained from these diodes that the beam energy is high enough to burn and cut etc. You can feel the effect of these bright beams by putting your hand in front of the projector – there is so much light there that it penetrates your skin and affects the nerves in your hand! This highlights the danger of looking directly into these beams – they WILL damage your eyes. As mentioned above, heating is also an issue with a dark 35mm slide when the lamphouse optics are modified to increase the incident power on the slide to the full 15 Watts in the 24x36 field. The issue here is that the dark slide absorbs the light energy and it converts to heat. A very light slide would not have that issue. Force cooling the slide would help, but the tolerance against slide damage is very small. Who would have thought that the ultimate power limit for the incident light on a 35mm slide was less than 15 Watts? And to remind the reader again – a heat filter does not work as they only deal with the actual radiated heat from a very high temperature light source and not the energy contained in the visible light.

Special note on projection lens heating: Again probably particular to conversion of a 35mm projector, there is a chance that there is so much light going through the projector lens that the edges of the elements could overheat, and logically that could be the case if the original design did not take that into account. Some projector lenses involve cemented elements and overheating the edge of one of those could easily cause damage to the cement. Simple observations of what is super-bright inside the projecting lens might help, but even looking there carries a risk to your eyesight. It might just have to remain as a risk of experiment – where a failure means "start again". This turns out not to be a trivial matter. A Leitz Prado projector fitted with an XHP70 chip running at 15 Watts, and with the slide carrier "open" with a 4x4cm aperture, demonstrated more than a 10°C rise in the temperature of the Leitz 120mm f2.5 Hektor lens after 10-15 minutes, during which time there was no temperature change in the projector housing, and the heatsink on the XHP chip was still less than 20°C above the ambient room temperature. Restricting the field to a cardboard 24x36mm slide holder with no film present made a noticeable difference to the observed brightness inside the Hektor lens around the element edges.

A curious result comes from this project – that technology has actually reached a practical limit for the amount of light that you can put through a 35mm slide as part of a projection system – as the darker parts of a slide will overheat to destruction when the light is absorbed and converted to heat in the slide. Forced cooling will allow a bit more light, and digital approaches will allow brighter projected images provided that darker areas are not produced by light absorption.

The derivative equipment – photographic enlargers: Very early in the history of photography, and particularly after the invention of photosensitive papers such as those that used Bromide processes, the idea of using a projector to enlarge for example a 3¼" by 4¼" (quarter-plate) negative to produce an enlarged positive print was a very natural progression. Thus those early magic lanterns found their way into the darkroom – initially as the "horizontal enlarger" and many were able to serve the double purpose as projectors as well. Some of those units could enlarge up to a full plate negative and a few had huge double condensers up around 21cm diameter.

Optically they were pretty much the same as a magic lantern employing a double condenser, a transparency stage a projecting lens of some sort and a screen. After a while the more convenient form emerged as the vertical enlarger that became the standard to the end of the film era. Without going into too much detail, an enlarger incorporating a good condenser set will produce sharper images with higher contrast when compared with a simple "diffusion enlarger" that places an opal glass behind the transparency. This loss of contrast and definition is known as the "Callier effect" and arises due to the scattering of the light. In practice, a condenser type enlarger can produce prints that are "too detailed" and "too contrasty" and it is common to use an "Opal Globe" as a way of introducing some diffusion. Some enlargers increase the diffusion a little bit more by modifying the lamphouse and utilising a single condenser, at the same time improving the uniformity of the illumination..

For most photographic work there is no need for any more than a double condenser and that arrangement was the most common right up to the end of the film era – and those double condensers are simply scaled from the designs of the middle of the 19th Century. In the darkroom, the experience of the enlarger getting too hot will be very familiar but changing to one of the new point source solid-state lamps could increase contrast and the effects of negative faults and dust more than the photographer wishes. However one of the new solid-state household lamps, particularly the latest versions with a single emitter area of about ¾" (18mm) diameter and a daylight colour temperature or even a bit blue will work very well for black and white photography.

But is there a case for using a point source? When the first of the HID arc lamps emerged in the 1950s, you could get low power versions made specifically for use in enlargers – the selling point being increased contrast and definition – and there was some promotion of "point source enlarging". That has more or less been forgotten with one very important exception – photo-lithography used in the manufacture of electronic semiconductors such as computer components – memory – CPUs etc. In that case the search is for contrast and definition at the absolute limit of technology, and those lamphouses are exceptionally complex. That technology used conventional HID arc lamps right up to the limits of lens technology. More recently the sources are things like Excimer Lasers having exceptionally narrow bandwidths, and entirely new methods of achieving the necessary results are employed. None of these are relevant to conventional photography.

Summary – the case for updating lanterns and projectors: There are a few common scenarios:

- An old magic lantern where the original liquid or gas illumination has been replaced by an incandescent lamp of some sort.
- A projector where the original incandescent lamp or even a QI lamp is hard to obtain.
- Any projector where there is a distinct advantage in lowering the "illumination energy".
- Where a projector is needed to view transparencies and a modern high efficiency solution is sought.

These scenarios could have happened at any time in the last Century, and the common approach was to "update" the unit using the latest type of lamp, sometimes adding features like reflectors that were not in the original. Bringing that forward to today, the latest is the solid-state LED at the limit of what can be made in a way that is easy to implement – and that just happens to be the CREE XHP70 series of mounted chips fitted with a hemispherical lens, and this article shows that it can be achieved effectively and cheaply. Importantly from a conservation point of view, no physical changes to the original lanterns and projectors seem to be necessary – particularly for the early units. Some later projectors have additional cooling etc that is associated with their original lamps, and at least in some of those cases all that is needed is to disconnect them.

One outcome is very obvious, the cost of a solid-state conversion is very low – and comparable with the replacement cost of one globe – if one of those can be found! In the case of the conversion of a Leitz Prado 300 projector, the conversion creates a very useful projector from a unit that otherwise could be headed to landfill, and you end up with a projector that works as well as or better than the later Prado Universal fitted with a 250Watt QI lamp!.

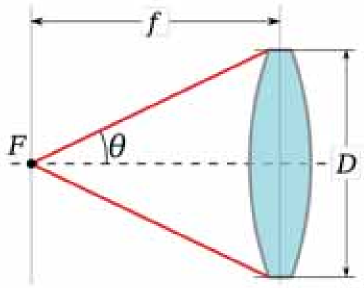
There are a lot of those old Prado projectors around and while most are fitted with f2.5 Hektor lenses (85mm, 100mm, and 120mm), some are fitted with the excellent f2.5 90mm Colorplan, and for large venue work there are longer lenses up to 300mm, but for best results you do need the associated collimator elements that go behind the transparency stage.

PART 5: Limits of a lens system – Numerical Aperture and related parameters.

Central to all projection systems is the need for brightness and resolution, and it has been realised since the 18th Century that these go hand in hand. The original effort seeking high efficiency was probably entirely in the world of microscopy, and the early microscopes that had the greatest magnification employed the largest lenses relative to the viewed areas – both the objectives and the condensers.

It seems that effective condenser design or maybe just practice was common knowledge in the UK and France but not in Germany and it was not until the 1860s that Abbe – working at Zeiss – wrote down the equation that linked it all and explained why those existing designs were so effective – defining the Numerical Aperture (NA) of a lens as:

$$NA = n \sin\Theta = n\, D/2f \text{ (approx.)}$$



In that equation, n is the refractive index of the medium, Θ is the half-angle subtended by the lens at the focal point, D is the diameter of the lens and f is the focal length. In microscopy the NA is accepted as the all-important parameter, allowing the limits of a system to be estimated, and objectives and condensers are almost always marked with the NA, and extreme performance involves changing the value of “n” using immersion oil etc. In photography we observe the f-number of the lens as a measure of the lighting performance as this is more appropriate for exposure calculations – approximately D/f – although that has to be modified for close-up work. Ultimately when exposure is super critical – as it can be for television etc – then a new parameter called the Transmission number (T) is used which takes into account losses in the optics. The above is a simplistic approach and assumes a simple thin lens.

Acting on complaints that Zeiss condensers were inferior to those by other makers, Abbe designed some new condensers for microscopy in the 1860s that were better than any of the predecessors, resulting in units with high Numerical Aperture. These arose from the realisation of the diffraction limit, “d”, for a perfect lens – Abbe’s law:

$d = \lambda/(2n \sin\Theta) = \lambda/2NA$ where λ is the wavelength, and the other symbols are as before.

This is highly relevant in microscopes and photographic enlargers – particularly when dealing with small negatives. The best resolution comes when the NA of both the objective and the condenser are high – and it is common to have them about the same. The British Physicist, Lord Rayleigh arrived at another but related entity for the limit of resolution observing the Airey Disks that are generated by circular apertures, and that Criteria is usually stated as:

$\Theta = 1.22\, \lambda/D$ Symbols as before.

The improvements that Abbe’s work forecast did not find their way into magic lanterns at that time as the existing designs were already good but maybe more particularly because increasing the NA was not possible with the techniques of lens grinding that were available until much later when aspherics were introduced. Microscopy also had a lot to do with magnification and resolution limits and gains in NA affected both of those. With magic lanterns, the image is limited by what can be put on a glass slide, and all that was necessary was to get resolution on the screen that the human eye could see.

PART 6: The slides

As this article is to do mainly with the relatively modern magic lantern that emerged in the middle of the 19th Century, this summary of the slides that were viewed is restricted to what we commonly observe as a 3¼” by 3¼” slide today from that era. At that time the magic lantern was a major source of entertainment as other forms of public display etc were still in the future. Of course there was live entertainment but the magic lantern introduced images that were often inventive and ultimately were not particularly costly. As production techniques that later became the core of the movie film industry were still in the future, observers had justification to consider what they saw on those early screens as some sort of magic. Some presenters incorporated trick imaging using multiple projectors etc that observers would not normally be expected to understand, heightening the magical aspects. The earliest slides were predominantly in colour and fell into a few categories and are commonly considered to be:

Painted Images: Scenes and entertainment drawn and hand painted on glass plates, often using very thin paints that produced well graded images.

Slip slides: Mechanisms where two or more slides are slid over each other so as to give the impression of a moving image. Sometimes it was a single long slide that in modern terms would be called a sliding panorama.

Mechanised slides: Mechanisms arranged so that movements other than sliding could be displayed. A typical scene might be a windmill where the sails of the mill were rotated via a crank handle from the end of a slide.

The moment that photography became real and ways of producing a transparent positive were discovered, they were adapted to the magic lantern and that technique became the common way of creating slides right through to the digital age. Those slides varied very widely in subject matter – quite obviously as we now assume that we know what slides are all about – if you can photograph a subject, you can turn it into a slide. While the early photographic processes were monochrome – usually black and white but commonly sepia and other toning that experimenters used, a lot were tinted with coloured pigments producing often very good coloured images. Over the years many of those have faded as the tinting was not always permanent. But there are a few categories that help explain why the magic lantern and its successors were so common.

Portraits: Photography was almost instantly used as an alternative to portrait painting and much of the 19th Century images were of people. They found their way into magic lanterns very quickly. A technical adoption concerned the use of “quarter-plate” cameras – 3¼” by 4¼” – and they were cut to the square format but often (particularly in the USA) the lanterns were made for the larger plates.

Landscapes and group photographs: The larger quarter-plate sizes were common for outdoor photography, but the square format remained as the most common form.

Religious subjects: Church organisations that allowed images to be viewed adopted the magic lantern very early and huge quantities of slides were produced. Whole biblical stories were portrayed in series of slides, the words for hymns were displayed that way and particularly in the missionary world, photographs of missionary activities were put on slides as a way of publicising what was happening in the field. Some organisations undertook massive productions this way and most notably the Salvation Army had major production facilities wherever they worked.

Architecture: People are interested in buildings and such creations – and many such items are very well recorded in the historic lantern slides.

Tourism: Just as modern tourists seem to take photographs of everything as they move around, the 19th Century tourists did exactly the same – so that they could relive their holidays and show off to their friends back home.

Education: Just about any subject that can be taught can be supported by images ranging from illustrations to lecture notes.

Advertising: Goods and services for sale have always been subjects for viewing by groups – often as an extra while other main subjects are presented. The quarter-plate slides were very common in modern picture theatres – as the large size allowed high power lamp-houses to keep the brightness about the same as the main attractions.

Forensics: Crime scenes and evidence are natural subjects for photography and lantern slides were used as a way of displaying such details.

Archives: Slides were seen as having better archival quality than a lot of paper archives and were often seen as being more space efficient. As the technology improved, smaller images were used as special systems like the microfiche emerged. Some of that miniaturisation went to extremes as microdots etc were used to hide information – only to be viewed by those who knew how.

Research: Photography was used to capture transient events and some of the early nuclear experimental data only exists today because it was recorded on slides – often only as a negative.

Toys: Very primitive projectors emerged with children's stories on slides.

Other subjects: Of course, there are subjects that are considered to be maybe less than acceptable socially, and that often has to be considered in terms of how we treat the subjects, and even when those judgements are made. Glamour photography, "What the butler saw", Pornography and so on have been very popular over the history of photography, and for those who produce such things, they are usually part of a very profitable business.

An issue of importance is the potential life of a lantern slide. In many cases a long life is sought and a Silver image on a glass slide that is correctly stored should last for Centuries, and maybe a lot longer than a paper equivalent. There are modern photographic process – particularly in colour – that are not permanent. Have a look at most of the slides made in the 1960s and they will have deteriorated very significantly, but look at a 19th Century lantern slide using Silver processes and the chances are that it is exactly as it was when it was made.



A few lantern slides - tourism - architecture - to film advertising in the 1950s

This article is an enlarged version of a presentation to the APCS in February 2023 which also included other projectors classed as "magic lanterns" and alternative new generation light sources.

“The KOMBI” a camera and graphoscope Brian Howden

The Mini Marvel of the 1890s

The KOMBI was an interesting and important historic camera, it’s importance in photographic history was notable because it was :-

- The world’s first miniature roll film camera.
- The first camera to use film manufactured by Eastman Kodak Co solely for use in another brand of camera.
- The first camera whereby you could take your pictures and then view them in the same instrument.
- The first roll film camera with an all metal body.
- The first interchangeable roll film back camera.

A very small box form all metal camera measuring 2in (50mm) x 1 3/8in (41mm) x 1 3/8in (41mm), taking 25 pictures 1 1/8in x 1 1/8in square or 1 1/8in round on 1 1/4in x 30in of roll film specially made by the Eastman Kodak Co.

The KOMBI was invented by William V Esmond, Chicago, US patent 488,331 on December 20th 1892. (British patent 23487 of 20th December 1892) and later a more detailed and improved model by Christian H Stoelting also of Chicago, US patent 533,618 on 5th February 1895 (British patent 2544 5th February 1895).

Manufacture of the little camera was undertaken by Alfred C Kemper of Chicago and over it’s life from 1893 to 1897 a considerable number were produced, advertisements in 1896 claiming 50,000 units had been sold in one year.

The Scovill & Adams Co under contract to Kemper produced 100,000 of the cameras, interestingly in 1895 the manufacturer was listed as Alfred C Kemper but Advertisements in 1896 showed “The KOMBI Camera Co” as the manufacturer?

The camera was still listed as available in the E & HT Anthony Co catalogue for 1897.

The KOMBI was introduced in time for the Columbian Exposition of 1893 and was an instant success.

As well as being a miniature camera it had the additional feature of being a viewer which coined the phrase “A combined camera & graphoscope” this being embossed on the front of the Camera and this feature gave rise to the name, The KOMBI, the cost of the camera in 1893 being $3.50 ea.

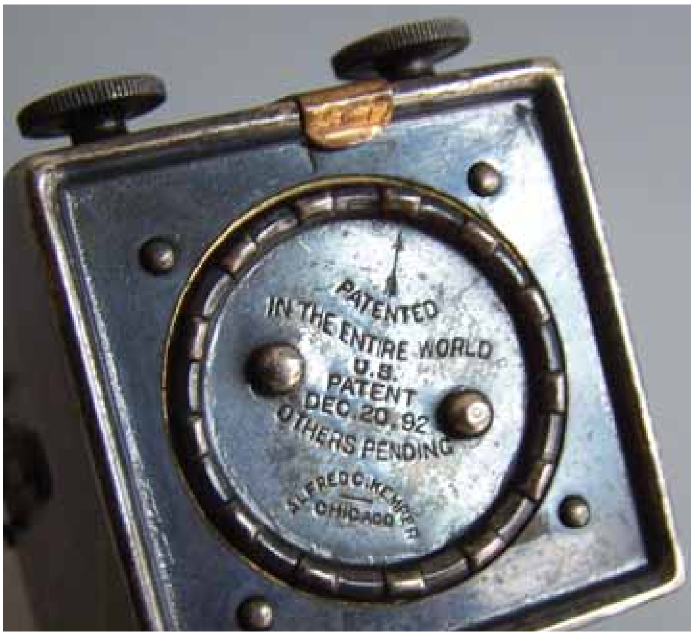
The camera was made of brass in two sections, the precision of the fit held the two sections firmly together but a spring retaining clip was available to lock the two parts together if required, it had stamped on it the word “Loaded” which when in position also served as a reminder that the camera was indeed loaded with film, spare clips were available at $0.10.

Each of the two halves of the camera had a serial number stamped on them, mine is numbered 6858 which would indicate fairly early manufacture.

The front half carries the lens and shutter with the rear half being the roll film back or holder with it’s rollers, platen to keep the film flat, and either the square format mask or the round one, spare masks were available at $0.20 ea.

The camera had an oxidised finish with silver diagonal stripes, quite attractive but subject to wear with heavy use.

Optically the camera was very basic having a Non-Achromatic Bi-Convex lens of f:12 33mm fixed focus.



The shutter was a simple sector type non-capping fixed speed with time and instantaneous settings, the quadrant shaped piece on the front top above the lens is what arms and releases the shutter it is attached to a spring arm riveted to the top of the camera with a small button on top, and the quadrant has two notches, one at the top centre and one at the far side these notches latch the shutter arm which is the round piece at the top front below the quadrant fixed with a central screw.

To arm the shutter you depress the spring on top and rotate the shutter arm to locate either the first or second notch, the centre notch sets the shutter for time exposures, the far one sets it for instantaneous exposures.

After arming the shutter depressing the top spring releases or fires the shutter, before arming the shutter it was most important to remember to cover the lens with your finger as this is a non -capping shutter, this procedure was not unusual back in those days as many early shutters required capping before setting.

Film loading had to be done in the dark room and there were two methods of processing your film. You could do your own using the available kit or use the develop and print factory service for either negative and prints or positive transparencies. If using the factory service you sent the roll film back or the whole camera in by post. After processing, your roll film back or complete camera was returned to you with your prints/positive transparency film and with the roll film back or complete camera loaded with fresh film.

I can find nothing in my research about the cost of this processing, it would also be interesting to know if this processing was done in house by Kemper or if in fact this was another arrangement with George Eastman?

A home developing kit with comprehensive instructions was available at a cost of $3.00 ea.

It was also a good idea to purchase a second roll film back as this would allow you to carry on taking pictures whilst your original roll film back was away being processed, these were available loaded with film for $1.50 ea.

To use your camera as a viewer it had to be empty of film, then remove the platen and format mask, then at the rear of the camera is a circular panel, removing this was done by rotating it anti clockwise using the two protrusions, it was a bayonet type mount, and lift it off.

You could now load your positive transparency film by winding it onto the film rollers, viewing was through the camera lens holding the camera up to a light source and rotating the rollers, the viewed image was approx 3X magnification.

It was unusual for a camera to have two wind on knobs but this was done to allow the viewer to wind the positive film back and forth during viewing, also as the film did not have a spool as purchased the second knob would have aided darkroom loading and setting the film tension.

The negative/positive film as mentioned was especially made for Kemper by the Eastman Kodak Co and cost $1.00 for five loads of 25 exposures, when winding on the film for the next shot three clicks of the wind knob brought the next unexposed frame into position.

The Eastman Kodak Co's unusual decision to manufacture a special film for The KOMBI was one based purely on commercial considerations and one of the few times they manufactured special film for other camera makers, another being Houghton's Ensignette, with the number of cameras claimed to have been made Eastman probably did very nicely out of the arrangement.

There were two lens caps available, and each of these caps were actually apertures as they had different size openings in them. The cap with the smaller opening was used to take time exposures where as the one with the larger opening was used for instantaneous shots in very bright light conditions. The lens protrusion itself is what the caps slipped over, and with no cap fitted was used for taking pictures in normal daylight as well as the eyepiece for viewing your transparencies.

It was recommended for beginners to only make time exposures, this was so they could take better pictures in most light situations, of course a tripod was recommended for time exposures to give steady support and these were available with a special fixing plate for $2.00 ea.

The KOMBI instruction booklet gave a very comprehensive guide to selecting exposure times for various light conditions, from 1 second in bright light up to 50 seconds in poor light.

Although The KOMBI appeared to be an easy camera to use in fact it was anything but and its small size did not help.

Processing your own film was also a difficult operation even with the kit having very detailed instructions.

The most difficult part lay in reloading with a fresh roll of film as the two film rollers were different, one having a small pin on one end, this pin located with a click spring and gave an audible click with each revolution and as mentioned before three clicks wound the film on one frame, this being the only way to advance the film correctly there being no film counter or red window, very primitive indeed, and all done in the dark.

It would have been very difficult to remember how many pictures had been taken particularly if you had not used the camera for some time.

The KOMBI had three main shortcomings, these being, :-

• No viewfinder.

• A non- capping shutter.

• No positive way of counting the number of pictures taken.

However at this period when photography was really still in its infancy and right at the dawn of roll film, picture taking and film processing procedures were full of difficulties.

The KOMBI for all its faults was a precision well made little camera with good feel and everything worked nicely. Today it is a very collectable little camera, and although not rare they don't come up for sale all that often and usually command fairly high prices when they do, dependent on completeness (Such as original box) and condition.

A nice addition to any collection of cameras and early photographica.

The advertising of the day proclaimed…..”Not a Toy”, “Even a child can use it”, “Strongest made”, “Simple to use”, “Five times smaller than any camera made”, “Every KOMBI guaranteed”, “Carried easy as a pack of cards”, etc,etc.

Meet the Member Alex Spektor

I have been a member of the APCS for 40 years when my friend Holger Schultz brought me along to a meeting, creating many friendships that have lasted. This is an environment when discussions around new acquisitions are probably the most commen subject of conversation.

Many years have passed, many interesting people, members of our club have left this world and we have aged too, but despite this, we have an interest in collecting cameras. A lot of new people have come to the club and I really want these people to get acquainted and we get to know each other better, to tell each other what brought them to the club, why they began to collect cameras, what photo accessories thety collect etc.

In the beginning, I collected everything, but now I concentrate on miniature cameras. Every collector has an interesting story that lasts a lifetime and I am no different. One day, looking through the American eBay, I accidentally noticed one advertisement for “4 cameras for spare parts”.

The photos were poorly taken, but after a close examination, I identified one mini camera. It turned out that the seller was engaged in serious antique businesses, but did not have any other cameras. I decided to bet one bid of US$50. The auction ran for 7 days but there were few bids and eventually I won the lot for US$49 plus US$25 postage.

After 3 weeks, my parcel arrived. I opened the parcel and could not believe my eyes. In the package there was a “Darling-16” Japanese mini camera from 1957, but no film back, in good cosmetic and working condition. Also a “Zany” camera, but with a disassembled shutter with all the parts inside the camera. It was not difficult for me, along with my friend a jeweler, to assemble - this is the camera that I am holding in the picture below with Holger, and as you can see it is in excellent condition.

There was also an extremely rare Cubitt 828 Roll back made in London to adapt the Compass for 828 Roll film, and a Canon VT Deluxe body with no lens but in good working condition. In this photo, I am with Holger on the photo market discussing a very rare camera from my collection” Zany”- circa 1950 by Nihon Seimitsu Kogyo,made in Japan. This takes sub miniature 10x14mm images on16mm film in special cassettes. It has a fixed-focus Gemmy Anastigmat f:4.5/25mm lens and an internal shutter. My camera is marked -NSK- on top whereas others are marked -N.D.K-. It is a extremely rare sub-miniature camera.

“Canon” collectables of the future

Peter Kitchingman

In the 1990s the camera industry was in development turmoil as emerging digital photography replaced the film technology of the past and made serious inroads on the commercial viability of those firms that had made film their business for the previous Century. It would be a decade before things settled down and in that time many cameras and variants emerged that will be the collectables of the future.

Emerging photography in the 1990s:

Several major camera and film production firms relied on film in the 1990s. A special group cooperated – Eastman Kodak, Canon, Nikon, Minolta, and Fuji Photo Film – to meet the inevitable competition from digital imaging and maybe even extend the viability of traditional film. Two key issues were evident.

- Modern technology could assist in indexing and managing images from camera to print.

- Digital photography was eventually going to dominate, but film was still viable.

Today we can look back and only surmise that some very interesting discussions must have gone on as traditional ideology fought with new inventions. However some of the history is emerging but much of that is yet to be confirmed and related.

In the very early 1990s the “group of 5” settled on the idea of APS – “Advanced Photo System” and each firm sought to maximise their commercial viability around the emerging technology. Just what that APS system was depended on who was defining it and in some cases there were different opinions from a single organisation, and just as those firms were cooperating, they were also in competition internally as well as externally, and just who did what and when is probably still embroiled in controversy. Huge numbers of patents were applied for and granted, and not surprisingly, some of the forms of APS varied for no other reason than to avoid copyright and patent infringement.

Fundamentally APS took a photographic image and by one way or another added features to identify and control the image. New languages evolved – for example “IX” revered at the time in camera names etc originally stood for “Information eXchange” which was stored magnetically and optically in film formats depending on the camera and later in the now familiar EXIF data coding that is attached to most digital images.

A common detail was the image format – smaller than a traditional full-frame 35mm image – and with a crop factor of about 1.6. Although that figure changed a bit, it was to survive for the next 20 years in film and digital until the imaging technology went back to full-frame and related formats. It is relevant that the APS in its various forms did not attract the professional users to any extent, but that changed with the development of the full-frame digital format – which in some respects retained many of the advanced features of the APS system. Indeed, the most common surviving standard in the digital world is simply known as “APS-C” (Advanced Photo System – Classic) and there is little sign of that disappearing any time soon. It is a curiosity that the “Classic” in APS-C was supposed to be the size of the APS film format that was 16.7x30.2mm but with company variations can range from 13.8x20.7 up to 19.1x28.7mm with variations on that for various aspect ratios. A further issue arises as the sensor area in a digital camera is slightly larger than the stored image area. The exact physical sizes are not particularly important but if that level of precision is needed then the handbooks for the particular camera will need to be consulted.

Digital cameras using analogue techniques (a bit like television) had been around for the whole of the 1980s but it was Fuji who in 1988 announced the first camera that looked like what became APS in format and support. The digital versions of APS were first to market in the early 1990s from Kodak, Canon and Nikon in particular, but the film development continued and became a product across the group of 5 in 1996.

APS-film and the cameras that used it:

I have a special interest in Canon cameras, so when an on-line auction for a pile of Minolta APS cameras (a successful bid of $25) came my way, it strengthened the interest in the Canon APS cameras that I already had. This prompted the following narrative around the film version of APS.

I was staggered at the retail price tags still attached to some of the boxes. At a guesstimate, the whole Minolta outfit going on the advertised price stickers would have been around $4000 in 1996.

After checking out the Minolta hoard I dug out my esoteric collection of about six Canon APS cameras with one being a boxed Canon 60th anniversary gold IXUS and checked them also on-line. Again, my eyebrows were raised when I realised how many APS camera were released by Canon during the brief time of six years (1996-2002) the APS system was on the market. This period was another thing I didn’t know about (stuck in the Canon RF era too long) but it piqued my curiosity to find out more.

The APS film system:

As outlined in the introduction, the APS film system was developed jointly by five companies Eastman Kodak, Canon, Nikon, Minolta, and Fuji Photo Film and released onto the market in January 1996 introducing a new film format called IX240. Kodak introduced the brand name ADVANTIX for their cameras while Canon branded their cameras with ELPH, IXUS and IXY while Fujifilm used NEXIA and EPION, Minolta used VECTIS, Nikon with PRONEA and NEVIS and a gaggle of other companies also jumping on the bandwagon. (And to confuse things, some of those names, eg Nikon’s PRONEA-6i and some of Canon’s IXUS cameras were digital!) Note the dominance of the “IX” in the names!

The APS film system was developed as an alternative to the 35mm film cassettes and at its introduction it did appeal to the general “point and shoot” public as APS cameras were sold in the thousands, but they were never accepted by the professional photographers. One of the main reasons was the reduction in size of the negative from 35mm full frame 24x36mm down to approximately APS size of

17x30mm and the consequent loss of detail. Also, the lack of control the photographer had over access and the use of the negative film (it never came in positive format).

The film was 24mm wide and could store three various size formats which were controlled and set on most APS cameras. These three sizes were set by moving a small lever to the format you intended to use. The letters were H, C and P where “H” stood for “High Definition” (30.2 x 16.7mm) and was good for 4”x7” prints, the letter “C” was for “Classic” (25.1 x 16.7mm) which was targeted for 4”x6” prints and the last letter was “P” which stood for “Panoramic” (30.2 x 9.5mm) which was targeted for 4”x11”prints. The negative sizes varied a bit from camera to camera and the letters - eg “C’ - did not parallel the digital versions either, so comparisons are at best approximate.

Comparison of 35mm and APS film

The information after taking a photo regardless of what size format you used is stored on the film and read by the developing laboratory machine – and both optical and magnetic storage were used, depending on the camera. Once the photos are printed from the negatives the film is rewound back into its original cassette. Great for storage but a bit useless if you wanted to look at a negative quickly. However, a six-digit code found on the cassette is imprinted on the back of each print and at the end of each roll of negatives. The date and a title can be also printed on the back of each print if this feature has been activated. The film was available in three exposure lengths, 40, 25 and 15 and was housed in a 39mm long plastic cartridge which was rewound back into the cartridge after being exposed in the camera. One advantage of the APS system was the ability to rewind a film mid use and then load it back into the camera at some other time. This was known as the “MID ROLL CHANGE” or MRC which can be found on the more expensive APS cameras.

APS cassette with door open

The 39mm long plastic cassette has a small door at the film entrance which is light tight and dust proof and is opened automatically by the camera to wind the film into the camera after loading the cassette. This cassette can be easily opened by using a small screwdriver to unlock the door and then placing the screwdriver into the spool end and turn it clock wise and bingo the developed film pops out.

APS cassettes showing the MRC flags

One bonus with the spool is if you do an MRC, then the cassette records it on the end, in the form of four windows showing a white indicator. The “circle” indicates that the roll is unused, the “half-circle” indicates the cassette is partially used while the “X” indicates that film has been fully exposed. The last window is a “square,” and this indicates the film has been developed and returned to the cassette and then back to the customer.

The APS Cameras:

I mentioned that some of the major companies jumped on board when the APS film system hit the market in January 1996, but I will stick with the Canon APS system which was released in May 1996.

Since I got “hooked” by the collecting bug, I have managed in four months to accumulate around forty-nine examples out of the 62 APS cameras that Canon released between 1996 and 2002. What Canon released was either named “ELPH” for the USA market, “IXUS” for EU/Oceania and “IXY” for the home market in Japan.

ELPH, IXUS adn IXY cameras were the same but destined for different markets.

Most of these cameras can be purchased online between 1c to $30 for the “run of the mill” APS Canon cameras up to the “hard to come by” late versions which I paid around $80.00. Since the APS system was confined to the bin 20yrs ago a lot of cameras can still be purchased either “New” in boxes or in “unused” condition.

Canon were incredibly wise. Out of the sixty-two cameras that were marketed, they manufactured just twenty-three models and rebranded them either ELPH, IXUS or IXY with some coming in black or other colours. Some APS models were released exclusively in either USA, EU, or Japan. In all three area markets the more expensive APS cameras were called “EOS” and appeared under that name alongside various model names. The first Canon APS camera was released in May 1996 was just called the EPLH/IXUS/IXY depending on what market it was sold in, but I have called them the “Originals” for want of a better name!

Back and top views of the ELPH

I am totally impressed with the compactness of the original Canon APS camera (87mm x 57mm x 27mm) which is about the size of a cigarette packet or pack of playing cards. Around three quarters of the camera is taken up by the film cassette, battery, lens compartment and flash along with at least two internal motors. With the rest, taken up by smart whizz bang electronics.

After checking most of the Canon APS cameras I own I noticed that they display the same basic features. The only difference being the relocation of some of those features.

All for more sales as usual!

The Original APS camera, as does most of the following models, has the quick loading feature where the cassette is dropped into the loading bay and once the door is closed the camera winds the film into the camera. This can be followed by looking on the small display screen on top of the camera.

There was one thing that did annoy me with these first little cameras. After loading the single CR2 battery into the chamber and then trying to replace the cover back over the chamber the cover flew off in all directions when putting any pressure on it with a coin. Whoever designed that feature must have been fired as it was soon replaced with a more practical solution.

Once the film is loaded the small rectangular display (16mmx13mm) shows you the number of shots you can take or have taken and a battery check outline. By pressing the top button to the left of the display screen you have a choice of using a self-timer or the remote-control device.

Below that is the title and date feature buttons. The information relating to the title and date feature is dialled into the camera prior to loading the film and is recorded on the film and printed on the back of each photo during processing.

On the back of the camera there are two black thumb size buttons. The right button moves the small 24-40mm zoom lens out while the other moves it in.

Pressing a small button just below the viewfinder you have a choice of five flash settings which appear in the display screen on top. To the right of the viewfinder is the C, H, P dial which you set one according to what format you would like to use the photo in. One other tiny feature is a film cassette picture for which you will need a pointed pen or a paper clip to press into the hole. This activates the MRC feature of the camera. Most cameras after this model were marked "MRC" near this button.

One neat thing I haven't seen in other makers' cameras was, the ability to see the Self-Timer count down the 10 seconds in the small display screen on top of the camera. There again if you are racing back to get into the photo, you're not going to see that feature in any case?

CANON APS film cameras 1996 to 2002:

As I mentioned above Canon produced only twenty-three models but rebadged them for release in areas which Canon deemed as "Marketable Continents" for the want of a better description.

A chart at the end of this article shows all the twenty-three cameras manufactured between 1996 and 2002 with the names of each camera that was released into the "Marketable Continents" or Areas.

North and South Americas, which included USA and Canada, had a total of 16 APS camera models released there under the names ELPH or EOS (Electro Optical System).

Europe and Oceania, which included Australia and New Zealand, had 18 APS cameras released there under the names IXUS or EOS.

Japan had a total of 15 APS models released there under the names IXY or EOS couple of Canon APS cameras that stand out amongst the rest because they are quite innovative in design and use. The ELPH Sport/IXUS X-1/IXY D5 was a compact underwater camera which carries most of the features of its land siblings but has a larger than normal viewfinder. Advertised at the time as the smallest underwater camera available, it was good up to a depth of 5m and surprise, surprise, will also float. Located on the back is a quick thumb driven dial which has pictures for underwater macro mode and six flash settings.

Just above this dial is the C, H, P dial which when set appears in the viewfinder as bright lines. All this is packed into a robust three-quarter moon shaped, hard plastic camera shell coated in silver with a deep green coloured front and back. Some IXUS and ELPH Sport cameras can be found in a brown colour but are not common. The Sport/X-1/D5 was a camera for the beach or fun in the pool.

The other APS camera models of note were the "Shades" (USA) and "Concept" (EU/OC) issued right at the end of production in 2002. When Canon released these cameras the APS film system was on its knees as digital had virtually taken over as the camera of choice by the public and professionals alike.

There were two models in the "shades" and "concept' range but were named differently depending on the area in which they were released. Named "Glacier and Sunshine" in the USA/CDN market and "Summer and Arancia" in the EU/Oceania market, but neither model was ever released in Japan.

The two Shade cameras were released in the USA/CDN market in small, coloured boxes with a large window showing the camera. The EU/Oceania versions were displayed in a stylish green or orange egg-shaped container. The camera rested on a plastic stand and surrounded by a shaped piece of sponge.

The Glacier and Summer cameras are the same size as the Original 1996 camera but just slightly thicker in width. They still contained all the features of the previous Canon APS cameras but were more attractive to the ladies. I have managed to collect three of the four 2002 released cameras, unused, in original boxes at very reasonable prices.

APS IXUS "Gold" 60th edition for Canon.

Beside the small compact APS cameras three companies Canon, Nikon and Minolta produced SLR cameras using the APS system. Canon's SLR camera called EOS IX would accept some of the current 35mm EF range of lenses while Nikons SLR camera called the Pronea could also accept their own 35mm range of lenses. Minolta SLR camera named Vectis S-1 was developed around a totally new lens mount which later was used on their early digital cameras.

Other companies such as Pentax, Panasonic, Olympus, Konica, Leica, Contax, Samsung, Vivitar, Yashica and some smaller companies all dabbled in producing APS cameras be it in small numbers but not to the extent that Kodak, Canon, and Fujifilm did during the six years the format was on the market.

Interest in the APS film system began to wane when Digital Cameras became more affordable to the public and by 2002 Canon had released its last models, with Kodak ceasing production of APS film cameras in 2004. APS film was discontinued in 2012/14 although 10 years later it can still be purchased on eBay even though all the film is outdated.

At this point in the story we note that "APS" meant different things to different people and the Digital version of APS was to survive and is still viable. As is with most things which ceased to exist (the APS film system in this case) there is always a diehard number of enthusiasts who carry on the tradition and APS film is no different as it has created a cult and a Facebook page dedicated to the film and its off-beat colour photographs.

Much like 35mm film cameras which has been found by the younger generation as they pick up their parents' or grandparents' older SLR cameras and realise the benefits of film. LP vinyl is another example with the Generation X, Y or Z. Take your pick!

Although the APS digital standards of the 1990s and 2000-2020s are now being replaced by tiny sensors in phones – especially for amateur and popular use, the APS-C format is surviving in a couple of digital areas that are popular in professional circles as well as advanced amateur. The key issue there is that the resolution of the latest APS-C cameras is adequate for most professional applications and Canon and Fuji in particular have some very popular cameras. We must mention the "Micro 4/3" format which has a solid following particularly in video circles for professional work – a bit smaller than APS-C, it is still good enough. But even that format includes EXIF data which is a fundamental part of APS.

Date of Issue	Area released	Name	Model name	Camera Colour
May-96	USA/CDN	ELPH	Original	Silver
May-96	EU/OC	IXUS	Original	Silver
May-96	Japan	IXY	Original	silver
Jun-96	USA/CDN	ELPH	490Z	silver
Jun-96	EU/OC	IXUS	Z90	Silver
Jun-96	Japan	IXY	G	silver
Oct-96	USA/CDN	ELPH	10AF	black
Oct-96	EU/OC	IXUS	AF-S	black
Oct-96	Japan	IXY	20	black
Oct-96	EU/OC	EOS	IX	Silver
Oct-96	USA/CDN	EOS	IX	Silver
Oct-96	Japan	EOS	IX-E	silver
Nov-96	USA/CDN	ELPH	10	Black
Nov-96	EU/OC	IXUS	FF25	black
Nov-96	Japan	IXY	10	black
Mar-97	Japan*	IXY	GE	silver
Jul-97	USA/CDN	ELPH	260Z	Silver
Jul-97	EU/OC	IXUS	Z60 IX	Silver
Jul-97	Japan	IXY	25	silver
Sep-97	USA/CDN	ELPH	Limited 60th	Gold
Sep-97	EU/OC	IXUS	Limited 60th	Gold
Sep-97	Japan	IXY	Limited 60th	gold
Sep-97	USA/CDN	ELPH	JR	Silver
Sep-97	USA/CDN	ELPH	JR	black
Sep-97	EU/OC	IXUS	L-1	Silver
Sep-97	EU/OC	IXUS	L-1	Black
Sep-97	Japan	IXY	310	silver
Sep-97	Japan	IXY	310	black
Mar-98	USA/CDN	ELPH	370Z	Silver
Mar-98	EU/OC	IXUS	Z70	Silver
Mar-98	Japan	IXY	330	Silver
Mar-98	USA/CDN	EOS	IX Lite	Silver
Mar-98	EU/OC	EOS	IX 7	Silver
Mar-98	Japan	EOS	IX 50	silver

Date of Issue	Area released	Name	Model name	Camera Colour
Sep-98	USA/CDN	ELPH	LT	Silver
Sep-98	USA/CDN	ELPH	LT	Green
Sep-98	EU/OC	IXUS	M-1	Silver
Sep-98	Japan	IXY	210	silver
Mar-99	USA/CDN	ELPH	2	silver
Mar-99	EU/OC	IXUS	II	Silver
Mar-99	Japan	IXY	320	Silver
Mar-99	EU/OC*	IXUS	FF	Silver
Mar-99	EU/OC*	IXUS	AF	Blue
Mar-99	EU/OC*	IXUS	FF Date	Silver
Mar-99	EU/OC*	IXUS	AF Date	Black
Nov-99	USA/CDN	ELPH	Sport	Green
Nov-99	USA/CDN	ELPH	Sport	Brown
Nov-99	EU/OC	EOS	X-1	Silver
Nov-99	Japan	IXY	D5	Green
Mar-00	USA/CDN	ELPH	LT260	silver
Mar-00	EU/OC	IXUS	Z50	Silver
Mar-00	Japan	IXY	220	silver
Feb-01	USA/CDN	ELPH	LT270	silver
Feb-01	EU/OC	IXUS	Z65	Silver
Feb-01	Japan	IXY	230	Silver
Mar-02	USA/CDN*	ELPH	Shades Glacier	Green
Mar-02	USA/CDN*	ELPH	Shades Sunshine	Orange
Mar-02	EU/OC*	IXUS	Concept Summer	Green
Mar-02	EU/OC*	IXUS	Concept Arancia	Orange
Mar-03	USA/CDN	ELPH	Z-3	silver
Mar-02	EU/OC	IXUS	III	Silver
Mar-02	Japan	IXY	i	silver

* = Models released exclusivly into these areas.

Each colour in ELPH,IXUS or IXY groups indicates the model that was rebadged for the various areas they were released in.

A chart of the Canon cameras that used APS film

This article is an outline of a talk that was given by Peter Kitchingman on the subject of Canon APS cameras to a meeting of the APCS in 2022.

The Australian Photographic Collectors' Society Inc. (founded 1976) is an incorporated "not-for-profit" Australian Society dedicated to the collection and preservation of Photographica. Members' interests include cameras of all kinds, their lenses and accessories, literature, processes, images and photographs. The Society conducts monthly meetings, photographic markets and auctions. Benefits include social interaction with others having like interests, a reference library, a monthly newsletter and this journal, Back Focus.

Membership is open to all who wish to share our aims. - see the membership page on the website www.apcsociety.com.au

Social meetings, often including technical presentations are open to visitors and are held at the meeting hall of the Australian Model Railway Association, 92 Wills Street, Glen Iris, Victoria. Refer to the Calendar on the website.

APCS public markets are held in the Box Hill Town Hall - in a suburb of Melbourne, and in the Hungarian Club in Norwood, a suburb of Adelaide. The schedules can be seen on the calendar and market pages of the APCS website: www.apcsociety.com.au

Tables can be reserved for a fee of $60 (subject to change) which also covers liability insurance. A small fee applies to general admission. Almost anything associated with photography can be found, although some risk classifications including chemicals and electrical items are not permitted.

AUSTRALIAN PHOTOGRAPHIC COLLECTORS' SOCIETY Inc

A0016888V

(Founded 1976)

48th ANNUAL REPORT

Included with Back Focus No. 118 – June 2023

And to be presented at the

ANNUAL GENERAL MEETING

on

Sunday 16th July 2023 at 2pm Eastern Standard Time

AMRA Hall – 92 Wills Street, Glen Iris, Victoria

President's Report

The Society survived the worst years of the COVID pandemic. Officially the pandemic was proclaimed over during the year and we are supposed to be back to normal. However many members of the APCS are conservative and are still wary of the risks. There were also changes in general attitudes since the pre-covid era. Around the world, photographic collecting societies encountered similar issues that can be summarised as:

- A distinct move by members towards relying on the internet.
- A change from "collecting" to "trading".
- A conservatism, with regards to COVID risks, that keeps older members from venturing out.
- An increase in the average age of members.

The attendance at the public markets in Adelaide and Melbourne in the last year has doubled – mostly by young people who are experimenting with chemical photography and/or are part of the business of investing in photographic items for commercial gain. It may be that the APCS needs to contemplate a change in its aims towards the trading of cameras rather than the collections, as this would seem to be the more popular activity around heritage photography.

The program for the year followed the pattern of pre-COVID years with a couple of additional events.

On 9th October the APCS held a dinner in Melbourne attended by Jim and Joan McKeown, the renown editor of the camera guide. Jim gave us a presentation on some of the more interesting camera in his collection. Around a dozen members and friends joined us for the evening – an enjoyable time and hopefully an indication that we can return to some social events that have lapsed in the last few years.

There was an initiative earlier in the year that should have resulted in a major photographic competition and presentation in November but after no submissions were made by the scheduled deadline it was decided to cancel the event until a date to be determined. However since that decision it has emerged that photographic competitions around the world have run into similar issues and it may be some time before we have the confidence to try again.

The Adelaide public market was held again on Monday 3rd October, and not on a Sunday as the Hungarian Club had been booked for all Sundays in the year by another organisation. This was very well attended by the non-member public and indicates strong interest in such events.

Membership: The membership level fell in the first of the COVID years to the lowest numbers since the early days of the APCS, and currently remains at that level – ie 167 full members of which 10 have been awarded Life Membership. While we lost contact with 18 members during the year who did not renew subscriptions, we also gained 17 new members and welcome them to the society.

Membership fees have changed and are now at $50 per annum – there was a transitional year for existing members in 2022 with only half the increase being imposed. The primary driver for those increases was the postal costs for Back Focus which has doubled in the last couple of years.

Publications: In 2019 we made a decision to reduce the number of issues of Back Focus – mostly for financial reasons, and since then there has only been a single issue of Back Focus in each year – but one which was much larger than previously and with an improved presentation. A further consequence of the cost of postage is that overseas postage is now untenable and delivery to overseas members in now by electronic means.

We have had typically a dozen issues of the newsletter each year for nearly a decade now – each with the central reason of publicising the next APCS event the following week. In January 2023 we again produced a special edition of the newsletter that announced the expected program for the rest of the year, and sent a copy to each Australian member by snail-mail to ensure that all members got the copy which contained the full program for the following year, noting that there are still a few members without internet or email access.

The whole photographic industry continues to change and most notably in the improvements in the cameras that are now part of the new mobile phones, to the extent that the latest devices perform rather better than almost any dedicated camera from a couple of years ago. For most of the world, the camera in their mobile phone is the only one that they have, and the ability of those phones to store images in the cloud means some very big changes to how photography is perceived and used. Just how this plays out in the collectability of cameras it yet to evolve.

Finances: The APCS has strong financial resources, made possible by the profitable events like the markets and auctions, and some very generous donations and bequests. The continuance of the APCS is not at risk for many years, as we will weather the inevitable changes post-COVID and how the hobby, or is it business, of the practice of collecting cameras develops. The costs of venue rental, Back Focus and postal services continue to rise with inflation and business changes in those areas, but at least for the present, revenues from our activities are keeping pace.

Risks, Insurance and the Future: The general population has become even more conservative and risk-averse following the COVID years, and that has also affected the insurance industry. It used to be that we had a simple insurance policy to cover what we did, but legislative changes about what we are allowed to do with dangerous photographic chemicals, and the approvals of electrical items have forced the APCS to restrict what can be traded and sold at public events. We were mostly wary of those dangers but the insurance industry and the rest of the world sees it differently and we will have to change with those attitudes. The insurance industry has also responded to the perceived risks and along with that, venues like the Box Hill Town Hall, where we hold the Melbourne public markets, have required additional insurance to mitigate the public risks. That in turn has increased the cost of those activities and we have been forced to increase the market "table fees".

There are bound to be more changes as we meet the future. We are a society of collectors and it is up to you to tell the committee what you want the society to do for you and how it might provide the environment that you need.

Rod Reynolds, President

Treasurer's Report

Financials: This financial year ended with an operating surplus of $9,510.57 compared to a deficit the previous year of $394.21. Once again the activities of the society were curtailed partly by the pandemic, however, we were able to conduct revenue activities of two auctions and three markets. Expenses rose considerably with the increase in activities, particularly with large turnover in our August auction. Subscription fees rose to $50 effective with the start of 2023.

Equity: The equity of the society rose from $79,352.19 to $88,863.16 This was the result of an increased surplus resulting from higher prices for auction items and increased attendance at markets.

Expenses: Expenses increased in the areas of Back Focus costs, insurance, postage and bank fees.

Fixed Investments: Our fixed investments continue to be managed by UCA Funds Management. They are placed in the U Ethical Cash management Trust fund. The interest rate has dropped from 1.2% to 0.91% at the present time. This is likely to improve in the next reporting season.

EFTPOS: The NAB bank EFTPOS service has been used extensively at both auctions and markets. The majority of patrons at markets paid by EFTPOS and also availed themselves of the cash out facility. The service was also used by vendors at the markets to facilitate cashless sales of mainly high value items. The service costs 1.5% of transactions and this cost is recovered on all transactions other than payments to the society.

I would like to thank Kevin Saunders for his assistance in reviewing the accuracy of the reports.

John T Young, Honorary Treasurer

FINANCIAL STATEMENTS FOR THE YEAR ENDED 31 MAY 2023

Profit and Loss statement

2022		Notes	2023
	Income		
4,965.00	Subscriptions	3	4,175.00
714.50	Interest Income		651.34
0.00	Auction Bid Payments	4	27,094.75
1,714.00	Market Door Entry Fees	5	7,939.20
2,345.00	Market Table Fees and Sundry Sales	5	5,133.00
0.00	Adelaide Market	5	1,881.30
1,295.00	EFTPOS sales		3,280.00
35.00	Other income		305.80
50.05	UCA Cash management rebate		0.00
11,118.55	Total Income		50,460.39
	Expenses		
0.00	Auction Seller Payments	4	21,710.80
1,280.00	EFTPOS payments		2,908.50
0.00	Auction Expenses	4	102.50
2,632.50	Market Expenses Melbourne	5	3,537.50
	Market Expenses Adelaide	5	440.00
0.00	Table refunds Markets	5	0.00
5,010.75	Back Focus	6	7,259.43
85.00	Social and refreshments		507.00
0.00	Website		86.00
0.00	Depreciation		0.00
986.45	Insurance		2,339.53
0.00	Meetings-AGM		122.40
588.21	Office Expenses, Stationary & Software		221.95
0.00	Other expenses		0.00
0.00	Postage		612.00
660.00	Rental		550.00
0.00	Newsletter		30.00
269.85	Bank fees		521.81
11,512.76	Total Expenses		40,949.42
-394.21	Operating Surplus/Deficit for Year		9,510.97

Balance Sheet As At 31 May 2023

2022		Notes	2023
	Assets		
	Current Assets		
71,950.19	Cash and Bank Accounts	7	81,731.16
71,950.19			81,731.16
	Non Current Assets		
7,882.00	Library at Cost		7,882.00
1,681.00	Equipment at Cost	8	1,681.00
1,681.00	Less Depreciation	8	1,681.00
7,882.00	Total Non Current Assets at WDV		7,882.00
79,832.19	**Total Assets**		89,613.16
	Liabilities		
	Current Liabilities		
480.00	Subscriptions in Advance		750.00
480.00	**Total Liabilities**		750.00
79,352.19	**Net Assets**		88,863.16
	Equity		
79,746.40	Retained Earnings		79,352.19
-394.21	Operating Surplus/Deficit for Year		9,510.97
79,352.19			88,863.16

Statement of Cash Flows

2022		2023
	Cash flows from operating activities	
4,785.00	Total Subscriptions Received	4,445.00
714.50	Interest Income Received	651.34
0.00	Proceeds from Auctions	27,094.75
4,059.00	Proceeds from Markets	14,953.50
1,295.00	EFTPOS sales	3,280.00
85.05	Other income	305.80
-11,512.76	Payments to All Suppliers	-40,949.42
-574.21	**Net cash inflow/outflow from operating activities**	9,780.97
-574.21	**Net increase/decrease in cash held**	9,780.97
72,524.40	Cash at the Beginning of the Financial Year	71,950.19
71,950.19	**Cash at the end of the financial year**	81,731.16
	Reconciliation of operating surplus to net cash	
-394.21	Operating Surplus/Deficit	9,510.97
0.00	Depreciation	0.00
-180.00	Change in Subscriptions in Advance	270.00
-574.21	**Net cash inflow/outflow from operating activities**	9,780.97

Notes To and Forming Part of the 2023 Financial Statements

Note 1 Statement of Significant Accounting Policies

This special purpose financial report was prepared for distribution to the members to fulfill the committee's financial reporting requirements under the Australian Photographic Collectors Society's constitution and the *Association Incorporation Reform Act 2012* (Vic). The accounting policies used in preparation of this report, as described below, are in the opinion of the committee appropriate to meet the needs of the members:

(a) The financial report was prepared on a modified cash basis of accounting, including the historical cost convention and the going concern assumption.

(b) The requirements of accounting standards and other professional reporting requirements in Australia do not have mandatory application to Australian Photographic Collectors Society because it is not a 'reporting entity'. The committee has, however, prepared the financial report in accordance with all applicable Australian accounting standards.

(c) Property, Plant and Equipment is carried in the accounts at cost less, where applicable, any accumulated depreciation. The depreciable amount of Property, Plant and Equipment is depreciated over the useful life of the assets of the Society commencing from the date the assets are first held ready to use.

(d) Cash and Cash Equivalents. This includes cash on hand and deposits held with banks including trading accounts and term deposits. Interest earned is brought to account as it is received and credited to the account.

(e) Goods and Services Tax. Australian Photographic Collectors Society is not registered for GST. All amounts are recognised inclusive of the amount of GST where it applies.

Note 2 Trade Receivables

The Society trades on the cash basis of accounting. It does not bring sales to account when the sale is recorded but only when payment is received.

Note 3 Subscriptions

2022		2023
660.00	Prior Subscriptions in Advance	480.00
4,785.00	Subscriptions Received	4,445.00
-480.00	Subscriptions in Advance	-750.00
4,965.00		4,175.00

	2022		2023
Note 4 Auctions			
	0.00	August receipts	20,542.10
	0.00	August Payments	-15,770.90
	0.00	August refunds	-685.00
		August Expenses	-102.50
	0.00	April receipts	6,552.65
	0.00	April payment	-5,254.90
	0.00	Profit / (Loss)	5,281.45
	0.00	October Bid receipts	0.00
	0.00	October Seller payments	0.00
	0.00	October expenses	0.00
	0.00	Profit	0.00
Note 5 Markets			
	0.00	September Door Entry Fees	4,195.00
	0.00	September Table Fees and Sundry Sales	1,290.00
	0.00	September Expenses	0.00
	0.00	Profit	5,485.00
	1,714.00	March Door Entry Fees	3,744.20
	2,345.00	March Table Fees and Sundry Sales	3,843.00
	-2,632.50	March Expenses	-3,537.50
	1,426.50	Profit	4,049.70
	0.00	Adelaide market - result	1,881.30
	0.00	Other market miscellaneous expenses	-440.00
	0.00	Total Adelaide market	1,441.30
	4,059.00	Total Market proceeds	14,953.50
	-2,632.50	Total Market expenses/table refunds	-3,977.50
	1,426.50	Total Market Profit	10,976.00
Note 6 Back Focus			
	150.00	Articles	2,200.00
	4,860.75	Production	5,059.43
	5,010.75		7,259.43
Note 7 Cash and Bank Accounts			
	21,920.28	NAB Trading Account/Quicken balance	31,701.25
	50,029.91	UCA Cash Management Account	50,029.91
	71,950.19		81,731.16
Note 8 Equipment at Cost			
	798.00	Library Cabinets	798.00
	475.00	Furniture	475.00
	408.00	IC LCD Flat Screen	408.00
	1,681.00		1,681.00
Depreciation			
	798.00	Library Cabinets	798.00
	475.00	Furniture	475.00
	408.00	IC LCD Flat Screen	408.00
	1,681.00		1,681.00

Officials and Contacts

Office Bearers 2022-2023

PRESIDENT	Rod Reynolds – president@apcsociety.com.au
VICE PRESIDENT	Ken Anderson
SECRETARY	Kevin Saunders – secretary@apcsociety.com.au
TREASURER	John Young – treasurer@apcsociety.com.au
COMMITTEE	Matt Makinson Paul Ewins
NEWSLETTERS	email to web@apcsociety.com.au
BACK FOCUS	email to backfocus@apcsociety.com.au
AUCTIONS	email to auctions@apcsociety.com.au
MARKETS	email to market@apcsociety.com.au
WEBMASTER	Rod Reynolds – web@apcsociety.com.au

Clubrooms

MEETINGS	AMRA Hall 92 Wills Street, GLEN IRIS

Contacting the APCS

MAIL	THE APCS C/o The Secretary (See the web, newsletter & Back Focus for current details)
PHONE	(See the web, newsletter & Back Focus for current details)
WEBSITE	http://www.apcsociety.com.au

BACK FOCUS

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