THE

PROCESSES OF PURE PHOTOGRAPHY,

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PREFACE.

Of the two writers, both have zealously followed photography as something more than a mere amusement, for a considerable number of years. One of the writers has studied the science from a theoretical and experimental point, while the other writer's attention has been almost entirely directed to the production of practical results by the processes known, and by each process as it has been given to the world. As joint authors, therefore, we trust that our joint work may be acceptable to the photographic public; not as replacing, or superior to, other works, but rather as filling a place not occupied by any other work. The chief claim made for our work is that every word we have written in it refers to subjects with which we are personally and intimately acquainted; not a direction nor a formula is given on trust, every one has been successfully used by one or other of us, in most cases we have both used the formulæ found in this book.

At first our MSS. extended to a very considerable length, and treated photography completely as theoretical, practical, and artistic; but circumstances caused us to abridge our work, and to produce a book less complete, and, perhaps, less interesting, but, as we hope, more generally useful, not only to amateurs and beginners, but also to those who desire authentic instructions and formula for every-day work. Such instructions and formulæ, tested carefully by ourselves, and likely to be useful to our readers, it has been our ambition to give the public. Whether or not our aspirations have been fulfilled, each member of the public may judge for himself, by application (suitably accompanied) to the publishers of our little book!

W. K. B.
A. P.

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The Processes of Pure Photography.

CHAPTER I.

INTRODUCTORY AND HISTORICAL.

PHOTOGRAPHY is one of the greatest *facts* of the present day. Its influence is of very wide scope, because it is not only an almost infallible means of recording *facts*, but also a simple means whereby the artistically inclined may, to a certain extent, find expression for their *fancy*. Photography not only affords us evidence of what we, and nature, appear, but enables us to depict, within limits, what we, and the rest of nature, might be. Briefly, photography is at once a science and an art. Without a certain knowledge of the science, we cannot produce any effect at all, artistic or otherwise; but we may master the science, stop there, and still have in our hands a most potent agent for depicting, graphically, *facts*. Again, if our ultimate object be to use photography as an art, we must master the science, first of all, that we may be able to produce a graphic result, and next, that we may control our result, so that our scientific means may lend themselves to our artistic aspirations; and the more control over, and facility in, our scientific operations we have, the more fully shall we be able to give our minds to the realization of our artistic conceptions.

In the same way, if our ultimate object be purely scientific, if our sole ambition is to give true photographic copies of what we see, especially if we see it under difficulties, such as those of great magnification, or reduction in size, we must still master our photographic science, so that the combined difficulties of seeing and depicting what we see may not overpower and conquer us.

In this book we do not propose to deal with art, nor with any science except purely photographic science; and our aim is to lay bare, as clearly as space will permit us, the principles regulating, and the practices most suitable for, successful photography. We are prevented by circumstances from fully entering into the theories, or touching on more than very few of the practices which control successful photography, but it is our ambition to so lay down the practice that close elucidation of the theories will not be essential to the intelligent reader, or, at least, so that the reader may, while acquiring the power of producing photographs, be only tickled, and not driven to study the theories.

On the above basis it is clearly unnecessary for us to give more than a cursory *résumé* of the chief results that mark the history of photography. The great landmarks are those following. We can attach no date to the first observation of light action on silver chloride, but to do so we should have to go back at least 300 years. That different parts of the solar spectrum affected silver chloride in different ways was observed by Ritter and Seebeck, in 1801 and 1810. Wedgewood and Davey observed more energetic light action on the silver salt on a basis of white leather than on paper. This contained the germ of *development* processes acting by *reduction* of the silver salt, the tannin of the leather playing the important part.

Camera photography may be attributed to Joseph Nicephore de Nièpce, who gave the first authentic account of it. He used bitumen spread on a metal plate. Bitumen, on exposure to light, loses its pristine solubility in certain oils. With de Nièpce, Daguerre, a miniature portrait painter, in 1829, entered into partnership; in 1839 the Daguerreotype process was announced. Between these dates Nièpce had died, and whatever share of the credit was due to him Daguerre claimed the whole of it, and attached his name to the process. Then followed the addition to the silver iodide of Nièpce, of silver bromide, by Goddard, in 1840; also, in 1840, Sir J. Herschell added an important step to the progress, discovering the solubility of silver salts in sodic hyposulphite, so that a method was no longer wanting to *fix* the image. This sodic salt is an important item in the photographic laboratory of the present day.

In 1839—that eventful year for photography—Fox Talbot published his first process, wherein he coated paper with sodic chloride, and thereafter brushed over it silver nitrate, thereby forming silver chloride in presence of excess of silver nitrate, the basis, with the addition of albumen, also suggested by Talbot, of our "silver printing" process of to-day.

Talbot again comes to the front with an enormous stride in his negative process, whereby, in place of one positive picture being the *ultimatum* of a whole set of operations, we produce by one set of operations a negative, forming a *matrix* for a theoretically unlimited number of positive pictures. (See chapter on Positive and Negative, p. 34). This process, which Talbot called "calotype," was a development process, the reagents being silver nitrate and gallic acid, the latter due to the Rev. J. B. Reade.

About 1850, Le Gray seems to have suggested the use of collodion as a "vehicle" for the sensitive silver salts; Scott Archer certainly published the first collodion process. It is worthy of note, however, that the lately deceased Mr. J. G. Tunny, of Edinburgh, has stated in our hearing, that Le Gray furnished him with a good practical collodion process before Archer's was published; and, further, that he (Mr. Tunny) used Le Gray's process in conjunction with the "iron developer."

For many years, and with great reason, the wet-collodion process reigned supreme; but, grand as its qualities were, it had the drawback that the plates had to be used wet, and a great load of paraphernalia had to be carried afield for the work. The advent of dry-collodion processes was felt, as a matter of convenience at least, to be a marked advance. The free silver nitrate of the wet process was replaced by other iodine absorbents of organic nature, and photographers "ran riot" among such substances as beer, tea, coffee, tannin, beef-tea, tobacco—and who knows what besides!

The discovery, in 1862, of the alkaline developer gave a great "fillip" to dry processes, for by it not only the free silver nitrate on the film is reduced, but also the silver haloids in the film.

The bath was dispensed with, at last, in favor of emulsion processes, the joint invention of Messrs. B. J. Sayce and W. B. Bolton, both of whom are to be credited with the advance. Finally, gelatine replaced collodion, the first published gelatine emulsion process being that of Dr. R. L. Maddox, in 1871. In 1874, Mr. R. Kennett made gelatine pellicle, and, in 1878, gelatine began to leave all other "vehicles" behind it. In this year, 1878, in March, Mr. Charles Bennett published his process, whereby he produced gelatino-bromide emulsion of a sensitiveness that utterly overshadowed all previous preparations; this he achieved by prolonged digestion of the emulsion at medium temperature. Mr. Bolton is again heard of in his suggestion to gain sensitiveness by short boiling in presence of a minimum of gelatine in place of long digestion with the full bulk of gelatine. The only really important modification since that was the ammonio-nitrate process, of which full details will be found in our chapter dealing with the subject.

In development, since the "alkaline developer" was published, we have to record no striking variation, save the ferrous oxalate developer of Messrs. Carey Lea and W. Willis. Mr. Lea's process was first published, but we are able to state that Mr. Willis' memorandum of the process was in the hands of the editor of a periodical three months before Mr. Lea's process was published, accident only depriving Mr. Willis of the credit.

The advances in printing processes have been of no less importance than those in negative processes. For a long time the production of prints more stable than those formed from silver chloride on paper was a problem, but the discovery by Mungo Ponton, in 1838, of the sensitiveness to light of potassic bichromate in presence of certain organic substances, led up after a course of experiments by Becquerel, Poitevin, Pouncey, and others, to the publication, by Swan, of the "carbon" or "pigment" printing process, certainly the first that could go under the name of "permanent."

Out of certain other qualities of chromates, in presence of organic matter, arose a long series of photo-mechanical processes with which we cannot here deal.

The platinotype process, treated later by us, is due to Mr. W. Willis.

The latest advances in photography are connected with "orthochromatics" or color correct photography, and in this field the labors of Vogel, Ives, Eder, Schumann, and Bothamley are conspicuous.

To those interested in the historical development of photography, we recommend the "History of Photography," by W. J. Harrison.

CHAPTER II.

THE THEORIES OF PHOTOGRAPHY.

LIGHT is supposed to consist of, or to be produced by, waves of a substance known as ether, all-pervading and imponderable. Light is merely the name by which we call the sensation produced upon our senses by these ether waves.

Matter is supposed to consist of *atoms*, particles so infinitesimally small as to be incapable of division and in constant motion among each other. "Molecule" is the name we give to an aggregation of two or more atoms of different kinds in combination.

The waves constituting light are not all equal in length from crest to crest, nor do they travel from their source at equal paces. Some light waves are very much shorter than others, and, moreover, when in their course they pass from a medium of one density into a medium of another density, some waves or "rays" are turned out of their course ("refracted") more than others. The rays formed by short waves are turned out of their course more than the rays formed by longer waves. A ray of white light is composed of a vast number of waves of different lengths and different "refrangibilities," and, moreover, at each extremity of the scale of visible wave-lengths are rays which our eye cannot appreciate, just as in sound there are waves so frequent and others so distant from each other that our ear fails to record them to our brain.

The visible light rays which are shortest from crest to crest, and which are the most "refracted" on changing the medium through which they travel, convey to our mind the sensations of what we call blue or violet colors. Still shorter and still more refrangible are many rays invisible to us. These short, highly refrangible, visible rays, and the still shorter and more refrangible invisible rays are remarkable for the energy with which they exert chemical action, and to the chemical action exerted by these rays specially we owe the power of producing a photographic image. The usually accepted theory is that the wave length of these chemical rays is of such a "measure" as to produce vibration synchronous with the vibrations already mentioned as taking place among atoms, and so either causing entire severance between the atoms forming a molecule, or else placing these atoms in such a condition that the severance is ready to take place when suitable steps are taken or conditions observed to complete the inchoate process of separation. In photography with silver salts the molecule consists of an atom of silver and an atom or atoms of some other substance, photographic action consisting in this case of a severance between the silver atom and the other atom.

If all the rays composing visible light exerted anything like an equal amount of chemical activity, it is evident that photographic action might take place and yet be totally useless to us, because uncontrollable by us; for in that case we should be unable to see any of our processes. But it so happens that while we have some of the rays composing white light exerting strong chemical action, we have other rays of much greater wave-length and much less refrangibility marked by much inferior chemical energy, though their wave-lengths are still great enough for our eye to appreciate. These rays which produce on our mind, tutored by our eyes, the sensations of orange and red colors are called "heat rays," and beyond the scale of visible heat rays there are other rays even longer and even less refrangible, and possessing even less chemical energy than the visible red rays. So that while we can use the "chemical rays" of light to obtain photographic action, we can use the "heat rays" to enable us to see sufficiently well to manipulate our photographic materials while we prepare our "sensitive" substances, and while we complete the processes started by the chemical agency of light, referred to by us as "inchoate," but ready to be completed under certain conditions.

In short, by a non-chemical or "non-actinic" light, we prepare our sensitive material; to chemical action of light we expose it, and by non-actinic light we "develop" the action started by the light; a "sensitive" material being one capable of being acted upon by light.

There are other rays forming components of white light intermediate between the heat rays and chemical rays, in points of wave length and refrangibility. These intermediate rays have a speciality of their own, viz., visual brightness, and we call them "yellow" or "green." The yellow is not so much endowed with heat characteristics as the red rays, nor is the green so remarkable for chemical activity as the violet rays; but all the component parts of a ray of white light have a certain amount of chemical power, and a certain amount of heating power, just as all the visible component rays of white light have a certain amount of visual brightness.

If an opaque object appears to us "red," it appears so in virtue of its *absorbing* the other rays and *reflecting* to our eyes red alone. If a sheet of glass were stained really and purely red, no visible rays would pass through it except red. An opaque object "reflects," a transparent object "transmits," light; but, so far as color is concerned, the theory holds good for reflection as for transmission. A beam of white light caused to change its course by being passed out of one medium through another of different density in a certain simple manner, may be analyzed or broken up into its component rays, so that these rays can be distinguished ocularly from each other from their different colors and by the different directions in which they travel after "refraction," and an instrument made for the purpose of facilitating the observation of these differentiations is called a spectroscope, the analyzed or separated and colored band of rays being called a "spectrum."

The science of optics depends, equally with the science of photographic chemistry, on these qualities of light, and while the refraction *per se* is the action most useful in optics, the coloring dependent on the "bending" is a factor that requires to be carefully minimized or totally counteracted.

The chief processes of photography depend on what is called "reduction." We start with a compound of (say) silver and something else. Actinic light either "reduces," or prepares for "reduction," our compound, and the "reduction" consists in removing the something else, and leaving the silver alone to form the visible photographic image.

The optics of photography are directed chiefly to regulating the size of our image, light unaided is quite able to effect all our purposes, but without the aid of optical appliances light would be for us an unmanageable and unprofitable servant.

We do not expect, and still less wish, this summary to be taken as touching more than the extreme outskirts of the subject of photographic theory. We believe that a thorough mastery of the whole theory is almost essential to a thorough mastery over the practice, but our limits absolutely preclude other explanation.

Certain processes are not even touched by the above remarks; on encountering these processes in their turn, we shall say a word or two on the special theories regulating them.

CHAPTER III.

APPARATUS.

The apparatus required for the production of a photograph, by the usual processes, may be summed up under two heads: 1st. Apparatus for producing a negative, or a direct positive. 2d. Apparatus for producing prints from a negative.

The apparatus required essentially for the production of a negative are, a camera, a lens, and an apartment, or box, illuminated by a non-actinic light. (A lens is not absolutely necessary, but is almost always used). For convenience we require a support for the camera, and vessels of suitable size and shape for chemical operations.

Cameras are merely light-tight boxes for preventing light, other than that passing through the lens, from reaching the sensitive plate, and cameras further afford a means of varying the distance between the lens and the sensitive surface, so that the plate may be placed at one focus of the lens. As ocular examination is required to enable us accurately to place the plate in that focus, the camera is provided with a piece of ground-glass representing the sensitive plate in position, while the plate itself is securely carried in a light-tight receptacle, known as a "dark-slide," or "carrier," until the light is to act upon it in the camera, at which juncture a shutter is removed from the slide or carrier *in situ* in the camera, so that the light from the lens reaches the plate, while no other light can reach it. Evidently the sensitive plate, when undergoing light-action, must in position coincide accurately with the position occupied by the ground-glass, while we were placing the ground-glass in the focus of the lens. This coincidence of position between ground-glass and sensitive plate is known as "register."

As a matter of convenience and efficiency, cameras are made in two types, a camera for outdoor work, and a camera for studio or indoor operations. The studio camera, not requiring to be carried about, should be of strong material, and should have every mechanical convenience without respect to weight. The "outdoor," "landscape" or "tourist's" camera should have every mechanical motion, and be made of the strongest material consistent with portability.

Certain conveniences should be found in every camera, irrespective of weight, and certain qualities are essential to every camera, irrespective of all other considerations. A sufficient amount of stretch, sufficient strength, and complete rigidity are essentials to every camera. In studio cameras these qualities are usually present; in tourist cameras they are frequently neglected in the mania for lightness.

A camera, for perfect efficiency, should have a front so made that the lens, the flange of which is attached to the front, may be moved up and down, at least, and across, if possible, parallel to the sensitive surface. It is frequently convenient, for certain reasons, to be able to put the sensitive surface out of perpendicularity to the axis of the lens; and it is frequently convenient, while tipping the lens upwards, to preserve the parallelism of the sensitive surface with the plane of sight, or with upright objects in the view. These desirable qualities are obtained by what is known as a "swingback."

Time and temper are sometimes lost when, on an oblong plate, the view has to be taken with the plate in the vertical position instead of the more usual horizontal. If the camera be not unscrewed from its bearings on the stand and placed bodily in the desired position, a "reversing back" is required, and it is certainly a great convenience. The camera-body has to be made square for a reversing back to be permissible, but the extra weight and expense entailed are usually made up for by the extra convenience.

To save weight, the greater portion of camera-body is usually made of leather, in the form of bellows; and to save bulk, the bellows are often made to taper more or less towards the front. This taper is convenient, but must not be too sudden or carried to too small a point, otherwise the bellows may interfere with the image.

In some tourist cameras the stretching operation is effected upon the front, in others upon the back of the camera. Each system has its advantages, and each its disadvantages. If the front part of the base-board projects too far in front of the lens, there is, at certain times, a danger of the projecting front trespassing on the field of the lens. We figure a camera of

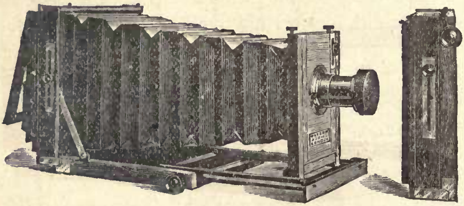

FIG. 1.

each of the types in general demand, No. 1 being a tourist camera, No. 2 a studio camera. It is not within our province minutely to describe any special camera; we have suggested what we consider the essentials of a good camera. The purchaser must rely upon the honesty of the parties with whom he deals. Our remarks are only intended to prime the tyro, so that when he goes to make a purchase he may have at least a faint idea of what he ought to ask for.

A regular studio camera, as Fig. 2, will probably be suitable only to a professional portraitist, but as there are many amateurs who lay themselves out for portraiture, and as to prevent fatigue on the part of either and confusion on the part of operator, it is well to have every convenience. We have shown the general appearance of a studio camera that will fulfill every condition of perfection.

Not the least important part of the camera is the "dark slide" or "carrier" already mentioned. As it is the receptacle wherein the sensitive plate is carried, and as it comes into play at a time when the operator needs all his faculties about him, the dark slide must not only be thoroughly strong and absolutely light-tight, but should be of such neat workmanship as to work certainly and "sweetly" under all circumstances.

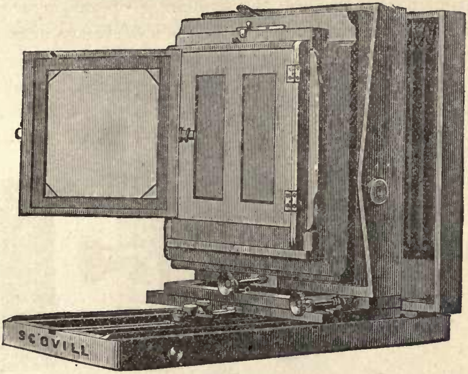

FIG. 2.

For dry-plates, now almost universally used, the slide is usually made "double," carrying two plates back to back, with an opaque partition between them. The double slide, as a rule, opens at one end, after the manner of a long pocket-book. The partition must separate the plates over all their surface, and may conveniently be hinged on the slide.

When it is desired to use in the dark slide a plate of a size less than the full size of the slide, we use what is known in England as a "carrier," in America as a "kit," merely a frame fitting internally the small plate, externally the dark slide rebate.

In America the "shutter" of the dark slide—the part removed from the front of the plate during exposure—is so made as to pull right out of the slide, having a "cut-off" to prevent light entering as the shutter comes out and is replaced. In England the shutter has usually a "stop," which prevents it from coming right out, and hinges which allow it to be folded out of the way and out of the wind during exposure. We do not venture to decide between these two systems; each has its merits.

"Roller slides" or "roll-holders" for carrying paper films shall be noticed later.

The considerations that regulate the choice of supports or stands for the camera are pretty much the same as those regu-

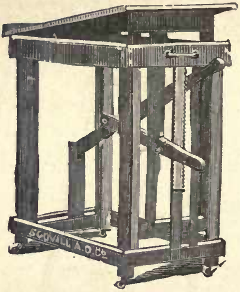

FIG. 3.

lating the choice of the camera itself. The studio stand must have every motion, irrespective of weight, and two good sam-

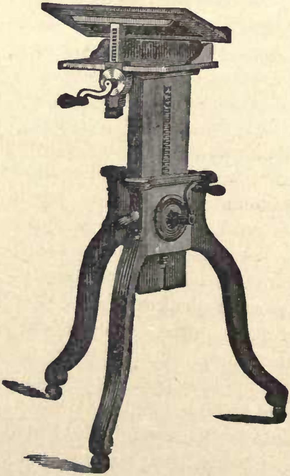

FIG. 3*a*.

ples are shown at Figs. 3 and 3*a*. A stand for outdoor purposes must be as rigid as possible, consistent with portability; should have sliding legs to meet contingencies of very uneven ground, but should, withal, pack into as small bulk as possible. The point upon which rigidity chiefly depends is the breadth and force of grip with which the tripod head is grasped by the tops of the legs. Fig. 4 shows a good tripod stand.

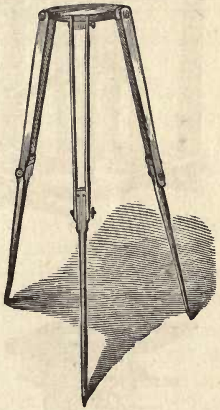

FIG. 4.

Photographic lenses are of a few different types, and made of many different focal lengths. The focal length of a lens is really the paramount consideration, provided, of course, the manufacture is good. Each type of lens is made with a view to meet certain special requirements, to a special degree, and a good lens for any special purpose is really a pure compromise between a number of qualities, special attention being given to the special quality required for the special purpose. Thus the portrait lens, the triumph of photographic optical compromises, is so made as, with the least possible sacrifice of other qualities, to give the greatest possible rapidity of action. The portrait lens was the outcome of the struggle for rapidity at any price, in the days of slow plates; it is now gradually falling into disuse, and its place is being taken by the rectilinear, or symmetrical lens. The rectilinear lens is formed of two combinations, sometimes alike, sometimes dissimilar. Its uses are at least two-fold, it secures rectilinearity of lines in the camera image, and it enables us, under certain conditions, to work rapidly; hence we have the term "rapid rectilinear," or "rapid symmetrical." We have other "symmetrical" lenses, which, by reason of their special uses, cannot be used at all times for rapid work. The term "wide-angle" is so frequently used, without comprehension of its true signification, that we explain. The "covering power" of a lens depends mainly upon its focal length, and if we use a lens to cover a plate large in proportion to the focal length of the lens, we are using that lens at a "wide-angle"; so it has come about that lenses made with a view to cover a plate large in proportion to their focal length are called "wide-angle lenses." A lens is used as a narrow, or wide, or medium angle lens according to the size of the plate upon which it is used, in proportion to its focal length. A complete treatise on these subjects would require a vast amount of space, more than we can give the subject here.

The so-called "single" lens has certain qualities which place it, in our estimation, higher than any other kind of lens. The number of reflections inside the lens is reduced to a minimum, and the result is a quality, especially in the shadows, not given by doublet or triplet lenses. Until lately the single lens had to be so "stopped down" as to make its action very slow, but this defect has, to a great extent, been rectified; the other defect is that when a single lens is made to embrace too wide an angle, straight lines in the subject are distorted in the photograph. This defect has been greatly exaggerated, and we believe that the cases where the use of a "single" lens, used at moderate angle, is not permissible, are much more rare than is generally known by operators, or admitted by opticians. For portraiture the writers have found the "single" lens inferior to no other type of lens, but it is advisable that the single lens, for this purpose, be made to work with as wide an aperture, and be used at as narrow an angle, as possible.

"Group lenses," so called, are compromises between the portrait and the rectilinear types. "Wide-angle rectilinears" are made so as to give non-distorted lines while working at wide angles. Perhaps the type of lens that will most completely meet every class of requirement is the rapid rectilinear, and lenses of this type go under many different names in different countries.

The focal length of lens necessary to cover a plate may be calculated from the diagonal of the plate. In cases of necessity, lenses may be used of focal length less than the diagonal of the plate, but, as a general rule, the focal length ought to be at least 50 per cent. over the length of the plate.

The exposure required depends, so far as the lens is concerned, entirely on the proportion of the area of aperture to the focal length at which the lens is being used. If a lens is focused on a very distant object, as the sun, when the sun-image is in focus on the ground-glass of the camera, the sun is in the position known as the anterior conjugate focus of the lens, and the ground-glass is at the posterior conjugate focus, or, briefly, the solar focus. The focus of a lens is usually measured from the "stop," in case of a combination lens, from the lens itself in the case of a single lens, to the ground-glass. This is not *strictly* scientific. But if we focus a closer object, say ten feet off, with a lens of about four inches focus, principal focus, the ground-glass will be found further from the lens than it was when the sun was focused with the same lens; the ground-glass is still at a focus of the lens, but it is not the solar focus, and, in calculating our exposure by means of the proportion of aperture to focus, it is not the sun focus we have to deal with, but the focus of the object which we are focusing; a very different matter in the case of close objects. From inattention to this point persons are often greatly deceived in their exposures when working upon near objects. The proportion of aperture to focal length is usually called the "intensity ratio," and expressed as a fraction thus: $\frac{1}{x}$ or $\frac{f}{x}$, x being the focal length in inches, and the numerator of the fraction being the measure of the aperture. "Stops" or "diaphragms" are always sold with lenses for photography; these stops may be separated from the lens and used by being placed in a slot made for the purpose in the lens tube, or they may be fixed to the lens and rotated so that any of the apertures may be used. The stops are usually so cut as to give, with the lenses to which they belong, intensity ratios as follows: $\frac{f}{4}$, $\frac{f}{6}$ (these two usually confined to portrait lenses); $\frac{f}{8}$, $\frac{f}{11.3}$, $\frac{f}{16}$, $\frac{f}{22.6}$, $\frac{f}{32}$, $\frac{f}{45.2}$, beyond which it is not usual nor, indeed, advisable to go, except in special cases, when $\frac{f}{64}$ may be used. These terms simply express that the solar focal length of the lens is 4, 6, 8, 11.3, etc., times the diameter of the aperture. Exposures are calculated by comparing the *squares* of the denominators of these fractions. If at $\frac{f}{16}$ the proper exposure is found to be ten seconds, the exposure at $\frac{f}{32}$ will be not twenty seconds but forty seconds.

As $16^2 : 32^2 :: 10 : 40$.

In calculating exposures for close objects, the caution above given as to real focal length must not be neglected. Some opticians number their stops according to an arbitrary table drawn up by a committee of the Photographic Society of Great Britain. A table will be found at the end of this book showing the connection between the so-called "Uniform System" of numbering stops and—what is really the crucial point—the intensity ratios.

For the special province called instantaneous photography, mechanical "shutters" are required. The simplest and the oldest is the "Drop" or Guillotine shutter, figured No. 5,

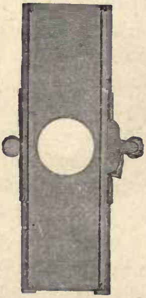

Fig. 5.

wherein a loose piece with an aperture falls across the axis of the lens, the shutter being placed sometimes on the hood or front of the lens, sometimes at the back of it. As, usually, it is desirable to expose the foreground of a subject more than the upper part, this form of shutter is preferably placed behind the lens; for if it is in front, the increasing velocity of the falling *plaque* of wood, metal, or other material allows the foreground less exposure than the upper part.

Shutters of this type should have their aperture by no means less than the working aperture of the lens. An aperture longer than the lens diameter is recommended, and the action may be quickened by an elastic spring.

Many shutters are used in the centre of the lens, and, in certain ways, these shutters have great merits. As a rule, the apertures of these shutters are of square or diamond-shape, and cross each other in the act of exposure. When a shutter acting in this way is placed either in front or in rear of the lens, the inequality of lighting inherent in certain types of lenses is exaggerated; when the shutter is placed in the centre of the lens, not only is this defect not exaggerated, but the result

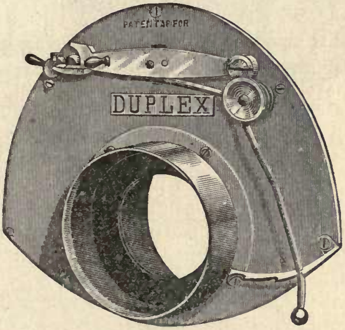

FIG. 6.

is better, in this respect, than if the lens were used with the same stop and the lens-cap. There is an advantage to be found in shutters opening from the centre, viz., that the loss of time occupied in opening and shutting is made up for by the fact that the shutter acts during part of the exposure as a stop. The advantage of using a stop is that, thereby, greater sharpness is obtained over the plate, and planes of the subject at various distances from the lens are brought more evenly into focus on the plate.

The markets teem with shutters for instantaneous exposures. If the purchaser can procure one which will work without jar *during* the exposure, which will, at will, give an exposure as short as one-hundredth of a second, or as long as half a

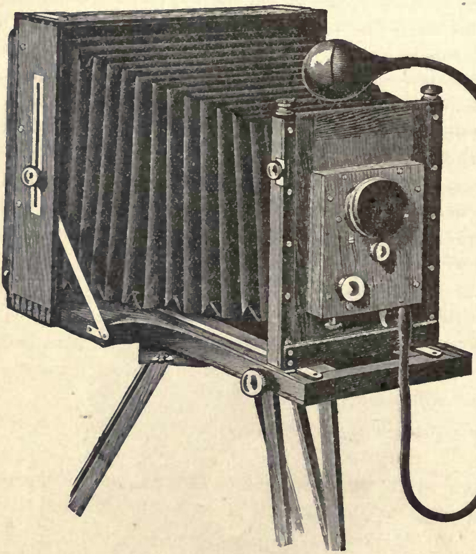

FIG. 7.

second; if it give either even illumination all over the plate, or extra exposure to the foreground; if it allows the full amount of light to act on the plate during the greater part of the duration of its working ("co-efficient of light"); and if, in addition, it can be made to give an exposure regulated by the hand of the worker, that purchaser will not regret his purchase. It would be invidious, from such a number of good shutters, to single out any one as the best, but we give figures (6 and 7) of two good shutters, one well known in America, the other in Great Britain.

With the ordinary lens-cap, by hand, an exposure can be, with a little practice, made not exceeding one-fourth or one-fifth of a second, but the performance is, in some hands, risky.

It will be noticed that as yet we have not written a word of suggestion as to *size*, nor do we propose to more than allude to the matter. The photographer must choose the size for himself, according to his bank account, his bodily rigour, his available leisure, and his object. Expense, exertion, and attention required, all increase, at an enormous rate, as size of work increases. The smallest size commonly used is known as "quarter-plate," the size of plate being 4¼x3¼ inches. The *impedimenta* for work of this size are not worth mention, and the expense moderate. By an easy process lantern-slides can be produced from quarter-plate negatives, and we doubt whether we could name a nobler finale to a set of photographic operations than a good lantern-slide, for which we shall give very careful instructions in this book.

"Half-plate," 6½x4¾ (in England), 6½x4¼ (in America), is, perhaps, the smallest size from which a direct print can be made that will not look trivial.

"Whole-plate," 8½x6½ inches, is a very convenient, and in our opinion, elegant size.

The largest size we can recommend for amateurs, in a general way, is 10x8 inches, which most persons will find quite enough to carry into the field.

For portraiture, where weight is a matter of no consideration, we recommend the largest size the would-be purchaser can afford. We confess ourselves sick of the everlasting "cabinet" portrait, and its little brother, the "carte." If the amateur must trespass on the domain of the professional, let him do so "*en grand seigneur.*"

Besides such necessaries as we have touched upon, there are a number of smaller articles which will be required. These we shall merely advert to.

A cloth, known, too often, as the "black cloth," or "black rag," is used to cover the camera while focusing is being done. This cloth looks much better when dark-colored, but not black, and waterproof cloth is far superior to velvet, because it *is*

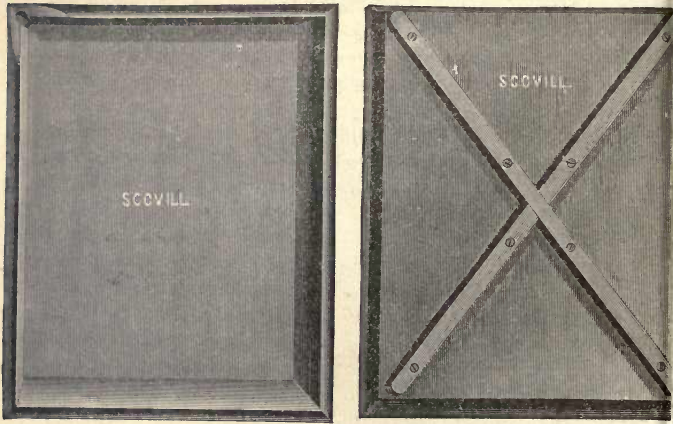

FIG. 8.

waterproof, and often useful in that capacity; because it has a

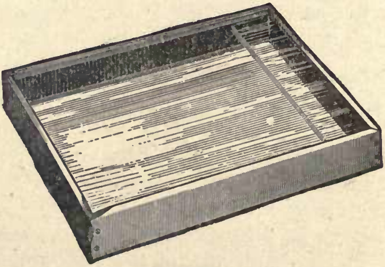

FIG. 8*a*.

better appearance, and because it does not cling to the cap, or hair, when the head is being withdrawn from under it. The cloth should be tied, or buttoned, on to the camera front, and should be of ample size.

Dishes for development of ordinary dry-plates should be black, and papier-maché is perhaps the best material. To save extra quantity of solution the bottom should be flat, but in order to avoid staining the fingers in lifting the plate up for examination, either a hook must be used, or the dish made with ridges at bottom. For other operations, as "toning," porcelain dishes are to be preferred. For the smaller sizes, glass dishes are found very elegant, but they have the defects of weight and brittleness.

Graduated measures of different sizes, scales and weights, filter-funnels, and other laboratory requisites are necessary in small quantities, but need no remark.

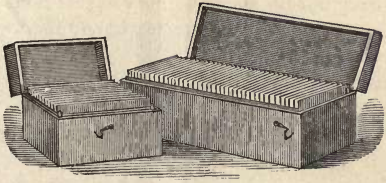

FIG. 9.

Plate boxes for storing sensitive plates must be made carefully light-tight, and of such wood or other material as will not affect the most sensitive plates (Fig. 9).

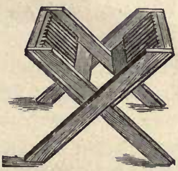

FIG. 10.

A rack for drying plates is preferable to leaning the plates against a wall, or other object to dry (Fig. 10).

Other apparatus will be described, as the need for it turns up, in our future chapters.

CHAPTER IV.

THE DARK-ROOM.

THE above is the name technically, but not accurately, given to the apartment wherein are conducted such operations as would be hurt or impossible in actinic light, by reason of its action upon our sensitive salts, as described briefly in Chapter II. The requirements of an operating-room are of the simplest, but it may not be amiss to give a few hints as to the easiest and best way to arrange an apartment for the purposes with which we propose next to deal.

Many amateurs find it impossible or highly inconvenient to secure an apartment of any kind for their work, and for such a "dark-tent" may be the most convenient way out of the difficulty. But it is probable that each of our readers will be able either to adapt, or to find, or to build an apartment for his photographic requirements.

If a room is to be used only occasionally or temporarily as an operating-room, the most required will be to stop out all white light by whatever means appear most handy. A window may either be blocked up entirely by opaque material, such as thick brown paper, or brown paper in several layers, or it may be preferable to block out the light only partially with opaque material, and allow some light into the room through some medium, such as ruby glass or orange or yellow paper. The color and thickness of these light-filtering media depend on the sensitiveness of the photographic substances we propose to use. For wet collodion, dry collodion, or gelatine-chloride plates, yellow glass or lemon-colored paper will be sufficient protection, even from daylight. For processes wherein we use gelatine-bromide of silver in a moderate state of sensitiveness, as for "lantern-slides," "bromide prints," or "slow gelatine-bromide plates," an orange-colored filtering medium, a single ruby glass, or "canary medium" may be used. With very rapid gelatine-bromide plates we must use several thicknesses of orange or canary paper, or we must add to the ruby glass a thickness of yellow glass. If we are going to expose our sensitive material to the light for a prolonged period, as in emulsion-making, we must redouble our precautions in this line, and for orthochromatic work (see Chapter XVIII), we must not only restrict ourselves to ruby light, but we must, as far as possible, restrict the quantity of that. If there be any doubt as to the "safety" of our light, we should expose a sample of the material with which we are working under a "sensitometer screen," or under a negative, to the suspected light, and ascertain by development whether any light-action takes place. We may place one

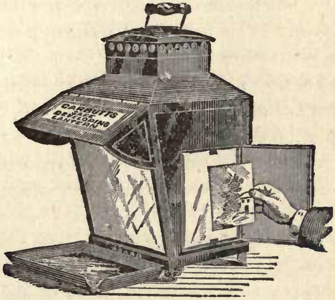

FIG. 11.

of our plates in a book, so that part is protected by the book and part exposed to the suspected light for (say) five minutes. If, on development, any action is observed on the exposed part it is evident that further precaution must be taken with regard to the light.

Alternatively, and perhaps preferably, the light may be entirely, blocked out of the room, and a "non-actinic lamp" used. The variety of these in the market is infinite. We figure one only, Fig 11.

If gas is laid on, we recommend the principle of building a lantern around a jet, so that (1) the heated air and combustion-products are carried right out of the apartment, if possible; (2) the gas can be raised or lowered from the outside of the lantern.

In the case of a room temporarily used as an operating-room, it is well to cover the tables with waterproof or "American" cloth. A basin or foot-pail may serve as a sink, and any vessel of suitable size and shape may be "annexed" for water. We have, in a hotel bedroom in Italy, made rapid gelatine emulsion, coated, dried and developed plates, with some little exercise of ingenuity, but without accident or failure.

But we venture to say that success will most likely attend operations conducted in apartments made or adapted solely for the purpose of these operations. The apartment chosen or built must be thoroughly ventilated as well as thoroughly light-proof, otherwise the accruing vapors will damage both the health and the success of the operator. A north aspect should, if possible, be chosen for the window. A window should exist in the room, whether that window is to be used for the photographic operations or whether it is to be blocked up during operations. The system of dark-room lighting, which we find most satisfactory, is to have our window glazed with perfectly safe light, but to have, also, our gas lantern lighted and worked from the outside. We commence developing operations by daylight filtered through our "safe" window, and when we come to the point where critical examination is required, we turn up our non-actinic gas lantern, which is provided with various filtering media—viz., clear ruby glass at one side, canary medium paper at another, and ruby glass, ground on one side, at another. Ruby glass ground on one side is one of the most perfect *media* we know. Of "ruby glasses," the safest sample we have ever seen was ordinary "metal-flashed ruby" on one side and "stained yellow" on the other side. Some persons cannot tolerate ruby color; others dislike yellow-greens. The ruby tints are used clear, and often combined with clear yellows. The yellow *media* require the light to be more or less diffused, either by paper or ground-glass, or semi-obscured glass in some form or other. Of course, a medium that may be "safe" with artificial light might be disastrous if used with daylight; and, moreover, a medium safe with daylight in mid winter may be fatal in spring or summer. The test recommended above is equally useful here.

The sink for an operating-room is often made of stoneware, often of iron. We greatly prefer wood lined with sheet-lead, which does not, perhaps, look so pretty, but does not fracture a measure knocked over or laid too briskly down on it.

The tap should be of the "arm" kind, but the turning of the arm must not regulate the water-flow; there should be a cock to turn the water on and off.

On one side, at least, of the sink, and projecting slightly over the sink, should be a table, lead-lined, and sloping down towards the sink. This is to receive dripping measures, dishes, plates, etc., and to carry the drip into the sink. A slightly-raised ledge, or "beading," round the table, will prevent liquids reaching the floor.

Shelves, cupboards, tables, etc., are evident requirements of an operating-room. Hot water supply is an immense boon. A fixed syphon trough for washing negatives is a great convenience.

The nozzle of the tap should end in a thread, to which, by means of a gas coupling, can be attached a variety of small apparatus, as a rose tap—an invaluable article—a rubber tube, etc.

Drying presses and other matters shall be described as their uses are treated.

The dark-room should be kept, as far as possible, at an even and moderate temperature. Whatever be the fuel used the products of combustion must be carried right out of the room. Gas, in particular, has a noxious effect on many of our products.

CHAPTER V.

"NEGATIVE" AND "POSITIVE."

THE result of every set of photographic operations is either a positive or a negative. A "positive" shows the light colors in nature as whites, the shadows as dark, while a "negative" shows the high lights of nature as dark, the shadows as light. A positive may be looked either *at* or *through*, a negative is not intended for looking at, but is merely intended to be *printed through*, so as to produce what is always our ultimate object—a positive. Positives are very seldom now produced direct from nature, they are almost always produced through the intervention of negatives. A negative is of no value or merit irrespective of the value or merit of the positives which may be produced from it.

We have to deal with "positives" as prints on paper, on opal, or on other opaque or semi-opaque supports; and with 'transparent positives," as "lantern-slides," window transparencies, etc.

"VEHICLE" AND "SUPPORT."

We require for our sensitive salts (1) a substance wherein they may be suspended, because we cannot, in practice, spread or use them on a hard, repelling surface, such as glass. The suspending substance is called the "vehicle," and may be collodion, albumen, gelatine, paper, or other substances. (2) Some "support," to hold our suspended sensitive substances in such a layer and condition, that we may expose a considerable surface of our sensitive substances to light-action, and be able, thereafter, to manipulate them. Glass is the commonest "support" now in use, but we have, also, acting as supports, paper, gelatine films, metal plates, etc., etc.

The support may be "temporary," as in cases where, after operations are complete, we strip our vehicle, with its suspended substances, from the temporary support; or the support may be "permanent," as in the cases of the glass of our ordinary negatives, or the paper of our ordinary prints. Paper, among other substances, may be at once vehicle and support, temporary support and permanent support.

We propose first to deal with the wet collodion process, which may be used as (1) a negative process, (2) a transparent positive process, as in the case of lantern-slides, (3) an opaque (or simply) positive process. As the use of wet collodion, under No. 3, is now rare and confined to the production of positives not remarkable for excellence at the best, we shall not do more than allude to it under this heading.

We cannot do the wet collodion process full justice, as we are well aware, in our limited space, but the process is so interesting, so educative, and so beautiful in many of its results, that, though of late years it has fallen into comparative disuse, we feel impelled by our own wish, as well as for the good of our readers, to devote some space, however unworthy of its merits, to the process.

CHAPTER VI.

THE WET COLLODION PROCESS.

In this process collodion forms the vehicle, glass the support, and silver haloids the sensitive salts. The latter salts are formed in the vehicle by the chemical action known as "double decomposition." The vehicle at first holds in suspension an iodide (as of potassium), or a bromide, or a chloride, or all three; these halogens, coming in contact with silver nitrate in solution, combine with the silver to form the silver haloids in the vehicular film of collodion, and these haloids are the salts that receive the light-action, and determine another action known as development, which is really a reduction of the silver to the metallic state. It is utterly impossible, in a few words, to explain, even in outline, a series of chemical actions such as this; the safer way, for all parties, will be not to attempt desultory and partial theory.

Collodion is a solution of gun-cotton in ether and alcohol, and is sold ready for our purpose either "iodized" or with a separate bottle of "iodizer," to be mixed with the plain collodion, according to instructions. As a rule there is, along with the iodide, a certain proportion of bromide, and for landscape work a good proportion of bromide is desirable.

A plate of glass, being thoroughly cleaned, is "coated" with iodized collodion, and is thereafter immersed in a solution of silver nitrate. The now sensitized plate is exposed in the camera, brought back to the operating-room, where it was sensitized in non-actinic light, flooded with a developer, consisting of a salt of iron in solution, washed, "fixed," and washed again, when it is supposed to be a finished negative. To take these operations in detail:

Cleaning the Glass Plate is usually performed with a mixture of alcohol and ammonia, containing a little rouge powder or tripoli. If the plate has been used previously, the cleaning must be performed with all the more care, and a preliminary bath of nitric acid and water is desirable; in any case, the plate, back and front, must be scrupulously clean and free from the *slightest trace* of grease or organic matter of any kind. Sometimes the plate is flowed twice with albumen thinned with water and alkalized with ammonia, and, of course, most carefully filtered; this is preferable to having a dirty plate, but is apt to disorder the silver-bath. After the plate is cleaned, it must be "polished" with a scrupulously clean chamois leather. The plate must not be rubbed with silk immediately before coating.

Coating the Plate with Collodion.—This is an operation which requires both care and practice. In no process of photography is more attention to apparently trivial details re-

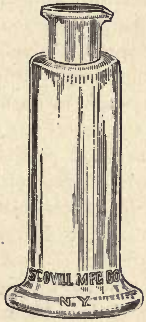

FIG. 12.

quired than in the wet collodion process; absolute cleanliness, freedom from dust, and method are required at every step. The first crucial operation is that of "coating the plate." The collodion containing the "iodizing" agents must be kept clear of dust, free from solid particles of collodion, in a bottle of such form as to permit of neat and even pouring, and to prevent solid or semi-solid particles from settling on the plate. A suitable bottle is shown in Fig. 12. The collodion must run evenly over the whole of the face of the plate, must run over no part twice, nor stop for any considerable time on any part. The operation is performed in the following way, and those uninitiated, yet unwilling to waste collodion, may try their "prentice hands" with milk or thin cream.

The polished plate is taken by one extreme corner, or, much preferably, on a pneumatic-holder scrupulously clean (Fig. 13).

FIG. 13.

The face and back are quickly dusted with a camel's-hair brush, and the plate held in the left hand in the position shown in the figure, A E being next the operator's body.

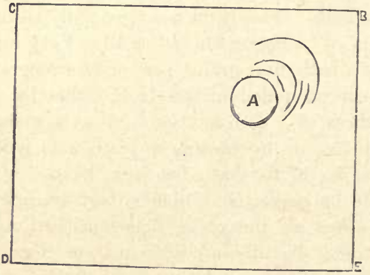

FIG. 14.

A pool of collodion is poured about the point A in sufficient quantity to more than cover the whole plate, the pool as it widens is guided by tilting the plate slowly but steadily towards B, then around towards C, then towards A; the now broad wave is directed towards D, at which corner it is poured off the plate into a second bottle, through a filter if convenient.

The plate, while the collodion is running off, must be gently and slowly rocked by depressing alternately corners E and B, and the corner E may be gently touched by the neck of the second bottle, or the filter, but must on no account be ground against any hard substance. When the collodion is "tacky," or takes the impression of the skin of the finger at corner D, the plate must without delay be placed in the "nitrate bath." Many operators hold the plate, while coating it, with the narrow end next the body, pouring the pool of collodion near the right top corner; some pour it on near the left side next the body, but we, after considerable experience, prefer the method we have given.

The "Silver Bath," or "Sensitizing Bath," is as simple to make as it is difficult to keep in order. Therefore, it should be made in two batches at once, one solution to replace the other when the first used goes wrong:

Silver nitrate (crystallized)	35 grains
Pure water	1 ounce

in sufficient quantities, of course, to cover the plate thoroughly in the bath. This is the most generally useful strength, and the limits of variation are but small. Very cold weather may indicate a bath five grains per ounce stronger. A trace of iodine must be added to this bath, either by adding for every ten ounces of "bath solution" about a grain of potassic iodide direct, or by coating a plate with iodized collodion and leaving in the bath for some hours. If the addition of iodide be neglected, pinholes (tiny transparent spots) will surely affect all the plates first sensitized in the bath. The water must be absolutely free from organic matter; water distilled in a glass or clean metal "still" will answer, or rain water caught direct from the clouds in a clean—not metal or wood—vessel. Even rain water is not entirely to be trusted. A crystal of silver nitrate should be placed in about a pint of rain water, the vessel containing it allowed to stand some days in bright light, and the water carefully filtered through pure filter paper. To prepare the bath: Dissolve the full quantity of silver nitrate in about one-half the full quantity of water, add the iodide if the addition is to be made directly; then make up with water to full bulk, and filter.

The "bath" is at all times, after long use, liable to become supersaturated with either (1) iodine, or (2) collodion solvents —ether and alcohol. No. 1 is indicated by "pinholes" in the negatives; to cure this, dilute the bath to half its strength, make up to original strength with silver nitrate, and filter carefully. If No. 2 be indicated by unequal sensitizing and streaky development, the application of heat will drive off the offending solvents. A third adulteration, that of organic matter, is more difficult to get rid of; it will be indicated by fog, "veil," dirty negatives, etc. To remove organic matters which get into the bath from the fingers, the clothes, the atmosphere, or dirty plates, make the solution distinctly alkaline with sodic carbonate, and place the solution in a strong light for some days, after which filter out the black deposit, re-acidify with nitric or acetic acid, and filter again.

The sensitizing bath must never be used alkaline; it must be tested for acidity with blue litmus paper. If the paper does not turn red, acid—nitric or acetic—must be added to the bath till the paper shows distinct redness. For negative work, acetic acid is, perhaps, preferable; for positives, nitric acid.

When the collodion has "set" on the plate, as described—the time requisite for setting depending chiefly on the temperature, and varying from twenty seconds upwards—the plate is to be immersed in the "bath."

Two kinds of receptacles are used for the bath solution. In some countries we find the dipping bath almost in universal use; in other countries an ordinary flat porcelain or glass dish is used. The dipping bath, figured at No. 15, requires a "dipper" of silver, porcelain, or varnished wood (the last *not* strongly recommended), and it also necessitates a much larger quantity of solution than the flat dish, but it has the advantage of better protecting the plate and the solution from dust and other impurities. We leave the choice to our readers, saying only that, having used both, we prefer, on the whole, the flat dish, keeping it carefully covered and the solution frequently filtered. The plate is to be immersed in the solution steadily, without either a sudden plunge or a hesitating stoppage, and the lower end of the plate, where the collodion is probably thicker, is to be immersed first. In a few seconds a change will be seen on the plate, a kind of gray or bluish-gray film appearing, due to the formation, by "double decomposition," of the silver haloids. After the plate has been in the bath about forty-five seconds, the thick collodion end, if in a flat dish, the whole plate on the dipper, if in a dipping bath, should be gently and only slightly raised. The sensitization is complete when there is no longer any appearance of "greasiness" on the plate, that appearance being due to the collodion

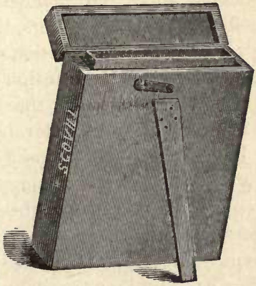

FIG. 15.

solvents. The plate should now be covered with a perfectly even film of gray or bluish-gray (according to the salts in the collodion) color. Of course, the sensitizing of the plate must be done in non-actinic light—in the present case yellow glass, or even a candle shaded by yellow paper will afford sufficiently safe illumination.

The plate, now sensitive, is raised from the bath slowly, the drops at the lower end blotted off on *clean* filter or blotting paper, the back wiped with similar paper, and the plate is placed in the dark-slide, propped up in the position it will occupy in the camera. The plate being placed in position, film to the front and against the silver or glass corners in the slide, a piece of red blotting paper, which may with advantage be damped, is placed behind the plate, and the slide is closed.

As a rule, the thicker part of the collodion film should be placed at the upper part of the dark-slide which will receive the foreground of the picture. The slide once charged in its proper position must never be waved about nor reversed so as to cause the silver solution to run back over the plate; it must be carried steadily, and if laid down must preserve the position in which it was charged.

We then proceed to make an exposure (see Chapter XIII.), and after exposure, return to the dark-room with the slide, which we again prop up in its former position, till we are ready to develop the plate.

Development.—An average iron developer may be formulated thus:

Iron protosulphate....	12 grains
Acetic acid (glacial)....	30 minims
Water....	1 ounce
Alcohol....	q. s.

For the acetic acid we may substitute nitric acid, 1 minim. The quantity of alcohol is regulated by the amount of alcohol in the bath, a new bath necessitates almost no alcohol in the developer; as the bath ages, so the alcohol in the developer must be increased, otherwise streaks will appear.

The iron protosulphate must be fresh, and of a fine green color; the yellow crust, often seen, is due to oxidation, and does mischief acting as a restrainer (Abney). The proportions of iron may vary greatly; as little as five grains, and as much as forty grains, to each ounce, may be used under certain conditions. One of the writers used with great satisfaction, in Italy, the following:

Ammonia sulphate of iron....	77 grains
Acetic acid....	70 minims
Alcohol....	q. s.
Water....	3 ounces

The acid is in each case used as a "restrainer" or "retarder." Without it the image would flash out, fog, and be not only uncontrolable, but useless.

The plate is taken out of the slide by "safe" light, preferably with the pneumatic holder (*vide supra*), is held over the sink with the thicker end of the collodion film next the operator. Sufficient of the developer, amply to cover the plate, is taken in a cup, and *swept over the plate* in one wave, not violently, but without hesitation; if possible, no solution should be spilled. This is allowed to *move* over the plate for half a minute, more or less, and is then poured off into the sink, or into a residue jar. If the image flashes up gray, the exposure has been too great; if it comes up reluctantly, or black and white, or not at all, the exposure has been too short, in each case supposing the "bath" and the developer in proper order. In place of acid, certain viscous substances are sometimes used as "retarders" of development, making the developing solution more "syrupy," and so offering more resistance to the solid particles traveling through it. Among substances recommended for this purpose are sugar, glycerine, gelatine, and the "collocine" of Mr. Carey Lea.

Re-development.—It is probable, especially if the wave of developer carries any solution over the edge of the plate, that the image, after development, will not be dense enough for printing purposes, and possible that there may be a lack of detail, as well as of density. In this case the plate is washed under the tap, and a further dose of developer is applied, with the addition, this time, of some silver nitrate. To each ounce of the fresh developer, in the cup, we may add ten or twelve drops of a ten per-cent. solution of silver nitrate. (Silver nitrate forty-eight grains, water up to one ounce, acidified with nitric acid.) This is applied to the plate, and allowed to move over it as before, density and detail will both increase. If, after development, the image is weak, and wants detail, redevelopment is wanted; if weak, and full of detail, it is contraindicated. In the latter case intensification (see p. 44) is indicated as necessary.

Fixing.—The plate, after re-development, is again washed and fixed (*i. e.*, the unaltered-by-light silver salts are dissolved) by pouring on either:

Potassic cyanide	25 grains
Water	1 ounce

Or,

Sodic hyposulphite	100 grains
Water	1 ounce

till the yellow veil disappears from the plate entirely.

The potassic cyanide is highly poisonous, even by absorption, its fumes are noxious to some persons; the sodic salt is harmless. After the plate is perfectly "fixed" or "cleared" it must be carefully washed, especially after "hypo."

Intensification is resorted to for plates that are wanting in density, and consists of an operation very similar to re-development; the same solution may be applied as for re-development, or the iron, this time, may be replaced by three grains of pyrogallic acid. The silver nitrate is to be added as before in re-development. The plate is finally washed and allowed to dry. Drying before a fire will slightly increase the density.

These processes are practically the same for a transparent positive (as a lantern-slide) as for a negative. The wave of developer may be allowed to carry a little solution over the edge of the plate, and any increase of density must be administered with caution.

The collodion film is very delicate, and requires to be protected by a varnish usually composed of gums dissolved in spirits. Varnish is sold by every dealer, but may at need be made thus:

Seed lac	1 pound
Methylated spirit	1 quart

Keep some days in a warm place, shaking occasionally. After four days decant and filter.

To apply varnish: Heat the plate to blood heat, apply the varnish after the manner of collodion, drain well, removing the last drip by resting lower part of the plate on bibulous (filter or blotting) paper. Then heat again till the back of hand cannot bear it. The varnish must not be allowed to dry cold.

For certain purposes negatives in black and white are required. For such purposes—copies of plans, line engravings, etc—the negative may be intensified thus:

Mercuric chloride	1 part
Water	20 parts

Acidified with hydrochloric acid.

Immerse in this till the image is almost, or quite, white. Then plunge, after thorough washing, into:

Liquor ammonia, fort	1 part
Water	20 parts

The image will now turn densely black. Wash thoroughly. Dry, and varnish as before.

CHAPTER VII.

A DRY COLLODION PROCESS.

Dry collodion plates are very rarely, if ever, now used for making negatives, but, as the process naturally follows the wet collodion process, we propose to insert here a dry collodion process, which we have used extensively and successfully for lantern-slides, and which *may* be used, if desired, for negative-making. The formula is mainly due to Mr. W. B. Bolton.

Dry collodion emulsion is called "washed" or "unwashed," according to the stage at which it is washed, for washed it always is, at one stage or another. Instead of using a bath of silver nitrate solution, and immersing a coated plate therein, we add the silver nitrate to the liquid salted collodion, thereby producing an "emulsion" of silver haloids in collodion, and that emulsion, sensitive to light, we pour on plates which we thereafter dry. But in the process of "double decomposition," by which the sensitive salts are formed, there are formed other compounds, or "bye-products," which, if left to dry on the emulsion, or on the film, would crystallize, and spoil all our plates. In the "washed" emulsion process these bye-products are washed out of the bulk of emulsion before the plates are coated. In the "unwashed" emulsion process the bye-products are washed out of the film of each plate after it is coated.

Unwashed Collodion Emulsion Process.

The zinc bromide must be dry, or dried by heat on a clean surface. The pyroxyline is that made at, and known as, "high temperature."

Sulphuric ether, .720	3¼	fluid ounces.
Alcohol, .820	2	fluid ounces.
Pyroxyline, (H.T.)	36	grains.
Zinc bromide	59	grains.

Mix in this order, and let stand one day, at least, to settle.

After the above are fully dissolved and any precipitate settled, dissolve ninety grains silver nitrate in a test-tube, with forty-five minims of distilled water, boiling. Boil, in another test-tube, six drams of alcohol .820, and while both test-tubes are at the boil, pour about four drams of the alcohol into the silver solution, reserving two drams for future use. Now take the two test-tubes and the bromized collodion into the dark-room (yellow light will do) and little by little pour the hot alcoholic-aqueous silver solution into the collodion, shaking the latter violently after each addition of silver. After all the silver solution is into the collodion, use the two drams of alcohol in reserve to rinse out the silver which will be crystallized, probably, in the test-tube, and add *that* to the collodion. Shake vigorously for a minute or two. We have now formed a collodio emulsion of silver bromide, which is left to "ripen" for several days. When fully "ripened," the emulsion is filtered through pure cotton wool, glass wool, or swan's-down calico, and plates are coated with it. For this process, the plates should be carefully cleaned, and they should have a substratum of albumen, or an "edging" of india-rubber dissolved in pure benzole. The albumen solution is made by switching the white of an egg with forty ounces of water, adding liquor ammonia till the smell of ammonia is distinctly perceptible, letting stand, and filtering most carefully. This improves by keeping, but the ammonia smell must be kept up. The clean but wet glass plate is flowed *twice* with the albumen, then dried.

The plate coated with collodion emulsion is left till the collodion sets, when it is plunged into *distilled* water, after which it may be washed in ordinarily pure water till greasiness disappears; after this it is placed for about a minute in one of the following solutions:

1. Coffee (ground)................................	2 ounces
Boiling water................................	10 ounces

carefully filtered.

2. Bitter beer................................	10 ounces
Pyrogallol................................	10 grains

filtered.

After No. 2 the plate is to be washed before drying, but not after No. 1. Drying may be accelerated by gentle heat.

Washed Collodion Emulsion.—Process of sensitizing is very similar to that given for unwashed emulsion.

Ether, .720	3¼ ounces
Alcohol, .820	2 ounces
Pyroxyline	48 grains
Zinc bromide	72 grains

To sensitize use, this time, silver nitrate 120 grains. The ripening is allowed to proceed as before, and thereafter the emulsion is poured out into a large, flat, clean dish in the dark-room, and allowed to set thoroughly. As a skin forms on the top, it is broken with a clean bone, horn, ivory or silver instrument, so that it may "set," by evaporation of the solvents, to the very bottom. The emulsion is then cut or broken or torn into very small shreds, and washed in running water for several hours. The "pellicle," or dry emulsion, after being broken up, may be put into a tea-pot, a piece of muslin tied over the top, and a stream of water directed down the spout for a night. The pellicle is next thoroughly dried, first, by squeezing, next, by submersion under alcohol for an hour or two. It is then dissolved in ether and alcohol, thus:

Pellicle	20 grains
Ether	4 drams
Alcohol	4 drams

The plates are coated with this, and require only to be dried.

Development.—For lantern-slides the developers we prefer will be found under the heading appropriate, page 176. We here briefly state a method suitable for plates made by this process, and exposed upon landscape subjects. The required exposure, we may say, is very long compared with other negative processes in common use.

Flow the film with

Methylated spirit	1 part
Water	1 part

for half a minute. Wash under the tap.

Col. Stuart Wortley's Developer.

1.	Pyrogallol	96 grains
	Alcohol	1 ounce
2.	Potassic bromide	120 grains
	Water	1 ounce
3.	Liquor ammonia	6 minims
	Water	1 ounce

Developer consists of

No. 1	6 minims
No. 2	3 minims
No. 3	3 drams

mixed.

This is poured upon the plate, or into a flat dish in which the plate is placed, and after a short time the image will begin slowly to appear and gradually to gain strength, Development does not progress nearly so quickly as with wet collodion.

Re-development, fixing, intensification, and varnishing may be conducted exactly as in the wet process; "pyro" being preferable to iron for "strengthening" processes.

As a rule, a dry collodion plate for landscape work, the film being very thin and transparent, requires "backing." This is done by painting the back of the plate with a pigment of the following nature (Abney):

Powdered sienna, burnt	1 ounce
Gum arabic	1 ounce
Glycerine	2 drams
Water	10 ounces.

This is to be removed before development, a sponge being used.

The ferrous oxalate developer gives fine results with dry collodion plates (see page 91.)

CHAPTER VIII.

GELATINE EMULSION PROCESSES—PRELIMINARY.

We cheerfully acknowledge, and proudly assert, that in the markets of every civilized country, plates prepared for photographic purposes, with gelatine emulsion, are found, excellent in their qualities, and suitable for every purpose for which they may be intended. We do not expect that any person making emulsion on a small scale, or with limited appliances, will produce plates of such even perfection as those of professional plate-makers; and we are pretty confident that the amateur plate-maker will not save any money by his plate-making. *But* we urge upon every one who wishes to work with intelligent comprehension of what he is doing, and every one who has the ambition to *further photographic knowledge*, by his own efforts to acquire a perfect knowledge of, and facility in, the production of gelatine emulsion, and the preparation of plates, or paper, therewith. No treatise on modern photography would, in our opinion, be worthy the name, unless it showed evidence of an attempt, at least, to initiate its readers into this, the most important photographic process of the present day. Our modest directions shall be given, to the best of our ability, in such a way that any intelligent person following them, shall be able to produce a good emulsion, and with a little practice, to prepare good plates; at any rate, so that any person reading them with moderate attention shall grasp the facts guiding our practice, and the conditions necessary to ensure success. The change of "vehicle" from collodion to gelatine carries in its train more important considerations than might, at first sight, be expected. In a collodion emulsion the collodion is practically a purely mechanical *menstruum*, in a gelatine emulsion the part played by the gelatine is more, by far, than mechanical. Many of our most mysterious and aggravating failures arise from this fact. Again, one property of gelatine is, that it permits of a silver haloid being formed in it in a state of very fine division, and of that fine state of division being carried through various stages to a much coarser state; as a number of "marbles" lying together expose to light a much larger amount of surface than a much larger number of "shot drops," so a coarse-grained deposit of silver haloid is more affected by light than a fine-grained one. Moreover, the gelatine is a more powerful halogen absorbent than collodion, and so conduces to greater sensitiveness; and lastly, the gelatine, apparently protecting more strongly the silver haloid molecules, permits of a much more vigorous reducing agent being applied in development.

The haloid chiefly used in gelatine emulsions, for negative work, is silver bromide, and as its general sensitiveness, as well as its special sensitiveness to the less refrangible rays, is greater than that of iodide, we have to take greater precautions as to safety of our light with gelatine bromide emulsion than with either collodio-bromide or the iodide of the wet collodion process. In fact, if we propose to make gelatine bromide emulsion of any suitable degree of sensitiveness, we should use for illumination either ruby and yellow glasses, or several layers of orange paper, or other fabric.

Certain apparatus must be provided before any other step should be taken towards emulsion making.

A drying-press will be required for drying the plates after they are coated, and it must be noted that aqueous solution of gelatine is by no means easily or speedily dried. The press must, of course, be absolutely light-tight, and the drying must depend on a constant current of cool, dry air rather than on any system depending on heat. We illustrate by a cut, Fig. 16, a press, the principle of which may serve to guide others who wish to construct a drying-press.

Drying-closet, designed by one of the writers (see *Photographic Times*, 1888, pp. 133–135), 6x6 feet by 9 feet high; cross section of air-passage one square foot area. The air is drawn from a veranda and heated by an oil stove. No burnt air comes in contact with the plates, the heat being used solely to create draught. (For full description, see article *cit. sup.*)

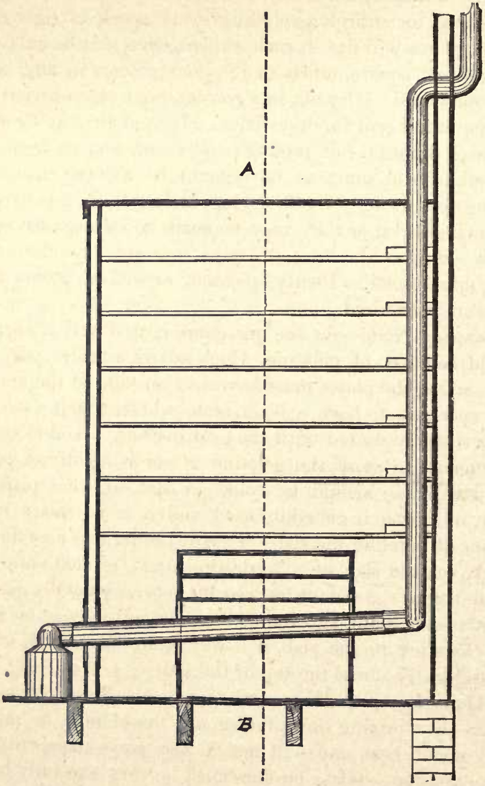

FIG 16.

Receptacles, too small to be called "presses," are sometimes used on a small scale; these are described and figured in many journals and books; one designed by Mr. W. England is, perhaps, as good as any.

A drying-room will be found far superior to smaller receptacles. If any apartment provided with thorough ventilation and means for entirely excluding every speck of light can be found, plates will dry in such a room, even if it be only ten or twelve feet square, much more quickly than in any box, or even cupboard. Dry air, in a constant and vigorous current, is the required agent for desiccation. Heated air may be used to create a draught, but products of combustion, as from burnt gas, oil, or coal, must on no account be allowed to enter the drying receptacle. While drying, the plates are usually placed on drying-racks, or they may be made to lean against upright spars, with the film turned away from any direction whence dust might come. Plenty of room, as well as plenty of air-current, is required.

Leveling Slab.—As the plates are coated with a warm and liquid solution of gelatine, which sets in a firmer jelly when cold, and as the plates must have an even film of the emulsion, it is necessary to have a level table whereon to lay the plates after they are coated until the gelatine sets. And as it is advantageous to cause the gelatine to set as rapidly as possible, this level table should be cold. A slab of thick plate glass, slate, or marble is generally used, and it is necessary to have means of leveling the slab. One of the writers uses the large, thick, marble slab of a wash-hand-stand, leveled with screws from below. As emulsion usually gets accidentally upon the back of the plate, and causes the plate not only to be unlevel, but to stick to the slab, it is well to stretch strings or piano wires tightly across the top of the slab.

Apparatus for Mixing, Cooking, and Washing the Emulsion.—For mixing the emulsion any vessel may be used that will stand heat and will not in any way chemically affect the emulsion. Glass beakers must be very carefully handled, and vitrified stoneware jars are preferable; glazed earthenware must be avoided. We figure an article, known as a "shut-over jar," which we find admirably suited for emulsion operations; the price is trifling, and the jars are practically light-tight, though we do not unnecessarily expose them to light. Flasks or bottles should be of glass, so that we can tell whether they are clean or not.

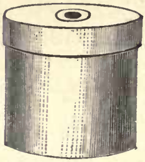

FIG. 17.

Some appliance is needed in order, at a certain stage, to break up the emulsion which has set into a jelly, and this appliance must, if metal, be of "noble" metal—silver, gold, platinum, etc.; or it may be of ivory, ebonite, etc. Frequently the jelly is forced through a piece of coarse canvas, which must be thoroughly clean. Sometimes the jelly is forced through a silver wire mesh by means of a plunger working in a cylinder.

For washing the emulsion a hair sieve will be handy, as described later, or a tea-pot may be utilized, as also mentioned later. Mr. Henderson, of London, provides the most satisfactory emulsion washer we have seen, but we have not space to describe or illustrate it here. An operation superior, in our estimation, to washing is that of "centrifugal separation," remarks on which we must also reserve.

CHAPTER IX.

GELATINE-BROMIDE EMULSION.

Part I.

To Make a Slow Gelatino-Chloro-Bromide Emulsion, suitable for subjects with which shortness of exposure is no object. The exposure for this emulsion will be about the same as that for an ordinary "wet-plate."

a. Gelatine—Nelson's No. 1...................... 60 grains

Soak in

Water... 6 ounces

for a few minutes. Add

Potassic bromide	275 grains
Potassic chloride	40 grains
Ten per cent. dilution of strong hydrochloric acid in water	25 minims
b. Silver nitrate	400 grains
Water	6 ounces

Remarks on the above, which will apply throughout our chapters on emulsion-making. *Potassic bromide* is frequently found alkaline. Such must at once be *rejected*. *Slight* acidity no harm. The same applies to *potassic chloride*. The amount of argentic chloride resulting from the above quantity of potassic chloride is very small, but the color of the image seems to be improved by the presence of the chloride. Hence we recommend this emulsion for lantern-slides (see Chapter XXX.)

Nelson's No. 1 gelatine is generally used for the emulsification on account of its purity, but it is not, on account of its softness, so well adapted for forming the bulk of the gelatine in the finished emulsion. (*vide* "*c.*")

The *water* may be good tap-water, but we prefer *distilled.* The *silver nitrate* is obtainable of the utmost purity at a proper price, and from a proper source.

The ingredients of *a* being all mixed, heat is applied till all are melted.

It is well now to prepare *c.*

c. "Hard" gelatine, as Heinrich's, or Nelson's "X Opaque" .... 600 grains
Water to cover it.

This gelatine should be previously washed once or twice in distilled water to which a drop or two of ammonia is added; but there is to be no ammonia in *c* when actually used.

Emulsification.—Put *a* into a large vessel, capable of holding at least five times the measure of *a.* Heat both *a* and *b* to 150 deg. Fahr., and take them into the dark-room, which, from this stage, must be "safely" lighted (see previous remarks.) Shake *a* vigorously in its bottle till it froths, and pour into it a *small* quantity of *b.* Shake vigorously, and go on, little by little, pouring *b* into *a*, shaking vigorously each time, till the whole of *b* is mixed into *a*, and *a* is in a complete state of froth. Rinse out *b* with a *small* quantity of water; pour into *a*, and shake for two or three minutes. *a* will now be a creamy emulsion of gelatine and silver chloro-bromide. A cover is now placed on the vessel containing *a* and *b* mixed, or, failing a cover, the emulsion is by other means kept warm for about an hour, being well stirred several times during that time. Then *c*, being melted by heat, gently applied, the emulsion is mixed with it, and the two thoroughly incorporated by stirring vigorously. The whole should be heated to about 140 deg. Fahr., and is then placed aside to cool and to "set." In very hot weather it may be reluctant to set, or it may refuse, in extreme cases of heat, to set at all. In this case cold or even iced-water may be required to make it set. The jar containing the now complete but unwashed emulsion, may be placed in iced-water till the emulsion sets into a stiff jelly.

Emulsification is conveniently performed sometimes in a manner suggested by Mr. T. S. Davis. The silver nitrate of *b* is added in the dry crystallized state to *a*, the water of *b* being added at first to *a*. In this case, the crystals of *b* are added all at once to *a*, and vigorous shaking goes on till the crystals are no longer heard clinking in the vessel containing *a*.

Washing is necessary, as we have hinted, to eliminate the bye-product of decomposition, which, in this case, is potassic nitrate; this salt, if left in the emulsion, would probably crystallize on the film; but luckily it is soluble in water, while our sensitive silver haloids are not soluble in water. We, therefore, only require to let water reach the soluble nitrate in order to dissolve it, but the *crux* is to ensure the water reaching the nitrate through the mass of repellant gelatine. Our plan is to break or cut up the emulsion jelly into very fine fragments or shreds, and to allow water to percolate for a considerable time through and among these fragments. There are several methods of breaking up the jelly. It may be removed from its jar with a silver spoon or spatula, or a clean ivory, bone, or ebonite paper-cutter, and placed on a piece of canvas with a large mesh. The canvas is then gathered up at the corners, so as to form a bag, the bottom of which is held under water, while the top is twisted up tighter and tighter, till the jelly oozes out into the water, in long, fine threads. We frankly own this operation is not to our taste. We prefer to cut the jelly into small cubes, place these in a cylinder of glass or vulcanite, having at its end a mesh of silver wire, into the other end fits nicely a plunger, which we force down upon the jelly, till the latter oozes out, as before, in long threads, into water kept (or naturally) cold. Either of these operations may, with advantage, be repeated later, to insure more complete washing.

The shreds of jelly may be received under water in a hair-sieve, which is lifted occasionally during the washing. The sieve may sit in an ordinary china basin. If the washing be performed with running water, and the sieve be occasionally lifted and the basin emptied, the washing should be complete in an hour. The threads may be received in an earthen teapot, a piece of muslin tied over the top, and water run in through the spout for an hour. For years we used the teapot for washing, and found it answer well. The water should not be of higher temperature than 65 deg. Fahr.; lower is preferable.

The threads, being washed, may be gathered into a muslin bag, and squeezed, to remove superfluous moisture. Or the bag, being of ample size, may be whirled round the operator's head energetically. In any case, not much water must remain, or there will be a danger of the finally-melted emulsion being too thin. Finally, add to the emulsion, in a jar, one and a half ounce of the following:

Alcohol	1 pint
Thymol	100 grains

The emulsion now only requires to be melted by heat, and filtered through swan's down calico, or some similar medium, when it is ready for coating plates.

A Rapid Gelatine Bromide Emulsion by the Boiling Process.—In this case much greater sensitiveness is obtained by boiling the emulsion in presence of only a small proportion of the gelatine used in the last process for emulsification. Gelatine is decomposed by boiling, and loses its power of setting, so that the less we can use during the boiling the better. Moreover, boiling in the presence of a chloride is apt to produce fog, and further, the color of the image, in a process used solely as this is, for the production of *negatives*, is of no moment. The addition of an iodide is found to give greater clearness to the plates prepared with the emulsion, so in this process we replace the chloride of last process by an iodide.

a.	Potassic bromide	320 grains
	Potassic iodide	20 grains
	Gelatine—Nelson's No. 1	60 grains
	Water	6 ounces

Mixed as before, and slightly acidified with hydrochloric acid as before.

b.	Silver nitrate	400 grains
	Water	6 ounces

As before.

c.	Gelatine—hard, as before	500 grains
	Water to cover it.	

Washed as before.

If *a* be alkaline, fog will supervene. If too acid, long boiling will be required to produce great sensitiveness.

Emulsify precisely as before, but after emulsification, instead of placing the emulsion aside to cool gradually, place the vessel containing it in a saucepan of hot water. If emulsification was conducted in a glass flask, the emulsion should at this stage be put into a "shut-over jar" (*vide supra*), and the jar, with its cover on, put into the saucepan, or other covered vessel of water; the water is then to be boiled for a certain time, the jar standing in it. It is impossible to say how long the emulsion is to be "cooked" in this way. The only way to tell when to stop boiling is by examining the color of the emulsion, spread out in a thin, watery film, on a piece of glass.

Immediately after emulsification the emulsion should be stirred with a slip of glass, and the glass examined by aid of a flame of gas, or an oil lamp. (Of course the emulsion in the jar must be kept covered if the examination take place in the dark-room). The emulsion will show a dark orange, or even ruby color at first, but as boiling progresses, the color will gradually become more blue, until, at last, it is distinctly blue. The emulsion at this stage has acquired fair sensitiveness. If we desire more than this, we may go on boiling as long again as was required first to obtain the blue tint. But when the boiling is continued long after the blue tint is reached, the dangers of the process come in, and extravagant boiling will result in granularity and utter fog. The microscopic test is also valuable as an aid to the color test. If the emulsion on the strip of glass used for stirring (which should be pretty frequent, at intervals of say ten minutes) be occasionally examined under the microscope, the same power being always used, it will be noticed that as boiling is continued, the "grain" of the emulsion becomes coarser and coarser, and practice will enable the worker to use the microscope as a valuable aid to the color test.

After the boiling is judged to be sufficient, the emulsion is cooled to 140 deg Fahr., added to *c*, and operations are the same as those given for the slow emulsion.

CHAPTER X.

GELATINE-BROMIDE EMULSION BY THE AMMONIO-NITRATE PROCESS, AND PRECIPITATION BY ALCOHOL.—CENTRIFUGAL SEPARATION.

In the process known as the ammonio-nitrate process, boiling of the emulsion is dispensed with, and in place of the boiling is substituted a system of keeping the emulsion at a medium temperature for a certain time, but in a condition of strong alkalinity. As a general rule, it may be stated that a high degree of sensitiveness is more easily obtained, and the results are more equal, by the ammonia than by the boiling process; while, on the other hand, the opinion is common, if not universal, that the general quality of a boiled emulsion is superior to that of an ammonia emulsion.

The defect most frequently attributed to emulsion made by the ammonio-nitrate process, is a propensity to "green fog," a disease not easy to describe, but easy to diagnose from the name when once it is seen. The formula we now give will, we venture to state, give an emulsion of the highest sensitiveness when required, and will none the less be free from fog, and will stand without fogging an unusual amount of "forcing" by alkali in development. The system, as will be seen, may be described as a compromise between the ammonio-nitrate process, where the silver is entirely "converted," and the boiling process, wherein the gelatine used in cooking is practically destroyed, and, so far as possible, rejected.

A.	Ammonium bromide	270 grains
	Potassic iodide	20 grains
	Gelatine—Nelson's No. 1	60 grains
	Water	10 ounces
B.	Silver nitrate crystals	250 grains

D.	Silver nitrate	150 grains
	Water	1½ ounce
C.	Gelatine—hard, as in last chapter..............	400 grains

C is "converted" into ammonio-nitrate thus: The silver nitrate being fully dissolved, strong liquor ammonia is added to the solution slowly, a little at a time at first, and latterly drop by drop. At the first additions of ammonia, a dark precipitate is formed, but as the additions go on the precipitate at last is re-dissolved and disappears. The vessel should be well shaken towards the end, or its contents well stirred; and in order that the progress may be seen, glass should be the material for the vessel. As soon as the precipitate is entirely re-dissolved the operation is complete.

D requires no remark further than that the proportion of gelatine finally allotted to an emulsion seems to make very little difference to its qualities. A *very* large quantity of gelatine slows an emulsion slightly, but allows of more "forcing" in development.

To Emulsify.—Raise *A* to a temperature varying from 100 to 160 deg. Fahr., according to the sensitiveness required in the final emulsion. The higher the temperature the more sensitive ought to be the emulsion. Even 180 deg. Fahr. is permissible, and will give an exceedingly sensitive emulsion, but there is a danger of fog, and, probably, the plates will require great care in working, even if actual and irremediable fog be avoided. A temperature of 100 deg. Fahr. at this stage will give quite a slow emulsion, probably; 160 deg. Fahr. will give a plate as rapid as most so-called "extra-rapid" plates in the market. To insure thorough solution and mixing of the ingredients of *A*, the temperature should be raised to 150 deg. Fahr., anyhow; and if 100 or 120 deg. Fahr. be the temperature desired for emulsification, the solution may be allowed to cool to the desired point. As it is evident that temperature is the crucial point in this operation; as, clearly, a small bulk of solution will cool more rapidly than a large bulk, and as regularity of result is desirable, a large quantity of water should be heated to the desired temperature in a covered saucepan—a gallon or two, but always the same quantity—and in this the jar containing A is to be immersed till A takes the desired temperature. B is now added, with shaking, to A, as in last chapter. Next, C is added, cold, little by little, with vigorous stirring after each addition. Of course, the emulsification must be done in the dark-room, and with special precautions as to light, for this emulsion is pretty sensitive, from its very formation. After the whole of C is added, the entire bulk must get a vigorous, or even violent, shaking, for two or three minutes, and is then covered and put in the covered saucepan for two hours. Beyond two hours it is dangerous to go, and after that time it is well to help the cooling, by placing the jar containing the emulsion in cold water. When the temperature has fallen to 70 deg. Fahr., the gelatine, D, is placed, dry, in the emulsion; or D may be washed, if it is a greasy or otherwise impure sample, with water containing a trace of ammonia; this washing should be done quickly, and the water squeezed entirely out of the gelatine before it is put into the emulsion. D having been allowed to soak for about half an hour in the emulsion, the heat is slowly raised to *not over* 110 deg. Fahr., preferably 100 deg. Fahr., when the whole of the gelatine ought to be in a liquid state. Stir well, cool quickly, and allow to set in a stiff jelly. This may be washed, as in last chapter, or may be precipitated for washing.

Precipitation by Alcohol.—Silver bromide is insoluble in alcohol as in water; gelatine is soluble in water but insoluble in alcohol. So, if an emulsion containing gelatine be poured into alcohol, the gelatine will form a clot, the water being removed from it, and along with the water will be removed a great proportion of whatever soluble salts it contains—as nitrates, in this instance. In the ordinary washing process, we have but little control over the quantity of water which will be absorbed by the gelatine, so that, under certain conditions, our final emulsion is too watery, and the following difficulty arises: If, during the "setting" of the gelatine on a coated plate, the silver bromide is allowed to sink through the gelatine down to near the glass or other "support," the quality of the plates must evidently be damaged; if the emulsion be very watery, this sinking will surely take place, and the coarser the "grains" of the silver haloid, the more surely and more rapidly will this detrimental settling take place. The danger and the damage increase in direct ratio with the sensitiveness of the emulsion, or the grain-size of the silver haloid. Again, when we are dealing with exceedingly sensitive emulsion, the drying of the plates is a process fraught with danger of fog, and the more prolonged the drying the greater the risk of fog. Moreover, as a very sensitive emulsion is more transparent than a less rapid one, a thicker coating of the former than of the latter is required to give a robust image. We need surely add no further arguments in favor of a *small* quantity of water in the finished emulsion; and by the washing process the quantity of water is a factor more or less beyond our power to regulate, while, by precipitation, it is reduced to the minimum. Some authorities advocate the precipitation method, because, by it the emulsion acquires a greater "covering power," in other words, because less emulsion is required for each plate; the claim is well founded, though we would warn our reader against stinting the quantity of emulsion allotted to each plate. The precipitation process is certainly commendable for very sensitive ammonio nitrate emulsions. The practice follows:

Take a jar fit to hold at least four times the quantity of emulsion to be treated; into this place ordinary commercial alcohol, in quantity two or three times as great as the quantity of emulsion. The quantity of alcohol varies according to (1) the quality of alcohol, *i. e.*, the quantity of water in it; (2) the temperature of the alcohol and of the emulsion. The higher these temperatures the more spirit required. Cool the alcohol to 40 deg. Fahr., and let the emulsion be as cool as possible, consistent with fluidity, and alcohol two and a half parts to emulsion one part ought to suffice for complete coagulation.

The spirit being placed in the larger vessel and the emulsion about 90 deg. Fahr., the latter is poured in a very fine stream into the former, stirring being kept up with a glass rod all the time. Clots will form, some sticking to the glass rod, some to the sides and bottom of the jar. When no further *coagulum* is formed, the whole clot is to be pressed hard into one lump, over which a few ounces of fresh alcohol should be poured. We have now a comparatively small, dense mass of gelatine-clot containing all the silver salts, while the large vessel contains nearly all of the water and of the bye-products. The clot still requires a careful washing. Tear it up with the fingers, or cut it with scissors into *very* small pieces, which are to be placed in water to be changed frequently during twenty-four hours, or the pieces may be washed in the sieve or teapot, as in last chapter. Light should be entirely excluded during all operations where it is not absolutely essential, and in any case the light used must be of the "safest."

When, after washing and "dripping," this emulsion comes to be melted up, it will be found to be much smaller in quantity and thicker in consistency than the batches made by our previous methods. It should, after solution by heat, and the addition of alcohol and thymol, as before, be made up with water to at least twelve ounces.

Separation by Centrifugal Force.—By this process, which, we admit, entails extra and rather expensive apparatus, not only is the messy and tedious, and, at the best, uncertain process of washing done away with, but all uncertainty and irregularity in the components, and consistency of the finished emulsion, are entirely eliminated. Decomposed gelatine, and its too frequent concomitant—fog—are practically banished, and in various respects the ultimate quality of the emulsion is reduced to a matter of weights and measures. The process is applicable to all qualities of emulsion, but unless the principles be understood, the practice is certain to be conducted wrongly, and inevitable trouble and possible failure will arise.

The emulsion, after "cooking," whether by the boiling or by the ammonio-nitrate process, is placed in a vessel which is caused to rotate at a very great speed on its own axis. By the law of centrifugal forces, given a liquid (as water) containing substances not in solution (as silver bromide, iodide, etc.), the liquid being caused to rotate rapidly in a vessel also rotating, the solids not in solution will fly outwards from the centre of rotation with force and velocity directly as their density. The larger the diameter of the rotating vessel—*i. e.*, the longer the radius of revolution—the less is the speed of rotation required to produce a given centrifugal force ; *vice versa*, the smaller the diameter of our vessel, the more quickly we must cause it to rotate to produce a given effect. The whole theory is exceedingly interesting, but we cannot follow it out here.

The machine used in Great Britain is figured here, and is made by Messrs. Watson, Laidlaw & Co., of Glasgow.* This figure shows the smallest size made. It was, indeed, specially designed for amateurs and experimentalists, and the "drum" is so constructed as to be used in daylight. Larger sizes are

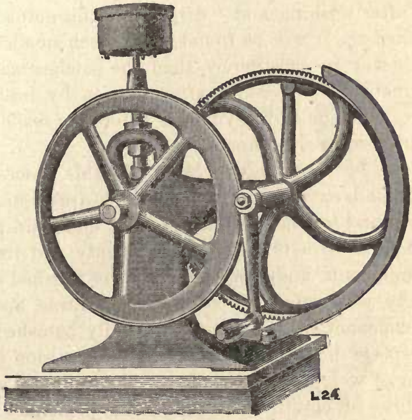

FIG. 18.

made open at the top, for use in the dark-room, and the larger sizes may be driven by steam. Into our small size ($4\frac{1}{2}$ inch "drum") we can only put 10 or 12 ounces of emulsion at a time, but into the larger open sizes emulsion can be poured in enormous quantities as separation proceeds, for the solids stick to the sides while the liquid keeps running out. The whole apparatus must be accurately made to insure steady running and high speed, and the "drum" is made of metal heavily

* The Eastman Company are now agents for these machines.

silver-plated. In our little machine the drum can be made to revolve about four thousand times per minute without undue muscular exertion, and, as a rule, three minutes at full speed suffices for our purpose.

It is evident that the denser our grains of silver haloid, and still more, the more completely our gelatine is decomposed and has lost its viscosity by cooking, the more completely will our solids (the silver salts) separate from the gelatine. So it is that the more sensitive our emulsion, by cooking, has been made, the more quickly and the more markedly is our separation accomplished.

We place our cooked emulsion in the "drum," which is the name given to the revolving vessel, the emulsion being at a temperature of not less than 100 deg. Fahr. We start the machine slowly till we have attained the highest convenient speed, and that speed we keep up for not more than three minutes, unless we are using a very slow emulsion. There should be at least four grains of gelatine in each ounce of emulsion actually in the drum. If there is a larger amount of gelatine, no harm will be done, only separation may be a little more protracted. Whatever gelatine is present, during separation, is practically entirely rejected afterwards, and we believe that decomposed gelatine is *entirely* rejected, which, indeed, is one of our strongest claims for the process.

There is not much fear of underdoing the separation, but there is much fear, and we believe a frequent habit, of overdoing it. We cannot account for, we can only state, the fact that over-separation leads to a thin, weak, and even foggy emulsion. Our separation must, therefore, be regulated by the sensitiveness (grain-size) of the emulsion, quantity of gelatine present, and temperature. The larger the grain, the less the proportion of gelatine, and the higher the temperature, the less violent or prolonged must be our separation. If we find we are getting into thin, weak, or foggy emulsions, we may either separate less, or add (say) twenty grains per ounce of gelatine before separation. It has been recommended in case of thinness, etc., to re-emulsify for a time with a small quantity of a soluble nitrate, but we deprecate any such plan. If our emulsion is thin, etc., we simply count it a failure, and try again, with greater precautions than before; either more gelatine or less separation.

The separation process must be stopped very gradually to prevent "scour" inside the drum; that is to say, to prevent the liquid, whirling round inside, from washing off the silver salts sticking to the sides of the drum. If the drum fits loosely on its spindle it will stop slowly of itself, if not the motion must be regulated down to a standstill with the handles.

Separation being complete, the drum is carried into the dark-room, and opened with an apparatus which accompanies each machine (for the lid will be very tightly jammed.

The liquid in the middle is carefully poured out into a beaker, where it may be preserved for examination. A little cold water is put into the drum, and gently carried round it, and lastly poured out. In the drum nothing remains but our silver haloids, bound together to the side of the drum by a trace of normal gelatine, and we know precisely what we have to deal with. If we are making a twelve ounce batch of emulsion, as last described, we take 400 grains of hard gelatine, as Nelson's X Opaque, soak it for a time in cold water, ten ounces, and with the soaked gelatine, a little at a time, we mop the drum out, till nothing is left on the sides. This must be carefully and thoroughly done; and when separation has been very complete, as with a very rapid emulsion, long separated, a piece of clean flannel may even be required to remove the solid substance from the sides of the drum. We do not, with our small drum, and a small batch of emulsion, such as described, like to find the solids sticking very tightly to the drum; this a sign of over-separation. Where large quantities of emulsion have been separated, and where the operation has been protracted, the stuff is always in close adherence to the drum, especially that next to the sides.

Our soaked gelatine is now covered with a mass of gray silver bromide and gelatine; alcohol is added, as before, and heat gently applied, during which the bromide and the gelatine must be most thoroughly incorporated by stirring, or even switching. We have now a batch of emulsion of which we know the ingredients to a fraction. Decomposed gelatine is entirely absent, and with it red fog and other plagues frequently accompanying washing processes.

A plate may be coated for test at once, but it is much better to let the emulsion cool and set at least once before use. Each subsequent melting of an emulsion increases its rapidity to an appreciable extent; too many meltings may fog it.

A word or two on the quality of gelatine used for the bulk of the emulsion. An acid gelatine is not adapted for giving the highest sensitiveness to the plates, and an alkaline soft gelatine is apt to frill or melt in hot weather. We try to steer clear of these defects by using either a "hard" aluminated gelatine washed in alkaline water, or a "soft" gelatine treated with chrome alum added with the alcohol at the last stage. But once the emulsion becomes dry, in presence of alum it cannot again be dissolved, so it is necessary to add the alum only to such quantity as can be used at once.

CHAPTER XI.

COATING PLATES WITH GELATINE BROMIDE EMULSION, DRYING ETC.

THE glass used for coating with gelatine emulsion must be quite clean, but need not be polished to such a degree as is required for wet collodion. But when we come to the operation of coating the plates, a considerable difference will be found between coating a half-dirty and a well-cleaned plate. Plates that have been used before should be bathed for some days in weak acid, one part of hydrochloric or nitric acid to twenty of water. If the film previously on the plate was gelatine, washing in hot water should follow. In any case the plates should be bathed for a few minutes in a hot solution of washing soda, and then well washed under a tap. Next, a creamy mixture of whiting and water is made, rubbed with a clean pad of cloth or flannel all over the plate, and set aside till the whiting is dry and easily dusted off. It should be dusted off, special attention being given to the edges of the plate, and the plate finally polished with a clean, dry cloth. The plates are then racked or laid in a pile till required. If the plates be rinsed over with a weak solution (one per cent.) of chrome alum carefully filtered, frilling will be obviated in the hottest weather (Henderson.)

Coating.—The emulsion is to be melted by heat, but at the time of coating the temperature should not exceed 110 deg., or 120 deg. Fahr. at the very highest. So long as the emulsion will flow readily and not set on the plate with inconvenient haste, it can hardly be too cool. If the weather is very cold the plates may have the "chill off," but anything like heating them is a source of danger. What we have to avoid is the setting taking too long, and, consequently, the silver bromide sinking through the gelatine to or towards the glass plate. The bromide should be, so far as possible, kept in the upper stratum of the film.

The "setting-table," with its slab of marble, glass, or slate, being arranged dead level, and being within reach of the operator's hand, while he stands at the coating table; the emulsion jar being placed in a considerable quantity of water of the proper temperature, and the light being arranged so that the operator may easily examine the film, all is in readiness for a start. The emulsion, if not previously filtered, must be filtered now, and this may be done in several ways. Perhaps the simplest way is to use, for coating, an earthen, ware tea-pot, having in place of a lid a bag of swan's-down calico, supported by either a wire hoop or an elastic band around the top of the pot, and the bag dipping down to the very bottom of the tea-pot. The tea-pot is placed in the hot water, and all the emulsion is poured into it through the bag before it is poured upon the plates, or the emulsion may be filtered through swan's-down calico into an open-mouthed jar in the hot water, and a silver ladle used to pour the emulsion upon the plate. As a novice is sure to be at a loss how much emulsion to put on each plate, we recommend a silver ladle with a "lip" and a wooden handle—an ancient "toddy ladle" is the article we mean—or a ladle may be made on the old pattern so as to hold a given quantity. Our ladle for plates 10x8 holds just an ounce, for 7x5 or 8x5 just half an ounce. It is impossible to regulate the quantity exactly, as "a little" is usually run off the plate in some cases, and much depends on the quality of the emulsion and the purpose for which the plates are intended. The emulsion must be much thicker on the plate than would appear, to a beginner, necessary; thinly coated plates have of late promised fair to damage the reputation of all concerned.

If the plates are well cleaned, and the emulsion in good order, the coating should be possible almost as with collodion; but if the emulsion has any tendency not to run evenly over the plate, the finger in one case, or the bottom of the ladle in the other, may be used to guide it over the plate. The spout of the teapot or the lip of the ladle are to be brought close to the plate; the emulsion must not be poured from a height, else bubbles will form. The emulsion is to be poured nearer the centre of the plate than when collodion is used, but still not right in the centre. If too much emulsion is on the plate, the excess is to be rejected by a quick and short "tipping" of the plate over a clean and separate jar, placed in the hot water; nothing like "draining" is permissible, as the film would be too thin. The plate may be held in the fingers, but a pneumatic holder (Fig. 13) is superior to the hand. The operator must not mind if a little emulsion flows over the edge, he should have a large flat dish below his hand, to catch any such overflow. We do not know at what rate plates *can* be coated by hand, but we usually expect to coat two 10 x 8 plates per minute.

To test whether each plate has a sufficient quantity of emulsion, we examine the plate, after it has set, by a gas or lamp flame, behind clear ruby glass. If we can see the shape of the flame, the plate is too thinly coated for negative purposes at least.

The plate is laid on the level cooling slab, as quickly as possible, after an even film has been obtained on the plate in the hand. The sooner the plate sets after this the better. Three minutes should suffice for the setting; if five minutes are required, ice must be used to cool the slab. As a rule, except in the very warmest weather, our plates are set at the end of two minutes, and sometimes very much sooner. To ascertain whether the gelatine is set, or not, a corner of the plate may be touched with the finger, but in no case must a plate be lifted before it is set; a plate raised from the level when just setting, or partly set, is a plate ruined.

As soon as the setting is certainly complete, the plates are dried in a drying-box, press, or room, as already described.

Drying should not take less than five or six, nor more than eighteen or twenty hours. Twelve hours will be found a suitable time. When once the plates are in the drying receptacle and shut in, the door must not be opened for many hours—not until the plates are expected to be dry—nor should there be any, even temporary, change or check of the draught, as these things will surely lead to "drying-marks," which are beyond cure, and very unsightly wherever they appear. If plates take longer than thirty-five to forty hours to dry, drying marks may be looked upon as almost inevitable. Heat may be used to provoke a current of air, but heated air should not reach the plates, still less, as we said before, any burnt air.

Packing Plates.—When the plates are *perfectly* dry they may be placed in plate-boxes or packed in boxes of cardboard. The plates should be packed face to face, and between each pair of faces should be put a piece of *pure* tissue-paper the full size of the plate, kept for some days beforehand in the dark, and absolutely dry. It is no use to pack carefully away blemished plates, which would only lead to disappointment at critical junctures. The plates, as they leave the drying-box, should be examined, the good ones packed carefully for special work, the blemished ones placed aside for experimental work, of which too much cannot be done.

CHAPTER XII.

THE CAMERA IN THE FIELD.

To do full justice to this heading a long book, instead of a short chapter in a little book, would be required. We must, however, exercise our ingenuity, and try in a brief chapter to give such hints as may enable any intelligent reader to make a public appearance with his camera, and without "shame and confusion of face." As indoor photography at the best presents certain difficulties of technique not likely to be overcome without some practice, we propose to assume that the first set of photographic operations by the tyro will be conducted out-of-doors. In most cases a friend is the victim first immolated on the altar of photographic ambition; but let us warn our gentle reader that there is no surer way to jeopardize friendship, or to bring contempt on ourselves, than to try our prentice photographic hand on a human subject. The best subject, if we could only persuade our reader to take our advice, is something in the nature of a bust or a carved object of some sort, placed in a well-lighted situation out-of-doors.

But, to save space, let us suppose our first attempt to be made on a landscape: a foreground, let us say, of bushes, a house or a pool of water in the mid-distance, and, about one hundred yards away, a clump of trees. The sun must be neither straight behind nor right in front of us, but slightly behind the camera on one side or the other. We shall suppose that a dry plate is to be used, in which case we have with us a dark-slide containing a plate, which slide we always keep carefully shielded from strong light in a case of some sort. American cloth does well for the cases, and a number may be painted on the glazed outside of the cloth, so that we know what slides we are going to use.

First, we set up our tripod, the leg-points on solid ground, not on stones, or bits of wood, which may move away and overset the camera; the triangle, or tripod head, nearly level. We fix our camera to the tripod head in the usual way, screw home our lens, tie or button upon the camera the "black-cloth." One leg of the tripod stand is to point to the view, the other two to stretch to right and left of the operator, the ground-glass about the height of the operator's mouth. With our head under the cloth, we now look at the image on the ground-glass; ten to one it is not arranged anything like as we require it. The first thing to do, if not already done in opening the camera, is to get roughly the focus, which is done with the rack and pinion of the camera. The first step toward arranging the view as we wish it on the ground-glass, is to take the two legs to right and left of us, one in each hand, leaving the front leg firm in the ground, and regulating the height, aspect, and level of the camera, by the two legs in our hands. The ludicrous public exhibitions, such as are too often seen, will be entirely obviated by this system of grasping two legs, and using the front one as a pivot. Having, after this manœuvre, planted the camera firmly once more with the view approximately on the ground-glass as desired, any further slight alterations may be made by slightly shifting one leg at a time. By means such as these the camera should be got as nearly level as the eye can judge. The camera may be twisted on its screw from side to side, so that the worker may study the composition of the picture at various angles. A beginner is sure to be greatly puzzled by two things: 1st. The fact that the view is seen upside down on the ground-glass. 2d. The unexpectedly lovely coloring. To both of these he will become habituated by practice. The color is a matter of very great import, however, and is apt to puzzle the most experienced; for the very colors that look so charmingly bright on the ground-glass, are the very ones that ordinary photography renders as shadows, viz: yellows, reds, and greens.

Perhaps, even yet, the arrangement of view on the focusing screen is not to our mind. We have several "motions" yet in reserve. The front of the camera may be raised to cut off foreground, or get into the picture the top of the house or of the tree. Tilting the camera is only recommended as a last resource, raising the front must be tried first. Having got the view as nearly to our taste on the ground-glass as possible, we insert a medium-sized "diaphragm" or "stop" in the lens, and focus carefully with a Ramdsen, or other eye-piece, or with the naked eye. If the insertion of the stop shuts out too much light, and makes the view appear too dark, remove the stop, or substitute a larger. In focusing, attention should be chiefly directed to the chief object, or "motif" of the picture, and that, as a general rule, should be neither in the centre, nor near one side. Possibly it will be found impracticable to get foreground and distance in decent focus at one time, this will be, to a great extent, cured when a small stop is inserted, and after a little practice the swing-back may be used to meet this difficulty, but we deprecate the use of the swing-back by a beginner. Many workers focus on the foreground, paying no attention to the distance whatever, but trusting to stops to put all right.

The focus being adjusted, we have next to determine what stop to use in the lens. Practically the issue lies between three stops $\frac{f}{16}$, $\frac{f}{22}$, and $\frac{f}{32}$. A larger stop than $\frac{f}{16}$ is seldom used for landscape, and a smaller than $\frac{f}{32}$ is seldom needed. Of course, the smaller the stop, the sharper the focus, and the longer the exposure. In Chapter III. we pointed this out, but we repeat that $\frac{f}{22}$ requires twice the exposure of $\frac{f}{16}$, and $\frac{f}{32}$ twice the exposure of $\frac{f}{22}$. (We omit decimals). If there is anything moving, or likely to move, in our view, we must use the largest stop that will give reasonable definition; while the larger the distance through which our view spreads, from front to back, the smaller the stop required to insure reasonable sharpness.

We most earnestly urge not only the beginner but the more practised hand not to muddle among too many stops. Practically we use but two stops, $\frac{f}{16}$ when we must expose quickly, $\frac{f}{32}$ when there is no hurry. In a few cases, as in a very dark glen, where the exposure with $\frac{f}{32}$ would be very considerable, we sometimes use $\frac{f}{22}$, but this is very rare in landscape work. The photographer has quite enough of varying circumstances *beyond* his control without varying operations within his command.

If the subject includes parallel vertical or horizontal lines, as in architecture, some further considerations require notice, and the following remarks apply particularly to cases where the architecture either fills a large portion of the plate or falls near the edge of the picture. In such a case the first necessity is that the camera shall be dead level. But, possibly, the whole of the building will now not "come into" the plate. The first expedient is to go as far away from the building as possible. Failing that, if the top of the building will not come into the field, the front of the camera must be raised as far as it will go without letting light into the camera. Failing that, the vertical position of the plate may be tried, by reversing the back or turning the camera on its side. If this is not satisfactory, the camera must be tilted upwards, always supposing we have only one lens. A shorter focus lens might, of course, remove the difficulty; but tilting the camera upwards will at once cause the straight lines of the building to be "distorted," and in that case we *must* use the swing-back. The lower part of the swing-back must be drawn out, or the upper part pushed forward, till the ground-glass hangs vertical—parallel, that is, with the lines of the building—and in this case a very small stop is required, for reasons into which we cannot enter here.

The Swing-back is very frequently totally misunderstood and shamefully abused, the reason being that photographers do not know, or at least fail to realize, that the swing-back has two uses totally distinct from each other. The uses of the swing-back are: (1st) that suggested a few lines higher, viz., to prevent distortion when the camera is tilted, and (2d), to aid in getting into simultaneous focus a near object and a distant one. On (1) we have said all that seems necessary; on (2) a few words may not be wasted. The focus for an object close to the lens is, as everybody must have observed, further back or further from the lens than the focus for an object at a considerable distance away; so that with the ground-glass hanging vertical when a distant object is in focus the image of a near object is in front of the focus and blurred. If we focus on the middle distance, or on an object (say) fifty times the focus of the lens distant from the camera, both the distance and the foreground are out of focus, the distance on the ground-glass being behind the best focus and the foreground in front of its best focus. Plainly, therefore, if our swing-back works on its centre, as every swing-back ought to do, and if we pull the top of the swing-back backwards, we shall also push the bottom of it forward, so that the middle distance will *remain* in focus and the foreground and far distance will each find its proper focus. With a central-swing this is plain enough, but with a swing-back working from the top on a pivot at the foot, we are very apt to make the general focus far worse than it was. With such a swing-back, which is usually a swinging of the whole back of the camera, we must either focus on the distance, and then pull back the upper part till the foreground is focused, or we must pull the top towards us first, and try to focus thereafter, a very awkward and uncertain proceeding at the best. The first use of the swing-back—to prevent distortion—necessitates the use of a small stop; the second use, to a great extent, obviates the necessity for a stop, or, at any rate, permits of the use of a larger stop. In all cases the focus should be examined after the use of the swing-back.

We shall leave consideration of what would naturally follow here, viz., exposure, until we have touched briefly on a few other circumstances frequently met with in the field.

It is well to have as few detached articles as possible when going into the field. The tripod screw should either be let into the head, so as not to come out unless purposely removed, or it should be tied to some part of the stand. The stops should not only be tied to the lens (if Waterhouse stops are not fixed in the lens tube), but they should be riveted together in such a way as to allow the one required to be turned aside from the others when it is used. The lens cap may be tied to the lens by raising a small portion of the velvet lining the cap, boring a hole through the leather, passing a bit of catgut through the hole, knotting the end inside the cap, and then replacing the velvet with glue over the knot.

It is, of course, necessary to avoid exposing the same plate twice. Various devices are used to render this mishap impossible. In America a shutter is used for the dark slide, having on one side the word "exposed," in large letters; after exposure this shutter is replaced with the legend outwards. A device is used in England whereby the shutter, once drawn and closed, cannot be again drawn without set purpose and special operations. A beginner during a big day's work is pretty certain to "double expose" a plate now and again, nothing but care and deliberation can prevent it, unless some mechanical device, such as suggested above, is used. When a roll-holder is in use, one very often forgets at the critical moment whether the paper has been rolled off since last exposure, and very painful doubt harasses the worker. We recommend that the rolling be performed immediately after each exposure is made. This is the time when the mental strain is over, and often there is a hurry when the next exposure draws near. Dust has no business to get into a roll-holder, and if it does get in it will do as much damage to an exposed as to an unexposed surface of film.

Everyone should carry a note-book, and note in it every exposure made. Books ruled for the purpose with suitable columns are to be had, but probably an unruled book is quite as good, for frequently the ruled columns do not allow of enough space being filled in special cases. Under the head of "remarks" we include a description of the nature and chief characteristics of the view, the points we wish to bring out, the nature of negative required; and with such details we sometimes fill half a page of any ordinary pocket-book.

To test a camera for "light-tightness" put a lens in its place, a stop in, and the cap on. Place an ample black cloth over the back of the camera as near the ground-glass as possible. Place the dark cloth over the head and draw it tightly around the neck so as to prevent any light entering the camera from behind the operator. The ground-glass being turned away or removed, take the camera up in the hands, gaze earnestly for at least a minute into the interior of the camera in a blaze of sunlight, or (even better) near a strong gas or lamp flame. Holding the camera in the hands and the face close to the open camera back, turn the camera in every direction, up and down, to the right and left, over on one side, then on the other, always close to the light, if artificial. Any small hole will soon be detected. We have repeatedly found new cameras defective in this matter. The stop-slit of most lenses lets in light; this is a piece of gross carelessness on the part of the makers, and must be remedied by a broad rubber band with a short slit made lengthwise to take the finger-piece of the stop.

The advantages of sliding legs for the tripod are found out not only when working on very uneven ground, but in certain other cases where the camera ought to be very low. Where there is a large exposure of foreground objectionable or uninteresting, as the bed of a river or the water of a lake; or where we wish to emphasize height, as of waves or mountains, the camera can hardly be put too low. For such views it is frequently advisable to place the camera so near to the ground that we require to sit or even lie down in order to focus.

Photography of interiors presents so many exceptional phases that it may almost be called a separate process. As a rule, the camera requires to be mounted to a considerable height for this work, and here again sliding legs are useful. Frequently the floors of edifices are slippery, and the sharp metal "shoes" of the tripod will not grip to floor. The sloping-marble roof of Milan Cathedral was the most slippery place with which we have ever dealt; we overcame the trouble by placing under our tripod feet thick discs of leather wetted previously. Corks, into which the sharp points of the legs are stuck, frequently answer the purpose.

For cases of exceptional difficulty, as for instantaneous "shots" from and at moving objects, there are so many devices to be found in the market that it would be hopeless for us to attempt to describe them. We refer to Detective cameras, and a host of "view-meters" and "finders," many of them sufficiently ingenious to catch the dollars of the amateur, if not the images of the moving objects they are intended to catch. Of "finders," some are practically useful, we may mention one, called in America, the "Waterbury," and in England the "Argus," which fairly answers its purpose.

For "focusing and finding" simultaneously, no device that we know is of any value, except such as amounts practically to a second camera, furnished with a second lens of the same focal length as the lens in the camera proper. True, the secondary, or "finding and focusing," camera is generally smaller than the working camera; an example of this is found in the small telescope suggested by Mr. J. Traill Taylor. This telescopes fits along the top or side of the camera, and opens out as the camera opens; and the lens of the telescope is of the same focal length as the camera lens but of much simpler and cheaper construction.

Another suggestion made lately is to erect on the front of the camera over the lens another lens of equal focus, to turn the ground-glass of the camera up so that it may stand vertically over its usual position. The "finding" lens will cast an image on the erect ground-glass, which image will be visible under the black cloth, if not without it. When these "finders and focusers" are being used, the shutter of the dark slide is, of course, open, and the instantaneous shutter set for work; so that when in the "finding" arrangement the object is seen in the desired position and focus, the exposure is made with the instantaneous shutter in the usual way.

CHAPTER XIII.

EXPOSURE AND DEVELOPMENT GENERALLY TREATED.

At the end of this book will be found a table compiled for the purpose of assisting the beginner to form an approximate idea as to how long he should expose a plate under various circumstances; but it must be clearly understood that this table is intended merely approximately correct, and by no means to be taken as infallible, or as a crutch, to be depended upon by the worker of experience. Nothing but practice can ever teach the proper exposure, and if our table should cause any reader to use it, or any other "table of exposures," as other than aid to the tyro, we should regret having given it. The table, however, obviates the necessity of our giving further special hints for any cases coming under such heads as will be found in the table. The old rule is to-day just as good as the day it was first enunciated—"Take care of the shadows, and the lights will take care of themselves."

A "good technical negative" is a very elastic phrase; still it is a useful one. Our negative must first be such as will give a "good print." A good print is one that will justly represent the aspect we wish to portray. Whatever else a negative may be, it must be clean, and must be within certain undefinable limits of density and thinness. All the details visible on the subject must certainly be present in the print, and "clear glass" ought to have no place on a negative, whatever others may say.

Luckily for the artistic side of photography, it is not the case that there is only one exposure and only one development which will give a perfect negative. A brilliant negative may be quite as perfect as a tender or soft one; and if we are to claim any art for photography, we must be able to produce at will a good negative of any desired kind, brilliant or soft, "plucky," or "harmonious."

Exposure and development hang together. One is useless without the other; one may nullify the other; one may emphasize the other; we may produce many different aspects of a view by various negatives—all *good* negatives.

Our next remarks will be devoted to showing how various aspects or qualities may be produced on various negatives—all good—by various treatments, all equally scientific.

There is a minimum exposure, the least that will permit of the production of a good technical negative. There is a maximum exposure, the greatest that can, without abnormal development, be given without ruin to the technique of the negative; and there is a normal exposure midway between the two, what scientifically may be called "the correct exposure," though, artistically speaking, there are many correct exposures. Taking the normal exposure as our standard of comparison, we say:

1. Long exposure leads to softness, harmony, effeminacy.
2. Short exposure gives brilliance, vigor, hardness.

Now, turning to development, we define normal as that which will, with a scientifically correct exposure, give a scientifically perfect negative. Again we take "normal" as our standard of comparison, and we say, *cæteris paribus:*

Strong or short development gives softness, harmony, effeminacy.

Weak or long development gives contrast, vigor, hardness.

(There are, we admit, marked exceptions to these statements.)

Super-normal pyro in development gives contrast, hardness.

Super-normal alkali in development gives detail, harmony.

Super-normal restrainer in development gives hardness, want of detail.

(See chapter on development of gelatine bromide plates, to which these remarks are intended to apply.)

These statements are all to be taken as general.

By attending to the above suggestions the reader may acquire a certain amount of control over the quality of his negatives; he may learn not only how to produce certain effects, but how to avoid certain dangers. If on his subject he find violent contrasts beyond what he wishes to portray, as is often the case in snow scenes and dark wooded glens, he will get a hint not to under-expose nor to use a supernormal quantity of restrainer. If he has a wide, monotonous expanse of landscape, he will be warned not to over-expose nor to over-dose his development with alkali.

Where a subject contains masses of shadows and masses of high lights in over-violent contrast, and where there is fear of the lights being seriously over-exposed while the shadows are being, according to the old rule, "looked after," the cap of the lens, or a "flap shutter," may, with great advantage and a little practice, be used to shade the light parts while the shadows are being exposed.

CHAPTER XIV.

DEVELOPMENT OF GELATINE BROMIDE PLATES.

Alkaline Pyrogallol Developer.—In this developer the pyrogallol, pyrogallic acid, or "pyro," is used on account of its power of absorbing the oxygen of the water with which it is dissolved, and thus leaving the hydrogen free to combine with part of the haloid silver salts in the film. Hydrochinon, another substance similarly used, acts on the same lines. The alkali, always required with the pyro developer, acts as, and is called, the "accelerator" of the action of the pyro. The "restrainer," consisting usually of a soluble bromide, is used to prevent too great rapidity of action, and to obviate the danger of development or fog in unexposed parts of the plate. The action of soluble bromides as restrainers is a matter very imperfectly understood, and as we have nothing to do with theories here, we confine ourselves to saying that the soluble free bromide acts much more forcibly as a restraint upon the portions not acted upon by light than upon those portions of the film which have received light action. The larger the dose of free soluble bromide the larger may be the proportion of the alkali without danger of fog.

As accelerators, any of the alkalis might be used but for certain inconveniences not directly connected with the process of development. There are but four alkalis commonly used: Ammonia, sodic carbonate, potassic carbonate, and ammonic carbonate. To these we might add hydroxylamine.

Ammonia.—Aqueous solution of ammonical gas. This, used as an accelerator, has the advantage of great vigor, and we claim that with it, *under suitable circumstances*, a negative may be produced, perhaps a shade superior to the best that can be got with any other alkali. But, unfortunately, many plates now on our markets, especially those produced by the ammonio-nitrate emulsion process, have a strong tendency to green fog when treated with the ammonio-pyro developer. And the ammonia solution being very volatile, it is next to impossible to calculate the precise amount of ammonia present in any quantity of the "liquor ammoniæ fort.," sold as such, and stated to have the specific gravity ·880. As a matter of fact, liquor ammoniæ of so low specific gravity as ·880 is extremely scarce, and, even if procured, would very soon lose much of its gas if the bottle were opened a few times. At specific gravity ·880 the solution contains only 40 per cent. of ammonia. Consulting the table of Carius (given at the end of this book), we find that at a specific gravity of ·92 the liquid contains 20 per cent. of gas; so that if we wish to measure very accurately the quantity of real ammonia we are to use, the best plan is to dilute whatever ammonia liquor we have till our specific gravity test shows ·92, and then to use double the quantity we shall give throughout our formulæ, which are based approximately on "·880 liquor ammoniæ."

Sodic and Potassic Carbonates are not volatile, and not prone to produce green fog in use; however, they give off carbonic acid, itself a restrainer, so that with these carbonates, and also with ammonic carbonate, we use less soluble bromide or none at all. The sodic carbonate gives density *par excellence*, the potassic salt, perhaps, gives a little extra detail. Carbonate of ammonia (ammonic carbonate) is remarkable for its power of giving density, but it acts very slowly, and, both as a solid and in solution, it is unstable. Nevertheless, it deserves more attention as an alkali for development than it receives, as a rule.

Increase of pyro, up to a certain limit, produces increased density; increase of accelerator increases detail and also density, provided that the line where fog begins is not passed. Increase of restrainer protracts the time required for development, is apt to produce thinness, and to prevent detail from appearing if the plate is the least under-exposed.

We are often astonished, and always puzzled, by the ridiculously intricate formulæ sent out by plate makers as instructions for working their plates to the best advantage. We seldom dream of making up stock solutions in the terms of these empiric formulæ, but we always endeavor to analyze the formulæ so as to find out, as nearly as may be, without a long string of "repeating decimals," how much of each reagent each formula contains. From this calculation, generally troublesome, we gather what are the qualities we may expect from the plates in question.*

There is no virtue beyond that of convenience in ten-per-cent. solutions, but ten-per-cent. solutions will be found to answer all purposes. We shall state the method of making such solutions for alkaline developers, and thereafter we shall give formulæ only in terms of the reagents actually employed.

Pyro Solution, "10 *per cent.*"—If we took an avoirdupois ounce of pyro, dissolved it in water, and made the bulk up to nine fluid ounces, we should have approximately a 10 per cent. solution, and every ten minims would contain one grain of pyro. But pyro dissolved in this way would oxidize, and in a very short time become useless. Two drams of citric acid added would improve the keeping qualities, but we give two methods far superior, the first due to the ingenuity of Mr. H. B. Berkeley, the second a modification, by ourselves, of a formula first promulgated by Messrs. Mawson & Swan, of Newcastle, England:

SULPHO-PYROGALLOL (BERKELEY.)

Take

No. 1.	Sodic sulphite, best obtainable...	4 ounces avoirdupois
	Water, hot................	about 6 ounces

dissolve; add citric or sulphurous acid till the reaction is distinctly acid. Add to one commercial ounce of pyro, dissolve, filter, make up with water to nine ounces. Label: "Pyro. 10 per cent. 10 minims = 1 grain pyro."

Take

No. 2.	Potassic bisulphite........................	½ ounce
	Water..............................	about 5 ounces

dissolve, pour into an ounce of pyro, make up to nine ounces,

* See the table compiled by Messrs. Clarke and Ferrero.

filter. Label: "Pyro. 10 per cent. 10 minims = 1 grain."

(Messrs. Mawson & Swan formulate "Meta-bisulphite of Potash." We know nothing about this salt, which is not listed by any manufacturer we know, except the above firm; we have used the meta-bisulphite, and also ordinary bisulphite, and can distinguish no difference in the result.)

BROMIDE SOLUTION. 10 PER CENT.

Take

Potassic or ammonic bromide...........1 ounce avoirdupois
Water...........................about 7 ounces

dissolve, make up to nine ounces. Label: "Bromide. 10 per cent. 10 minims = 1 grain."

AMMONIA SOLUTION. 10 PER CENT.

Take

Liq. ammonia, .880.........................1 fluid ounce
Water....................................9 fluid ounces

Label: "Ammonia. 10 per cent. 10 minims = 1 minim liq. ammonia, .880."

Make, in the same manner as the bromide solution, 10 per cent. solutions of sodic and potassic carb., or proceed as follows, for a solution which can be recommended:

Take

Sodic carb. crystals not "anhydrous"..½ ounce avoirdupois
Potassic carb.........................½ ounce avoirdupois

dissolve in water, and make up to nine ounces. Label: "Carbonates. 10 per cent. 10 minims = ½ grain sod. and ½ grain pot. carb."

A normal developer may be thus:

1. Pyro.. 2 grains
Ammonia.. 2 minims
Bromide... 1 grain
Water to.. 1 ounce

Or,

2. Pyro.. 3 grains
Sodic carbonate.................................12 grains
Water to.. 1 ounce

Or,

3.	Pyro	4 grains
	Potassic carbonate	20 grains
	Water to	1 ounce

Or,

4.	Pyro	4 grains
	Potassic and sodic carbonates	16 grains
	Water to	1 ounce

To each of the developers (2, 3, and 4) may be added, if there is the least fear of over-exposure, one-half grain of bromide, but it must be remembered that with the carbonate developers the restraining action of bromide appears disproportionately vigorous.

These are by no means the limits in either direction of our use of the accelerators, nor are we restricted to any particular time for duration of development. The carbonate developers in particular will go on acting for a very long time, but, as a rule, the action of the ammonia developer is sooner exhausted, and a little more ammonia may be added, the quantity varying with the requirements of the case and the capability of the plate for tolerating ammonia. If bromide be also added, a very considerable quantity of ammonia is permissible. It may be said that the above developers ought to fully develop a plate properly exposed in three minutes, but in the case of of ammonia a perfect negative may result even if we require to add another minim or two of ammonia to each ounce of developer.

Soluble bromide, as we have said, has a strong tendency to prevent density, and where, on this or any other account, the use of a large quantity of soluble bromide is contra-indicated, use may be made of citrates, as first pointed out by, we believe, Mr. G. W. Webster. The citrates may be made up in 10 per cent. solutions, thus:

Sodic or potassic citrate................1 ounce, avoirdupois

Dissolve in

Water and make up to..............9 ounces

As there is some doubt as to which citrate is the better, we use both:

Sodic citrate........................	½ ounce, avoirdupois
Potassic citrate......................	½ ounce, avoirdupois
Water to.........................9 ounces	

For cases of very great over-exposure, four grains of citrate may be used for each minim of ammonia in the developer, but, as a rule, two grains will be found sufficient. The citrate, combining with the ammonia to form ammonic citrate, allows density to increase, but prevents the appearance of further details.

For cases of over-exposure we decrease the alkali, increase the bromide and the pyro. With the carbonates the addition of water frequently has the desired effect. For gross over-exposure, whether known before development, or discovered after development is started (see below), the citrates may be used with ammonia.

Under-exposure, if it can be met at all, will be met by reducing the pyro and bromide, and increasing the alkali and the water where there is fear of over-density.

Subjects presenting violent contrasts of light and shade, as interiors, dark glens, etc., will be developed into the best negatives, if the exposure has been full, by considerably reducing the pyro and bromide, increasing the alkali, as far as is safe, and developing lightly, that is, not carrying the developing action so far as for a normal subject.

Subjects monotonous, or devoid of contrast, may be treated with an extra dose of pyro and bromide, just enough alkali to secure detail, and a development carried to a super-normal degree.

The variations that can be made in alkaline pyrogallic development are simply innumerable; in fact, its "elasticity" is its strong point of advantage over the "ferrous oxalate." (See lower.) The ferrous oxalate has a certain amount of range also, but in this matter it is distinctly inferior to the alkaline process.

When the worker is undecided as to whether his exposure has been approximately correct or not, the simple and evident plan is to develop slowly at first till the quality of the image slowly growing can be examined. For this purpose the normal developer may be made up, but with only one half of the alkali, the other half being kept apart till the image either refuses to appear, or appears over-exposed, as will presently be explained. Or two complete but totally different solutions may be prepared, one strong in restraining, the other in accelerating, reagents. Thus, No. 1 may contain: pyro, 4 grains; bromide, 3 grains; ammonia, 2 minims to each ounce; and No. 2 may contain: pyro, 1 grain; bromide, 1 grain; ammonia, 4 minims. The plate is treated with No. 1 first; if no image appear, and if it is not hopelessly under-exposed, No. 2 will probably put it right, if it is over-exposed No. 1 will probably save it, if anything can, or citrate may be added when the details are all visible; or if in No. 2 details begin to appear too quickly, we can put the plate back into No. 1 till density is gained.

As plate after plate is sometimes, for economy's sake, developed in the same solution, we must point out that in such cases not only is the pyro oxidized, and rendered inert, but fresh bromide is formed, and also the ammonia decreased by the action between the liberated bromine and the ammonia, ammonia bromide being, in fact, formed, or sodic, or potassic bromide, as the case may be.

The Hydrochinon Developer was introduced some years ago, by Captain Abney, but for some time fell into disuse; it appears to be once more attracting notice. The substance, hydrochinon, does not keep well (Eder), and in our experience does not, as a developer, work well with ammonia. But with a carbonate it will, when fresh, be found to give fine results. We give the formula of the discoverer, and in a later chapter will be found another method of using it for another purpose.

1.	Hydrochinon	10 grains
	Water	10 ounces

2. Carbonate of potash, a saturated solution, in water.

To each ounce of No. 1 is added 1 dram of No. 2, and about 10 drops of 10 grains to the ounce solution of chloride of sodium (common salt.)

Possibly some workers may prefer to keep their carbonates and citrates in more concentrated solutions than the 10 per cent. we have suggested. To make a 30 per cent. solution of carbonates, for instance:

Take

Sodic carb	$1\frac{1}{2}$ ounce avoirdupois
Potassic carb	$1\frac{1}{2}$ ounce avoirdupois
Water to	9 ounces.

Label: "Carb. Solution, 30 per cent.—10 minims = 3 grains carbs."

By way of example of the use of these 10 per cent. and 30 per cent. solutions, let us suppose we wish to make two normal developers as above in quantities of 3 ounces each.

For our so-called Normal Ammonia Developer, No. 1 (page 87) take:

10 per cent. pyro	60 minims
10 per cent. ammonia	60 minims
10 per cent. bromide	30 minims
Water to	3 ounces

For a normal, such as No. 4 (page 88):

	10 per cent. pyro	120 minims (= 2 drams)
	10 per cent. carbs	480 minims (= 1 ounce)
or:	30 per cent. carbs	160 minims (= 2 drams 40 minims)
	Water to	3 ounces

If to the former we wish to add 1 drop of ammonia per ounce of developer, then add

10 per cent. ammonia .... $3 \times 10 = 30$ minims

The *Ferrous Oxalate Developer*, largely used on the European continent on account, perhaps, of the quick-printing quality of the negatives produced. Ferrous oxalate is a yellow salt insoluble in water, but soluble in potassic oxalate. By mixing ferrous sulphate with potassic oxalate we not only form ferrous oxalate, but hold it in solution by the excess of potassic oxalate.

Take

1. Potassic oxalate	1 part
Water, hot	3 parts

The oxalate should be acidified with oxalic acid. The water should be free from lime.

Take

2. Ferrous sulphate (protosulphate of iron).......... 1 part
   Water, hot........ ... . 4 parts
   Acidify with sulphuric acid.

To make the developer: Pour one part of No. 2 into four parts of No. 1. Do *not* pour No. 1 into No. 2. A little bromide (say half a grain per ounce of the above mixture) may be added in case of known over-exposure; but it is not necessary nor, indeed, advisable in ordinary cases. This developer, also, may be varied within limits, and the best way to get "latitude" of working with it is to make several mixtures of various proportions, as No. 2 one part, to No. 1 five parts; or, No. 2 one part, to No. 1 six parts; and to begin development with the weakest, passing the plate to the stronger solutions as, and if, desired. A *trace* of sodic hyposulphite added to this solution of ferrous oxalate increases its developing activity, but this must be added with great caution, as it often results in catastrophe to the negative.

This developer, once mixed, may be used over and over again so long as it is used within a certain time after the mixture of the two solutions. The mixture, however, may be long preserved by keeping it under a layer of oil, as may be done by the device figured here. The mixed developer is poured in at the top, oil is poured on top of it, the cork is replaced till developer is required, when the cork (and with it the end of the rubber tube), is lowered over a dish, and the developing liquid, of course, pours out. Sometimes, in order to maintain the vigor of this developer, bright iron wire is kept in contact with it.

FIG. 19.

Manipulations of Development.—The exposed plate being removed from the dark slide in the dark-room, should be dusted with a broad camel's-hair brush and laid face upwards in a black developing-dish, such as described in our chapter on apparatus.

The developing solution is then swept over the film in such a way as to cover every part at the first sweep. Plenty of solution should be allowed by the beginner, in order to prevent any part of the film being missed by the first wave of the developer, and so uneven markings being produced; the solution is to be *kept moving* over the film.

In a period varying from ten seconds to twenty-five or thirty, in a general way, the image may be expected to put in an appearance. The period varies considerably, and depends on the quality of gelatine used in the emulsion chiefly, but, of course, this refers to "normal" exposure and developer. If the exposure or developer be far wide of the normal, it is impossible to say how long or how short a time the image may take before it appears. The first appearance of the image under the action of a normal developer ought to be most carefully scrutinized. We consider this appearance by far the best guide to the future regulation of the developing process.

If the image comes up very gradually, almost reluctantly, one detail following another with a considerable lagging in the progress, the exposure has probably been insufficient. The negative, however, *may* be saved by an addition of alkali, and, perhaps, of water; or, the developer may be rejected, the plate washed, and a new developer made up containing less restrainer and more accelerator, in certain cases with less pyro.

If, on the other hand, the high-lights are instantly followed by half-tones, and a gray color appears over the whole film, the plate has certainly been over-exposed. An over-exposed plate, *taken in time*, may almost always be saved, unless the over-exposure is very gross. In bad cases of over-exposure the developer should be instantly rejected, the plate washed, and a new developer made up, containing more restrainer and pyro, and less accelerator.

If, after the application of this, the image still comes up very gray, it is well to allow the details to appear in their entirety, and then to add to the developer a dose of the citrate solution, recommended in the proportion of from two to four grains of citrate to each minim of ammonia. If a carbonate developer is being used, the developer may be instantly watered on the appearance of the grayness; and if that is not sufficient to allow the high-lights to gain density, a dose of bromide may be added.

With a normal developer, such as any of those we have given, the image, in a case of proper exposure, will begin to appear in from ten to thirty seconds, the high-lights will appear first, but before they have acquired any considerable density, the half-tones will appear, followed in turn by the shadows. The whole process of revelation will be gradual, steady, unhalting. When the density appears sufficient, and when no longer any white, and not much gray, is seen on the face, the plate may be examined by transmitted light, and the back may also be examined, so that the operator may note to what extent the action of the developer has penetrated the film. The back of the plate is no real criterion of anything, except the quality of the emulsion and the method of coating and setting the plate. Combined with examination of the image by reflected and transmitted light, examination of the back of the plate may be of service when the worker knows the qualities of his batch of plates. Experience alone can teach to what point a plate should be developed.

If, in any particular part, details appear reluctant to appear, the developer may be repeatedly poured upon that part from the cup or measure, or a camel's-hair brush may be well wetted with the developer and rubbed over the weak part. We have even dipped the brush in stronger developer in a separate vessel, and with it "locally developed" details.

When the development is judged complete, the plate is well washed under the tap, and either fixed at once, or placed in a strong solution of common alum, and fixed after washing. The object of the alum is to harden the gelatine, and prevent possible blistering, or frilling, in later operations. For the alum bath before fixing no acid should be used, except after ferrous oxalate, when a small quantity of citric, or acetic, acid may be added, though we do not insist on it. If there are grounds for expecting frilling, the plate, after pyro development, may be put into a slightly acid alum solution, straight from the developer; in this case the acid is of use in arresting development. As a rule, it will be found advisable not to alum before fixing, as after fixing the negative may be of such a quality as to be better unalumed, *i. e.*, the negative may be slightly thin for printing purposes, and the stain which the alum is partly used to remove might be advantageous to such a negative.

CHAPTER XV.

GELATINE BROMIDE PLATES, FIXING, INTENSIFICATION, REDUCTION, Etc.

The fixing solution is as follows:

Sodic hyposulphite	5 ounces
Water	1 pint

Ammonia, or ammonic carbonate till the solution is distinctly alkaline. And it must always be kept alkaline and up to strength. After the plate has been in the fixing solution for a certain time, the white (unaltered salts) will disappear from the back of the plate; the plate is at that stage just half fixed, and must be left about as long again to insure proper fixing. If, after a negative has been kept for some time, and, perhaps, printed from a good many times, a yellow-brown discoloration appears upon it, usually starting at or near one edge, that plate was only half fixed, and it is to be regretted that this matter is so frequently overlooked as it is.

After fixation is complete the negative has to be thoroughly washed, and with a glass negative this is not always so simple an operation as might be expected. The plates may be washed in about ten minutes by causing a good rose tap to play on each, but this is not always convenient, so they are either to be soaked for some hours face downwards in a suitable vessel, the water being frequently changed, or they may be washed, a good number at a time, in running water by the aid of an article figured Nos. 23 and 23*a*.

There are a great many apparatus on the market for washing glass negatives, most of them on the syphon principle; as a rule, these are good.

The washing after fixing need not, in its first stage, be so very prolonged if the alum and acid bath is to be used. But the negative should be well washed and not merely rinsed before it is immersed in the following bath, which may be omitted if the plate was immersed for a considerable time in alum solution before fixing:

Potash alum, solution saturated in cold water.

Citric acid, to each pint of the above, three ounces; or this also may be saturated in the alum solution.

Or hydrochloric acid to each pint of the above double saturated solution, half an ounce.

This bath will harden the gelatine and will remove any stain due to the pyro used in development.

After again washing, the plates are allowed to dry; heat must not be used to hurry the drying. If it is required to dry a plate in a hurry, soak it five minutes in good alcohol, take it out of the dish and, holding it tightly in the hand, whirl it rapidly or wave it quickly through the air. If frilling makes its appearance during the last washing, at once cease washing and plunge the plate into alcohol, leaving it there till the frilling disappears, which may take many hours. If a batch of plates shows a tendency to frilling, alum each plate well before fixing, and after fixing put a good dose of common salt into a dish with water and immerse in it each plate as it leaves the fixer. If the plates frill in spite of these precautions send them back to the maker, they are not reasonably adapted for the purpose for which they were bought, or for which they were sold.

After drying, the negative may or may not be varnished. The gelatine film is quite strong enough to stand the ordinary wear of an amateur's printing; but if there is fear of damp, or of scratches, or if a great number of prints are likely to be required, the negatives may be varnished in the manner given for collodion negatives. A film of plain collodion over the gelatine is a good preservative, and may be followed by a film of varnish. Among our formulæ at the end will be found one for varnish.

Intensifying gelatine bromide negatives is in most hands a very uncertain and dangerous operation; but if the precautions we shall point out are duly attended to, there ought to be no difficulty. Still, it is much better to make negatives such as are certain not to require intensification, especially as reduction is an operation much more simple, safe, and certain, than intensification.

There must, in the first place, be not a trace of hypo left in the film; if any hypo remain, the negative will be ruined, to a certainty. Various hypo-eliminators are suggested and recommended, chiefly depending on the action of chlorine in one shape or other. We cannot advise the use of any hypo-eliminator except water; some of the advertised articles eliminate the hypo, certainly, but introduce something worse than what they eliminate. Chlorine, at all events, should be avoided.

MERCURY INTENSIFIER.

Mercuric chloride	1 part
Water	20 parts

Of this, one pint. Strong hydrochloric acid, 30 minims. (Due to Mr. Arnold Spiller.)

In this the plate is soaked till the image becomes a pearly white or bright gray color. Wash *thoroughly*. Put the plate into a dish, and sweep over it sufficient of

Ammonia	1 part
Water	20 parts

Or,

Sodic sulphite	1 ounce
Water	1 pint

The former solution gives more density than the latter, but the color of the image produced by the latter is better. If sufficient density be not gained by the first operations, they can be repeated, beginning with the mercury, washing and finishing with the sulphite. The washing after intensification must be thorough.

Reduction of Gelatine Bromide Negatives.—If a fixed and washed negative be found too dense, it may be reduced in the following simple manner, suggested by Mr. E. Howard Farmer, of London, England.

Make a fresh solution of sodic hyposulphite, as for the fixing-bath, but omit the alkali. Make also a strong solution of potassic ferricyanide ("red prussiate of potash.") Place the negative in the hypo for some minutes, and put into a cup or measure a few drops of the ferricyanide solution. Pour the hypo into the measure with the ferricyanide, so as to mix the two well, and then pour the mixture on the negative in the dish. Immediately a reducing action will begin, and the first dose may be sufficient; if the action ceases before sufficient reduction has taken place, add a little more ferricyanide, as before.

"Local" reduction, *i. e.*, reduction of parts only of a negative, may be easily performed by rubbing the parts with a rag, dipped in alcohol. The rubbing must be fairly vigorous and prolonged; but care must be taken not to break the film by over-rubbing, nor by allowing any grit to get between film and rag.

CHAPTER XVI.

DEFECTS IN GELATINE-BROMIDE NEGATIVE.

The gelatine-bromide process is, like all other processes involving delicate manipulation (especially in semi-darkness) and accurate chemical calculations, liable to defects, and sometimes a worker will produce a defect altogether peculiar to his own manner of working and unintelligible to others. All that can be done in this chapter is to deal with the defects that anyone may fall upon, and that the writers have themselves experienced and seen.

Fog may be due to many causes. It is not difficult to recognize, and hardly needs description, but we may liken it to a general *veil*, of more or less pronounced character, all over the plate. There are two kinds of fog, distinct in nature, appearance, and *rationale*. *Green fog* is, unfortunately, common in commercial plates kept for any considerable time, and is noticed first in the shadows of a negative as seen from the back of the plate. In this shape it does very little harm; but what we take to be a variety of the same fog shows itself as a bronzing, spotty, metallic-looking stain, which usually begins at the edges of a plate and creeps inward, finally culminating in red fog, which is a hopeless calamity to the plate. We have watched the progress of this fog from the inchoate "shadow-fog," through the "bronze-period" "into the region of eternal night." Ammonia aggravates it, and in our opinion causes it; and plates showing a tendency to green fog should be developed with carbonates or ferrous oxalate. Plates even above suspicion of this fog, when they are new, often acquire it if kept in an atmosphere where much carburetted hydrogen gas is burned. Sometimes, indeed frequently, the green fog which appears to be on the surface of the film, can be removed by rubbing the film with a rag dipped in spirits. So far as we know, Mr. R. W. Robinson first brought this cure under our notice. *Red* fog we have never been able to cure or even to mitigate. We *believe* it is merely an exaggerated form of green fog. In emulsion-making, red fog may be caused by the boiling process in presence of alkali; such red fog may be "separated" by the action of "centrifugal force" (see page 64), which makes it probable that this fog is due to some gelatine combination.

Grey fog may arise from *over-exposure*—the cure is evident, or rather, the means of prevention; *unsafe light* in the developing-room, *camera or dark-room*, *slide not light-tight; reflections* inside camera or lens-tube. All these can be readily discovered and remedied. Fog may be produced by too long a time being employed for the drying of plates after coating with emulsion, the danger or defect being aggravated in proportion as the drying atmosphere is damp or contaminated with carburetted hydrogen or sulphurous fumes.

To discover for certain whether the light of the operating-room is at fault, one of the plates may be exposed to the light suspected, for five minutes, in contact with a negative or the screen of a "sensitizer." If no image appear on subsequent development, the light is "safe." We have already given a method for testing the camera, etc., for light-tightness. Another method is to place a plate in the camera in the dark-slide as usual, and to draw the shutter, leaving the cap on the lens. The whole is allowed to stand in bright light for a few minutes. On development, fog will show if due to leakage in the camera, or reflections arising therefrom.

Fog may be due to *development*, to overdose of alkali in pyro development, or to alkaline reaction in ferrous oxalate development.

Over-density of the negative may be due to over-development, pure and simple, or to over-forcing in development of an under-exposed plate. In the former case the cure will be found in the method of "reduction" given on page 99. The other defect, where the high lights are dense out of proportion with the shadows, is difficult, if not impossible, to remedy.

Thinness, or *want of density*, may be due to several causes. *Under-development;* intensification will be found more easy in this kind of case than in any other. *Over-exposure;* intensification may be resorted to. *Light fog*, in quantity not sufficient to entirely ruin the plate, will produce a thin image; thus a very dim reflection in the camera, or a moderately unsafe light in the operating-room, while not sufficient to produce a regular fog, will produce a thin image. Thinness may be due to the *emulsion*. If the plate is too thinly coated; if the emulsion does not contain sufficient of the silver haloid; if the emulsion has an over-acid, or a very alkaline reaction; if too much chrome alum be used in the emulsion, and under many other less common conditions, a thin image may result.

Frilling may be due to *dirty plates;* plates *overheated* before coating; an improper *quality of gelatine*, or *want of alum* in the gelatine in very warm weather; *osmotic action* in the hypo, produced usually by a too strong solution of hypo; action of too strong *acids* on the film at some stage, as in the alum bath. Sometimes plates will frill in spite of all that can be done to prevent it, but in commercial products frilling is now happily very rare.

Yellow Stain all over the plate, due to the *pyro*, and occuring especially with the carbonate developers. The alum and acid bath will remove this stain.

Spots.—Small *transparent* spots on the negative are usually due to dust. *Opaque* spots may arise from the quality of the gelatine; we have known immense crops of them produced by iron rust in the water supply. *Circular transparent spots, with sharp outline*, are due to air-bubbles forming in development, or in the emulsion. (See our instructions for applying the developer.) A broad camel's-hair brush may be used to spread the developer over the film in the developing dish immediately after the first application of the developing solution. Some workers soak their plates in plain water before development, there is no harm in, nor need for, this operation with glass plates.

Halation (appearance of "halo.")—Found when objects in high light and objects in deep shadow are close to each other in the picture, the most frequent examples being the windows in interiors, and branches of trees against a brilliant sky. Halation is due to two causes, which must not be confounded. 1st. *Reflection from the back of the glass plate*, at an angle near to that of "total reflection." This kind of halation may be obviated by using films in place of glass plates, and to a certain extent by "backing" the glass plates with some substances of non-actinic color in optical contact with the glass. *Burnt sienna*, rubbed into a paste with gum and water, may be applied to the back of the plate before exposure, and removed with a sponge before development, or a piece of black "carbon tissue" may be wetted and squeegeed into contact with the back of the plate. A *thin film* of emulsion, especially in the absence of the yellow stain due to iodide, is very apt to give halation. The defect may, to some extent, be removed by rubbing with a rag dipped in alcohol. (See page 100.)

2d. Halation due to *dust in the air*. This is, of course, not true halation, in the technical acceptation of the word, but it is often mistaken for the true halation. Neither the use of a film nor "backing" will prevent this kind of halation, but the same cure may be tried, viz.: rubbing down the over-dense parts with alcohol on a rag.

Various curious markings may be produced by various blunders. *Scummy* marks are over-produced by using too small a quantity of developer, and not keeping the solution in motion during development. *Crape-like* marks occur frequently with certain brands of plates, and seem due to dirty glass plates.

If, during drying of a negative, water is splashed on to the film, a mark will occur which we can neither account for nor efface; the result is a patch *lighter* than the rest of the negative.

Sometimes a bronze-like, metallic-looking scum forms on negatives developed with pyro preserved with sodic sulphite. This may be removed with a rag and alcohol. Whether it is identical with one form of green fog we cannot say.

CHAPTER XVII.

PAPER NEGATIVES AND STRIPPING FILMS.

In the chemical operations of developing an image in gelatine emulsion, there is no difference whether the film of gelatine be on a rigid, permanent support, or a flexible, textile, temporary support, but of necessity the manipulations must be somewhat altered to suit the altered circumstances. The composition of the solutions for developing, fixing, clearing, etc., already given, will answer for paper negatives and films quite as well as for glass plates.

Paper Negatives, wherein the paper remains permanently the support, of which, as a type, we may take Eastman's Negative Films. These may be exposed in cut sheets, for experiment; but vastly preferable are the roll-holders known as the Eastman-Walker. In one of these is placed, with every convenience for exposure, a long band of negative paper, to be unwound for exposure in proper quantity and position, which can be determined by fittings forming essential parts of the apparatus. In Fig. 20 we show the latest pattern of the East-

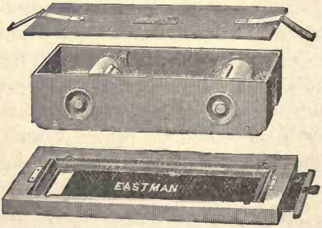

Fig. 20.

man-Walker Roll-holder, and as full instructions are given in various places for its use, we need not waste space in repeating these instructions. We will, however, give one or two hints, which we think may prove useful, whether "negative films" or "stripping films" are used in this roll-holder. Although the instrument itself registers on the paper the extremities of each exposure, it is well, whenever opportunity offers—during a tour, for instance—to mark in pencil each end of the film as it presents itself when the shutter is withdrawn. This will form a further safeguard, beyond the small punched holes, against cutting up the film in the wrong places. (The necessity for this is much lessened in the new pattern.) When about to develop a spool of exposed films, the inexperienced will do well to cut off one exposure at a time, and develop one before he cuts off another. (The new pattern is vastly improved in this respect, also; in fact, the new design is so superior, in almost every essential point, to the pattern originally introduced, that those who bought the original pattern have a distinct grievance, that, so soon after they had purchased one pattern, another so greatly superior should be brought under their notice, and should excite their covetousness and tempt them to extravagance.)

The exposed length of film for development, being cut off, is immersed in water face downwards for a few seconds, being slidden sideways, if possible, into the water; after the few seconds have elapsed it is lifted face up and either brushed over with a broad hair brush under water, or pulled quickly along the face up under water. This is simply to prevent air-bells. Development follows, then fixing, washing, clearing, washing again. Then the film is squeegeed face downwards to a polished sheet of vulcanite, where it is allowed to dry, and whence, when dry, it ought to strip off with ease, one corner being raised with a knife or other pointed instrument. According to the instructions, the negative should then be rendered translucent by the application of some oily lubricant, such as the "translucine," sold for the purpose. Against this oiling we protest. Printing truly is rendered more rapid, and "grain," possibly, may be slightly eliminated, but without special and highly inconvenient means the negatives so treated cannot be preserved for any considerable length of time. The best method by far, if the negatives are of any nature, is to leave them as they come from the vulcanite.

Stripping films (also "Eastman") are coming into more and more general use by rapid strides. In this case development, fixing, and washing are precisely as before; but, for evident reasons, the paper being removed finally, the development should be carried a little further, apparently (*i. e.*, as observed in the dark-room), than in the case of glass plates, and considerably further than in the case of paper negative films. The Eastman Company strongly advise the carbonate developer in place of the ammonia—we can vouch for the excellence of ammonia, and other authorities can equally vouch for the carbonates. The films should not be alumed until a later stage; there is no necessity for, and there may be danger in, the alum.

The stripping films, after fixation, are washed; but as they have to undergo several future washings, the first need not be of any very great duration. A plate of glass, a little larger than the film, is cleaned, rubbed all over with powdered talc (French chalk), the talc rubbed apparently all off, and the plate "edged" or coated with a very thin solution of pure India rubber in benzole, also pure. It is then coated with thin, plain collodion, which, when set, but not dry, is washed till the greasy appearance due to the solvents is gone. The film is now squeegeed to the collodion film, blotting-paper laid over the paper film, and a weight applied for at least quarter of an hour, and as much longer as convenient. The paper may even be allowed to dry, but it must not be partially dry, it must be all damp or all dry. After a suitable time has elapsed the plate bearing the collodion and the paper film is placed in water at about 120 deg. Fahr. The tissue is prepared by the makers in this way: The paper is coated with a fairly thick film of soluble gelatine, which is then calendered. The emulsion, rendered totally insoluble with alum, follows. So that when the tissue is placed in hot water, as above, the soluble gelatine melts and the paper can be removed. No attempt must be made to remove the paper until air-bubbles are seen from the back to form under the paper. The paper when detached is thrown away, the film washed under the tap, and if desired, cleaned in alum and acid, and washed again.

A "skin" (consisting of gelatine and glycerine poured on a glass plate, dried and stripped), is now soaked for a few moments in water, placed on the negative film adhering to the glass plate, the squeegee is gently applied in sweeps to the back of the skin so as to expel air-bells and superfluous water, and the whole is set aside to dry spontaneously. When the film is dry it is coated with plain collodion and again allowed to dry. The margins are then cut round with a sharp point, and one corner raised from the glass, when the whole negative will leave the glass and remain in the hand, a real thing of beauty so far as its own inherent qualities are concerned. The negative film now consists of an image of silver in an extremely attenuated film of insoluble gelatine, strengthened by the skin, and the whole almost hermetically sealed between two strata of damp proof collodion.

It need not be matter for surprise if the beginner find some little trouble in such a series of operations, but a little practice and thought will enable anyone to make a certain success of the stripping operations. The accidents most frequent are:

"*Grain*," appearing in certain parts of the negative. Due to the soluble gelatine substratum being too thin. Remedy: Reject or return at once to the maker all the spools bearing that batch number. This fault has been, by the perseverance and care of the makers, almost or entirely eliminated from all the stripping films we have seen of late.

The *paper refuses to strip* from the film on glass. Substratum becomes insoluble from tanning in prolonged pyro development, or, more probably, the film has been kept too long before use.

The *whole film threatens to leave the glass* in the hot water. Dirty plate, improperly talced, collodion not properly washed, stripping too soon after squeegeeing, castor oil or greasy matter in the collodion, India rubber solution too thick.

Blisters after stripping. Water too hot, acid in "clearing solution" too strong, collodion oily, plate dirty, talcing im-

After the "skin" is applied and when film is nearly dry, film showing tendency to *jump from the plate.* Skin not enough soaked. In certain cases, especially in hot weather, a little glycerine may be added to the water in which the skin is soaked. The thinner the skin and the warmer the water the less soaking is required; in extreme cases the skin may be simply passed through the water. A thick skin must be soaked till just limp. If the glass plate be not coated or edged with rubber, or if the collodion be too thick, the film may spring from the plate prematurely.

The film, when dry, *refuses to strip* from the plate, a very unlikely cause of failure. Dirty plate, want of talc, or too much left on plate, or the plate too much polished after talcing.

The finally stripped film, if not quite flat, may be placed under pressure after the face has been rubbed with the soft part of the hand to remove the thin film of rubber due to the coating of the plate with rubber solution, if the plate was so coated.

There is no necessity for stripping a film, unless we choose, before a trial print is taken from it. It can be dried after fixing and washing, *but not alumed*, and can be stripped at any future time. But in this case the film must be well soaked in water before squeegeeing to glass plate, and the water for stripping will probably require to be hotter. As a rule, hot water entails no danger to the emulsion, we have stripped in boiling water, but this ought not to be needed, and certainly is not recommended.

In cases where reversal of right and left is a matter of no consequence, as in portraiture in certain cases, the final stripping need not be resorted to. The film, *minus* the paper, can be left adhering to the glass plate in a reversed position, in fact, for certain purposes this is a necessity, while for other purposes it is immaterial one way or the other.

There are other tissues and films on the market, some of which give promise of future excellence, if, indeed, they do not already possess merit. So far as we have seen the failing in these transparent films has been not in the support so much as in the emulsion itself, which has, in our experience, often been of inferior quality, and carelessly applied. A London firm is now coming into notice with a film which we ourselves introduced to the notice of the firm, the Vergara Film Co. The film in this case consists of gelatine heavily chromated, and is certainly beautifully transparent; of the general qualities of the tissue we have, at the time of writing, had little opportunity of judging.

CHAPTER XVIII.

"COLOR-CORRECT," OR "ORTHOCHROMATIC" PHOTOGRAPHY.

Every one who has had even slight experience of photography must have noticed the fact, that the color yellow, which appears brightest of all the colors to the eye, is rendered on a photographic negative as nearly clear glass, and on a print as nearly black, while the dark blues of nature, so little brilliant to the eye, are rendered as more or less high-lights, dark on the negative, and light on a positive. Clearly this is a defect of, and a reproach to, photography, and any means by which we may more correctly render the visual value of these colors must be welcomed. Great steps have been made of late years in this respect, and greater would doubtless have been made had not researches into the matter been more or less hampered by patents in certain countries.

It is very long since the discovery was made that by photographing certain colored objects through yellow media the color values were more correctly rendered, a certain amount of the actinic blue and violet being shut out by the yellow medium.

This was, indeed, a short step in the right direction; of late much greater strides have been made, for gelatine-bromide films have been produced, actually more sensitive to the yellow and yellow-green of the spectrum, than to the blue and violet. As a rule films are, by treatment with certain aniline dyes, made much more sensitive to the yellow, yellow-green, and even to the red rays than they are normally without such treatment; and the action is further eked out by the use of yellow screens, which further decrease the disproportionate actinism of the blues and violets by partly "filtering out" these portions of the normal spectrum.

It must be clearly understood that the action of the dyes is not merely a staining action; the staining has undoubtedly an effect, *per se*, but the important factor in the matter is the new compound formed by the combination of the dye with the silver in the film, or in the emulsion. Nor must it be forgotten that outside the solar spectrum there is no existing *pure* blue or any other color, and we have, moreover, always to take into account *reflection*. The yellow color of an object may be due to a mixture of colors by no means identical with prismatic yellow; and the light reflected from an object may completely upset all our impressions as to the real color of that object. This reflected white light renders our plates (however we may have endowed them with "color-sensitiveness") *relatively* less orthochromatic by increasing the intensity of the blues and violets.

The substances most commonly used for gelatine plates are eosine compounds, such as the dyes known as erythrosine, rose bengal, and eosine itself, and with these is generally used an alkali, viz., ammonia. The form in which these are used is generally that of a bath applied to the coated and dried plate, but frequently the dye is added to the emulsion in bulk in the liquid state before plates are coated. We shall confine our attention to the process of bathing a ready-prepared plate. Every precaution must be taken to guard against fog as the plates are rendered not only highly sensitive to yellow and orange, but also strongly alkaline in reaction, in which state a plate is always highly susceptible to fog, not only from light, but from every sort of noxious vapor. The light used must be of the deepest ruby color, and, indeed, the less of even that used the better. Certain dyes also fog plates even in darkness.

A plate should be chosen with an emulsion containing little or no silver iodide; we have known as little as three parts of iodide per centum of bromide to nullify our attempts to get a good orthochromatic effect. The plate is first bathed for two minutes in a solution—

Liquor ammonia	1 part
Water	100 parts

Then without washing immerse in

Dye (eosine "B," erythrosine or rose bengal, etc.)	1 part
Water	10,000 parts
Ammonia	100 parts

The most convenient way to arrive at these very dilute solutions of the dye is as follows. Make first an aqueous solution of (say)

Erythrosine	1 part (1 gram, for instance)
Water	1000 parts (1000 c.c. for instance)

This may be kept a considerable time in the dark.

The ordinary 10 per cent. ammonia solution may be used. Then take

Dye (1 to 1000)	1 part
Ammonia (10 per cent.)	1 part
Water	8 parts

Some dyes useful for this purpose are insoluble in water; in these cases alcohol (absolute) may be used for the first solution:,

Dye (as cyanine)	1 part (1 gram, for instance)
Absolute alcohol	1,000 parts (1000 c.c., for instance)

Some workers find difficulty in using the alcoholic solutions, as there is a marked tendency to uneven staining of the plates.

Mr. J. B. Wellington, of London, has shown a way to overcome the awkward precipitation that takes place when cyanine is dissolved in water.

Prof. C. H. Bothamley, F.I.C., F.C.S., of Leeds, has done much to elucidate the practice and principles of this process, his writings may be found in files of the *Photographic News*, 1887, and elsewhere. We mention his name simply because it has been prominently brought forward lately, and not at all to the exclusion of others, as Vogel, Eder, Ives, Abney, Schumann, &c.

We have said that in many cases, in order to get the best effect, we require to use a yellow "screen." This may be of yellow glass, but the sides of the glass must be absolutely parallel. A much better plan is to dissolve *aurantia* dye in alcohol and to mix the alcohol with plain collodion, which is poured upon a talced glass plate, and when dry stripped. A piece of this collodion film may be fixed by any suitable permanent or temporary means over the aperture of the lens diaphragm. But the screen must be used with discretion. The same screen will not answer for all purposes. The more intense the blues with which we have to deal, the darker should be the yellow stain. With artificial light, as gas or paraffin, the screen will probably not be required at all. In such a light the general sensitiveness of the dyed plate will be found very great.

For landscape work, on account of the reflections already mentioned, a very dark-yellow screen is usually required, but, again, it is pointed out that in the yellow or reddish light of approaching sunset a screen is not needed at all.*

It is within the mark to say that in color-correct photography lies the future of the science and of the art.

At the conference of the Camera Club, in March, 1888, Captain Abney read a paper relating to his theories on orthochromatic processes. He recommended the application to the dried gelatine film of collodion or varnish containing certain suitable dyes, but we are not aware of success having followed this practice in any hands, other than those of the Captain, who, indeed, probably used the process for his own special purposes of spectrum photography.

Of all the processes tried by the writers, none seems to them more satisfactory; certainly none is more simple than that last suggested by Mr. Ives, of Philadelphia. It may be stated thus:

In four ounces of absolute alcohol dissolve one grain of erythrosine or cyanine. Soak the gelatine bromide plate in this for a minute. Allow to dry. Wash for a short time in running water. Dry, and use. No alkali is used. The plates

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*There is a danger in using a screen too dark-yellow for landscape; in such a case the foliage may be represented in the print as light where the artist intended it for the shadow of his picture.

keep well. The cyanine renders the plates so very sensitive, even to red rays, that these operations, as well as development, must be conducted practically in darkness. The erythrosine formula has proved in our hands eminently satisfactory, the cyanine no less so, but the precautions necessary with it apt to be irksome.

CHAPTER XIX.

STEREOSCOPIC PHOTOGRAPHY.

As we see a natural object with two eyes at once, and as our eyes are about two and a-half inches apart, it is plain that we really see two images from slightly different bases, or points of view; our right eye sees rather more of the right side of the object than our left eye sees, and *vice versa.* Yet our vision and our brain so work together that we do not, *as a rule*, see objects double, but single. Photography, in producing stereoscopic pictures, imitates nature in her provisions for enabling us to see things with a certain amount of roundness or *solidity*, and for enabling us, to a certain extent, to realize the distances between objects on different planes.

At one time stereoscopic photography was a fashion, if not a craze; and when the fashion died out, so great was the reaction that from a position of undue importance, stereoscopic photography fell into a position of unmerited contempt. In England, of late, it has been once more attracting attention, and we think we shall not do amiss by saying a few words on the subject.

The camera used for this class of work is provided either with one lens fitted to a long-range sliding front, so that after one picture is taken the lens is slid about two and a-half to three inches to one side, and another picture is taken; or the camera has two lenses, side by side, their centres distant about two and a-half to three inches, and their foci exactly equal, for which reason they are often called "twin" lenses. Three inches is by no means the limit of separation, for with a distance of only three inches between the axis of the lenses, objects at a distance will not be shown stereoscopically at all; we have ourselves moved the whole camera several feet, with certain precautions, and succeeding in producing stereoscopic effect, where, without that proceeding, we should have got none. But for near objects, three inches will be found quite sufficient.

If the camera be moved at all, it must be moved only horizontally on the axis of the lens; or, in other words, both views must be taken on the same base-line. Various ingenious devices for shifting the camera in this manner on its stand have been designed.

The usual size of a "stereo" plate is $6\frac{3}{4}$ x $3\frac{1}{4}$ inches, but, so long as the *centres* of the mounted prints are *not over* $2\frac{5}{8}$ *or* 3 *inches apart*, the height need not be limited to $3\frac{1}{4}$ inches; in fact, we have seen very fine stereographs five inches high. Mr. J. Traill Taylor, whose authority on such subjects cannot be impugned, recommends for stereo-work a plate 8 x 5 inches.

A little consideration will show that if the two halves of the stereoscopic picture are taken on one plate, these halves will require to be transposed if the view is to be seen stereoscopically, unless they are purposely transposed on the plate by taking the right view on the left side of the plate and the left view on the right. A camera and slide used to be made for this very purpose of transposing, but, as a rule, cameras now made for stereo-work are "binocular," *i. e.*, consist practically of two cameras, side by side, a division stretching inside the full size camera from front to rear. In cases where a binocular camera is used, the two prints must always be transposed in mounting, unless the two negatives are transposed in printing. The negatives to be transposed may be cut down the centre with a diamond, if glass, or with a pair of scissors, if paper, and may then be printed side by side in the transposed position; but, unless the negatives are trimmed according to the following rules, there is no gain in dividing the two halves.

Some persons can see stereographs without a stereoscope, but probably these persons are few. Certainly most persons require a stereoscope for the purpose. With a "reflecting stereoscope," pictures of almost any size can be seen, but the instrument commonly used is the well-known "refracting stereoscope." We cannot enlarge on this instrument further than to say that the majority of those in the market are useless. The lenses should be adjustable as to their distance from each other, to suit various pairs of eyes.

The crucial point in stereography is mounting the prints. We shall suppose that the negatives have not been transposed, and that we have to mount a double print, the sides having to be transposed.

First, we have to determine a *base line.* The first trimming-line is to be drawn so that it cuts a given object in the foreground of each half at precisely the same point. The top of the prints is then to be trimmed *parallel* with the base line. Next, the two halves have to be separated and transposed. The pictures are to be mounted so that their centres shall be not less than two and three-quarter inches nor more than three inches apart. In trimming the sides of the pictures, we must, on the print that is to be mounted on the right-hand side, leave more subject on the right than we leave on the right of the left-hand picture; and on the left-hand picture we must leave more of the left side than we leave on the left of the right-hand picture. In other words, we must trim the right picture a little more to the right of any given object appearing in both halves, and we must trim the left-hand picture a little further to the left than we trim the right-hand picture, and still we must keep the pictures exactly the same size, and their centres the distance apart already specified (read "British Journal Almanac, 1887," article of the editor.)

CHAPTER XX.

PART II.

PRINTING PROCESS—PRELIMINARY.

We have so far treated almost entirely of processes for producing negatives, we now come to processes for producing positives, or prints.

Printing may be by "contact" or by "enlargement," or by "reduction"; the image may be "printed out" or "developed," on paper, glass, opal, cloth, etc. Lastly, a print may be on an opaque support or on a translucent support used as opaque; or it may be on a transparent support, as glass ("transparent positive," or "transparency," or "lantern-slide,") or it may be on a translucent support, as an "opal transparency."

The order which we propose to follow is, first, printing on paper with silver salts; second, printing on paper with salts not of silver; third, the processes specially adapted for producing the beautiful and useful positive known as a lantern-slide.

The Printing Frame.—We may once for all dispose of the mechanical operations of printing by contact, they are of the simplest description. The only apparatus actually necessary is a "printing frame," which is merely an arrangement for holding the negative and the sensitive surface firmly together face to face, and for allowing the progress of printing to be observed without danger of moving the two from the position with relation to each other in which they were originally placed. Two kinds of printing frames are Figs. 21 and 22, each typical of a class. Fig. 21 shows the appearance of the lighter class of printing frame, and this style is usually made to take in its rebate one size of negative

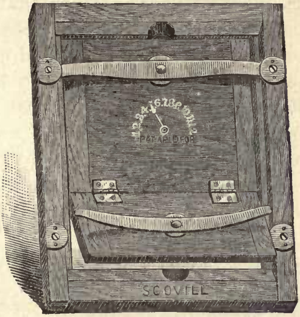

FIG. 21.

only, while Fig. 22 is heavier, being furnished with a plate of glass which ought to be "plate glass," or at least perfectly

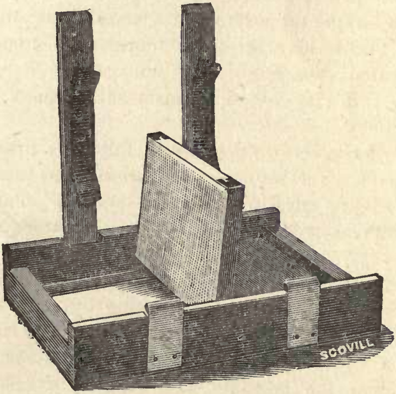

FIG. 22

flat to avoid breakage of negatives. The springs in this latter frame should be strong so as to insure perfect contact at all times between negative and sensitive surface.

The negative is laid face up in one of these frames, the sensitive material is laid face down on top of the negative, a pad, or several pads, of paper, felt, or cloth is placed next the sensitive material, the back of the frame covers the pad, and the frame is closed. It is then placed with its front to the light. The printing-room should be dry but cool.

The back of the frame is hinged so that one-half can be turned back and the progress of printing examined without shifting the position of the other half.

In large sizes two hinges are to be recommended. Indeed, an 8x10 double-hinged printing-frame has often made its convenience felt to the writers.

For printing processes where "combination" printing may be required, special "registering" frames are made; we do not think it necessary to describe these.

CHAPTER XXI.

PRINTING ON ALBUMENIZED PAPER WITH SILVER CHLORIDE.

In this process, paper of specially good quality is, by means of special appliances, coated with albumen (or white of egg), containing a certain proportion of a soluble chloride, usually ammonium chloride. When this is floated on a solution of silver nitrate of sufficient strength, silver chloride is formed by double decomposition and the silver chloride remains in the albumen in conjunction with a certain excess of silver nitrate, a necessary condition for success. The silver chloride blackens on being exposed to light, but there is a further combination which exercises an important influence on our results and on our operations: that combination being one between the silver nitrate and the albumen, and, further, probably between the silver nitrate and the "size" of the paper. The presence of these organic silver salts accounts for much of the beauty and many of the disadvantages of this process.

It would be hopeless for anyone not in the trade to attempt to produce salted albumenized paper of quality comparable to that made by the few firms who produce albumenized paper; we, therefore, shall accept as certain that our reader will purchase for his work paper ready-albumenized and salted. On the quantity of soluble chloride in the albumen depends chiefly the strength of the "sensitizing" bath, and, as a rule, instructions accompany each sample of paper sold.

Sometimes the paper presents a very high gloss, and is called "double albumenized;" this paper is slightly more difficult to work, but the results are by many considered superior.

The sensitizing bath consists of a neutral solution of silver nitrate, varying from about forty to sixty-five grains of silver nitrate to each ounce of water. A bath of lower grade than thirty grains to the ounce will fail to effect the necessary coagulation of the albumen, but in the other direction we may go far beyond a sixty-five-grain bath. A large quantity of chloride in the albumen and a double albumenized paper indicate a strong bath, as a rule, but the condition of the albumen must also regulate the strength of the bath.

The *time* of flotation necessary also requires consideration. The albumenized salted paper is floated on the solution of silver nitrate; if we do not float long enough we get poor prints, if we float too long we waste silver. We have to utilize all the salt in the paper, and in order to make certain that all the soluble chloride is converted into silver chloride, we use the following pretty and simple test. A solution of potassic chromate five grains, water one ounce, is made, and a drop put on the back of the paper to be timed. The paper is now floated (albumen downwards) on the silver bath, the time being carefully noted; when the originally yellow spot of chromate has become deep orange color, the conversion is complete; this will form a guide to the time required when the serious operation of sensitizing larger sheets is in progress.

We may take as a normal sensitizing bath:

Silver nitrate	60 grains
Distilled water	1 ounce

Tested with litmus, and if acid, neutralized with sodic carbonate. The worker must determine for himself the size of sheet he is to sensitize at one time, and a white porcelain dish, scrupulously clean, will be found the most convenient receptacle for the solution.

As sheet after sheet of paper is sensitized, the strength of the bath naturally falls, as of course a certain quantity of the silver nitrate is converted by the chloride in each sheet, and further, the bulk is also diminished. The latter is of less moment than the former matter; both may be met by making up the deficiency in bulk, with a more concentrated solution than that constituting the bath. Our reserve stock solution may be about 100 grains of silver nitrate to each ounce of water, and the addition of this in sufficient quantity to keep our bath up to its original bulk will probably suffice to keep it up also to its original strength. The "argentometer" will not here give us correct readings, on account of the organic salts, sure to be present in the bath solution; and we may, to make sure that our solution is *up to* a certain standard, use the following instructive test.

We first determine what is the minimum grade to which our bath may be allowed to fall, the test will inform us whether or not the bath has fallen below that minimum.

We require the chromate solution already formulated on another page. We further require a solution of potassic bromide of one or other of the following standard strengths. In making up the bromide solution we must weigh out the solid bromide, dissolve it in less than an ounce, and then make up to an ounce of water.

For a minimum grade of silver nitrate per ounce of bath.	We make a solution of potassic bromide.	
50 grains	35 grains	To each ounce of bromide solution.
55 grains	38.5 grains	
60 grains	42 grains	
65 grains	45.5 grains	
70 grains	49 grains	

We *fill* a small pipette with the best bromide solution, and put the contents of the pipette into a *white* cup or saucer, and add to it about 20 times its measure of water. We then put in enough of the chromate solution to make this faintly yellow. Having cleaned out the pipette, we *fill* it with the bath solution under test, and we let the bath solution fall, drop by drop, into the faintly yellow bromide solution. As each drop touches the solution at first, a red stain will appear, but will immediately disappear on stirring, but as the dropping goes on a point will finally be reached when the red stain will become permanent, and will not disappear on any amount of stirring. If this critical point be reached just as our pipette is empty, the bath is just about our minimum standard; if the red become permanent before our pipette is empty, the bath is above our standard; but if we have to add a few drops of the bath after the pipette is empty to make the red disappear, then our bath is below our standard; and with a little practice, by noting how much extra bath solution is required, we shall be able to judge approximately *how much* our bath is below "par."

After a few sheets of paper have been sensitized, the bath solution will become discolored, owing to the presence of organic salts. In this case add to the solution a few drops of a concentrated solution of sodic carbonate till the bath is neutral, shake up, and place in strong day—or sun—light. A black precipitate will fall to the bottom; this is to be filtered out. Thereafter, add a little more soda to the bath and it is ready for use again.

Manipulations of Sensitizing.—Keep the albumenized paper in a place slightly damp, as a cellar, for some hours at least previous to sensitizing. The sensitizing solution is poured into a flat porcelain or glass dish, the depth of solution being not less than half an inch. Bend the sheet to be sensitized into a loose roll, albumen inward, for a moment or two; seize two opposite corners of the sheet with the two first fingers and thumb of each hand, knuckles upward; make the middle of the sheet droop, albumen downward, so as to meet the surface of the solution evenly; lower the ends of the sheet gradually, but without stoppage, till the whole sheet lies flat on the solution. Or one end of the paper may first be brought into contact with the solution, and the rest of the sheet slidden onto the solution. For instance, if the left side of the sheet is to touch the solution first, lower it to the right-hand side of the dish, and slide it gradually to the left, lowering the other parts of the sheet all the time. If in either case the ends seem inclined to rise up, blow them down with the breath or touch them gently with a clean instrument. No bath solution should get on the back of the paper. And in either case, after the sheet lies flat, each corner should be raised in turn and air-bells, if found, burst with a sharp point, as of a quill or silver instrument. We have already given directions for regulating the time of flotation; it will be found to vary from three to five minutes, depending to a considerable extent upon temperature. Flotation and drying should be carried on by yellow light; naked gas, or lamp light is quite safe.

When the flotation is complete the paper is to be taken by one end or corner with horn forceps or a silver instrument, and being seized in finger and thumb of each hand is to be *very slowly* removed from the bath. It may be drawn over the edge of the dish, or over a glass rod for the purpose fixed over the dish in some suitable manner. The paper is then hung up to dry in a well-ventilated room. It may be hung by two corners by glass clips, or it may be laid over glass rods face upward. The only danger is that the corners drying first may curl inward and damage the wet or damp centre. There will probably be no trouble in this drying matter. A small piece of bibulous paper should be pressed against any corner that shows signs of collecting a drop, and these bits of paper, as well as all filter papers used for silver nitrate solutions, should be laid aside for future reduction with other residues (see chapter on residues, page 182.) When the paper is surface dry, and before it has curled seriously, it may with advantage be laid out flat between sheets of pure blotting paper and so preserved under weight.

Paper prepared in this way will turn yellow in periods ranging from twenty-four to forty-eight hours, unless specially treated in one of the ways to be described presently.

Fuming sensitized paper is a very common practice in America, and it presents, under certain circumstances, indubitable advantages. The process of fuming consists simply in shutting up the sensitized paper in a cupboard with a saucer of liquor ammonia. The paper is hung by clips to the upper part of the press and the ammonia is placed in the lower part. This system is particularly beneficial when the paper is apt to get too dry. Paper fumed in this way is probably even more liable to the yellowing described in last paragraph.

To preserve sensitized albumen paper—that is to say, to prevent the yellow discoloration just mentioned, soak stout blotting-paper in a half-saturated solution of sodic carbonate, and dry it. As each sheet of paper leaves the sensitizing bath it is blotted with clean blotting-paper, and is immediately thereafter placed between two sheets of the blotting-paper prepared as above, a weight placed on top of the entire lot, and in this state the paper will keep white and good for weeks or months. Sheets of blotting-paper similarly prepared may, with great benefit in results, be used as pads for the printing frame, especially when, owing to bad light or dense negatives, the printing is very protracted.

Ready-sensitized paper is an article of commerce largely used, and being more and more used every day. Its qualities are often excellent, and in use it in no way differs from home sensitized albumen paper. The method of production is supposed to be a trade secret.

Printing presents no difficulties to those who have acquired experience. The critical point is the extent to which the printing should be allowed to go, and nothing but experience will ever teach that. Papers differ and negatives differ in this respect; tastes also differ. We may say, however, that with albumen paper the printing is always to be carried several degrees beyond the depth required finally, as all papers lose more or less depth in the subsequent processes of toning and fixing. "Double printing," "vignetting," and other special manipulations are treated in another chapter (page 133, *et sq.*). After the print leaves the printing frame it is placed aside in the dark, or in safe light, till a sufficient number are ready for the next processes.

Toning.—The paper when it leaves the printing frame is still, of course, sensitive to light and requires fixing; but were it fixed without an intermediate operation, the image would not only be of a most unsightly color, but would be "fugitive" and fade in a comparatively short time. By the process of toning, or "gilding," as it has been aptly called, we give the image not only a pleasant color but superior permanence. Toning consists of either replacing a certain quantity of the reduced silver (oxide ?) by gold, according to one theory; or depositing a layer of gold over the reduced silver, according to the theory which appears better founded. The gold is deposited from an alkaline solution of its ter-chloride, and the toning bath commonly used is known as the "alkaline gold toning" bath. The action changes the color of the image from a rusty red to brown, violet, purple, or blue, according to the color of the underlying substance seen through the gold layer, and according to the thickness and state of division of the gold layer. Thus, in order to produce a rich, warm tone, it is necessary that the image, before toning, shall have a more or less ruddy color, for it is evident that if on a purple or violet ground we superpose a layer of metallic gold, itself black or nearly so, we can never produce a warm blending of color. Thus, in the washing necessary previous to toning, we should endeavor to produce—if we wish warm tones finally—a substratum as warm or ruddy as possible, Moreover, the more gold we can pile upon our image, without giving the image too much of the cold color characteristic of gold in fine division, the greater the chance of permanence for our image; for it is the complicated organic silver compound that causes fading, and not the gold, as may easily be proved by comparing the action of agents destructive to a print—as mercuric chloride—upon a toned and an untoned print.

Following out the above reasoning, we need have no doubt as to our operations in washing previous to toning. Some papers leave the printing frame with a ruddy color, which is accentuated on washing in water. These prints only require to be washed in plain water, till free silver nitrate is removed; three or four changes of water suffice, as a rule, to remove the silver nitrate, the last water should show no sign of milkiness, due to the nitrate, combined with salts, in the water. But these red papers are usually acid, having been "preserved" by a method entailing free acid; and as acid in the toning bath is objectionable, it is advisable to put into the second washing water a small quantity of sodic carbonate. The prints must not convey acid, nor, as a rule, carbonates, to the toning-bath. Prints that leave the printing frame violet must be reddened for a warm tone, and to insure this a quantity of sodic chloride (common salt) is put into the second washing water; but neither should this substance be allowed to get into the toning-bath. During washing the prints should be kept moving for about ten minutes in each "water," and should not be touched on the face with the fingers. After washing, the prints are conveyed separately to the toning solution. The dish containing this should be white porcelain, and of sufficient area to hold *two* prints, side by side, at least. The solution should be, at least, half an inch deep, we prefer more depth. In the "toner" the prints must be kept moving, and should be, at first, anyhow, face down.

Very many toning-bath formulæ have been suggested; as a matter of fact, the mode of using influences the results far more than the formulæ used. The temperature should not be under 65 deg. Fahr., nor over 75 deg. Fahr. We give two formulæ only, the first is the oldest of its kind, so far as we know, and we are quite certain it has never yet been surpassed for beauty of action, certainty, and keeping qualities.

1. Sodic acetate	375 grains
Water	120 ounces

Put a fifteen grain tube of "terchloride of gold" into a large bottle, break the tube in the bottle, and pour in the above solution. Ready for use after twenty-four hours, or may be made ready sooner by using the acetate solution, boiling and using the toning solution when cooled to 70 deg. Fahr. We prefer to allow the twenty-four hours to pass. This solution will keep good for any length of time, provided the gold when used up by toning, is replenished by a stock solution, which may be made as follows:

Terchloride of gold	15 grains
Water to	2 ounces

Each dram contains about one grain gold chloride, and a sheet of paper 17x22 inches will absorb about one grain of gold. We take for granted that the reader will buy his "gold" in the hermetically-sealed glass tubes on the market. It is never pure, and seldom up to announced strength, but answers the purpose when used as above.

2. Sodic biborate ("borax")	60 grains
Hot water	10 ounces
Gold terchloride	1 grain

Gives good, warm tones, but must be used at once, as it will not keep. It is, above all, important to keep toning solutions *alkaline*, distinctly, but not violently, so, and ammonia will be found as suituable as any alkali for the purpose.

If the prints tone very rapidly to a blue color, the gold is, probably, in too great quantity; the prints will lose their tone in the fixer, and the result will be fugitive. If the prints tone unevenly, the cause is either acidity, too much gold, or too high temperature. If patches refuse to tone, probably they have been touched with greasy fingers. The toning should take at least ten minutes, we prefer it to take fifteen or twenty. The prints must be kept in constant motion, and on no account be allowed to stick together, or to the side of the dish. The prints should be removed from the toner when by transmitted light they appear about the color finally desired; by reflected light there will be a trace of blue beginning to appear on the high lights. Practice alone can teach to what degree prints

FIG. 23.

should be toned; some workers tone by dull, diffused daylight, others prefer artificial light. So long as the same kind of light is used, and the color carefully noted, it is immaterial what light is used. After toning is finished, the prints are placed in clean water, but unless a little common salt is put into this water, toning is apt to continue.

Fixing is done in a solution of sodic hyposulphite one part, to water five or six parts, and the solution *must* be alkaline, and should be about 60 deg. Fahr., certainly not cooler. The prints should be moved about in the fixing solution as in the toning, and fifteen minutes at least should be allowed for the fixing. After fixing, the hypo must be thoroughly eliminated by washing. This is not so easily effected as might be imagined, for hypo sticks with great tenacity to textiles such as paper.

A great many washing machines are on the market, some good, others useless. It is important to remove the hypo as rapidly as possible, for prolonged soaking in water injures the prints. We advocate manual washing contrivances, so far as such can be carried out. If the print is laid face downward on a sheet of glass, a rose tap playing on the back, and a squeegee passed repeatedly over the back of the paper five or six times during two minutes, more hypo will be removed than by three or four hours of washing in any of the washing machines we know. Hot water removes a great proportion of hypo, but if too hot, it will alter the tone of the print. If a washing machine is to be used, it should be on the "exit-from-the-bottom" principle, as the hypo-contaminated water sinks; the prints must be kept in constant motion, and a false bottom, on which the prints may drip at intervals is an advantage. The

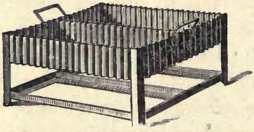

FIG. 23*a*.

old circular porcelain washing-dish answers our description as well as any; we use ourselves a large wash-tub arranged on the same principle. The change of water should be constant, and its current circular, so as to cause the prints to keep traveling around the machine. If running water cannot be used, frequent changes, with intermediate spongings, must be used in default. Our figure 23 shows a very good washing machine, and 23*a* shows a rack for holding glass plates in the same machine.

A sufficiently accurate test for hypo remaining in a print is starch iodide, prepared by adding to "tincture of iodine" a little starch dissolved in boiling water. This will give a dark blue liquid, to which water is added till the color is *very* pale blue. Touch the back of the print with blue solution; if hypo is present the blue will be dispelled; if there is no trace of hypo, the color will remain. If a print is *mashed up* in water, and the above test made with the water, the test will be more conclusive.

The washing being finished, the prints are dried between sheets of pure blotting-paper, or in any convenient way. Before they are quite dry they should be rolled, albumen side outward, round a cylinder of wood or cardboard, and kept so till quite dry, they will then leave the cylinder with a fine surface-gloss.

Blisters, large or small, sometimes appear on prints in the first water after fixing. Small blisters presenting a pretty hard surface usually disappear and do not finally damage the prints. The large, soft blisters always spoil prints, and, once they appear, seem to be incurable. To avoid both kinds: Let the first water after fixing be tepid. Add a little common salt to the first water after fixing. Add a little alcohol or ammonia liquor (ten drops to each half-pint of fixer) to the hypo solution. If these fail to prevent blisters, which appear on double albumenized paper, but not, within our experience, on ordinary albumen paper, wait for a change of weather; failing all these, reject the sample of paper.

Prints Yellow, where they ought to be white, are produced by keeping the paper too long after sensitized before printing, or after printing before toning.

Metallic Spots are due to impurities, probably iron, in the paper, or in the blotting-paper used at some stage.

Bronzed Shadows and *Violent Contrasts*, if the negatives are not at fault, point to over-strong sensitizing bath.

Want of Contrast, if not due to the negative, is due to a weak sensitizing bath.

The *Mounting* of prints hardly comes within our scope; we shall confine ourselves to saying that the mounts must be above suspicion of matter deleterious to the prints, and the mountant or adhesive substance used must be neither hygroscopic nor liable to turn acid. India-rubber solutions lose their adhesiveness after a time; *fresh* starch solution, and gelatine dissolved with an antiseptic such as thymol is often used. Good glue seems a favorite mountant with professional mounters. Mr. Alex. Cowan's ingenious method of mounting dry is well worthy of notice. Mr. Cowan applies starch to the back of the prints when damp, and thereafter allows them to dry. He damps the mount and not the print—which obviates the distortion due to stretching produced by wetting the print—and he lays and arranges the dry print on the dampened mount, then passing the whole through a rolling-press.

To Enamel Prints.—Coat a clean and talced glass plate (see page 106) with plain collodion; wash when set; lay the plate face up in a hot solution of: Gelatine (white), one ounce, water, ten ounces. Immerse the print face down in the same solution for a moment, then bring plate and print in contact out of the solution; squeegee the back of the print, using a rubber cloth between print and squeegee. Avoid air-bells; allow to dry. Cut round edges and strip. A very high gloss will be found on the print, if it was quite dry before stripping.

If it is desired to mount the print, this must be done before stripping, by placing a sheet of thin cardboard at the back of the print while it is on the glass plate, and still damp with gelatine solution. The cardboard itself may be laid for a moment on the gelatine solution before being placed in contact with the print, and to prevent the cardboard springing away from the print, a flat board may be laid on the top of the card and a weight placed on the board.

To Mount a Print in "Optical Contact" with Glass.—The glass should be free from scratches and as clear as possible. It is not talced nor collodionized, but the print is fastened to it with gelatine solution as for the enameling process.

After prints on albumen paper (not enameled) are mounted, they are usually passed through a hot "roller" or "burnisher," in order that they may have a certain amount of gloss.

The process of rolling calls for no remarks.

CHAPTER XXII.

PREPARATION OF NEGATIVES FOR PRINTING, COMBINATION PRINTING, VIGNETTING.

(Though many of the remarks in this chapter apply to all printing processes, we insert them in this place chiefly on the score of convenience to our readers and ourselves).

It must not be taken as a matter of course that the washed and dried negative is there and then ready for the printing frame. In some cases it may not be capable of improvement, but in many cases some manipulation is necessary, and in most cases the negative may be greatly improved by manipulation. Leaving alone the vexed question of "retouching," we may at least point out the immense value of manipulating *masses* on the negative. Weak foregrounds may be strengthened, glaring distances may be toned down, balances of light may be introduced, and to the artistic eye many improvements may suggest themselves which may be carried out by a little simple manipulation, and against which there is assuredly neither law nor reason. For such purposes as these, besides the processes of intensification and reduction, general or local, already mentioned, we may suggest a few dodges that may be used for making the best of negatives not quite perfect when completed by the processes already described.

To strengthen either locally or generally a finished negative, a film of a material more or less non-actinic may be used. For such a purpose the plate may be covered on the back with a coat of collodion or varnish containing a yellow dye, as *aurantia ;* the whole of the back is first coated in the usual way, and from the parts, if any, that are dense enough the film is scratched away. "Mat varnish" may be used in the same way, with the additional advantage that this medium takes very freely any ground pigment, as plumbago applied with a soft "stump," or even with the finger, or a pad of wool or cloth. A formula for mat varnish is to be found among our formulæ at the end, but it may be bought ready made at any dealers. A backing of any translucent or yellow-colored medium undoubtedly causes the negative to yield, with any contact printing process, a print more brilliant than without the backing would be obtained; but, perhaps, the amount of advantage gained by this proceeding has by many been overrated.

Printing in a strong light certainly yields prints of less vigor than printing in a subdued light; hence, an over-dense or "hard" negative should be printed in sunlight rather than in diffused light, and near a strong light rather than a weak one in printing processes where artificial light is used. (There are, however, exceptions to the latter part of the last sentence.) A very thin, weak negative printed in diffused light, or under ground-glass or tissue-paper or yellow glass, will undoubtedly yield a "pluckier" print than the same negative printed in the straightforward way.

What is called "double" or "combination" printing is in some hands carried to a point of great excellence; we do not propose to deal with it except in one phase—that of printing clouds from a separate negative over a view already printed from an ordinary landscape or architectural negative. A plain, white piece of paper intended to represent the beautiful canopy that stretches over our heads in nature, is an insult to artistic ideas seldom perpetrated nowadays. But incongruous, inappropriate or impossible clouds over a landscape is an insult still more gross than the white paper, and such carelessness as printing clouds on the top of architecture, trees or hills is unpardonable.

To make a cloud negative no special process is required. A slow plate and a rapid exposure coupled with a fairly restrained developer will insure a good cloud negative. The negative should not be made by any means dense, unnecessary density simply entails more trouble in printing. Of course, clouds must be chosen of a nature and in an aspect likely to be useful for the purpose for which they are intended. Very stormy clouds can very seldom be used, simply because landscapes are very seldom photographed in very stormy weather. Clouds with the sun right in the middle, whether the sun is seen or only suggested, will be of use only for landscapes taken with the sun right in the front of the lens, which is a matter of rare occurrence. Clouds such as found right overhead in the zenith are not likely to be appropriate for printing close to the horizon, any more than clouds characteristic of the ocean are likely to be suitable for inland scenery. Still more emphatically, clouds lighted from the left are not adapted for printing over a landscape lighted from the right, though we have seen a "gold medal" attached to a picture so composed.

Clouds are best photographed on the level, if possible; the less the eminence from which they are taken the better as a rule. But sometimes there is no choice.

If the original sky of the view negative print any degree beyond a pale gray, the sky will require to be "blocked out" with opaque paint of some kind. A pale gray horizon over a landscape is better than a hard, chalky white for our purpose, but anything darker than pale gray will require blocking out. If the gray is a shade darker than it ought to be, a cloud negative presenting considerable contrast may be chosen, provided it is otherwise suitable. As a rule, a very chalky sky means an under-exposed negative.

The blocking out may be done on the face of the negative with a solution as thick as possible of vermillion water-color paint or India ink.

Opaque material is, we believe, sold for this and similar purposes. So long as the landscape horizon presents a sharp line there is no difficulty for a steady hand, but if tree-branches project into the sky the operation becomes more difficult. Branches are best blocked out not by straight lines, but by "dabs" or stippling on the back of the negative. Practice alone will teach this. Very intricate architectural lines are often puzzling, but care and practice will enable us to block them out perfectly.

In our last chapter we showed the usual manipulation of printing by contact, and the reader must have a certain amount of practice in ordinary printing before he attempts, or is likely to wish to attempt, combination printing.

The landscape being printed by a printing-out process, and visible, as in the albumen paper process, or partially visible, as in the platinotype process, a suitable cloud negative is selected and placed face to face in a suitable position with the landscape print, which has the sky white, or nearly so. The two are then laid in a printing frame together, the cloud negative undermost, the frame is then closed in the usual way. If the cloud negative be not too dense, or the landscape sky not too dark, the shape of the cloud will be distinctly seen from the front of the frame, and the horizon line of the landscape will be easily recognized. The frame is laid face up in the usual way for printing, and the landscape is entirely covered with a *limp* opaque cloth, as velvet. When the horizon of the landscape is a sharp line, as of hills, the difficulty is slight; where the outline is jagged, the operation requires more skill. To avoid a hard line the upper edge of the velvet must be constantly moved if the printing is done in sunlight, frequently if in diffused light. The cloud picture is to be graduated or "vignetted" down to the landscape. Where there is a dark mass already printed against the sky, as in the case of heavy foliage, the mass may be practically disregarded, as that part, being already dark, any clouds in the negative coming over it cannot naturally be printed, the paper being already printed in these parts. Thus, where dark tree-branches come against the sky, the cloud may, in many cases, be printed right over and branches; if this is well done, the result is very natural the satisfactory.

"*Vignetting*," or graduating the margins of the picture instead of printing the subject dark to the edge, is performed in various ways. Glasses are sold with their centre white, and graduated in an oval or pear shape to a red edge. When these are well made they give a very good vignette. The usual way, however, is to cut out of a piece of cardboard, sheet lead, zinc, wood, or other opaque material, an opening of the desired shape and approximately the desired dimensions. The inner edges of the "masks" are serrated and the printing is done with the mask an inch or two in front of the negative. A piece of tissue-paper is usually placed over the aperture in the mask to insure better gradation. Vignette printing is done in diffused light, and the further the mark is away from the negative the softer the gradation. The "vignette" is a style highly popular for portraiture, and is well suited to many landscapes, though much less used for that class of subject.

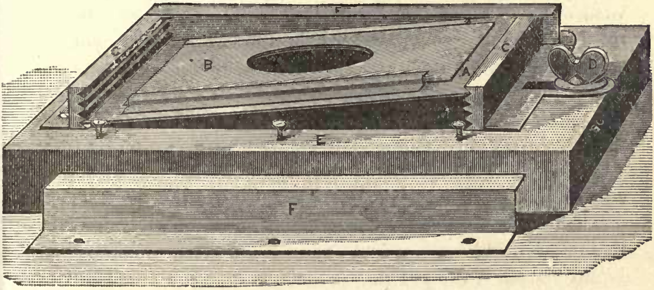

FIG. 24.

We figure an arrangement that will enable one to produce and to vary vignettes almost at will, and with a very little practice.

CHATER XXIII.

PRINTING OF PLAIN SALTED PAPER.

This is an old process, which has, unfortunately, gone somewhat out of use of late years; but none the less beautiful results can be got with it, and though it seems difficult to get a certain class of tone—engraving black, or very dark blue—still if the process were worked by many persons, there would be a chance of some one lighting on a system by which perfect tones of the desired kind could be obtained. As it is, very beautiful tones can be got, and we hope to see the process receive more attention in the future than in late years.

The paper used for albumenizing is eminently suited for this process, but any good wove paper will answer the purpose. It must be sized and salted. A formula found in "Hardwich's Photographic Chemistry," 5th edition, page 311, will suit all purposes. The paper (Saxe) is floated upon the following solution:

Ammonium chloride	60 grains
Gelatine	20 grains
Water	20 ounces

Dissolved by heat and filtered when cold.

Mr. Otto Schölzig, of London, favors us with a "size," which will be found splendid for an ordinary silver nitrate sensitizing bath. The ammonia-nitrate bath, which is recommended later, may dissolve the albumen, though in our hands it did not do so.

Sodic chloride	250 parts
Citric acid	10 parts
Irish moss	50 parts
Gelatine	20 parts
Albumen	500 parts
Water	2000 parts

The paper having been floated, face downward, on one of the above sizing and salting baths, is hung up to dry. The *back* of the paper may be recognized by the faint "crapy" marks due to the gauze on which the paper is laid to dry after its manufacture.

The sixty grain bath of silver nitrate as given for albumen paper will answer equally well for this paper.

Paper sized by our first formula (Hardwich's) may be sensitized on an ammonia-nitrate bath. A sixty grain solution of silver nitrate is taken and "converted" as described on page 61. Other operations are the same as for albumenized paper. After the plain silver nitrate bath, the paper may be floated, when only surface dry, face upward, on a bath of citric acid five parts, water one hundred parts. This will preserve it for a long time.

With plain paper the printing has to be considerably deeper than with albumen paper. Washing is conducted on the same principles; the ammonia-nitrate paper will probably require salt in the washing water.

Any good toning solution will answer for plain paper, but to get fine tones, as nearly as possible approaching black, the following toning bath is recommended.

Sodic tungstate	20 grains
Sodic phosphate	20 grains
Boiling water	3 ounces

Dissolve and add

Gold terchloride	1 grain

Allow to cool, then add

Water	5 ounces

The toning and fixing bath given as a toner for gelatine chloride paper, in next chapter, will also answer admirably for plain salted paper.

CHAPTER XXIV.

GELATINE-CHLORIDE PAPER FOR PRINTING-OUT.

Paper coated with an emulsion of silver chloride in gelatine, in the presence of a certain proportion of an organic silver salt, has found its way on to the English market. This class of paper will be found highly suitable for certain negatives and certain effects. Though the papers have reached us under two names, the preparation and qualities seem to be practically the same, certainly the same treatment answers both samples. Very thin negatives will be found to give better results on these gelatine chloride papers than on albumen or plain salted paper; and with very little trouble a very high gloss can be given to the finished prints. When so glazed the paper renders shadow detail in a remarkably perfect manner.

The printing is done by contact in the usual way, printing being, if anything, rather more rapid than with albumen paper.

The toning bath recommended for Dr. Liesegang's gelatine-chloride paper is his own.

Water	24 ounces
Sodic hyposulphite	6 ounces
Ammonium sulpho-cyanide	1 ounce
Saturated solution of potash alum	2 ounces

Dissolve, place in this solution some scraps of gelatine-chloride paper for twenty-four hours. Filter, and add:

Water	6 ounces
Gold terchloride	15 grains
Ammonium chloride	30 grains

This bath tones and fixes at the same time. No washing is required previous to immersion in this bath, nor fixing after it. The color during progress of toning must be judged by transmitted light; reflected light is here no criterion.

Herr Obernetter's paper will probably be found to work better with the following toning bath, followed by the usual fixation in hypo :

Ammonium sulpho-cyanide	140 grains
Sodic phosphate	140 grains
Sodic tungstate	100 grains
Water	24 ounces

Dissolve, place in the solution scraps of the paper as before, filter and then add:

Gold terchloride	15 grains
Water	4 ounces

Examine during toning by transmitted light (*i.e.*, by looking *through* the print) and tone to a fine rich brown or a purple blue, as desired. A solution of hypo one part, in water ten parts, is strong enough for fixing. After fixing and washing, the prints may be allowed to dry hanging up (*not* between sheets of blotting paper), in which case they will have a good medium surface; or they may be squeegeed to talced glass and stripped when dry, when they will have a very high gloss.

CHAPTER XXV.

CONTACT PRINTING ON GELATINE-BROMIDE PAPER.

This fine process has, during the last few years, thanks in a great measure to the perfection to which it has been brought by certain firms, gained a firm hold on public esteem. Certain marked and undeniable qualities in the product turn the balance strongly in favor of this process, as compared with all other processes where silver salts are used. There is no free silver nitrate to form suspicious or objectionable compounds with organic substances; gelatine is safer in the matter of sulphur compounds than albumen, even were free silver nitrate present to combine with the gelatine. The rapidity with which a single print, or a "long number" of prints may be produced, is far beyond that of most other processes. The latitude in quality of negatives is far greater with this process than any other, a good print may be made from a negative practically unprintable by any other process; lastly, the results are in artistic quality inferior to no process of pure photographic printing at present known. The chief disadvantage of the process is—and it is a serious one—that the image is invisible until developed, so that no combination printing can be effected without rather intricate and, at the best, uncertain operations and apparatus. It may also be put down as a failing that the progress of printing is invisible and that some experience is required before even decent results are obtained, but those who have had a little practice will probably spoil as few sheets of paper by this process as by any other.

A *good* sample of bromide paper is coated with a very thin layer of fairly rapid emulsion, containing a large proportion of the silver haloid. The thin layer is necessary to prevent the paper from curling in aqueous solutions, and the large proportion of silver is needed to give pluck to the very thin film. On account of the thinness of the film, and in spite of the large quantity of silver in the film, it will be found that there is but little "latitude" in exposure; and timing must be pretty nearly correct for our developer, or we shall fail to produce a satisfactory result. But a little practice and care will enable the worker to judge almost by intuition the exposure necessary for any particular negative, provided that the light used be always the same in actinic quality and visual intensity. On account of this important *proviso* artificial light is to be strongly recommended, if not insisted upon. It does not much matter what the radiant is, provided the light be constant and equal at all times. An oil lamp, always turned up to the same point, or a "regulating" gas burner will be found most suitable. Another point, which, if disregarded will introduce even more uncertainty and risk of failure than the light, is the *distance* from the light to the negative. Here the oft-quoted law comes in, that the intensity of light varies inversely as the *square* of the distance from the radiant to the recipient. If the correct exposure at two feet be twenty seconds, at eight feet it will be three hundred and twenty seconds, not eighty seconds, as some may suppose. Or if the correct exposure at two feet be twenty seconds, and if, by mistake, we expose at three feet instead of two feet, we shall under expose just two and a half times, as $2^2 : 3^2 :: 20 : 45$, forty-five seconds being the exposure required at three feet to correspond with twenty seconds at two feet.

Regarding exposure, a few general rules may be useful, but it must be remembered that they *are* general, and have exceptions:

The denser the negative the more the exposure required, and *vice versa*. Practically this has no exception.

Long exposure leads to softness, harmony, flatness.

Short exposure tends to brilliance, pluck, hardness.

Strong development gives pluck, contrast, hardness.

Weak development gives harmony, softness, effeminacy.

Strong restrainers lead to pluck, brilliance, hardness, bad color and want of detail.

These rules do not cover all circumstances; for instance, a long exposure coupled with a too strong developer would give flatness or fog in place of brilliance; but, given two prints of the same negative equally and normally exposed, a strong developer will yield a pluckier image than a weaker developer.

The standard or stock solutions for ferrous oxalate developer are saturated solutions of ferrous sulphate and potassic oxalate as given on page 91. As a rule the iron solution should bear a less proportion to the potassic oxalate solution for bromide prints than for development of negatives. And a small proportion of soluble bromide is to be recomended for development of bromide prints. A *strong* normal solution may be prepared thus:

A.	Potassic oxalate saturated solution	4 ounces
	Potassic bromide, 10 per cent. solution	25 minims
	Iron sulphate, saturated solution	1 ounce

A *weak* normal solution:

B.	Potassic oxalate, as above	6 ounces
	Potassic bromide, as above	25 minims
	Iron sulphate, as above	1 ounce

A *very weak* solution:

C.	*B* solution	2 ounces
	Water	2 ounces

We are now in a position to put into practice the principles laid down in the last page or two. If we have an average density negative we may make from it a plucky, brilliant print by infra-normal exposure and sharp development; or we may give our print a soft, harmonious character, by full exposure and a developer such as *B*. A "ghostly" negative, such as would be unprintable by any other process, may be exposed behind a sheet of ground or opal glass, the exposure being kept down and developer *A* being used, a little extra bromide being added if required. A "chalk and soot" negative will be best treated by very prolonged exposure followed by a weak developer as *B*, or in aggravated cases, by a watery developer as *C*.

When the exposure has been too short, a trace of sodic hyposulphite may be added to the ferrous oxalate developer; but it must be only a trace, and at the best it is a dangerous experiment, and one we do not recommend. It will be found better to make a fresh exposure, putting the spoiled sheet of paper among the residues.

After development, which must not be carried too far, the paper should be washed in acidulated water, not in plain water, least of all in ordinary tap water containing lime. Half an ounce of acetic or citric acid added to a quart of water will be found sufficient; the quantity does not matter so long as the reaction is acid and the acidity not strong enough to damage the gelatine. After two or three rinsings in acidulated water, which enables the iron to be washed out, the print is washed in plain water so that acidity may not be communicated to the fixing bath, which is the usual solution of sodic hyposulphite alkalized and requiring no special remark.

The ferrous oxalate developing solution may be used repeatedly while fresh; by certain workers a previously used solution is stated to give the best results. We have not been able to verify this statement, and this practice introduces an element of uncertainty which, for beginners, might prove puzzling.

The hydrochinon developer has, in our hands, with Eastman's bromide paper, given the very finest results, and we recommend this developer especially for beginners; provided the exposure has been sufficient and not outrageously overdone, the action of the developer is so even that nothing but attention is required to stop development at the proper stage in order to obtain grand results. The formula given is practically that given by Mr. B. J. Edwards for lantern-slide plates.

Mix in the following order:

Sodic sulphite	2 ounces
Water	20 ounces
Hydrochinon	30 grains
Sodic carbonate, "pure," but not "dried"	3 ounces
Potassic carbonate	3 ounces
Potassic bromide	40 grains

There may be a difficulty in causing solution of all these in the water unless the water is hot. The water may be divided into two quantities, the sodic sulphite, hydrochinon, and bromide being dissolved in one part, the other salts in the other part of the water. The solutions in this state will keep a long time and may be mixed in equal parts for use. But the hydrochinon must be reasonably fresh when dissolved, as it does not keep very long. When over-kept it acquires an unhealthy brown appearance in the dry state.

Sepia or brownish tones may be obtained by alkaline pyro development, though no very great measure of success has as yet attended this system. The following will be found fairly suitable:

Pyrogallol	1 to 2 grains
Water, with a trace of citric acid	1 ounce
Ammonia	2 minims
Bromide	3 grains

The prints must remain in the fixing-bath of hypo one part, water five parts, alkalized, for about fifteen minutes, and on being put into this bath, they must be immersed at once, and not unevenly acted upon by the hypo. The time allowed for fixation *must* be ample, and the solution *must* be alkaline, otherwise the claim for permanence of result will surely be falsified.

The manipulations of development call for few remarks; the prints should be soaked in clean water, air-bells being removed before development. This is simply to make them lie flat in the developing dish, which should be flat, and, preferably, white. In all cases where the ferrous oxalate developer is used, the iron solution is to be poured into the oxalate. If it is desired to keep the mixed solution, the bottle figured and described on page may 92 be used.

Washing and Drying Bromide Prints.—The same principles as we stated for washing albumen prints hold good here. Washing machines may be used, but are inferior to manual labor, and the use of the rose-tap and squeegee. (See page 130.) If any trace of discoloration of the high lights be observed after fixing and washing, the prints may be immersed in a saturated solution of alum with a little hydrochloric acid. After this they must again be carefully washed. If blisters occur after fixing, a little common salt added to the first washing-water will prevent a recurrence.

Bromide papers are sold usually in three qualities: No. 1, a fine paper with a smooth-surfaced film; No. 2, a heavier paper with a smooth surface; No. 3, a heavy paper with a rough surface. Prints on No. 3 should be allowed to dry spontaneously; those on Nos. 1 and 2, if dried spontaneously will have a very good smooth surface, but if squeegeed to talced glass or polished ebonite, and stripped when dry, will have a high gloss. To produce a very high glaze, a talced plate may be collodionized and washed, and used as given elsewhere.

Mr. H. Senier, of London, England, has produced warm tones in bromide prints by developing the prints after exposure in the usual way with ferrous oxalate, then bleaching the image out with chlorine water and re-developing in daylight with ferrous oxalate.

Bromide prints may be mounted by appplying to the back while they are drying on their ebonite or glass support sheets of thin cardboard, the mountant being starch, to which Messrs. Fry & Co., of Richmond, recommend the addition of a small quantity of lump sugar.

Opal plates bearing gelatine-bromide emulsion for this purpose may be treated in the same way as paper.

The last outcome of Eastman ingenuity is a process called "Transferotype." This is simply a stripping film of gelatine-bromide emulsion suitable for printing. The film of emulsion is said to be not over one five-thousandth of an inch thick. The prints are developed in the usual way. After washing they are squeegeed to opal plates prepared to retain the film permanently; the paper is removed by hot water, and the result is an opal positive of a quality that only requires to be seen in order to be appreciated. In this process two things are to be guarded against—over-exposure and over-development. (See remarks on Transferotype for Lantern-Slides, page 180.)

CHAPTER XXVI.

RAPID PRINTING PAPER.

About 1884 or 1885, a printing process was introduced, which came to be called the "rapid printing process," because it was more rapid than the printing-out processes commonly used at that time. The paper is coated with very slow gelatine bromide, or chloride, or chloro-bromide emulsion. The exposure is very long compared with other silver printing processes by development, and development produces a red image amenable to toning.

A bright yellow light may be used in the operating room, and exposure may be one or two seconds to daylight, or several minutes to artificial light. As a rule, the printed instructions mislead the worker into giving too short exposures.

The developer may be ferrous oxalate, very weak, and containing chloride, and sometimes a citrate. The following will serve as an example.

a.	Potassic oxalate	2 ounces
	Ammonic chloride	40 grains
	Water	20 ounces
b.	Ferrous sulphate	4 drams
	Citric acid	2 drams
	Water	20 ounces
c.	Ammonic bromide	1 ounce
	Water to	4 ounces

Developer.

a.	1 ounce
b.	1 ounce
c.	2 drams

Before development soak in water till the prints lie flat, and care must be taken not to over-develop. To prevent development going on after the prints are removed from the developer, they are put into water containing a good dose of common salt. A black tone after development proves insufficient exposure, and will, of course, prevent toning. After several changes of water, the prints are put into a concentrated solution of potash alum, and again washed, after which they are toned in

Sodic acetate	30 grains
Lime chloride (fresh)	3 grains
Gold terchloride	1 grain
Water	5 ounces

After toning, the prints being washed, are fixed in a one to ten alkaline hypo solution.

The prints may be, as suggested by Mons. Warnerke, toned and fixed in one bath. To do this, make the fixing-bath one to three, and add to every five ounces, one grain gold terchloride.

The prints may be dried, squeegeed to talced glass, or allowed to dry in the ordinary way.

CHAPTER XXVII.

PLATINOTYPE OR PRINTING IN PLATINUM.

THIS process is one daily gaining ground in public favor, and not without reason, for not only are the results of a beautiful and artistic character, but the process carries with it a prospect of permanence almost beyond the scope of reasonable doubt. This must not be taken to mean that a platinotype print is indestructible as to the image any more than as to the paper; but it may safely be asserted, and by one of the writers it has been tolerably clearly proved, that only tests utterly unlikely to occur in the ordinary treatment of any print will spoil or even affect a properly prepared platinotype print. The prints have a character in the shadows not vouchsafed to other processes of photographic printing, and the manipulations though requiring care in certain respects are perfectly simple. The chief disadvantage of the process, if it is a disadvantage, is that the negatives to be printed require to be of something rather better than average quality, a long range of gradation being almost a *conditio sine qua non* for a good print.

The image is composed of platinum presumably in the metallic state. The process was invented by Mr. W. Willis, Jr., of London, and is protected by letters patent in England and in America; a license is granted on nominal terms for working the process, and the materials requisite are supplied by the Platinotype Company. Indeed, it is little probable that anyone not an experienced chemist would be able to produce the chemicals himself, and even the paper has to be prepared in a special manner. The most complete work on the subject is by Pizzighelli and Hübl. ("Platinotype," by Capt. Pizzighelli and Baron A. Hübl, translated by the late J. F.

Iselin, M.A., and edited by Capt. W. de W. Abney, R.E., F.R.S. London: Harrison & Son, 59 Pall Mall.)

Organic ferric salts are by light reduced to the ferrous state, and these ferrous salts in solution reduce to the metallic state certain metallic salts, notably those of platinum. Paper treated with ferric oxalate and potassic chloro-platinite is exposed dry to light. The ferric oxalate becomes ferrous oxalate, which is soluble in potassic oxalate in solution. The exposed paper being treated with a solution of potassic oxalate the ferrous oxalate is dissolved, the potassic chloro-platinite is reduced, and metallic platinum is deposited in very fine division, its color in that state being black. The amount of platinum reduced is proportionate to the amount of light-action.

Evidently this is a development process; it is also to a certain extent a printing-out process, for the printed image is partially visible before development, and, as shown later, the process may be worked as one entirely of printing-out. The following important consideration should noticed. In a print-out process the reduction to the metallic, or at least to the visible state, takes place absolutely *in situ;* as the light action proceeds the deposit is piled up in the shadows; in a development process such as we are describing, the salt is being dissolved as the metal is being deposited, so that we may look for less "blocking up" in the shadows where the reduction is most energetic. We are informed on the best authority that a platinum printing-out process was worked as early as 1873, but rejected on account of this very blocking up of the shadows.

The Practice of the Process.—The paper for platinotype printing may be bought ready-sensitized, in which state under conditions to be stated presently, it will keep good for a long time—for a month, at least. The necessary conditions for keeping the paper are: Protection from actinic light and protection from *damp.* The prepared paper is in a high degree hygroscopic, and the slightest excess of damp to the paper will ruin it. To preserve the paper from both light and damp, a "calcium tube" is used. This is a cylinder of metal, capped at each end, and in one of the caps or lids is a perforated chamber containing calcic chloride, which attracts to itself all moisture, and so keeps the paper dry. Usually asbestos is impregnated with the calcic chloride, and when after a time the asbestos becomes a damp mass, it is put on an iron shovel or plate over a fire and the damp driven off by heat.

The Company also sell the paper and the sensitizing materials separately, and this is useful for those who work the process on a very large scale or only on rare occasions. Moreover, by varying the proportions of sensitizing ingredients, better results may be got from negatives of varying qualities.

The platinum salt is sold in the solid form, the iron as two separate solutions, which are to be mixed in various proportions. We do not know the precise constitution of these two solutions, which are simply marked "A" and "B," so we can only quote from the Company's printed instructions. By increasing the proportion of "A" to "B," half tone is lessened, so that a large proportion of "A" is suitable for weak, thin negatives. *Vice versa*, increasing the proportion of "B," gives a solution more suitable for hard negatives. An average mixture may be:

A	1 part
B	5 parts

Of such a mixture 1 ounce may be used to dissolve 60 grains of the dry "platinum salt," but this complete sensitizing mixture will not keep above half an hour, and in hot weather not above ten minutes. On no account must heat be applied to effect solution, stirring with a glass rod being sufficient to cause solution of the platinum salt. The paper is pinned to a flat board, and the sensitizing solution quickly spread over the paper with a perfectly clean sponge or pad of flannel. For each square foot of paper about 80 minims of sensitizing solution will be required. The solution is poured right on the middle of the paper, and immediately spread over the whole surface. It may be necessary to work in dull daylight, as by yellow light it is difficult to see to spread the yellow solution properly, but each sheet when coated must be at once removed to non-actinic light, and the sponge or pad must be frequently washed. Platinotype paper is, in the first place, much more sensitive to light than albumen paper (as two or three to one), and in the next place, light hurts platinotype paper more than albumen paper, for any slight veil contracted by the latter before toning is removed by the toning and fixing-baths, which is not the case with platinotype paper, with which there is no analogous "clearing" action. Platinotype paper should be dried in a room with a stove or open fire, and the room must be lighted non-actinically, if at all; the drying should be arranged so as to take about ten minutes. When apparently dry, the paper should be held near the fire for a minute to drive off all trace of moisture. It is then placed in a calcium tube and kept absolutely dry. Damp is probably by far the most frequent cause of failure with this process.

Printing is performed by daylight and contact, and special precautions should be taken against damp. The frame pads should be well dried, and a sheet of India rubber should not only cover, but overlap the platinotype paper in the frame. The printed image is of a peculiar yellow orange color, with a tinge of green in the deepest shadows. When the printing of an average negative is finished, the very highest lights are not visible, and the shadows present a color not easily described. Practice is the best, and, indeed, the only guide to correct judgment of printing. The print should not be *too* frequently examined, on account of the danger of both light-effect and damp. When the printing is finished the paper is placed in a calcium tube as before.

Development.—Make a saturated aqueous solution at 60 deg. Fahr. of potassic oxalate, rendered distinctly acid with oxalic acid. (The Company, it appears, now recommend a faintly alkaline solution.) Heat the solution to about 140 deg. Fahr., more or less, according to considerations to be pointed out presently. An enameled iron flat dish is the article generally used to contain the solution, and a Bunsen or other burner is placed below it to keep the solution up to temperature during the process. The prints are immersed in the solution for five or six seconds, or they may be pulled slowly through the solution; the image starts up in black suddenly. Air bells should be avoided, but if they occur the sheet must be replaced for a moment or two in the solution, and, as a rule, no harm will be found to result from the air bells if this be done.

The temperature of the bath is regulated chiefly by the amount of printing. An over-printed proof may be developed in a cooler solution, as 120 deg. Fahr. An under-printed proof will be saved by a higher temperature, as 180 deg. Fahr. But the best results are got by arranging the printing so that development will be performed at about 140 deg. Fahr.

After development the prints *must not* be placed in plain water, but in:

Water	60 parts
Hydrochloric acid	1 part

If, on immersion of the prints, this solution becomes milky, the acid is too weak. After a few minutes in this the prints are removed to a second bath of the same constituents, and after a few more minutes into a third. The last bath should not show the slightest tinge of yellow. After the third bath the prints are to be washed for about ten minutes in running water, when they will be ready for drying and mounting.

Sepiatones on platinum prints. The Company sell paper specially prepared, and a developing solution also prepared by special methods, the nature of which is not published, for producing a sepia tint. Borlinetto claims to produce a sepia tone by using a *cold* developer:

Saturated solution, potassic oxalate, as above	40 ounces
Oxalic acid	200 grains
Saturated solution of cupric chloride, as above	4 ounces

The prints may remain some time in this solution, as long as twenty minutes if necessary.

Pizzighelli's latest platinotype experiments. This able worker goes upon two leading principles: 1st. To prevent the sensitive substance from sinking into the paper; this he does by using a "vehicle" such as gum arabic or arrowroot. 2d. To combine with the sensitizer, from the very first, a developing solution. This he does by adding to the original potassic chloro-platinite a quantity of neutral ammonia-ferric oxalate or sodium-ferric oxalate. The processes for preparing these ferric oxalate solutions are too intricate for us to follow here.

With paper prepared in this manner we have several alternatives. The picture may be printed right out. It may be printed nearly out, and the print left in the dark to complete the printing, for "the reduction of platinous chloride, once introduced, is continuous in the dark." Or the partly printed out image may be developed by

Saturated solution of sodic carbonate	5 parts
Distilled water	100 parts

Lastly, the paper may be used exactly as ordinary platinotype paper. In all cases the "clearing" is performed as given above.

Any negative which will give a thoroughly good print on albumen paper will give a good platinotype print. The qualities essential to the negative for this process are fair density, and *long scale of gradation* from high-light to shadow. The dried prints do not "cockle," and the mounting needs no special notice.

CHAPTER XXVIII.

THE CARBON PROCESS, OR PIGMENT PRINTING.

If gelatine is exposed to light in presence of certain chromates, the chromate is reduced, chromic acid liberated, and the gelatine thereby rendered insoluble. If a finely-ground pigment be incorporated with the gelatine, the pigment will remain in the insoluble gelatine when the soluble is washed away, and an image consisting of pigmented gelatine will be the result. These are the fundamental principles of the carbon printing process.

Carbon tissue, as prepared for this process, consists of paper coated with gelatine, containing in intimate mixture certain pigments, and containing also a certain proportion of some such substance as sugar, to prevent the dried tissue from being too hard and brittle. The tissue is sometimes sent out sensitized, but it is better for the worker to sensitize it himself, unless he proposes to use his sensitized stock at once. The unsensitized tissue will keep indefinitely.

The tissue is sensitized in a solution of potassic bichromate, rendered alkaline with ammonia. The alkali increases the keeping qualities of the tissue, but perhaps makes the printing slower. A normal bath may be:

Potassic bichromate	1 ounce
Water	20 ounces
Ammonia, at least	1 dram

but not more than will change the reddish color of the bichromate solution to yellow.

In very hot weather and for very thin negatives the proportion of water may be greatly increased (say to 50 ounces for 1 ounce of bichromate), and for very hard negatives the solution may be more concentrated (as 7 ounces of water to 1 ounce bichromate.) In very hot weather as much as 30 per cent. of the water may be replaced by alcohol.

Apparatus required for sensitizing: A flat dish of porcelain, glass, zinc or papier maché, a sheet of glass larger than the sheet to be sensitized, and a squeegee. The solution to be about an inch deep in the dish, and the tissue to be *immersed* in the solution. If air bells form they are to be brushed away at once. The solution should be of moderate temperature, not over 60 deg. Fahr.; the colder the solution the longer the time of immersion, four or five minutes may be taken as an average time. After this time the tissue is laid face down on the glass plate, and the back squeegeed to remove surface moisture. The tissue is then removed from the glass, and dried in the form of a bow, face outward and upward, in a place absolutely free from noxious fumes, as of combustion of gas. The tissue is "insensitive" while wet, but is better dried in non-actinic light. When a brown discoloration is seen in the sensitizing solution it should be rejected.

Tissue, immediately after it is dry, prints somewhat slowly with strong contrast. As the tissue is kept after sensitizing it prints more and more quickly, giving even increasing "softness" till at last it passes into a state of fog and insolubility. If the tissue be kept dry it ought to remain workable for seven or ten days after being sensitized, and a large proportion of ammonia in the sensitizing bath conduces to this quality of keeping.

Mr. H. J. Burton has suggested an excellent method of sensitizing carbon tissue. He lays the tissue flat on clean blotting paper and sponges on to the *back* a very strong sensitizing solution.

Potassic Bichromate	4 ounces
Liq. Amm. fort	1 ounce
Water	20 ounces.

Mix the ammonia and the water, grind up the bichromate and dissolve in the mixture. The tissue by this process may be used much sooner, in hotter weather without fear of solution of the gelatine, and the face of the tissue is kept cleaner.

Before printing, a "safe edge" must be put round the negative, or, more accurately, round the edges of the sheet of tissue, though the safe edge is usually attached to the negative. Black varnish may be painted round the edges of the negative with a brush tied along a slip of wood, the wood acting as a guide along the edges of the negative; or a mask or yellow paper may be used, absolute opacity of the safe edge is not desirable. If the safe edge is omitted and the extremities of the tissue left unprotected, mischief will surely happen later.

The progress of printing cannot be gauged in the usual way, for no visible image is produced by light alone. We have therefore to judge the time necessary by comparison with some sensitive substance yielding a visible image by light action. Sensitized albumen paper is commonly used in an "actinometer." An actinometer containing a piece of sensitized albumenized paper is exposed to the light along with and beside the carbon tissue, and a proportion between the sensitiveness of the albumen paper and the tissue being established, nothing remains but to make allowance for the quality of the negative being printed on the tissue.

There are two types of actinometer, in one the sensitive paper is exposed uncovered to light, and close to the sensitive paper is a painted standard color similar to the color taken by a piece of sensitized albumen paper on exposure to light. When the exposed paper takes the color represented by the paint "one tint" is registered, a fresh white piece of paper exposed for the "second tint," and so on. This actinometer requires pretty constant watching. The other type consists of a small printing frame in which the sensitized paper is covered with a scale of squares of varying opacity. No. 1 square being the least opaque. The "Warnerke Sensitometer Screen" is an illustration of this principle. In this case the sensitive paper is exposed beneath the whole scale, and one figure becomes legible after the other; when, for instance, No. 4 is legible "4 tints" are said to be registered. As both of these sensitometers or actinometers are exposed alongside of the carbon tissue, it is evident that when once the proper exposure for any negative has been determined with either of these instruments, the same number of tints will always prove right for that negative, time and quality of light being *per se* matters of indifference. The proper number of "tints" for each negative, being once found. should be marked on the negative to save future trouble, Practised carbon printers can judge of the exposure necessary for each negative without using actinometers. Any number of negatives whose required "tints" are known can be printed at one time, provided that an actinometer is exposed at the same time as the tissue, for when the actinometer marks (say) "3 tints" all the negatives marked "3" are removed from the printing light. Carbon tissue prints on an average from 50 to 25 per cent. more quickly than albumenized paper.

If a carbon print after exposure be kept in the dark for a time, the effect on the print is the same as if a longer exposure had been given. This action has been called the "continuating action," and is directly proportionate to the amount of moisture reaching or present in the tissue. To some authorities it is a question whether this continuating action is not identical with the stages of insolubility reached by tissue never exposed to light. As the quantity of moisture in the air is constantly varying, it would be next to impossible to judge of the time for which a print might be kept after exposure, but luckily, in development we have ample power to correct any slight error in judgment as to exposure. Some authorities assert that tissue prints best perfectly dry; others prefer a slightly damp state. Testing these opinions, we found it impossible to judge between them, except that we noticed the effect of continuating action in the damp tissue; and it must be noted that this action begins with the *exposure* of the tissue.

Development consists simply of solution of the gelatine not affected by light, and hot water is the solvent; but certain considerations must not be overlooked. As the pigment is very dark, and the film pretty thick, it is certain that the part of the film next the paper is quite soluble, not having been acted upon by light. Therefore we have to dissolve the lower stratum of gelatine and remove the paper from the back. To do this we have to attach the tissue by its face to a support, rigid or flexible, and when the paper backing is removed we have evidently a "reversed" picture. This fact entails the operation known as "double transfer," unless in the first instance the negative was "reversed."

We shall begin by outlining the process of producing a positive by "single transfer," using, suppositiously, an opal plate for the final support of the picture. The apparatus required will be a dish as before, a squeegee, and a plate of opal. The opal is laid in the dish and covered with cold water to the depth of about two inches; the exposed sheet of tissue is immersed in the water. At first the tissue will curl up, but after a short time will uncurl and lie flat. As soon as it is flat it is brought face to face with the opal, and the two raised together from the water and laid down or a table, tissue uppermost. A piece of rubber or American cloth is laid on the tissue, the squeegee applied, the cloth removed, and a piece of blotting-paper put in place of the cloth; a flat board is laid on the top, and a weight on the board. If several sheets of tissue are to be developed, they go through this process one after another till all are piled one over the other, and the board and weight over all. Development must not be attempted with any tissue till it has been at least ten minutes under the weight—fifteen minutes will be safer. The dish is now filled with water at about 100 deg. Fahr., and the plates bearing the tissue put in altogether, or one by one. Baths are made with grooves, so that several plates can be developed at once. Presently the colored pigment will be seen to ooze out at the edge of the paper, if a "safe edge" was not omitted, and a short time later the paper will leave the plate at the corners. The paper may be then removed carefully with the hand. After this the plate is bathed with hot water till the mass of dirty black pigment is entirely removed from all but the image, a transformation both surprising, to the beginner, and pleasant. It is not advisable to raise the temperature of the water much above 100 or 110 deg. Fahr.

Under-exposure will show itself in over-solubility of the gelatine; the half-tones of the image will be washed right away and even the shadows will suffer. If anything at all can save an under-exposed print, reduction of the temperature to about

80 deg. will save it, but the better plan is to try again, giving more exposure a "tint" or two more.

Over-exposure will show itself by insolubility of the gelatine; the high-lights will persistently retain a dirty color, the shadows will appear simply a black mass. If prolonged development and persevering laving on of the water fail to complete the development, the temperature of the water may be raised till uncomfortable to the hand. Failing this, ammonia may be added to the water as a last resource; but the best plan is to make another exposure of several "tints" less, or to keep the tissue a shorter time after exposure.

When development is complete and the picture appears as is required, the image-bearing plate is washed in cold water, soaked in a four per cent. solution of potash alum, washed again, and dried. We have now produced a print by the single transfer process; it is on opal glass, and probably reversed; but instead of opal we might have used a glass plate or a piece of prepared paper, and in place of an ordinary negative we might have used one originally "reversed" by means of a prism, or reversal of the plate in the dark-slide.

But supposing our aim is to get a non-reversed print from an ordinary negative, all we have to do is to attach to our reversed positive a piece of paper and detach the positive in adhesion to the paper from the opal. This would be a "double transfer" process.

The double transfer process may be said to consist in transferring the image first to a temporary support, whereon it is developed, thereafter to its permanent support.

As temporary support we may use a prepared paper sold under the name of "flexible support," being coated with some highly polished and impervious substance which is waxed. The following will answer for the waxing solution:

Yellow resin	5 drams
Beeswax	3 drams
Turpentine	1 pint

(The paper, when first used, does not, as a rule, need to be waxed, as it is sold (by the Autotype Co., at least) ready for use. But if it is to be used over again it must be re-waxed.)

If a high gloss is required on the finished print, a plate of glass must be cleaned, rubbed with French chalk (or talc), collodionized, washed, etc., as on page 106.

A *grained* surface is obtained by using, as temporary support, a sheet of grained zinc, waxed as above. In any case, the first transfer is made exactly as already described, operations being the same up to the washing after alum; the washed film is not dried, but is brought into contact with a sheet of so-called "double transfer paper," or "permanent support." This is paper coated with gelatine and barium sulphate, to which alum is sometimes added. It is better, however, to omit the alum, as the Autotype Co. now do, and to bathe the unalumed paper in:

Potash alum	¾ of an ounce
Water	1 pint

A piece of permanent support for each print is immersed in this about the same time as the development of the print begins. This support is squeegeed in the usual way to the developed image, and the whole is allowed to dry, after which a knife point is inserted under one corner of the print and the print will readily leave the temporary support, which, if "flexible support," needs only re-waxing to be ready for use again. For obtaining the highest gloss a sheet of opal, collodionized as above, may be used, this enables the progress of development to be well watched.

To make lantern-slides by the single transfer carbon process, a tissue containing a large amount of coloring matter should be used; such a tissue is prepared by the Autotype Co. for the purpose. The glass used as support should be coated with the following and dried in full daylight.

Gelatine	1 ounce
Potassic bichromate	2 drams
Water	20 ounces

The rest of the process differs in no way from ordinary single transfer.

Defects and Remedies.

Insolubility of tissue, due to drying in warm damp air. Acid sensitizing bath. Too long keeping after sensitizing. Bichromate bath decomposed. Actinic light and "continuative action."

The tissue melts in the sensitizing bath. Too high temperature. Ice the solution or replace twenty-five per cent. of the water with alcohol.

The tissue becomes hard or crackly. Air too dry. Keep in a damp place or add a very little glycerine to sensitizer.

The prints refuse to adhere to temporary support before development. If at edges only, want of "safe edge." If all over, tissue insoluble. Or the tissue allowed to remain too long in the plain water before squeegeeing to temporary support. As the swelling of the gelatine causes the adhesion, it is evident that if the swelling is complete before squeegeeing no adhesion can result. Insufficient time allowed under the weight.

Spots.—Perhaps due to air bells between tissue and support. Air bells are very apt to form in the cold water bath; they must be watched for and removed.

Reticulation, or an appearance of "grain" in the image. A mysterious and not uncommon defect, due probably to incipient insolubility. Remedy: Observe all the precautions suggested for cases where the tissue refuses to adhere to temporary support.

The prints with their final support *refuse to leave the temporary support.* Imperfect waxing or talcing.

CHAPTER XXIX.

POSITIVES AND NEGATIVES BY ENLARGEMENT.

THE optics of enlargement may, in principles, be classified under two heads: 1st. The optical principles of *illuminating* the original. 2d. The optical principles of *projecting the image* to form the enlargement.

Under the first heading we have various processes depending upon the radiant, its nature and its position: if the source of light be infinitely distant, practically speaking, as the sun; or if it be practically at a point somewhere near the negative, as a lamp or electric arc; in other words, if the rays be parallel to each other or divergent, then we use a condenser to "condense" or collect rays that would otherwise pass outside of the objective or projecting lens. This condenser is a lens, or combination of lenses, at least as large in area as the negative (or positive) to be enlarged from, and it acts by collecting the rays, passing them all through the negative (or positive) and bringing them to a focus inside the projecting lens. Naturally, therefore, where an originally powerful light is used (as the direct rays of the sun), the light projected through the projecting lens is extremely powerful, and this process of solar enlargement is well suited for enlarging upon surfaces of low sensitiveness, as carbon tissue or albumen paper; and it is equally evident that where we have to use a light of but little actinic power, as a lamp light, a condenser enables us to succeed with an exposure which, even on a moderately sensitive surface, as bromide paper, would otherwise be totally inadequate to produce any developable image at all, not to mention an image on any printing-out material. Enlargement by the solar camera is now so little used by any but great firms requiring it for special purposes, and with the sensitiveness of the films at our service it is so little necessary, that it is not proposed to go into this subject here at all. Enlargement with a condenser in an optical lantern will be noticed presently. All that requires to be said here is that the diameter of the condenser must be at least equal to, and should be greater than, the diagonal of the original plate or part of the plate to be enlarged, and that the front focus of the condenser should fall within the projecting lens. To illustrate this we give a diagram, Fig. 25. Here *A*

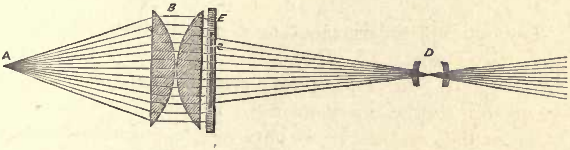

FIG. 25.

is the radiant; *B*, the condenser; *C*, the negative held in a frame *E*; *D* is the objective or projecting lens, in this case a photographic lens. To get the greatest benefit from *B* the relative distances of *A B* and *D* must be such that the focus of *B* falls within *D*. The larger the condenser the more light it will collect and concentrate, so the exposure varies inversely as the area of the condenser.*

Enlarging without a condenser by reflected or diffused light.—When daylight is used with such a printing surface as bromide paper or wet collodion, the exposure required is not unreasonably long; and this system will probably commend itself as, on the whole, the most simple and satisfactory process for obtaining either an enlarged negative for contact printing, or a direct positive enlargement. If the original is a negative we can only produce a direct positive; but if we have previously produced a positive from our original negative, and enlarge that positive, we shall get an enlarged negative, which can be printed by contact in the usual way. A positive made for the latter purpose should be full of detail and almost what might be called slightly fogged in the high lights. A positive

* It will be noticed that the condenser in this cut is capable of illuminating a larger negative than C.

resembling a good lantern-slide is not so suitable for this purpose as one resembling many of the lantern-slides often seen exhibited.

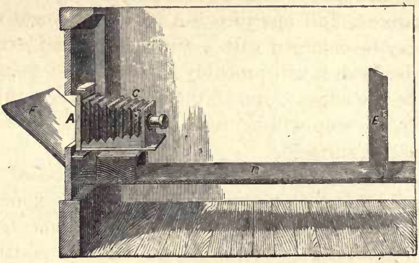

FIG. 26.

We here figure an arrangement for daylight enlarging, so simple that any intelligent reader will understand it, and so easily made that with the help of a carpenter anyone can construct a similar one in a few hours, except, perhaps, the camera, which, however, may be of the simplest construction.

The cut (Fig. 26) is taken from the "Practical Guide to Photographic and Photo-Mechanical Printing Processes," by one of the writers, and we are indebted to Messrs. Marion & Co. for the block. The design, though exceedingly simple, suffices to show the general arrangement of parts; greater elegance and convenience may be obtained by the addition of several movements, sufficiently evident. The negative to be enlarged from is placed in the back of the camera *C*, which is fixed to an aperture in a wall preferably facing the north, *D* is a long base-board, along which slides the easel *E*, to which is pinned the sensitive material, if paper, or on which is fixed, in any suitable way, the sensitive surface if glass. The easel *E* may have its centre cut out, and a piece of ground-glass may be fixed in a rebate, and the focusing done from behind. *F* is a reflector, and may be a board covered with some matt white substance, as blotting paper, but shiny papers should be avoided. *F* should be considerably larger than the plate being enlarged from, and *F* is to be so arranged that the plate view from inside is evenly illuminated all over.

As to the lens used for projection, though any lens, however short its focus, may be used with a condenser, the same does not hold good with a reflector. In the latter case the lens should be of sufficient focus, *at least*, to have produced the original negative at full aperture. A half-plate negative cannot in this way be enlarged with a 4-inch lens; and even if a $7\frac{1}{2}$-inch lens be used, it will probably require a stop to make it cover sharp to the edges. But if the focus of the projection lens be ample, no stop will be required at all, as we have to deal with parallel surfaces.

If a scale of inches be marked on the baseboard of the camera, and also on the long board, *D*, or on the floor in the case of a separate easel, and if the table of enlargements found at the end of this book be consulted, the relative positions of the various parts can be very easily regulated, and the focus almost precisely found without examination. Suppose, for instance, it is desired to enlarge a quarter-plate negative to a whole-plate positive, with a lens of 6 inches focus. Consulting the table, we find in the proper square under "4 times" $\frac{30}{7.5}$. We, therefore, at once place the centre of our lens $7\frac{1}{2}$ inches from the negative, and our easel 30 inches from the lens. We then arrange our picture suitably on a piece of plain white paper attached to the easel, raising or lowering our camera front or our easel as desired.

An even less costly arrangement for enlarging very small negatives, as quarter-plates, to moderate sizes, as 10x12 (provided the worker has two cameras, a small one and a large one, with sufficient stretch), is figured 27 on page 173. For enlarging, of course, this arrangement is reversed—that is to say, the small camera is placed next the light. With this arrangement good enlargements may be produced without any specially adapted apartment.

It is impossible to lay lown rules for exposure, so many different cases have to be met. The light varies, our sensitive materials vary, our negatives vary; but supposing there was no variation in these, and supposing the same lens with the same aperture to be invariably used, we can then give at least one rule which will be of service.

Exposure varies directly as "times" of enlargement. Example: To enlarge a quarter-plate negative to whole plate (4 areas) the required exposure is found to be ten minutes. To enlarge the same negative under the same conditions of light, lens, sensitive surface, etc., to 13x17 inches (16 areas), the exposure required would be forty minutes: 4 : 16 : : 10 : 40.

During exposure no actinic light must enter the apartment, and during focusing it is well to allow no light to enter the room at all, actinic or otherwise, except what passes through the negative and the projection lens. While the sensitive material is being put in position after focusing, the lens is to be capped, and the room may be illuminated by non-actinic light, for which provision was made. While the exposure is going on a great deal can be done in the way of "dodging." Vignettes of any shape can be produced by cutting an aperture of the required shape in a piece of cardboard or wood, and holding the mask so made between the lens and the sensitive surface, moving the mask constantly to and from the sensitive material. As the image is plainly seen projected on the sensitive surface, this operation is one of perfect simplicity. In like manner any part of the image that prints too dark can be shaded during part of the exposure. But in any case the mask should be kept on the move, else hard lines will result on the print.

Whatever be the sensitive surface used, bromide paper, wet collodion, etc., development is conducted as already laid down under the several headings. When large sheets of paper are used special developing dishes may be required; dishes for larger sheets may be made with plate glass bottoms and varnished wooden sides.

Enlarging by the Optical Lantern with (1) an oil lamp (2) oxyhydrogen lime light. This is perhaps the favorite process with amateurs, and it is certainly a convenient and simple process for enlarging small originals. But the condenser must be of diameter equal to, and ought to be of diameter slightly greater, than the diagonal of the part to be enlarged. In the next place the lantern nozzle should be so constructed as to allow the objective to be racked to at least twice its own focal length from the negative. The sensitive material is fixed in front of the objective, which may be a portrait lens, and the whole system from light to sensitive material should be axially centered, and the paper or glass parallel with the negative. No light must stray from the lantern so as to affect the sensitive material, so it is usual to inclose the ordinary optical lantern in a larger box, the nozzle only protruding through a hole for the purpose. Lanterns are, however, made specially for the purpose of enlarging, and usually are well adapted for that purpose.

When the oxyhydrogen light is used the area of incandescence of the lime, being but small, is easily placed in the focus of the condenser, but where a lamp with several wicks is used there is apt to be a considerable loss of light. To obviate this loss of light Mr. J. Traill Taylor suggests the use of a simple supplementary lens placed between the light and the condenser, and, like most of that gentleman's optical suggestions, this one is very valuable.

The same rules hold good for this process of enlarging, with regard to exposure, as for the daylight process. The effect of the condenser in shortening the exposure may seem astonishing to the beginner, who is ignorant of the optics of the matter. Vignetting and other "dodging" are quite as easy with artificial light as daylight.

We have seen and used an arrangement for enlarging still more simple and less costly than those described above. No condenser was used, but the artificial light was diffused over the original by means of a sheet of finely ground-glass placed between the light and the negative, and about one and one-half inch behind the original. By this process a much larger negative may be enlarged by artificial light, but the exposure is very long, and the rules for choice of projection lens are the same as for daylight enlarging with a reflector, that is to say the projecting lens must be of long focus. If the original be unusually large, as 8x10 or 10x12 inches, several lights will be required to illuminate the original evenly, the only alternative—removing the light to a considerable distance from the ground-glass—entailing an inconvenient duration of exposure.

Collodion Transfers are produced by coating a talced sheet of glass with iodized collodion, sensitizing, developing, fixing and washing in the usual way, provision being made for securing pleasing tones. The film is then placed in contact with a sheet of paper such as "Carbon Double Transfer" (see page 162), squeegeeing the paper to the film, drying, and stripping from the glass. These transfers are usually enlargements, which is our reason for mentioning them here.

CHAPTER XXX.

LANTERN SLIDES.

Photography, perhaps, reaches its climax of beauty and utility in a good lantern-slide shown on a good screen with a good light. The size of the view so shown is not *per se* the chief advantage, but it enables a number of people to see in company which is always pleasing to the majority of people. The optical lantern is valuable both to art and science, for while *pictures* may be shown on a scale more dignified and more worthy of their merits, scientific *facts* may be demonstrated in a manner precluding mistake, and with a weight of evidence precluding unbelief. But while a good lantern-slide is a thing of beauty and of utility, a bad one is a horror which we too often see in public exhibitions, not to mention private ones.

The worker must first learn the characteristics of a good slide, and they are not learned without considerable study. A slide may be a very pretty, little, positive transparency, and yet totally useless as a lantern-slide. A slide must have, first, absolute clearness in the highest lights; second, transparent shadows. If either of these points is transgressed the slide is useless, to start with. But besides the *highest* lights no other part must be absolutely clear. The *midsummer snow scenes*, so frequently seen—and frequently applauded by an ignorant public—are the results of neglect of this rule. These "hard" slides are usually the result of either hard negatives or under-exposure of the slides, necessitating forced development. A slide must have plenty of half tone, but not too much. The commonest type, perhaps, of bad slides, is that where we see nothing but half tone, to put it mildly, or nothing but incipient fog, to put it plainly. Beginners with gelatine bromide for lantern-slides are very apt to produce these foggy lides; nothing can be uglier, unless it is the snow scenes already alluded to. A slide must have:

1. Clear highest lights.
2. Half-tone in secondary lights.
3. Detail in the shadows.
4. A pleasing "tone" or color.

The processes commonly used for producing lantern-slides are: Wet collodion, dry collodion, gelatine chloride, gelatine bromide. In point of exposure the gelatine bromide is by far the quickest of these processes, gelatine chloride is so insensitive that practically it is only used for making "slides by contact." When the negative is just about the size required for a lantern-slide (three and a quarter inches square), contact printing is resorted to, a sensitive plate taking the place of a piece of paper used for ordinary printing in a frame; care must be taken not to scratch the negative nor the sensitive plate when bringing the two together. When the negative is larger than the standard slide size, the slide has to be made by "reduction in the camera." The process of reduction is simply making a copy on glass of the negative by transmitted light; the copy will, of course, be a positive.

Mechanical Arrangements for Reducing.—As a matter of practice any means whereby a copy may be made of the negative as above, the copy being of the proper size, will answer for making a slide by reduction, but it is found better to take precautions to prevent any light, other than what passes through the negative, from reaching the copying lens. Many costly and intricate arrangements have been devised for the mechanical part of the process, but we shall confine ourselves to the description of one apparatus which everyone is likely to have, or can at least get with very little trouble. The first requisite is the camera in which the original negative was taken, a wet-plate slide fitting that camera, or a double slide with the internal partition removed. The other requisite is also a camera, this time a quarter plate camera of the simplest description, no motion but a rack and pinion for focusing being required, fitted with a short focus lens, such as a rectilinear stereo lens.

The front, or part of the front of the larger camera is removed, and the small camera is fitted to the front of the larger camera, with the small lens protruding into the larger camera. We figure (Fig. 27) our own arrangement, as fitted up by our-

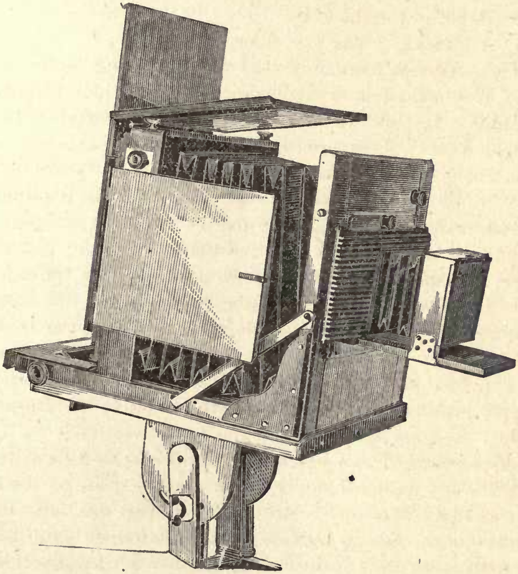

Fig. 27.

selves, and we have never yet found circumstances which this did not suit. The lens should be of very short focus, not over four inches or four and a half inches focus, and must be rectilinear. The negative to be copied goes into the dark-slide of the larger camera, the sensitive plate goes into the dark-slide of the small camera. The back of the larger camera may be pointed towards the sky, and a sheet of finely-ground glass placed about one or two inches behind the negative; *i. e.*, between the negative and the light; or a sheet of white paper large enough to illuminate by reflection, the whole negative may be inclined at 45 deg. between the light and the negative. The amount of reduction is regulated by the focusing arrangement of the larger camera, different parts of the negative may be selected for copying by the front motions of the larger camera, and focusing is performed on the ground-glass of the small camera, preferably with a Ramsden eyepiece.

The exposure with ground-glass behind the negative may vary at $\frac{f}{15}$:

With Gelatine Bromide lantern plates, from five to one hundred and twenty seconds.

With Wet Collodion, from thirty seconds to ten minutes.

With Dry Collodion, from three minutes to two hours.

We have, of course, gone beyond these limits in both directions; the table is given merely suggestively.

Even gelatine chloride plates may be used for reduction in the camera, the exposure being very long if the negatives are of average density. Gelatine chloride emulsion may be made more sensitive by cooking, but, as a rule, there is great danger of fogginess from this proceeding.

Gelatine chloride emulsion for lantern-slides and transparent positives. Plates prepared with this emulsion are usually exposed in contact with the negative, for a few seconds, to daylight. The negative is placed in a printing frame face upwards, and the chloride plate carefully laid on the negative film to film. Mr. A. Cowan, of London, has favored the public with some very fine developing formulæ for such plates, and by the use of his varied proportions and ingredients he produced a large range of tones on his plates.

Iron protosulphate	140 grains
Sulphuric acid	1 minim
Water	1 ounce

Add one part of this to three parts of any of the following, No. 1 giving cold tones, No. 3 almost crimson. No. 3 requires much more exposure than No. 2, and No. 2 more than No. 1.

1. Potassic citrate	136 grains
Potassic oxalate	44 grains
Hot water	1 ounce

2.	Citric Acid	120 grains
	Ammonia carbonate	88 grains
	Cold water	1 ounce
3.	Citric acid	180 grains
	Ammonia carbonate	60 grains
	Water	1 ounce

The following, due to Mr. B. J. Edwards, gives good tones.

a.	Neutral potassic oxalate	2 ounces
	Ammonium chloride	40 grains
	Distilled water	20 ounces
b.	Iron protosulphate	4 drams
	Citric acid	2 drams
	Potash alum	2 drams
	Water	20 ounces

Mix *a* and *b* in equal proportions.

Chloride plates should develop pretty rapidly; if the image appears to develop *too* rapidly add a few drops of a ten per cent. solution of common salt. Fix in hypo, and after washing clear with a saturated solution of potash alum, acidulated with sulphuric acid.

Glass and opal plates coated with this emulsion yield beautiful positives, when printed in contact and treated as above.

Lantern-Slides by Dry Collodion Processes.—Supposing plates to be coated with collodio-bromide emulsion prepared as given on page 46, *et seq.*, we proceed to give instructions how these plates may best be used for lantern-slides, and we may say that it is extremely doubtful whether for really good lantern-slides with clear lights, transparent shadows, and, above all, warm tones, this process can be surpassed.

To insure the warm tones on which we so much insist, the use of ammonia is contraindicated, and the carbonates coupled with a long exposure will be found best. The formulæ we give are due mostly to Mr. W. Brooks, of Reigate, who prepares emulsion, and with it slides not easily equaled.

PYRO SOLUTION.

Pyrogallol	96 grains
Alcohol	1 ounce

ALKALINE SOLUTIONS.

1. Saturated solution of ammonia carbonate	4 ounces
Potassic bromide	60 grains
Sodic acetate	120 grains
Water	8 ounces
2. Potassic carbonate	360 grains
Potassic bromide	60 grains
Sodic acetate	120 grains
Water	12 ounces
3. Potassic carbonate	300 grains
Potassic bicarbonate	150 grains
Potassic bromide	60 grains
Sodic acetate	120 grains
Water	12 ounces

No. 1 requires the longest exposure, and gives the warmest tones; the ammonium carbonate must be fresh and pure, and for saturation should be left several days in water, getting an occasional shaking. After this some of the crystals must be left at the bottom of the bottle. No. 2 is a more powerful alkaline solution than No. 1, and requires much less exposure. The tones given by No. 2 are not so good as those of No. 1. Nos. 1 and 3, mixed in equal quantities, give a grand chestnut tone with a moderate exposure.

After exposure the plate is flowed in yellow light with a mixture of methylated spirits and water in equal parts. This is allowed to act on the film for about a minute, and is then washed off. The plate may either be immersed in the developer in a dish or held in the hand by a pneumatic holder, and the developer flowed over it. Development is not so quick as with a gelatine plate; the image appears faint at first, with details, perhaps, all over, and density is gained very gradually.

The developer consists of

Pyro solution, as above	20 minims
One of the alkaline solutions, or a mixture of two of them	2 drams
Water	2 drams

The developer must not be poured off and on at first, but as details and density increase pouring off and on may be resorted to as a local intensification. Development to full density may occupy five or six minutes, and the plate is then to be washed and fixed with hypo, or, preferably, potassic cyanide, 20 grains; water, 1 ounce. Re-development may be resorted to with pyro and silver, as follows, but we do not like it, as the shadows are apt to get blocked up.

Re-developer (which may also be used later as an intensifier):

Pyrogallol	30 grains
Citric acid	30 grains
Alum	30 grains
Water	15 ounces

Flow a sufficient quantity of this over the plate, then return it to the cup to which meantime have been added, for every two drams of the pyro and acid solution, two or three drops of a twenty-grain solution of silver nitrate. This is to be poured on and off the plate, but the instant any cloudiness appears the solution must be rejected and a fresh quantity made if necessary.

To get various fine tones more nearly approaching the blues the plate may be toned with:

Platinic chloride	1 grain
Nitric acid	1 minim
Water	3 ounces

The plate may be removed when a warm brown tone is arrived at, or at any other desired stage, but to produce a very fine engraving black tone the plate may be left in the platinum solution till the image is almost gone, or very gray; it is then to be washed and intensified with the pyro intensifier given. Though we do not like re-development, we recommend intensification after fixing by this acid-alum-pyro solution, which is due to Mr. Brooks, and gives very fine tones indeed.

Any slight veil or fog on a collodion positive may be removed by flowing over it several times a strong colored solution of iodine made by adding water to the "tincture." Silver iodide is formed, and cyanide solution, as for fixing, will clear the plate at once.

Collodion slides and positives for window decoration, which may be made equally with slides by the above process, should be varnished with a clear white varnish (see formulæ at the end).

Wet collodion for lantern-slides. We have pointed out in Chapter VI. a suitable method of making slides by this process. The platinum toning bath may be used as above, or the following, due to Mr. T. N. Armstrong, an amateur of Glasgow:

Palladium chloride	15 grains
Water	15 ounces

For each ounce of water required to cover the slide in a dish take one dram of the above. Leave the slide in this till the tone has reached the back of the film, as seen through the glass plate. If any dense parts refuse to tone, pour the solution on to them several times from a slight height. Eight or ten minutes should suffice to tone a plate by this method, and the tone is not only unique but highly pleasing.

Gelatine Bromide for Lantern-Slides.—In the chapter on slow gelatine-bromide emulsion will be found directions for making an emulsion eminently suitable for the purpose of lantern-slide preparation. We may say that the "slower" the emulsion the more likely it will be to give good slides in the beginner's hands. The gelatine-bromide plates usually put on the market for this purpose are, in our opinion, too rapid and too liable in unskilled hands to give foggy slides, which of all kind of slides are the worst and the commonest. The exposure, whether by contact, or in the camera, must be such that no forcing, or abnormal quantity of alkali, is required in development; further we need not go.

For development the ferrous oxalate may be used, keeping the proportion of iron low, and using a proportion of soluble bromide (say half a grain to each ounce of a developer consisting of potassic oxalate solution, as given elsewhere (page 92), six parts, iron solution one part).

Mr. Carbutt, U. S. A., gives a formula which will be found to work well with many plates.

a. Potassic oxalate	8 ounces
Water	30 ounces
Citric acid	60 grains
Citrate of ammonia solution	2 ounces

b.	Ferrous sulphate	4 ounces
	Water	32 ounces
	Sulphuric acid	8 minims

The citrate of ammonia solution is:

Dissolve citric acid	1 ounce
Water	5 ounces

Add liquor ammonia till neutral, make up to eight ounces. The developer consists of

a	2 ounces
b	1 ounce
10 per cent solution of potassic bromide	5 minims

Mr. Edward's hydrochinon developer acts well. It will be found quoted on page 145.

Where a *warm tone* is required, undoubtedly the best developer is alkaline pyrogallol. But sodic sulphite must not form an ingredient of the alkaline pyro developer, we have never liked the tone peculiar to that salt, and we have never yet been able entirely to prevent the peculiar tone given by that salt from appearing in our slides. Very much superior, in our estimation, for this purpose, if for no other, is the potassic bisulphite, which first caught our attention in a formula promulgated by Messrs. Mawsan and Swan, of Newcastle. The salt was, in this formula, called "meta-bisulphite;" we have never yet met a satisfactory account of this name, and we find ordinary potassic bisulphite precisely the same in action as in appearance and odor. We shall, however, give Messrs. Mawsan and Swan's own formula, leaving the reader to use the "meta," if he can get it, or omit the "meta," if it is not forthcoming.

a.	Pyrogallol	40 grains
	Potassic meta-bisulphite	120 grains
	Water	20 ounces
b.	Liquor ammonia fort	$2\frac{1}{2}$ drams
	Ammonium bromide	40 grains
	Water	10 ounces

To develop mix *a* and *b* in equal proportions. With any of these developers the image should begin to appear after the plate has been in the solution about forty-five seconds or a minute. There should be no rushing up of details or density. Very pretty little glass dishes may be obtained for developing slides; they must be kept scrupulously clean; a stain that would never be noticed on a negative, may be ruin to so delicate a picture as a lantern-slide should be.

We give one more pyro developer, which may be called a standard developer; it works well with every good plate we have yet met.

a. Solution of pyro, preserved with citric acid, 20 grains to each ounce	10 per cent
b. Ammonia	10 per cent
c. Bromide (amm. or pot.)	10 per cent

DEVELOPER.

a	20 minims
b	20 to 25 minims
c	20 minims
Water	1 ounce

Fixing is done with

Sodic hyposulphite	1 part
Water	5 parts

After fixing, a scum is frequently noticed on slides. Strong solution of alum, acidified with sulphuric acid, poured on and off, will almost always remove the scum. Mr. Edwards recommends the addition of ferrous sulphate to the alum and acid. If the plate, after fixing, be not washed, but merely rinsed under the tap, a fine warm tone may be produced by pouring on a solution of the following nature:

Alum (potash) concentrated solution, containing citric acid to saturation	1 ounce
Iron protosulphate, saturated	½ ounce

The warm tone produced may be suspected of fugitiveness, but we find it permanent.

Eastman's transferotype process yields fine slides. (See page 147.) The development is conducted as usual, preferably with ferrous oxalate, and the finished paper film is squeegeed to a piece of glass of the required size, and scrupulously clean.

If the plates are just $3\frac{1}{4}$ inches square, the prints should, before being squeegeed, be trimmed slightly smaller, as the edges of the paper must not overlap the glass. After stripping, which must not be attempted until at least half an hour has elapsed after squeegeeing, the plate is cleared with alum and acid, washed and dried. All slides should be varnished with clear or "crystal" varnish.

To Mount Lantern-Slides.—Articles required: Masks of variously shaped apertures; "strips" to gum round edges; clean and thin glasses $3\frac{1}{4}$ inches square. The cover-glasses should be free from imperfections, as bubbles. The shape of the mask apertures is a matter not sufficiently attended to. Mr. J. W. Champney contributed to a New York society some remarks which deserve attention. The masks must be opaque. A very good paper for the purpose is white on one side and black on the other, the white side being utilized for writing the names of the subjects. "Strips" are sold ready-gummed. As a rule, these cannot be trusted to stick long, and the safer plan is to get plain strips of "needle-paper" about 14 inches long, and at the time of use to cover each strip with thin glue, to which is added a small quantity of oil of lavender, a hint for which we have to thank the illustrious Mr. George Washington Wilson, of Aberdeen.

The slide being finally mounted requires some mark, so that the lantern operator may know at a glance which way to put it into the lantern. Lay the slide down on the table *as the view appeared in nature*, and at each of the *two top corners* place a small disc of gummed paper, white on a black mask, and *vice versa*.

CHAPTER XXXI.

RESIDUES.

Amateurs, who find their hobby somewhat expensive, and professionals, whose yearly returns are not as large as might be desired, will do well to preserve carefully all material containing noble metals in any shape. A very small percentage of the silver originally used in the preparation of sensitive substances is present in the finished negative or print. We have seen it stated that a print on albumenized paper contains only about 3 per cent. of the silver originally present in it. We do not guarantee the accuracy of this estimate, but it is probably not very far wide of the mark.

The following should always be carefully preserved: 1st. All paper containing or bearing silver salts, as trimmings of untoned albumenized paper, bromide and chloride papers, filter papers used for silver solutions. 2d. Water wherein prints containing free silver nitrate have been washed. 3d. Old toning baths. 4th. Old fixing baths. 5th. Waste emulsions of any kind.

1. *Paper Residues.* After a considerable quantity of waste paper has been collected, it should be burned completely to fine ashes. An ordinary stove or grate will answer for burning, provided the draught do not carry away the very light ashes.

2. *Washing Waters.* The first two waters used for washing sensitized albumenized paper should be put into a reservoir with a tap about four to six inches from the bottom. When the vessel is pretty full, hydrochloric acid may be used to acidify the residue, and the silver may be thrown down as chloride by the addition of a quantity of concentrated solution of sodic chloride—common salt. Hydrochloric acid may be used to

throw down all the silver, but we prefer the salt. If too much salt be added, the chloride will be re-dissolved. When the chloride is all down, the supernatant liquid is drawn off by the tap, or siphoned off, or even baled off. The chloride is collected, washed in water, dried, and added to the paper ashes.

3. *Old Toning Baths.* In a toning bath the gold may be inert as a toning substance but can be saved. The bottle containing a toning bath often becomes encrusted with a deposit of gold; this may be dissolved by *aqua regia* and added to the bulk of old baths. The bulk being acidified with sulphuric acid, a saturated solution of ferrous sulphate is added till no more gold is precipitated. The precipitate is collected, washed, dried, and may either be added to Nos. 1 and 2, or kept separate.

4. *Old Fixing Baths* are usually the most valuable of all residues. Every plate, whether exposed or gone wrong before, during or after exposure, should be "fixed." The used fixing baths are to be preserved in a vessel similar to that used for No. 2. The solution should be acidified with sulphuric acid, and precipitation of the silver effected by the addition of a strong solution of potassic sulphide, "liver of sulphur." This, however, must not be done in the operating, nor, indeed, in any inhabited room; but in the open air, for the odor is both unpleasant and unwholesome. As an alternative, strips of zinc or copper may be suspended in the old hypo solution, when the silver will be precipitated on the strips or on the vessel. When the precipitation is complete, the deposit is collected, washed, dried, and kept separate from other residues.

5. *Old Emulsions*, if of collodion, may be poured out to set in a flat dish, allowed to desiccate, lifted or scraped from the dish, and added to the paper ashes, or the chlorides. If of gelatine, they should be treated in one of the following ways: Add to the waste emulsion, in a large iron pot, five times its weight of caustic alkali and boil for half an hour. The boiling will be very furious at first, but will subside after a little. Or several times its bulk of sulphuric acid may be added to the emulsion and the whole boiled for a few minutes. In each case the gelatine will be deprived of its setting power

or viscous quality, and the silver in whatever state it is will settle to the bottom and can be separated by decantation from the liquid. It may then be washed and added to the chlorides.

Platinum residues are very valuable and may be saved thus: All waste paper should be passed through the developing solution. Old potassic oxalate developing solutions are collected and boiled with one-fourth of their volume of ferrous sulphate. The platinum separates and can be collected on a filter.

We do not advise the reader to fuse his own residues as a matter of business, for a professional refiner will get much more noble metal out of them than the photographer is likely to do. As an interesting experiment, however, the following may be tried. Take the paper ash and the chlorides, with which may be included the gold, dry all thoroughly and mix with a *flux* consisting of four times the weight of the chlorides of a mixture in equal parts of the carbonates of soda and potash. Mix thoroughly and put into a crucible, subjecting it to white heat till the contents of the crucible are perfectly liquid. Then either pour out on to a cold stone floor, or allow to cool and break the crucible. In one case a bar, in the other a button of silver, will be found. If gold is present a refiner will allow for it.

FORMULÆ RECOMMENDED.

Varnish for gelatine negatives ("British Journal Almanac.")

Best Orange Shellac	1½ ounce
Methylated alcohol	1 pint

Keep in a warm place till dissolved, then add a large teaspoonful of whiting or prepared chalk; set aside to clear; decant.

Plate to be heated before and after application.

Ground Glass or "Matt" Varnish.

Sandarac	90 grains
Mastic	20 grains
Ether	2 ounces
Benzole	½ to 1½ ounces

More benzole added finer the matt obtained.

This varnish to be applied cold.

Gelatine Bromide Processes—Developers.

Edward's Glycerine Developer.

a. Pyro	1 ounce
Glycerine	1 ounce
Methyl alcohol	6 ounces

Mix spirits and glycerine, then add pyro.

a. One part of this to fifteen of water.

b. Potassic bromide	60 grains
Liq. Amm. .880	1 ounce
Glycerine	1 ounce
Water	6 ounces

b. One part of this to fifteen of water.

Developer: Equal parts of the above, *a* and *b.*

Mr. Wollaston's Modification of the Eastman Developer for Paper Negatives

a. Sodic sulphite pure	8 ounces
Hot distilled water	40 ounces

Cool to 60 deg. Fahr. Make just acid with citric acid. Pour on to one ounce of pyro.

b.	Sodic carb	4 ounces
	Potassic carb	1 ounce
	Distilled water	40 ounces

Equal parts of *a* and *b*.

A SIMPLE DEVELOPER FOR GELATINE BROMIDE.

a. Pyro .... 40 grains

Added to,

Water .... 10 ounces

In which is dissolved

Citric acid .... 10 grains

b.	Liq. Amm. .880	1 dram
	Amm. brom	25 grains
	Water	10 ounces

Equal parts of *a* and *b*.

HYDROCHINON DEVELOPER.

a.	Hydrochinon	20 grains
	Water	10 ounces
	Sodic sulphite	10 grains

Dissolved together first.

b. Carbonates according to Wollaston above or to formula in text.

CLEARING SOLUTIONS FOR GELATINE BROMIDE PLATES.

MR. EDWARDS'.

Alum	1 ounce
Citric acid	1 ounce
Sulphate of iron	3 ounces
Water	20 ounces

Another:

Alum	3 ounces
Hydrochloric acid	½ ounce
Water	20 ounces

INTENSIFYING SOLUTIONS FOR GELATINE PLATES.

a.	Mercuric chloride	1 part
	Ammonic chloride	1 part
	Water	20 parts

Bleach thoroughly, wash thoroughly, then pour on

b. Liquid ammonia	1 part
Water	20 parts

Or,

Sodic hyposulphite	1 part
Water	10 parts

Or,

Sodic sulphite	1 part
Water	5 parts

Uranium Intensifier.

a. Uranium nitrate in water	1 per cent.
b. Potassic ferricyanide in water	2 per cent.

Flood the plate with *a*, then mix in *b*.

Toning Baths.

Black Tones (Mr. Schölzig).

Sodic tungstate	30 grains
Boiling water	3 ounces

Dissolve, then add

Gold chloride	1 grain
Water to	8 ounces

Phosphate Bath.

Sodic phosphate	30 grains
Gold chloride	1 grain
Water	8 ounces

Does not keep well.

TABLE OF ATOMIC AND MOLECULAR WEIGHTS OF THE ELEMENTS.

(Derived from Professor F. W. Clarke's figures.)

Names and Symbols.	Weights.	Apprx Wghts.	Names and Symbols.	Weights.	Apprx Wghts.
Aluminum, Al....	27.0090	27.	Nickel, Ni...	57.9280	57.9
Antimony, Sb....	119.9550	120.	Niobium, Nb.....	93.8120	93.8
Arsenic, As	74.9180	74.9	Nitrogen, N......	14.0210	14.
Barium, Ba......	136.7630	136.8	Osmium, Os.....	198.4940	198.5
Bismuth, Bi......	207.5230	207.5	Oxygen, O.......	15.9633	16.
Boron, Bo........	10.9410	10.9	Palladium, Pd ...	105.7370	105.7
Bromine, Br......	79.7680	79.8	Phosphorous, P...	30.9580	31.
Cadmium, Cd....	111.8350	111.8	Platinum, Pt.....	194.4150	194.4
Cæsium, Cs......	132.5830	132.6	Potassium, K.....	39.0190	39.
Calcium, Ca......	39.9900	40.	Rhodium, Rh.....	104.0550	104.1
Carbon, C........	11.9736	12.	Rubidium, Rb....	85.2510	85.3
Cerium, Ce......	140.4240	140.4	Ruthenium, Ru..	104.2170	104.2
Chlorine, Cl......	35.3700	35.4	Scandium, Sc....	43.9800	44.
Chromium, Cr....	52.0090	52.	Selenium, Se......	78.7970	78.8
Cobalt, Co.......	58.8870	58.9	Silicon, Si........	28.1950	28.2
Copper, Cu.......	63.1730	63.2	Silver, Ag........	107.6750	107.7
Didymium, D....	144.5730	144.6	Sodium, Na.......	22.9980	23.
Erbium, E........	165.8910	165.9	Strontium, Sr....	87.3740	87.4
Fluorine, Fl......	18.9840	19.	Sulphur, S	31.9840	32.
Gallium, Ga......	68.8540	68.9	Tantalum, Ta....	182.1440	182.1
Glucinum, G.....	9.0850	9.1	Tellurium, Te....	127.9600	128.
Gold, Au...	196.1550	196.2	Thallium, Tl.....	203.7150	203.7
Hydrogen, H.....	1.0000	1.	Thorium, Th.....	233.4140	233.4
Indium, In.......	113.3980	113.4	Tin, Sn..........	117.6980	117.7
Iodine, I.........	126.5570	126.6	*Titanium, Ti....	47.0997	48.
Iridium, Ir.......	192.6510	192.7	Tungsten, W.....	183.6100	183.6
Iron, Fe.........	55.9130	55.9	Uranium, U	238.4820	238.5
Lanthanum La....	138.5260	138.5	Vanadium, Va....	51.2560	51.3
Lead, Pb........	206.4710	206.5	Ytterbium, Yb...	172.7610	172.8
Lithium, Li......	7.0073	7.	Yttrium, Y.......	89.8160	89.8
Magnesium, Mg..	23.9590	24.	Zinc, Zn.........	64.9045	64.9
Manganese, Mn...	53.9060	53.9	Zirconium, Zr....	89.3670	89.4
Mercury, Hg.....	199.7120	199.7			
Molybdenum, Mo	95.5270	95.5			

* Thorpe, T. E., *Chemical News*, 48; 251.

DR. JANEWAY'S TABLE OF THE SOLUBILITY OF PHOTOGRAPHIC CHEMICALS.

MADE FOR THE SOCIETY OF AMATEUR PHOTOGRAPHERS OF NEW YORK.

Abbreviations.—ins., insoluble; sp. s., sparingly soluble; m. s., moderately soluble; v. s., very soluble; dec., decomposed.

CHEMICALS.	WATER.		COLD ALCOHOL.
	59° F.	212° F.	
One part is soluble in	Parts.	Parts.	
Acid, Citric	0.75	.6	v. s.
Gallic	100	3	m. s.
Oxalic	8	1	v. s.
Pyrogallic	3.5	v. s.	v. s.
Tannic	6	v. s.	v. s.
Alum	10.5	v. s.	ins.
Chrome	10	dec.	ins.
Ammonium, Nitrate	0.5	v. s.	v. s.
Chloride	3	v. s.	sp. s.
Carbonate	4	dec.	m. s.
Sulphocyanate	v. s.	v. s.	v. s.
Bromide	1.5	0.7	sp. s.
Iodide	1	0.5	m. s.
Baryta, Nitrate	8	3	
Cadmium, Bromide	v. s.	v. s.	m. s.
Iodide	v. s.	v. s.	v. s.
Copper, Acetate	15	5	sp. s.
Sulphate	2.6	0.5	ins.
Gold, Chloride	v. s.	v. s.	v. s.
Gold and Sodium Chloride	v. s.	v. s.	m. s.
Iron, Perchloride	v. s.	v. s.	v. s.
Protosulphate	1.8	0.3	ins.
and Ammonia sulphate	3	0.8	ins.
Iodide (Ferrous)	v. s.	v. s.	sp. s.
Iodine	7000		m. s.
Kaolin	ins.	ins.	ins.
Lead, Acetate	1.8	0.5	m. s.
Chloride	v. sp.	33	ins.
Nitrate	2	0.8	ins.
Lithium, Bromide	v. s.	v. s.	m. s.
Iodide	v. s.	v. s.	m. s.
Magnesia, Nitrate	v. s.	v. s.	m. s.
Mercury, Bichloride	16	2	v. s.
Cyanide	12.8	3	ins.
Potassium, Acetate	0.4	v. s.	v. s.
Potassium, Bicarbonate	3.2	dec.	ins.
Bichromate	10	1.5	ins.
Bromide	1.6	1	sp. s.
Carbonate	1	0.7	ins.
Cyanide	2	1	m. s.
Ferricyanide	3.8	2	ins.
Ferrocyanide	4	2	ins.
Nitrate	4	0.4	ins.
Iodide	0.8	0.5	m. s.
Oxalate	3	v. s.	ins.
Permanganate	20	3	ins.
Sulphate	9	4	ins.
Sulphite	4	5	sp. s.
Sulphuret	2	1	sp. s.
Silver, Nitrate	0.8	0.4	m. s.
Oxide	v. sp. s.	v. sp. s.	ins.
Sodium, Acetate	3	1	m. s.
Bromide	1.2	0.5	m. s.
Bicarbonate	12	dec.	ins.
Carbonate	1.6	0.25	ins.
Citrate	v. s.	v. s.	sp. s.
Hyposulphite	1	v. s.	ins.
Iodide	0.6	0.3	m. s.
Nitrate	1.3	0.6	sp. s.
Phosphate	6	2	ins.
Pyrophosphate	12	1.1	ins.
Sulphite	4	0.9	sp. s.
Sulphate	2.8	0.4	ins.
Tungstate	4.0	2.0	ins.
Strontia, Chloride	1.88	v. s.	sp. s.
Uranium, Nitrate	v. s.	v. s.	m. s.
Zinc, Iodide	v. s.	v. s.	m. s.
Bromide	v. s.	v. s.	m. s.
Chloride	0.33	v. s.	v. s.

METRIC SYSTEM OF WEIGHTS AND MEASURES.

MEASURES OF LENGTH.

Denominations and Values.		Equivalents in Use.	
Myriameter	10,000 meters.	6.2137	miles.
Kilometer	1,000 meters.	.62137	mile, or 3,280 ft. 10 ins.
Hectometer	100 meters.	328.	feet and 1 inch.
Dekameter	10 meters.	393.7	inches.
Meter	1 meter.	39.37	inches.
Decimeter	1-10th of a meter.	3.937	inches.
Centimeter	1-100th of a meter.	.3937	inch.
Millimeter	1-1000th of a meter.	.0394	inch.

MEASURES OF SURFACE.

Denominations and Values.		Equivalents in Use.	
Hectare	10,000 square meters.	2.471	acres.
Are	100 square meters.	119.6	square yards.
Centare	1 square meter.	1,550.	square inches.

MEASURES OF VOLUME.

Denominations and Values.			Equivalents in Use.			
Names.	No. of Liters.	Cubic Measures.	Dry Measure.		Wine Measure.	
Kiloliter or stere	1,000	1 cubic meter.	1.308	cubic yards.	264.17	gallons.
Hectoliter	100	1-10th cubic meter.	2	bu. and 3.35 pecks.	26.417	gallons.
Dekaliter	10	10 cubic decimeters.	9.08	quarts.	2.6417	gallons.
Liter	1	1 cubic decimeter.	.908	quart.	1.0567	quarts.
Deciliter	1-10	1-10th cubic decimeter.	6.1022	cubic inches.	.845	gill.
Centiliter	1-100	10 cubic centimeters.	.6102	cubic inch.	.338	fluid oz.
Milliliter	1-1000	1 cubic centimeter.	.061	cubic inch.	.27	fl. drm.

WEIGHTS.

Denominations and Values.			Equivalents in Use.	
Names.	Number of Grams.	Weight of Volume of Water at its Maximum Density.	Avoirdupois Weight.	
Millier or Tonneau	1,000,000	1 cubic meter.	2204.6	pounds.
Quintal	100,000	1 hectoliter.	220.46	pounds.
Myriagram	10,000	10 liters.	22.046	pounds.
Kilogram or Kilo	1,000	1 liter.	2.2046	pounds.
Hectogram	100	1 deciliter.	3.5274	ounces.
Dekagram	10	10 cubic centimeters.	.3527	ounce.
Gram	1	1 cubic centimeter.	15.432	grains.
Decigram	1-10	1-10th of a cubic centimeter.	1.5432	grain.
Centigram	1-100	10 cubic millimeters.	.1543	grain.
Milligram	1-1000	1 cubic millimeter.	.0154	grain.

For measuring surfaces, the square dekameter is used under the term of ARE; the hectare, or 100 ares, is equal to about two acres. *The unit of capacity* is the cubic decimeter or LITER, and the series of measures is formed in the same way as in the case of the table of lengths. The cubic meter is the unit of measure for solid bodies, and is termed STERE. *The unit of weight* is the GRAMME, which is the weight of one cubic centimeter of pure water weighed in a vacuum at the temperature of 4 deg. Cent. or 39.2 deg. Fahr., which is about its temperature of maximum density. In practice, the term cubic centimeter, abbreviated c.c., is used instead of milliliter, and cubic meter instead of kiloliter.

UNITED STATES WEIGHTS AND MEASURES.

ACCORDING TO EXISTING STANDARDS.

LINEAL.

	Inches.	Feet.	Yards.	Rods.	Furlong.
12 inches = 1 foot.	12				
3 feet = 1 yard.	36 =	3			
5.5 yards = rod.	198 =	16.5 =	5.5		
40 rods = 1 furlong.	7,920 =	660 =	220 =	40	
8 furlongs = 1 mile.	63,360 =	5,280 =	1,760 =	320 =	8

SURFACE—LAND.

	Ft.	Yds.	Rods.	Roods.	Acres.
144 sq. ins. = 1 sq. ft.					
9 sq. ft. = 1 sq. yd.	9 =	1			
30.25 sq.yds.= 1 sq.rod.	272.25 =	30.25 =	1		
40 sq.rods.= 1 sq.rood.	10,890 =	1,210 =	40 =	1	
4 sq. roods = 1 acre.	43,560 =	4,840 =	160 =	4 =	1
640 acres 1 sq. mile.	27,878,400 =	3,097,600 =	102,400 =	2,560 =	640

VOLUME—LIQUID.

	Gills.	Pints.	Cub. In.
4 gills = 1 pint.	8		
2 pints = 1 quart.	32 =	8 =	231
4 quarts = 1 gallon.			

FLUID.

Gallon.		Pints.		Ounces.		Drams.		Minims.		Cubic Centimetres.
1	=	8	=	128	=	1,024	=	61,440	=	3,785.441
		1	=	16	=	128	=	7,680	=	473.180
				1	=	8	=	480	=	29.574
						1	=	60	=	3.697

16 ounces, or a pint, sometimes called a pound.

TROY WEIGHT.

Pound.		Ounces.		Pennyweights.		Grains.		Grams.
1	=	12	=	240	=	5,760	=	373.25
		1	=	20	=	480	=	31.10
				1	=	24	=	1.55

APOTHECARIES' WEIGHT.

lb. Pound.		℥ Ounces.		ʒ Drams.		℈ Scruples.		gr. Grains.		Grams.
1	=	12	=	96	=	288	=	5,760	=	373.25
		1	=	8	=	24	=	480	=	31.10
				1	=	3	=	60	=	3.89
						1	=	20	=	1.30
								1	=	.06
								15½.	=	1.00

The pound, ounce, and grain are the same as in Troy weight.

AVOIRDUPOIS WEIGHT.

Pound.		Ounces.		Drams.		Grains (Troy).		Grams.
1	=	16	=	256	=	7,000	=	453.60
		1	=	16	=	437.5	=	28.35
				1	=	27.34	=	1.77

TABLES FOR THE CONVERSION OF GRAMS (OR CUBIC CENTIMETRES) INTO OUNCES AND GRAINS.

CONVERSION OF GRAMS INTO GRAINS.

Grams.	Grains.
1	15.43
2	30.86
3	46.29
4	61.73
5	77.16
6	92.59
7	108.03
8	123.46
9	138.89

CONVERSION OF GRAINS INTO GRAMS.

Grains.	Grams.
1	.0648
2	.1296
3	.1944
4	.2592
5	.3240
6	.3888
7	.4536
8	.5184
9	.5832

CONVERSION OF GRAMS INTO TROY OUNCES.

Grams.	Troy Ounces.
1	.03215
2	.06430
3	.09645
4	.12860
5	.16075
6	.19290
7	.22505
8	.25720
9	.28935

CONVERSION OF GRAMS INTO AVOIRDUPOIS OUNCES.

Grams.	Avoirdupois Ounces.
1	.03527
2	.07054
3	.10581
4	.14108
5	.17635
6	.21162
7	.24689
8	.28216
9	.31743

The above tables render the conversion of the weights in question a matter of great ease, the error introduced in the last decimal place being trivial.

The use of the tables will be best illustrated by an example. Supposing that it is desired to find the equivalent in grains of 324.51 grams, we proceed by breaking up this number into the following series of constituent parts, and finding the grain-equivalent of each part from the table:

Portions of original number.	Equivalents in grains.
300.00	4630.
20.00	308.6
4.00	61.73
.50	7.716
.01	.1543
	5008.2003

The required quantity is 5008.2 grains. The numbers taken from the table will, in most cases, require a change as regards the position of the decimal point; thus, to find the value of 300 grams, one refers to the table, and finds 46.30 given as the equivalent, and a mere shifting of the decimal point two places towards the right multiplies this by 100, or gives the required number. In a similar manner, by shifting the decimal place of 30.86 one place to the right we obtain the value in grains of 20 grams; while the number 61.7 is taken from the table without alteration as the equivalent of 4 grams. For .50 the table number must have its point shifted on to the left, making it 7.716 instead of 77.16; and finally, the value of .01 is obtained by shifting the point of 15.43 two places to the left.

The above operations are, in actual practice, performed with considerable speed, the required equivalents being written down one after the other on a scrap of paper, and then added up.

TABLE SHOWING THE COMPARISON OF THE READINGS OF THERMOMETERS.

CELSIUS, OR CENTIGRADE (C). RÉAUMUR (R). FAHRENHEIT (F).

C.	R.	F.	C.	R.	F.
—30	—24.0	—22.0	23	18.4	73.4
—25	—20.0	—13.0	24	19.2	75.2
—20	—16.0	— 4.0	25	20.0	77.0
—15	—12.0	+ 5 0	26	20.8	78.8
—10	— 8.0	14.0	27	21.6	80.6
— 5	— 4.0	23.0	28	22.4	82.4
— 4	— 3.2	24.8	29	23 2	84.2
— 3	— 2.4	26.6	30	24.0	86.0
— 2	— 1.6	28.4	31	24.8	87.8
— 1	— 0.8	30.2	32	25.6	89.6
			33	26.4	91.4
Freezing point of water.			34	27.2	93.2
			35	28.0	95.0
0	0.0	32.0	36	28.8	96.8
1	0.8	33.8	37	29.6	98.6
2	1.6	35.6	38	30.4	100.4
3	2.4	37.4	39	31.2	102.2
4	3.2	39.2	40	32.0	104.0
5	4.0	41.0	41	32.8	105.8
6	4.8	42.8	42	33.6	107.6
7	5.6	44.6	43	34.4	109.4
8	6.4	46.4	44	35.2	111.2
9	7.2	48.2	45	36.0	113.0
10	8.0	50.0	50	40.0	122.0
11	8.8	51.8	55	44.0	131.0
12	9.6	53.6	60	48.0	140.0
13	10.4	55.4	65	52.0	149.0
14	11.2	57.2	70	56.0	158.0
15	12.0	59.0	75	60.0	167.0
16	12.8	60.8	80	64 0	176.0
17	13.6	62.6	85	68.0	185.0
18	14.4	64.4	90	72.0	194.0
19	15.2	66.2	95	76.0	203.0
20	16.0	68.0	100	80.0	212.0
21	16.8	69.8	Boiling point of water.		
22	17.6	71.6			

Readings on one scale can be changed into another by the following formulæ, in which t° indicates degrees of temperature:

Réau. to Fahr.	Cent. to Fahr.	Fahr. to Cent.
$\left(\frac{9}{4} t^\circ \text{ R}\right) + 32^\circ = t^\circ \text{ F}$	$\frac{9}{5} t^\circ \text{ C} + 32^\circ = t^\circ \text{ F}$	$\frac{5}{9}\left(t^\circ \text{ F} - 32^\circ\right) = t^\circ \text{ C}$
Réau. to Cent.	Cent. to Rèau.	Fahr. to Réau.
$\frac{5}{4} t^\circ \text{ R} = t^\circ \text{ C}$	$\frac{4}{5} t^\circ \text{ C} = t^\circ \text{ R}$	$\frac{4}{9}\left(t^\circ \text{ F} - 32\right) = t^\circ \text{ R}$

ACKLAND'S TABLES FOR THE SIMPLIFICATION OF EMULSION CALCULATIONS.

No. 1.

	Equivalent weights.	Weight of $AgNO_3$ required to convert one grain of soluble haloid.	Weight of soluble haloid required to convert one grain $AgNO_3$.	Weight of silver haloid produced by one grain of soluble haloid.	Weight of soluble haloid required to produce one grain of silver haloid.	Weight of silver haloid produced from one grain $AgNO_3$.
Ammonium bromide.......	98	1.734	.576	1.918	.521	1.106
Potassium "	119.1	1.427	.700	1.578	.633	
Sodium "	103	1.650	.606	1.825	.548	
Cadmium " com...	172	.988	1.012	1.093	.915	
" " anh....	136	1.25	.800	1.382	.723	
Zinc "	112.1	1.509	.663	1.670	.600	
Ammonium chloride.......	53.5	3.177	.315	2.682	.373	.844
Sodium "	58.5	2.906	.344	2.453	.408	
Ammonium iodide.........	145	1.172	.853	1.620	.617	1.382
Potassium "	166.1	1.023	.977	1.415	.707	
Sodium "	150	1.133	.882	1.566	.638	
Cadmium "	183	.929	1.076	1.284	.778	

Table No. 1 presents the actual weights of haloid or silver, as the case may be, required to convert or combine with one grain of another.

In order to make (say) ten ounces of emulsion by a new formula, which, for the sake of showing the working of the table, we will write down as follows:

Bromide of potassium..............................	150	grains.
Iodide of potassium..............................	10	"
Chloride of ammonium..............................	10	"
Gelatine..............................	200	"

we want to know how much silver nitrate should be employed in sensitizing this mixture. For this purpose we use the first column, in which we find against each haloid the exact quantity of silver nitrate required to fully decompose one grain. Taking, then, the figures we find in column No. 1 against the three salts in the above formula, and multiplying them by the number of grains of each used, we have the following sum:

Potassium bromide......................	$150 \times 1.427 = 214$	Weight silver nitrate required.
" iodide.......	$10 \times 1.023 = 10.23$	
Chloride of ammonium.................	$10 \times 3.177 = 31.77$	

or the total quantity of silver nitrate required for full conversion, 256.00 grains.

"UNIFORM SYSTEM" NUMBERS FOR STOPS FROM $\frac{f}{1}$ TO $\frac{f}{100}$.

In the following table Mr. S. A. Warburton has calculated the exposure necessary with every stop from $\frac{f}{1}$ to $\frac{f}{100}$ compared with the unit stop of the "uniform system" of the Photographic Society of Great Britain. The figures which are underlined show in the first column what $\frac{f}{a}$ must be in order to increase the exposure in geometrical ratio from $\frac{f}{4}$, the intermediate numbers showing the uniform system number for any other aperture.

f	U. S. No.	f	U. S. No.	f	U. S. No.
1	$\frac{1}{16}$	15	14.06	58	210.25
1¼	.097	16	16	59	217.56
1.414	⅛	17	18.06	60	225.00
1½	.140	18	20.25	61	232.56
1¾	.191	19	22.56	62	240.25
2	¼	20	25.00	63	248.06
2¼	.316	21	27.56	64	256
2½	.390	22	30.25	65	264.06
2.828	½	22.62	32	66	272.25
2¾	.472	23	33.06	67	280.56
3	.562	24	36.00	68	289.00
3¼	.660	25	39.06	69	297.56
3½	.765	26	42.25	70	306.25
3¾	.878	27	45.56	71	315.06
4	1.00	28	49.00	72	324.00
4¼	1.12	29	52.56	73	333.06
4½	1.26	30	56.25	74	342.25
4¾	1.41	31	60.06	75	351.56
5	1.56	32	64	76	361.00
5¼	1.72	33	68.06	77	370.56
5½	1.89	34	72.25	78	380.25
5.656	2	35	76.56	79	390.06
5¾	2.06	36	81.00	80	400.00
6	2.25	37	85.56	81	410.06
6¼	2.44	38	90.25	82	420.25
6½	2.64	39	95.06	83	430.56
6¾	2.84	40	100.00	84	440.00
7	3.06	41	105.06	85	451.56
7¼	3.28	42	110.25	86	462.25
7½	3.51	43	115.56	87	473.06
7¾	3.75	44	121.00	88	484.00
8	4	45	126.56	89	495.06
8¼	4.25	45.25	128	90	506.25
8½	4.51	46	132.25	90.50	512
8¾	4.78	47	138.06	91	517.56
9	5.06	48	144.00	92	529.00
9¼	5.34	49	150.06	93	540.56
9½	5.64	50	156.25	94	552.25
9¾	5.94	51	162.56	95	564.06
10	6.25	52	169.00	96	576.00
11	7.56	53	175.56	97	588.06
11.31	8	54	182.25	98	600.25
12	9.00	55	189.06	99	612.56
13	10.56	56	196.00	100	625.00
14	12.25	57	203.06		

TABLE FOR ENLARGEMENT AND REDUCTION

COMPUTED FOR CENTIMETERS OR INCHES.

Equivalent Focus of the Lens.	Distances of the Object and the Ground Glass Screen from the Center of the Objective.																								
	1 *t.*	2 *t.*	3 *t.*	4 *t.*	5 *t.*	6 *t.*	7 *t.*	8 *t.*	9 *t.*	10 *t.*	11 *t.*	12 *t.*	13 *t.*	14 *t.*	15 *t.*	16 *t.*	17 *t.*	18 *t.*	19 *t.*	20 *t.*	21 *t.*	22 *t.*	23 *t.*	24 *t.*	25 *t.*
5..	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130
	10	7.5	6.7	6.2	6	5.8	5.7	5.6	5.6	5.5	5.4	5.4	5.4	5.4	5.3	5.3	5.3	5.3	5.3	5.3	5.2	5.2	5.2	5.2	5.2
6..	12	18	24	30	36	42	48	54	60	66	72	78	84	90	92	102	108	114	120	126	132	138	144	150	156
	12	9	8	7.5	7.2	7	6.9	6.8	6.7	6.6	6.5	6.5	6.4	6.4	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.2
7..	14	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147	154	161	168	175	182
	14	10.5	9.3	8.8	8.4	8.2	8	7.9	7.8	7.7	7.6	7.6	7.5	7.5	7.5	7.4	7.4	7.4	7.4	7.4	7.3	7.3	7.3	7.3	7.3
8..	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160	168	176	184	192	200	208
	16	12	10.7	10	9.6	9.3	9.1	9	8.8	8.8	8.7	8.7	8.6	8.6	8.5	8.5	8.5	8.4	8.4	8.4	8.4	8.4	8.3	8.3	8.3
9..	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	162	171	180	189	198	207	216	225	234
	18	13.5	12	11.3	10.8	10.5	10.3	10.1	9.9	9.9	9.8	9.8	9.7	9.6	9.6	9.6	9.5	9.5	9.5	9.5	9.4	9.4	9.4	9.4	9.4
10..	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
	20	15	13.3	12.5	12	11.7	11.4	11.3	11.1	11	10.9	10.8	10.8	10.7	10.7	10.6	10.6	10.6	10.5	10.5	10.5	10.5	10.4	10.4	10.4
11..	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198	209	220	231	242	253	264	275	286
	22	16.5	14.7	13.8	13.2	12.8	12.6	12.4	12.2	12.1	12	11.9	11.8	11.8	11.7	11.7	11.6	11.6	11.6	11.6	11.5	11.5	11.5	11.5	11.4
12..	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312
	24	18	16	15	14.4	14	13.7	13.5	13.3	13.2	13.1	13	12.9	12.9	12.8	12.7	12.7	12.7	12.6	12.6	12.6	12.5	12.5	12.5	12.5
13..	26	39	52	65	78	91	104	117	130	143	156	169	182	195	208	221	234	247	260	273	286	299	312	325	338
	26	19.5	17.3	16.3	15.6	15.1	14.9	14.6	14.4	14.3	14.2	14.1	14	13.9	13.9	13.8	13.8	13.7	13.7	13.7	13.6	13.6	13.6	13.5	13.5
14..	28	42	56	70	84	98	112	126	140	154	168	182	196	210	224	238	252	266	280	294	308	322	336	350	364
	28	21	18.7	17.5	16.8	16.3	16	15.8	15.6	15.4	15.3	15.2	15.1	15	14.9	14.9	14.8	14.8	14.7	14.7	14.7	14.6	14.6	14.6	14.6
15..	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	360	375	390
	30	22.5	20	18.8	18	17.5	17.1	16.9	16.7	16.5	16.4	16.3	16.2	16.1	16	15.9	15.9	15.8	15.8	15.8	15.7	15.7	15.7	15.6	15.6

16..	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320	336	352	368	384	400	416
	32	24	21.3	20	19.2	18.7	18.3	18	17.8	17.6	17.5	17.3	17.2	17.1	17.1	16.9	16.9	16.9	16.8	16.8	16.8	16.7	16.7	16.7	16.6
17..	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340	357	374	391	408	425	442
	34	25.5	22.7	21.3	20.4	19.8	19.4	19.1	18.9	18.7	18.5	18.4	18.3	18.2	18.1	18.1	18	17.9	17.9	17.9	17.8	17.8	17.7	17.7	17.7
18..	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360	378	396	414	432	450	468
	36	27	24	22.5	21.6	21	20.6	20.3	20	19.8	19.6	19.5	19.4	19.3	19.2	19.1	19.1	19	18.9	18.9	18.8	18.8	18.8	18.8	18.7
19..	38	57	76	95	114	133	152	171	190	209	228	247	266	285	304	323	342	361	380	399	418	437	456	475	494
	38	28.5	25.3	23.8	22.8	22.2	21.7	21.4	21.1	20.9	20.7	20.6	20.5	20.4	20.3	20.2	20.1	20.1	20	20	19.9	19.8	19.8	19.8	19.8
20..	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520
	40	30	26.6	25	24	23.3	22.9	22.5	22.2	22	21.8	21.7	21.5	21.4	21.3	21.3	21.2	21.2	21.1	21	21	20.9	20.9	20.8	20.8
21..	42	63	84	105	126	147	168	189	210	231	252	273	294	315	336	357	378	399	420	441	462	483	504	525	546
	42	31.5	28	26.3	25.2	24.5	24	23.7	23.3	23.1	22.9	22.8	22.6	22.5	22.4	22.3	22.2	22.2	22.1	22.1	22	21.9	21.9	21.9	21.8
22..	44	66	88	110	132	154	176	198	220	242	264	286	308	330	352	374	396	418	440	462	484	506	528	550	572
	44	33	29.3	27.5	26.4	25.7	25.1	24.8	24.4	24.2	24	23.8	23.7	23.6	23.5	23.4	23.2	23.2	23.2	23.1	23	23	23	22.9	22.1
23..	46	69	92	115	138	161	184	207	230	253	276	299	322	345	368	391	414	437	460	483	506	529	552	575	598
	46	34.5	30.7	28.8	27.6	26.7	26.3	25.9	25.6	25.3	25.1	24.9	24.8	24.6	24.5	24.4	24 3	24.3	24.2	24.2	24.1	24	24	24	23.9
24..	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504	528	552	576	600	624
	48	36	32	30	28.8	28	27.4	27	26.7	26.4	26.2	26	25.8	25.7	25.6	25.5	25.4	25.3	25.3	25.2	25.1	25.1	25	25	25
25..	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650
	50	37.5	33.3	31.3	30	29.2	28.6	28.1	27.8	27.5	27.3	27.1	26.9	26.8	26.7	26.6	26.5	26.4	26.3	26.3	26.2	26.1	26.1	26	26

The use of the above table will best be explained by illustrations:

To enlarge six times with a lens of 15 centimeters (or inches) focal length. We find in the table under 6 *t.* and opposite the figures $\frac{105}{17.5}$, hence the object must be 17.5, and the screen 105 centimeters (or inches) from the centre of the lens.

To reduce eight times with a lens of 19 centimeters (or inches) focus, the object must be 171 and the screen 21.4 centimeters (or inches) from centre of lens.

The table can be formulated thus: Where p = focal length of lens, a = distance from ground-glass to centre of lens and b = distance from object to centre of lens, then $\frac{1}{a} + \frac{1}{b} = \frac{1}{p}$.

PROF. BURTON'S TABLE OF COMPARATIVE EXPOSURES.

Apertures Calculated on the Standard System of the Photographic Society.	Sea and Sky.	Open Land-scape.	Landscape with heavy foliage in foreground.	Under Trees, up to		Fairly Lighted Interiors.		Badly Lighted Interiors, up to		Portraits in bright diffused Light out of doors.	Portraits in good Studio Light.		Portraits in Ordinary Room.	
				mins.	secs.	mins.	secs.	hrs.	mins.		mins.	secs.	mins.	secs.
No. 1, or $\frac{f}{4}$	$\frac{1}{160}$ sec.	$\frac{1}{50}$ sec.	$\frac{1}{8}$ sec.	0	10	0	10	0	2	$\frac{1}{6}$ sec.	0	1	0	4
No. 2, or $\frac{f}{5.657}$	$\frac{1}{80}$ sec.	$\frac{1}{25}$ sec.	$\frac{1}{4}$ sec.	0	20	0	20	0	4	$\frac{1}{3}$ sec.	0	2	0	8
No. 4, or $\frac{f}{8}$	$\frac{1}{40}$ sec.	$\frac{1}{12}$ sec.	$\frac{1}{2}$ sec.	0	40	0	40	0	8	$\frac{2}{3}$ sec.	0	4	0	16
No. 8, or $\frac{f}{11.314}$	$\frac{1}{20}$ sec.	$\frac{1}{6}$ sec.	1 sec.	1	20	1	20	0	16	$1\frac{1}{3}$ sec.	0	8	0	32
No. 16, or $\frac{f}{16}$	$\frac{1}{10}$ sec.	$\frac{1}{3}$ sec.	2 secs.	2	40	2	40	0	32	$2\frac{2}{3}$ secs.	0	16	1	4
No. 32, or $\frac{f}{22.627}$	$\frac{1}{5}$ sec.	$\frac{2}{3}$ sec.	4 secs.	5	20	5	20	1	4	$5\frac{1}{3}$ secs.	0	32	2	8
No. 64, or $\frac{f}{32}$	$\frac{2}{5}$ sec.	$1\frac{1}{3}$ sec.	8 secs.	10	40	10	40	2	8	$10\frac{2}{3}$ secs.	1	4	4	16
No. 128, or $\frac{f}{45.255}$	$\frac{4}{5}$ sec.	$2\frac{2}{3}$ secs.	16 secs.	21	20	21	20	4	16	21 secs.	2	8	8	32
No. 256, or $\frac{f}{64}$	$1\frac{3}{5}$ sec.	$5\frac{1}{3}$ secs.	32 secs.	42	40	42	40	8	32	42 secs.	4	16	17	4

EXTRACTS FROM TABLE DEVELOPING FORMULÆ.

COMPILED BY MESSRS. LYONEL CLARK AND E. FERRERO, OF THE CAMERA CLUB.

The quantities are given in grains and minims per ounce of developer.

PLATES.	Pyro.	Ammonium Bromide.	Potassium Bromide.	Ammonia.	Sodium Carbonate.	Potassium Carbonate.	Ammonium Carbonate.	Sodium Sulphite.	Potassium Meta-bisulphite.
	Grains	Grains	Grains	Minims	Grains	Grains	Grains	Grains	Grains
*Abney and Derby	2	2 to 4	....	1.60 to 4	....	...	...	....	....
Ditto	3.60	....	....	....	....	22	....	18.80	....
*Academy	2	2	....	4	....	....	....	....	....
Albert	1.50	0.63	....	3.16	....	....	....	....	....
*Beechey (Dry Col.)	12	...	3	....	....	....	30	....	....
*Beernaert	4.78	....	....	....	16.05	....	....	32.10	....
*Britannia	2	2	....	4	....	....	....	....	....
*Cadett's	1.50	3	....	6	....	....	....	....	....
Charterhouse	1.36	3.40	....	1.36	....	....	....	2.72	....
Cranbourne	1.10	....	0.72	2.30	....	....	....	4.40	....
Derwent	2.18	....	....	....	14.4	....	....	38.4	....
*Eastman's Paper Negative	4.50	....	....	....	19	....	....	27	....
*Eastman's Stripping Film	4.50	....	....	....	19	....	....	27	....
Do. Do.	3.53	....	...	...	12	3	....	21.18	....
Edwards's XL	2.10	0.50	....	2	....	...	....	....	....
*England's Instantaneous	1.50	....	1	2	....	....	....	....	....
*Ditto, Do.	3.40	....	....	....	....	8.60	...	17	....
*Globe	2	1	....	4	....	....	....	....	....
*Ilford	1.85	2.50	....	4.50	....	....	....	....	....
Keystone	2.50	....	....	....	....	6.41	....	10	....
*Lancaster's	2.40	....	0.82	5	....	....	....	....	....
Ludgate	2.14	....	0.23	1.87	....	...	...	....	....
Mawson and Swan's	1.50	0.75	...	3.75	....	....	....	....	1.50
Do., New Cheap	1.50	1.50	....	3.75	....	....	....	....	...
Mawdsley	1.50	....	0.50	3	....	....	....	....	....

* The above analyses have been submitted to the makers of the plates, and asterisks are affixed to all the formulæ of which approval has been signified.

PERCENTAGE OF REAL AMMONIA IN SOLUTIONS OF DIFFERENT DENSITIES AT 14 DEG. CENTIGRADE.

(CARIUS.)

Specific Gravity.	Percentage Ammonia.	Specific Gravity.	Percentage Ammonia.	Specific Gravity.	Percentage Ammonia.	Specific Gravity.	Percentage Ammonia.
0.8844	36.0	0.9052	27.0	0.9314	18.0	0.9631	9.0
0.8864	35.0	0.9078	26.0	0.9347	17.0	0.9670	8.0
0.8885	34.0	0.9106	25.0	0.9380	16.0	0.9709	7.0
0 8907	33.0	0.9133	24 0	0.9414	15.0	0.9749	6.0
0.8929	32.0	0.9162	23.0	0.9449	14.0	0.9790	5.0
0.8953	31.0	0.9191	22.0	0.9484	13.0	0.9831	4.0
0.8976	30.0	0.9221	21.0	0.9520	12.0	0.9873	3.0
0.9001	29.0	0.9251	20.0	0.9556	11.0	0.9915	2.0
0.9026	28.0	0.9283	19.0	0.9593	10.0	0.9959	

ELSDEN'S TABLE OF POISONS AND ANTIDOTES.

	Poisons.	Remarks.	Characteristic Symptoms.	Antidote.
Vegetable Acids.	Oxalic Acid. including Potassium Oxalate.	1 dram is the smallest fatal dose known.	Hot, burning sensation in throat and stomach; vomiting, cramps, and numbness.	Chalk, whiting or magnesia, suspended in water. Plaster or mortar can be used in emergency.
Caustic Alkalies.	Ammonia. Potash. Soda.	Vapor of ammonia may cause inflammation of the lungs.	Swelling of tongue, mouth, and fauces; often followed by stricture of the œsophagus.	Vinegar and water.
Metallic Salts.	Mercuric Chloride.	3 grains the smallest known fatal dose.	Acrid, metallic taste, constriction and burning in throat and stomach, followed by nausea and vomiting.	White and yolk of raw eggs with milk. In emergency, flour paste may be used.
	Acetate of Lead.	The sub-acetate is still more poisonous.	Constriction in the throat and at pit of stomach; crampy pains and stiffness of abdomen; blue line round the gums.	Sulphates of soda or magnesia. Emetic of sulphate of zinc.
	Cyanide of Potassium.	*a.* Taken internally, 3 grs. fatal.	Insensibility, slow, gasping respiration, dilated pupils, and spasmodic closure of the jaws.	No certain remedy; cold affusion over the head and neck most efficacious.
		b. Applied to wounds and abrasures of the skin.	Smarting sensation.	Sulphate of iron should be applied immediately.
	Bichromate of Potassium	*a.* Taken internally.	Irritant pain in stomach, and vomiting.	Emetics and magnesia, or chalk.
		b. Applied to slight abrasions of the skin.	Produces troublesome sores and ulcers.	
	Nitrate of Silver.		Powerful irritant.	Common salt to be given immediately, followed by emetics.
Concentrated Mineral Acids.	Nitric Acid.	2 drams have been fatal. Inhalation of the fumes has also been fatal.	Corrosion of windpipe and violent inflammation.	Bicarbonate of soda, or carbonate of magnesia or chalk, plaster of the apartment beaten up in water.
	Hydrochloric Acid.	⅛ ounce has caused death.		
	Sulphuric Acid.	1 dram has been fatal.		
	Acetic Acid, concentrated, has as powerful an effect as the mineral acids.			
	Iodine.	Variable in its action; 3 grains have been fatal.	Acrid taste, tightness about the throat, vomiting.	Vomiting should be encouraged, and gruel, arrowroot and starch given freely.
	Ether.	When inhaled.	Effects similar to chloroform.	Cold affusion and artificial respiration.
	Pyrogallol.	2 grains sufficient to kill a dog.	Resemble phosphorus poisoning.	No certain remedy. Speedy emetic desirable.

INDEX.

LEWIS MILLER,
PRESIDENT.

JOHN H. VINCENT,
CHANCELLOR.

K. F. KIMBALL, BUFFALO, N. Y., SEC'Y C. S. P.

THE

Chautauqua School of Photography.

MOTTO: "AND THERE WAS LIGHT."

Corresponding Class of 1890 to 1891

Member's Name, Mrs E. S. Walling

Class No. 283

Post Office Address, Garden Grove

County, Orange

State, California

☞ CHANGE IN ADDRESS SHOULD BE REPORTED WITHOUT DELAY TO THE SCHOOL HEADQUARTERS.

SCHOOL HEADQUARTERS,

423 Broome Street, - New York,

Charles Ehrmann,
INSTRUCTOR.

TO THE MEMBERS

of the

CHAUTAUQUA SCHOOL OF PHOTOGRAPHY

ON JOINING THE CLASS.

Mrs. E. S. Walling

It is my agreeable duty to welcome you to membership in our class for the study of Photography, and to advise you that your name has been entered upon the books of the Chautauqua University. The payment of your fee for the full course of one year, is hereby acknowledged, and you have been enrolled upon the list at the headquarters of the C. S. of P.

A meeting of all members and ex-members of the school, graduates and undergraduates, will take place annually, immediately after the Recognition Day of the Chautauqua Literary and Scientific Circle, when Diplomas will be presented to the graduates of the school, premiums awarded to successful competitors, and discourses be held on photographic topics.

You are cordially invited to be present at all such occasions.

Trusting that you will enter into the school lessons with enthusiasm and in case of any perplexities, you will not hesitate to make use of the question box; also, that you will join with me in faithfully attending to the reading and practice in the order indicated by our programme, and that you will be one of the successful candidates for a diploma at Chautauqua, in 1891. I am,

Sincerely your friend,

Chas. Ehrmann

INSTRUCTOR C. S. OF P.

Programme.

The Chautauqua School of Photography instructs in four classes. (1) The Corresponding Class. (2) The Practicing Class at the Assembly Ground. (3) The Local Class at the School Headquarters, 423 Broome Street, New York. (4) The Post-graduate Course.

Every member of the *Corresponding Class* must read during the week the lesson which is sent by mail, and the answers to queries in the weekly PHOTOGRAPHIC TIMES, as well as everything else published there of interest to members of the C. S. of P.

After the expiration of the first term, which ends with the twenty-fourth weekly lesson, scholars are required to study during the rest of the year, "The Process of Pure Photography," by W. K. Burton and Andrew Pringle.

If there is anything that you do not understand in the lessons after you have read them carefully, please report your difficulty at once to the Question Box.

Members are requested to communicate frequently with the Instructor, to ask for information when needed and to present occasionally specimens of their work which will be duly criticised in the organ of the school.

At the expiration of the yearly course, examination papers will be sent to each member. The answers are to be filled in and the papers returned to headquarters at the time designated, accompanied by three finished photographs. All who answer 80 per cent. of the questions correctly, if their required work has also been done, will receive a diploma from the Chautauqua School of Photography on graduation day.

Any member who fails to pass the examination, and who wishes to try again, can do so by making application for a special examination, and will be expected to answer 90 per cent. of the second series of questions.

In the *Practicing Class* at the Assembly Grounds and the *Local Class* at New York, exercises in studies and field will be had, and instruction given in photographic theories, the preparation of photographic chemicals, and in such special branches as may be within the reach of the Institute. Scholars of these two classes will be admitted to examination and can compete for Diplomas or Premiums, if they have followed the reading of the Corresponding Class.

The students of the *Post-graduate Class* are instructed by the prescribed reading, and by special correspondence with the Instructor.

The course will last two years and comprises instruction in Chemistry, Photographic Theories, Optics and Aesthetics.

Examination every six months. From the general average of all the questions answered, the merits of the students will be determined. When 80 per cent. have been correctly answered, the student is entitled to the Advanced Diploma of the Chautauqua School of Photography.

Rules for Addressing the Question Box.

1.—Address all letters to the PHOTOGRAPHIC TIMES' QUESTION BOX, 423 Broome Street, New York City, giving your full name and *class number.*

2.—Write only on one side of the paper, and put each question on a separate slip of paper; sign every slip, and put on each your class number.

3.—Write plainly, briefly, and to the point. If you wish to study any particular branch of Photography, report names of books already read, and ask for names of others.

4.—Questions will be answered only for those whose record at school headquarters shows them to be active working members.

5.—Do not ask for employment or advice about business, as this is beyond the school work.

Rules for Governing Answers.

1.—Questions will be answered in the order of reception as far as possible to do so.

2.—All answers will be communicated through the Chautauqua Supplement to the monthly PHOTOGRAPHIC TIMES and the class number will be placed opposite the reply.

Books and Other Requisites.

Besides the prescribed reading, students are advised to read,

No. 28. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC. Finely illustrated. Paper; (by mail, 12 cents additional) $0 50

Library Edition, (by mail, 12 cents additional) 1 00

No. 30. PICTORIAL EFFECT IN PHOTOGRAPHY. By H. P. ROBINSON. A new edition. Illustrated. Mr. Robinson's first and best work. Cloth bound 1 50

No. 31. A DICTIONARY OF PHOTOGRAPHY. For the Professional and Amateur Photographer. By E. J. WALL. Illustrated. 240 pages. Cloth bound 1 50

Books and Photographic Requisites may be obtained through the Instructor.

CHAUTAUQUA UNIVERSITY.

LEWIS MILLER, President.

J. H. VINCENT, Chancellor. R. S. HOLMES, Registrar.

THE

Chautauqua School of Photography,

SCHOOL HEADQUARTERS,

423 BROOME STREET, NEW YORK.

CHARLES WAGER HULL,

Supt. of Instruction, C. S. of P.

INTRODUCTORY.

THE series of articles, or, perhaps, more properly speaking, lessons, which it is proposed shall follow this, are written more especially for those who know little or nothing of the charming art of photography, yet desire to be taught its mysteries by easy, simple methods, leaving for later study the whys and the wherefores, the chemistry and the science. My experience has proven that the amateur or the beginner is far too much inclined to ask questions that later on would be well and proper, too apt to become an experimenter while yet a tyro, too apt to fill his notebook and his head with conflicting theories and formulas, not patient enough when under simple instruction, too anxious to do everything at once; these rarely succeed; success attends those who move only as fast as they learn, and understand.

To become even moderately successful, photography demands of its votaries certain characteristics, a few of which it is proper the beginner should know of and appreciate; upon them success depends.

PATIENCE, for photography being based upon chemical conditions and changes, moves only just so fast, it cannot be hurried. You cannot make a better picture by using a stronger developer, thus gaining time, by "hurrying things up;" it is not like driving a nail or sawing a stick of wood. Patience to wait for the right time of day and the right sort of light; patience to look your subject *all over*, study it, find the most pleasing point of view; the resulting picture will then satisfy you, your labor has been rewarded. The writer knows quite a number of amateurs who should have painted on their cameras, "Wholesale only." They don't care half as much for quality as they do for quantity; they can make more pictures in a day than a painstaking, good working man can make in a week, but not one in a dozen is worth the cost of the soda contained in the developer.

This kind of photographer reminds one of the boy who busies himself on the Fourth of July by blazing away from a revolver, and measures his patriotism by the number of shots fired. This kind of chap never makes a good photographer.

ORDER.—This is an absolute requirement. When it is understood that each chemical is used to produce a certain condition, when brought into relation with another chemical, it is obvious that the bringing together of chemicals at the wrong time, or in the wrong order, must destroy the work in hand. If, as is constantly the case, various operations are going along at the same time, the greatest care must be used, by continually wiping the fingers, that those solutions which should be kept apart are so kept. Faith, not only in your teacher, but in your own efforts as well, is essential to success ; not that the methods of instruction or the formula to be given are any better than others ; but that they will enable the student to make as good a photograph as the writer can make, which, the writer flatters himself, will fully satisfy the student.

Follow closely and exactly everything that you are instructed to do; under no circumstances adopt or attempt changes; when all has been done as directed, the course finished, and good work made, then, and not until then, plunge into the boundless field of theory and experiment, and good may then come of it.

Those who think they know it all, or know somebody who does; who are not willing to follow as herein to be directed, will not do justice either to themselves or to the teacher. Last and by no means the least important requirement is that those who propose to learn the art of photography must love it, be patient and persevering; getting tired and saying "I guess that'll do," will never make a good picture. Now, a word or two as to the benefits to be derived.

BENEFITS.—Hidden here and there along every road-side, every hill-side stream, every woodland, everywhere, indeed, are beauties not seen by the uneducated eye; but pick up your camera on a fine bright morning, leisurely stroll along, and you will find new beauties each time; the more familiar you become with nature's beauties, the more familiar nature will become with you; you see what you never saw before, for the reason, you never observed, you never searched for her beauties; now that you know them, of them, you will never find the end. Pages might be written on this benefit alone; it is worth far more than it will cost to acquire it.

Another of the chief charms of photography is its unselfishness; the pictures made on a morning ramble are not alone enjoyed by the maker, but enjoyed as well by *all* his friends. This cannot be said of the ordinary pastimes of our day.

In closing this rather long Introductory, the writer desires to impress upon students the fact, that he considers its *maxims* quite as important as any directions which follow.

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Lesson No. I.

APPARATUS AND REQUISITES.

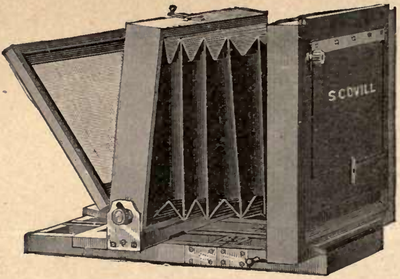
In photography, as in all other industrial pursuits, certain apparatus or tools, so to speak, are needed to produce a picture; some you can buy, others with but little labor and ingenuity you can make. This lesson is written to inform you of those you must have, and leave to your own judgment the purchase of those which, though not absolutely necessary, are, nevertheless, of considerable comfort in carrying forward the various operations through which you are to be led.

The first group of *essentials* will be the camera and plate-holder, the lens, the tripod, the cloth to be used when examining the image cast upon the ground glass by the lens, and the focusing-glass.

Cameras vary greatly in their design, and in the means adopted to produce certain necessary conditions. They should be as light as is consistent with the work they have to do, but not so light as to be liable to injury from the accidental blows they are almost certain to receive in out-door work.

Cost is too often held to be the first consideration; good workmanship and simplicity is, in the writer's opinion, of greater value to the amateur than the *few dollars* difference in price.

For all uses for which they are intended, the "Favorite" or "Waterbury" cameras meet every requirement.



The first-named of these cameras is made of light walnut, and the latter of mahogany. They have rubber bellows, folding platform, single swing, vertical shifting front, *record slides* and *side latch* for holding platform rigid. The two features last named are especially desirable; they are as light and compact as substantial cameras can be constructed. The sizes made of this style are for pictures 4 inches by 5 inches; 5 inches by 8 inches, and $6\frac{1}{2}$ inches by $8\frac{1}{2}$ inchcs. These, with rare exceptions, are the sizes used by amateurs.

To those readers who do not know anything about cameras, it is well to explain certain parts named, and their uses. The rubber bellows is that part between the front and back of camera, made to allow them to be moved together or apart as may be required in adjusting the focus, or the making sharp and distinct of the image on the ground glass. The ground glass is that part which in cut is represented as falling back, in the place of which, as will be described later on, the holder containing sensitive plate is placed.

The single swing is that part of the camera to which the ground glass is attached on left or back part of the cut; it is an adjustable arrangement held in place by a thumb-screw, as shown, and may be tilted, as shown in the cut, to the front or to the rear, or may be placed vertical. Its uses are many; it serves to equalize the focus; by proper use the foreground containing the near objects in a picture is made clear and distinct, or, as photographers say, "sharp."

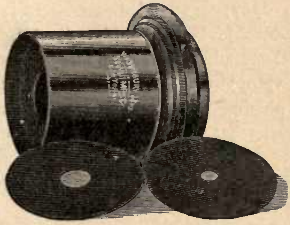
Vertical shifting front is that part on which the word "Scovill" is seen; it may be elevated or lowered at will, and is held firmly in place by a thumb-screw. On this front the lens is placed; by lowering it more foreground is brought into the picture; by elevating or raising, less foreground.

Side-latch for holding platform rigid, is the bolt seen on the platform or bed-piece, and holds rigidly the folding platform.

The folding platform folds up against the back of the camera, when the back has been pushed forward until it meets the front.

This simple and effective arrangement not alone renders the camera more portable, by reducing its size, but as well protects the bellows from injury during transportation.

One of the most important factors in the production of the photographic picture is the lens, of which, like the camera, there is an endless variety. Fortunately for the beginner of limited means, the improvement in lenses places within the reach of all good lenses for very little money. Nothing can surpass for all the ordinary views of still life the "Waterbury" lens. It is moderate in price, and for purpose stated, meets every requirement. It has good depth of focus, by which is meant objects near by and distant are both clearly defined; covers a good field, or breadth of subject, and works with fair rapidity.



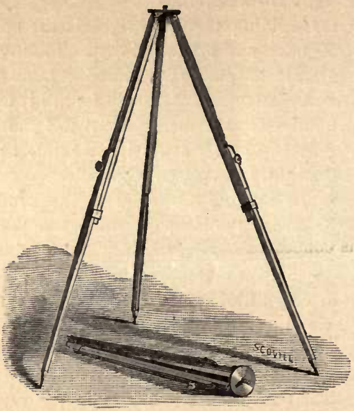
THE WATERBURY LENS AND DIAPHRAGMS

With it most excellent landscapes and groups can be made in a very few seconds; but to those who wish to include in their work pictures of moving objects, the more expensive lenses must be employed, of which the Morrison lenses are a representative type.

With one or the other of the two lenses named any work possible in photography can be produced.

The tripod is the stand on which the camera is placed, is adjustable, and must be made of well-seasoned wood; when not in use it is folded into compact form, placed in a bag, and is easily carried in the hand. One of the best forms made is that known as the Scovill Extension Tripod.

This tripod possesses special advantages. It can be set up ready for use quicker than any other, and with less trouble.



SCOVILL EXTENSION TRIPOD

When placed on uneven ground, the camera it supports may be brought to the proper level by simply adjusting the length of the legs. It has no detachable parts to be misplaced or lost. Without this tripod valuable time is often wasted, or opportune moments lost in placing the tripod legs and changing their position to include just what is wanted in a picture, and to level the camera.

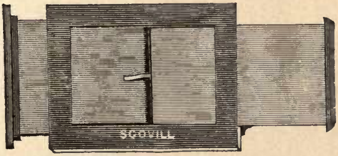
Next in the order of essentials named is the focusing cloth and the focusing glass.

The cloth should be about one yard square, of some dark material, impervious to light; such material can easily be found in any home. Many prefer a cloth made of some waterproof material; this has the two-fold advantage of excluding light, and in case of a shower serves to protect your camera, etc., from the rain.

SCOVILL FOCUSING GLASS.

This desirable little instrument is intended to aid the photographer in securing a sharply defined picture on the ground glass; to most people it is indispensable; the image on the glass being small and reversed, is at times somewhat difficult to determine as to exact sharpness.

The dry-plate holder (each holding two plates) which this cut represents, is a device for holding the sensitive plate, guarding it from light, and so constructed as to be placed upon the back of the camera, in the place occupied by the ground glass, with slides to be withdrawn when so placed that the image which was thrown upon the ground glass may then be thrown upon the face of the plate which is concealed in the holder.



The position of the face of the plate is exactly that first occupied by the ground glass; thus, whatever was seen upon it must now be thrown upon the plate; if the image was *sharp* (a photographic term for clearly defined) on the one, so it will be on the other.

Of these holders, as many are carried into the field as, in the opinion of the photographer, he will need for the work he has before him.

The articles named : camera, lens, tripod, cloth for covering the head, focusing glass, and plate holders, comprise all that is carried into the field, neatly packed, as they should be, in proper cases. This, at least so far as the holders are concerned, should never be neglected; as little exposure of them as possible to light should ever be the watchful rule of the careful photographer.

The next lesson will describe the methods of using the articles named in this one.

CHAUTAUQUA UNIVERSITY.
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Lesson No. II.

MANAGEMENT OF CAMERA AND LENS IN THE FIELD.

In the previous lesson effort was made to fully explain the apparatus named. Attention was called to its many parts, and setting aside the perhaps merited charge of prolixity, such part of each apparatus has thus far, and will be, to the end of these lessons, more fully explained than custom would seem to demand. We are writing to include those who know absolutely nothing as yet of the matter to which their attention is being called, to many students who are far away from any photographer, who have all to learn, no one near by to help them; to these detail in description will certainly be acceptable.

We now have the camera with its lens in place in the center of the sliding front where the word "Scovill" appears, the flange of which has been neatly fitted and firmly fastened with small screws; the tripod, the focusing cloth, and the focusing glass; for the present we will leave the plate-holder behind. Picking up the articles named let us step out upon the lawn, taking position so that the sun will be off a little to one side or the other, and behind us. We can hardly expect to secure a good picture with the sun or strongest light directly in front of us, neither can we look for good effects of light and shade (both are needed) if the light be either immediately over head or directly behind us. More, far more, depends upon the proper selection of the point of view and the direction of the light than many would suppose; there is a proper time of day, a proper direction from which the light should come for every landscape; a time when the shadows will so fall as to give proper effect, for from the shadows in their relations to the strong or high lights, do we get, when properly contrasted, the harmonious whole; the picture that always pleases. Let us place our camera here; before us lies a view combining conditions which will teach us the use of our lens with its diaphragms, more often called "stops." The first step to be taken is to choose the best point of view. In choosing this we are governed by the following considerations: The sun is to our back and to the right; in the immediate foreground we have a large rustic seat; further along and to the left is a rustic bower covered with vines; in the middle foreground a small pool of water, still and glassy as a mirror, with several small willows beautifully reflected from within it; further on to the left a magnificent cluster of large trees; beyond, in the distance, a little to the right, is a pretty villa not so thickly surrounded with trees as to obscure its architectural beauties; in front of it a lawn stretching down to the little pool that is situated, as stated, in the middle foreground. The light coming from the direction stated, falls in such a way as to light well into the large forest trees, casts the shadows of others aslant the lawn, and brings the projecting angles of the villa into bold relief. This effect of relief—the bold standing out from a flat surface—is nowhere better seen than in a well-painted sign: proper shading at a proper angle gives to the letters every appearance of being solid,—raised from the surface.

From this, it must be plain to all that the proper relief—the standing out from the flat surface—can only be produced by proper shading, proper kind of shadows; these it must now be seen, cannot be had to good effect when the light, as before stated, is either immediately over head or directly in front or behind.

Having selected our point of view, place the tripod firmly upon the ground and upon it place the camera, passing through the head of the tripod the thumb screw which secures the camera to it, only setting up the screw tight enough to hold the camera in place, yet allowing it to be turned from side to side as may later on be required. This done, see that the camera is level, look at it from all sides; this is an all important step, especially so when any architectural object forms part of the picture.

The tripod resting firmly, the camera being level, next remove the cap from the front of the lens and place the focusing cloth over all excepting the front of the lens. With the lens, there was sent to you the diaphragms. Of these there are several; they are flat thin pieces of blackened metal, with holes of various sizes in their center; they are also known as "stops," and are frequently spoken of as "openings." In focusing, which is soon to follow, we will use the largest opening or stop, for the reason that the image is brighter on the ground glass, due to the letting in of more light, than could be admitted through the smaller stops Having arranged the stop as directed, and removed the cap from front of the lens, next step to the rear, raise the cloth and place it over your head.

What do you see? Nothing, unless you have used a camera before. You would not have thought so; yet there is quite a little knack in finding the image on the ground glass. You are probably too near. Raise the cloth a little and draw your head slowly back, the image will soon appear. Now close the cloth tightly so as to exclude all the light, moving to or from the glass until you have the proper focus for your eye. Next loosen the thumb-screw that holds the movable part of the camera, so that by slowly and steadily moving it to or from you, you obtain a sharp image on the glass; this your focusing glass will enable you to do exactly. In using it place it against the back side of the glass and your eye at lens in the small end. It may be that the focusing glass does not suit your eye; it is adjustable; the eye-piece can be moved in or out as may be needed. Test it, however, by holding the ground glass between your eye and the light, the ground side from you, and move the eye-piece until the glass on ground side looks rough and distinct, as it will do under such conditions. In the landscape before us so move your camera by turning to right or left on the tripod as to bring the rustic seat into or near the upper right hand corner of the glass and the villa nearly to the lower left hand corner, as you see the inverted image before you. This upside down condition of things will confuse you at first, and so will the placing on the right of objects which are on the left, and those of the left on the right. However, you will soon become accustomed to this new order of things. In examining the image you may find that the villa is not all upon the plate. To bring it on, raise the sliding front until it is all upon the plate, and a fair piece of sky as well. If in doing this you have not lost your rustic seat in foreground, all is right. If you have, then you are too near your objects; move back, taking up a position that will give you on the ground glass all the objects you wish to have upon the sensitive plate. Your sliding front, as is now seen, will bring in more foreground by lowering, more sky by raising. Be sure to fasten tightly when proper position for it has been found; and fasten also the camera to the tripod by setting up the screw beneath. Nothing has been said as to letting down and making fast the folding bed. This, it is assumed, has been done.

In this picture you will not find any use for the swing-back; indeed, it is not often required for field work; then only as a rule when you are so placed as to have an object immediately in the foreground; so near that you are unable to obtain sharpness. In this case, set back the top which lengthens the foreground focus, so that the whole may be equalized.

When not in use, be careful to have it firmly fixed at right angles to the bed or platform.

Now to focus the image which has been arranged upon the glass. Choose some object in the middle foreground, the bark of a tree, a cluster of rocks that are moss-covered, any object, in short, on which, by aid of your glass, you can sharply focus. This done, examine the rustic seat in near foreground, and the villa in right distance; both are beyond doubt lacking in sharpness; now is the time to see what the stops will do. See if by using the next smallest if sharpness is had; if not, the next, until all parts of the image are sharp; this, within fairly reasonable bounds, providing the lens is suited to the size of plate in use, can be had; but, as you have seen, at a great sacrifice of light; this, however, we cannot avoid. In using the stops or diaphragms, always use the one with the largest opening that will give you the desired definition or sharpness; this for two reasons; you get more light on the plate, thus making your picture in a shorter time, and you get a more crisp, brilliant, and pleasing result. Before the camera has been long in use, the careful student will find that the nearer an object is, the further apart will be his lens and his ground glass when he makes sharp the image; the closer together when the object is at a greater distance.

He will also have observed that when the focus has been found for an object 75 to 100 feet away, and the proper stop has been used, that all beyond the distance named is equally sharp. Knowing this, a mark on the folding bed is made, and all pictures within the distances named, are made without using the ground glass; the camera is placed at the marked spot, and the photographer goes ahead with certainty of success.

Were it not so, the beautiful pictures of moving objects could not be made; to locate them on plate a little instrument is placed upon the camera, termed a finder. Of this, and its uses, more will be said when the methods of making instantaneous pictures are described.

The student is urged to work steadily with his camera, master the sliding front and other parts; before long he can try a sensitive plate.

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Lesson IV.

THE SENSITIVE PLATE: HOW IT IS PACKED; HOW TO PLACE IN HOLDER.

Of plates many manufacturers make several brands. Some are intended for instantaneous work, others for landscape, or subjects of still life, and plates for transparencies, such as may be hung in the window, made into lamp shades, or for use in the lantern; all are packed in the same way.

All that I have ever seen are put up in paper boxes containing one dozen, in the following manner: On the bottom of the box a plate is laid face up—that is, the side on which the sensitive preparation is placed; on this either a thin piece of paper is laid, or some other method is used to keep this surface from coming in contact with the one next above it, which is placed face down. The third plate is placed back to back to the second plate, and so on face to face, or back to back, to the top plate, which is back up.

Before opening the box containing the plates provide yourself with a broad, flat, long-haired and very soft brush of camel or sable hair at least two inches wide; light your ruby lantern, lay the brush on a clean piece of paper at your side, and all is ready for opening the box containing the sensitive plates. It is to be assumed that in an outer room you have opened and thoroughly dusted and cleaned the plate-holders or shields, as they are as often called. This should be done quite often; if not, you will probably find on your negatives transparent spots, the result of small specks of dust from dirty holders.

If you use the kind of holder referred to in cut in Lesson I., you will notice a slide at the left; this acts as a partition between the two plates; on either side is a flat spring of sheet brass, which presses against the back of each plate, holding it firmly in position. When this partition or slide is in place, it is held there by a catch on the edge of the holder. The slide on the right is the one which is drawn out when holder is placed on the camera, and when all is ready to make the exposure; of these there are two—one in front of each plate; the other in the cut is seen as closed.

Before we close the door of your dark room let us loosen the catch on the slide between the two plates, and pull each one in each holder out a short distance and place them on the shelf in order at our left, closing tightly the slides that are in front of the plates. This done, we close the door and fasten it on the inside to keep out any curious friend who on entering would bring in a very bad friend—light. This precaution taken, we sit down comfortably in our chair facing the broad shelf, having on one side the empty plate-holders, on the other the brush, and in front the box of sensitive plates; these to begin with shall be Carbutt's B or landscape plates.

Take the box, open it with care, removing lid and turning back to each side the paper that covers the plates; then by the edge gently raise the top plate, which we find back up. This can easily be determined, if in doubt, by holding it at an angle towards the ruby light, the back showing a bright reflection, the face a very dull one. Take the plate by one corner in the left hand, being careful not to touch its face except just at the corner, and pass the broad soft brush gently over the sensitive surface to remove any particles of dust that in the shaking it has had in the box may have lodged on it. This done, lay down the brush, take plate in the right hand, and having withdrawn the partition slide from the plate-holder, put the plate just dusted carefully into one side of it, having face to the outside; dust another plate and put it into holder, face out, as before, thus bringing the backs together; then slip in the partition slide between the two plates and fasten it; be sure that the other slides are also closed, and holder No. 1 with two plates is ready for use.

Be careful in sliding in the plates that you do not bring the face in contact with the holder, otherwise they may be scratched; the same care must be used in taking them out. If any plates are left in box, mark the number in it, the kind of plate, secure it by a string and put away in the darkest corner of your dark room.

This work may appear to be most simple, and so it is; all things appear simple to those who know how to do them and are in constant practice, but to the beginner the most simple seems difficult until mastered. It will be awkward work to you the first time; you will not be able to work with ease in almost total darkness; you will probably drop a plate or two on the floor; some of them will be put into the holder wrong side about, or scratched putting them in, and without doubt you will cut your fingers with the edges of the glass. None of these blunders will be made oftener than is necessary to teach you not to do it again.

There is considerable knack in handling a plate so that its surface shall not be injured or your fingers cut; to save the latter, be careful not to *draw* the fingers along the edges; if you do, it will probably spoil the plate and hurt the fingers

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Lesson V.

EXPOSURE OF PLATE.

No fixed rule can be given for this part of the photographic operation. No end of conditions serve to change the time required in a day's work out of doors; in-doors it is much more simple, shortening the time as we approach midday and lengthening as we pass into the later hours of the afternoon.

From eleven to two o'clock is about the time when exposure would be shortest, an hour or two before sunset the slowest, for then we often have in the summer months a peculiar red or yellowish light which renders photographing almost impossible.

The later spring and early summer months as a rule give our quickest lights; the fall months, though the day may be clear to the eye, are often hazy and yellowish in their color of light. Longer exposure will sometimes give us all we desire, always providing there is no haze. This no amount of time will ever offset.

When a haze or fog obscures to the eye the distance, do not make any attempt to work on distant subjects. It may be that subjects very near can be made, there being less haze or fog to look through. This, however, depends altogether on its density.

Under-exposure and over-exposure outside of certain comparatively narrow limits, is in a general sense fatal to good work; yet there is what photographers call latitude of exposure, which, be it more or less than just right, is not of necessity fatal to good work.

For instance, if four seconds should be exactly the right time of exposure to give on a certain subject, and either two or six seconds should have been given, the negative in the hands of a skilled photographer would not be lost; it would be noticed in the operation of development, and, as will be later shown, the method of treatment would be so changed as to produce a good negative. The main trouble in over-exposed and under-exposed plates lies in the fact that we do not discover the error made soon enough to apply the remedy. Of this more will be written when the lesson on development is in hand.

On one occasion, to test this question of latitude of exposure, the writer went so far, when making a group of sixteen people in a well-shaded grove away from all direct sunlight, as to give an exposure of two, four, six, eight, ten and twelve seconds. My judgment before making the exposure was that six seconds would be about the right time. What was the result? Every plate was good, alone excepting the one exposed two seconds. This was certainly great latitude, and would to the uninitiated seem to prove that the art of exposing was no great art after all. Such is far from being the fact.

In this case I had the advantage, for I was sure that I had both under and over-exposed. Knowing this, I first developed the one which I thought to be right in time, and finding by using the normal developer that it was so, I had only to make changes hereafter to be described to meet the conditions of those which had had the extremes. The one made in two seconds was deficient in proper detail; the ten and twelve were good, but not as brilliant as the other three. From this it will be seen that if, after having been out for a day's work, you should find that for any reason you had erred on one or other side in the exposure, if not too great, you can, knowing the error, do much to make good the blunder.

When the exposure has been too much one way or the other, no amount of coaxing or fussing will give a satisfactory result.

When in doubt give the doubt to the side of over-exposure. Time enough must always be given to impress the image on the plate; you can restrain an over-exposure, but no amount of coaxing will ever bring out in the negative that which has not been put there by your lens. You might as well give it up first as last.

Photography will do a great deal now-a-days, but it will not make an instantaneous picture of a yellow horse against a green background; it might do something for you if the horse was white. This brings up another phase of the subject, which at first, unless you stop to think, will give you trouble. The photographic character of subjects vary as much as do the subject.

A view of a house that is painted white will require less time for exposure than one that is painted with the reds, browns and yellows so common of late. Spring foliage will require less time than summer foliage that has faded somewhat, while the glorious tints of the fall are practically, if not wholly, beyond our art. People with sallow complexions and dark dresses will require more time than the child or young person whose complexion is clear and bright, and clothing light in color.

Dark eyes, as a rule, photograph well; light blue eyes do not. An ordinary open view with a Waterbury lens and medium stop will probably require, on a good clear day, about two to three seconds' exposure; with a Morrison wide angle, half that time. If the view to be made is through a well-wooded lane or roadway, or of a house well hidden in trees, the time will go to ten or twelve seconds; if of a dull lighted interior it may take hours. From what I have written it may be that my reader is fearful he will never know how much time to give. Do not despair, you will learn more easily than you imagine. I have a certain rule as to the time required for any given subject, the rule which I fancy must be the rule of all out-door workers; it is this: The point of view having been selected, the camera in position, everything ready for the exposure, I stop a moment, look carefully over the view, call to mind a certain view which in character of subject and conditions of light is similar to the one before me, and to which the right time had been given, judge this one by that, and expose accordingly; give it the same or more or less as in my judgment it may seem to demand. In my memory there is stored away for such use a few of such instances, which I may be allowed to term samples; one or other of them is quite certain to meet the present want; by it, as stated, I measure this. Of such there would not be many: a broad open view with distance, a view through a road well shaded by trees on either side, a view in woods with heavy foliage, a view through a grove with medium distance and rocky foreground; such and others that I do not need to name, Each have to me a certain photographic value; each I know well as to time given. I choose my sample, as I've termed it, and use my judgment. To one who has no standard in his mind this may appear difficult to understand; later on, when you have made a few good negatives, you will have them impressed on your memory and can then choose your own samples. There seems to be a sort of intuition about this matter of exposure that makes the subject hard to explain, for even after you have taken the cap from the lens, your mind made up as to the time, the chances are more than even that you will change it to longer or to shorter exposure, which nine times out of ten will be the right thing to do. This, of course, is after experience has been had.

An authority in photography said many years ago: "In the whole range of photographic manipulations, the sum of which goes to make up the perfect picture, there is not one of more importance than the correct time of exposure in the camera." This is true to-day.

In generalities I think enough has been written, let us now take our camera and plates and have "a shot," as we call it; in other words, let us make our first exposure. See that the camera and lens are clean and free from dust; see that the holders are tightly closed before leaving the dark-room; see that they are in a good box to shield them from light, not forgetting that, although light we must have, we only want that which passes through our lens; it is our friend, yet by carelessness it will prove our worst enemy.

The plate holders must always be well cared for, never laid about upon the grass in the sun, keep all in box but the one in use. Let us put up the camera here; a good foreground, moderate distance, bright foliage. Set tripod firmly, focus with a large stop in lens on an object, say a hundred or so feet away, adjust the sliding front, and so turn the camera to one or other side until you have upon the ground glass the subject you wish. Keep camera level, changing the stop to the size that will make foreground and distance both clear and distinct upon the glass; if immediate foreground is not as sharp as it should be, draw back the swing back at top until it is; screw up tightly all the set screws, and cap the lens.

After these things have been done remove the ground glass, take plate holder from box, throw your focusing cloth over it, close box, and put holder in place of the ground glass; draw the slide with a steady motion until nearly out, then with a quick motion entirely out, keeping cloth over it the whole time, and letting it remain over holder until returned to box. You are now ready to expose; study object, settle in your mind the time you should give—let us say it is four seconds on a Keystone B plate—uncap, give the time and re-cap. In taking off and putting on cap do it quickly and be careful not to jar or shake camera, particularly when you uncap; if you do you may cause vibration, thus rendering the picture indistinct.

The lens being capped, raise the corner of the focusing cloth that covers the holder, and return the slide you had removed; do this by a steady, quick motion, shielding it with the cloth and putting in the slide squarely, not one corner first, for inside there is a spring to cut off the light when slide is withdrawn; examine it when empty and you will see why it must go in square. Be particular about this.

Having now made one exposure, which we will assume to be exactly right, let us make two more, which we will find, later on, are wrong; one say for two seconds or a little less, and one for six or seven seconds, giving us for a future lesson one that is right, one that is under-exposed and one that is over-exposed; their action under the developer in the next lesson will give us the proof.

Later it will be seen that the plate to which was given four seconds proves to be just right—a good, clean, clear, sharp negative of fine intensity, all that we want. You now have a sample, as I have termed it, or standard for that character or class of views; for such, in future, you now have something to measure another exposure of similar subject by; if of little thicker foliage or foreground, or little less brilliant light, then in your judgment a little more time; if the reverse, then a little less time.

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Lesson VI.

DEVELOPMENT.

Development is that part of the photographic art which brings to sight the latent or hidden image on the sensitive plate after it has been exposed in the camera; it is a delicate operation, requires close attention, good eyesight and judgment, oftentimes patience; always care and cleanliness. It can only be carried forward when all but the ruby light has been excluded; if successful in it, we have our greatest photographic joy; if not, our greatest disappointment; for if a success, we have the negative from which, with care in its handling, hundreds of charming prints may be made. Before proceeding to develop the plates exposed in the last lesson, let us put our house in order, make the developer, etc., so that, when we close the door of the dark room, everything will be at hand and just where it should be. A good motto for the dark room would be the good old one of "A place for everything, and everything in its place," not only for the reason that it is always well to have it so, but in the darkness of the dark room it *must be so*, otherwise we will not be able to work. So dim is the light, excepting only just before us, that if anything be wanted, we must know just where to put a hand to find it.

At all times, before commencing, wash thoroughly each article that is to be used; cleanliness in photography is but the synonym for success. The developer which we shall first use will be made on Carbutt's formula; it differs but little from many others, is simple, and works satisfactorily. Just here let me impress one thing upon the student. During these lessons, use this developer only; under no circumstances try any other; good, most excellent work can be made with it. Leave experiments for the future, follow instructions closely ; if you do not, confusion and failure will result. Do not think that I would have you believe that this is the *only* good developer ; there are, doubtless, many as good, it may be many better. I only wish you to have one set of formulas on hand while learning, afterward you are welcome to the perplexity that will come of the thousands which you will read of and hear of. As a rule, almost without an exception, beginner make very poor work. There is no reason why they should make good work. They blame their formulas instead of their own want of knowledge and practice ; somebody says use so-and-so, another something else ; the work does not improve, discouragement follows, sometimes the charming art is given up in despair. Stick to the simple rules here given, and you are *sure* to make good work.

Now for the chemicals needed to compound the developer :

Sulphite of soda, crystals	1 pound.
Carbonate of potash, granulated	1 "
Carbonate of soda, granulated	1 "
Pyrogallic acid	4 ounces.
Sulphuric acid	1 ounce.
Bromide of potash	1 "

This quantity of chemicals will give you enough developer for nearly three hundred plates of 6½ by 8½ size, and will, if used with care and bought of a conscientious dealer in photographic chemicals, not cost you much over one cent for each plate, reference being had to proportions given below, and used on plates to which proper exposure has been given.

To compound the developer for use, proceed as follows : Procure two twelve-ounce bottles of clear white glass, for reason that you can always see if they are clean, with well-fitting corks ; mark one No. 1, pyro, the other No. 2, potash. This done, take the eight-ounce graduate, put into it five ounces of good soft spring water, or better still if in doubt as to the quality of the water, water from melted ice. Weigh and add two ounces of sulphite of soda crystals, stir with a glass rod or stick until dissolved, then add slowly half a dram, fluid measure, of sulphuric acid ; to this add 240 grains of pyrogallic acid : when dissolved fill up to eight ounces with water.

Next take the bottle which has been marked No. 1, pyro, place in it the funnel, into the neck of which you have first placed a little wad of clean wet cotton ; pour the solution into funnel, having cotton loose enough to allow it to trickle slowly into bottle. This solution is good for use so long as it is clear. When it becomes opaque or muddy looking it must be rejected.

Next make up solution for the bottle marked No. 2, alkali, by dissolving one ounce each of potash and soda in five ounces of water ; then add water to make eight ounces ; filter in same way, being sure that filter has been *thoroughly* washed. In hot weather, when chemicals work more rapidly than in winter, it is well to add to No. 1, pyro, about fifteen grains of bromide of potash. The contents now in the two bottles form what is known as stock solution, and for the process of developing are used as follows :

Water (as above)	4 fluid	ounces.
No. 1, pyro	2 "	drams.
No. 2, alkali	2 "	"

Of this, in the proportions given, as much may be mixed as at one sitting is likely to be needed.

The developer being ready, wash the pan or tray in which it is to be used (which should be of size known as 7 by 9 inches), and place over large pan described in a previous lesson, in front of the lighted ruby lantern. Place the holders eontaining the exposed plates, and the developer in handy position within reach, close and fasten dark room door, and take your seat facing lantern and tray, in which plate is to be developed.

All being ready, remove the slide which divides the plates in holder, and let the plate to which four seconds' exposure was given, slide out slowly face up to prevent scratching the film on face of plate, close holder and lay the plate in the tray *face up* (the dull looking side), then with a sweeping motion from one side to the other, throw the developer over it ; do not pour upon one spot, but gently sweep or dash it over the whole face.

This done, move the tray from side to side, being careful to have the solution wash over all parts of the plate and keep gently in motion. Should an air bubble appear on any part of plate, gently touch with the finger and break it, otherwise you will have a spot on which the developer not acting is after the process of fixing transparent. In a few moments a shadowy or darkening appearance on part of the plate will be noticed gradually growing in distinctness ; this will be the high lights, the sky, or objects of a light color on which the strongest light has fallen, followed by an indistinct outline, as it lies in the tray, of the view or picture thrown upon the plate by the lens. In a moment or two it will slightly fade from view, become less distinct ; then with the thimble on your forefinger slip the point of the little spear on thimble under plate and raise it from the tray ; hold it up to the light and examine as to its intensity and the detail of foliage, and see if the objects which were in shadow have all appeared.

If not quite intense enough, in other words, so opaque in the sky as to shut out all light as viewed by the ruby light; if the details in the shadows have not appeared, the bark on the trees be not distinct, replace it in the solution and continue the operation until these conditions are had. When had, wash it with a gentle stream of water from the upper pail, and it is ready to place in the alum solution. This we will not do in this lesson, but will stop with the development, assuming that it can be done, that the lessons may be more easily divided into the different processes.

Next, let us take the plate to which we gave two seconds or a little less, treat this in exactly the same way, and we will find that it "comes up," as photographers say, very, very slowly. We wait patiently, but the details do not appear in the shadows, the high lights become very opaque and intense; there is much more of the plate on which nothing appears than there was in the other; we continue twice as long in our efforts to "get something out;" it does not come; we give it up and wash as we did the other.

Lastly, we take the other and last plate, to which we gave an exposure of seven or eight seconds; treat this as the others; almost instantly we notice the action of the developer; it works rapidly; the whole view seems to flash up at once, detail in shadows, everything "comes up" in a jiffy; it appears to finish at once; we take it from the tray, and to stop further action of developer wash it. Here we will let them rest for future treatment, although the operation is in practice a continuous one. For each plate a fresh solution must be used; this I advise, though some use it for two or more plates; at all events do not do so during these lessons.

Between each plate wash the tray by playing the little hose into it to remove any of the old solution that has become a dark reddish color.

The amount of solution named above is really more than you require; when skilled, you can work well with about three ounces in a tray of size given; while a little awkward, the quantity named will be safer. In a general way I have aimed to describe the action of a plate under three conditions of exposure—proper time, too little, and too much. If in developing a plate that has had the right exposure given it, you should stop short in the development, you will find the details in the poorly lighted parts of the plate are wanting, and the intensity of the high lights and sky not dense enough to cut off the light when you come to print it on paper. This intensity should be such as to give, when the print is made, just a faint tinge to the paper, not so dense as to stop all light and leave the paper a pure white, nor lacking in intensity to such a degree as to allow the passage of too much light as to make a dark, dull, heavy sort of sky. If we push the development in the under-exposed plate in our efforts to get out the details, we will have the sky very dense, and, lacking the details, we have, when finished, a large portion of the plate that is little more than clear glass, giving us a negative of severe contrasts, and worthless, yielding a print with an absolutely white sky and heavy dark shadows.

The over-exposed plate will, if we push the development, or continue it too long, grow up, as it were, all over the plate, and, when finished, be of too even a tone, too much alike all over, lacking in contrast; if stopped short, it will be lacking in intensity in the high lights, and, like the under-exposed plate, worthless.

Of the two, under-exposure or over-exposure, the first-named is the wrong side to err on. If not exposed long enough to impress the image, no amount of coaxing will ever get it out; if not there, you cannot get it. Over-exposure, if not too great, you can control. If you have reason to know that a plate has been over-exposed, make developer as before, with this change: use but half as much of the No. 2 solution, and add half a dozen drops of a solution of the bromide, made up 50 grains to the ounce of water. The cutting down of the No. 2 will make the development slower; the bromide will also restrain the rapid action, and help to gain intensity. If it still dashes up, pour off solution, add a little more bromide; if too slow, add a little more of No. 2. In this way you may be able, by judgment in variously compounding, save a day's work that has been over-exposed. No amount of writing can tell you more than this; practice alone will teach you. If a plate is but little under-exposed it may be saved by using more of the No. 2; if much so, do not bother with it, for, as stated, an image not impressed on the plate cannot be developed.

If at any time a fog seems to overspread the plate, a sort of a veil, as it were, thrown over it, it may be from one of many causes, among them over-exposure, improper shade of ruby glass, or light entering the dark-room, a camera or holders that are defective, an old and decomposed solution of No. 1. Fine transparent lines on plate may come from using a brush to dust off with that has bristles that are too stiff, or from injury to plate in putting in or taking out of the holder.

Spots may occur from not breaking air bubbles, or from dust on plate. A transparent patch along edge of plate is often the result of not covering it with developer; the same careless act will give you a portion of plate which varies in intensity and detail from the other parts.

A swelling up, or frilling, as it is termed, generally along the edges, is the result of using a developer at too high a temperature. It was my intention to describe another method of development, that known as the ferrous oxalate, but upon considering the matter, I think that it is better to confine this lesson to but one, this one, with modifications, being the best for all work, giving greater latitude of exposure, better, therefore, for use by the beginner.

As yet, the negative cannot be exposed to white light; it must pass through the alum and hyposulphite of soda before it leaves the dark-room.

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Lesson No. VII.

Fixing, Washing, Drying and Varnishing.

PROCURE two half-gallon glass jars with wide mouths, in one make up the alum solution, one part of alum to eight or ten parts of water; in the other, the "hypo" solution, one part of the hyposulphite of soda to five parts of water; when dissolved and thoroughly mixed through the water, they are ready for use; they need not be filtered.

These chemicals you can buy by the pound; they are cheap and come neatly packed in paper boxes. For this work, purchase two trays of size known as eight by ten inches and about two inches deep (see Lesson III.), one to be used for each solution of which pour enough in the tray to fully cover the plate; if a dozen plates are to be passed through put in larger quantity than for a few plates; when through throw it away, it is cheap. The "hypo" especially should be renewed when it works slowly; it should do its work, as will be explained later, inside of ten minutes.

The negative having been washed after development, as directed in last lesson, it is to be placed in the alum solution, in which allow it to remain for four or five minutes; wash again, and next place in the "hypo" solution, where it must rest until all of the whiteness has disappeared, as seen from the back, which can be determined by examining from time to time. This may be conducted in the dark room with the door open, in a weak light; it is not well to trust to a strong outside light until all the whiteness has been removed by the "hypo;" after this you may expose it to any light.

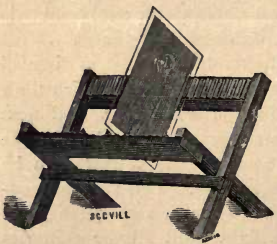
This is known as the process of "fixing." If after taking the negative from the "hypo" and examining it by a strong light outside the dark room, you should notice any brownish-mottled appearance in looking through it, return it to the "hypo" until it is removed. The operations herein described do not need any great skill or judgment, they are not as difficult to conduct as the exposure or the development, yet simple as they are, they need care and. attention, especially "fixing."

Let me again impress on the attention of the student the necessity of conducting this part of the process in a very weak light; do not open your dark-room door until plate has been placed in the hypo; even then my custom is to cover the tray when door is opened. After it has been in the "hypo" for five minutes the cover may be removed and plate examined by looking at the back, when in most cases you will notice a whitish cloud on a portion of the plate not yet dissolved by the action of the "hypo," permit it, as before stated to remain until this has disappeared.

Thorough "fixing," as it is termed, is all important; on it depends the life of the negative; if but half done you will some day (it may be a week or months) discover a brownish stain on that part of the plate on which the "hypo" had not fully acted.

After the "fixing," the plates are to be placed in water to wash; running water if you have it; if not, in a large tub or pail in which the water should be changed two or three times an hour for several hours; if running water is used, an hour will be ample time for the washing.

In Lesson III. an illustration of the Scovill Negative Washing Box is seen, a cheap and effective apparatus for the purpose. Upon removing the plate from the water, place in a drying rack, or in some way on end, and allow it to dry spontaneously.



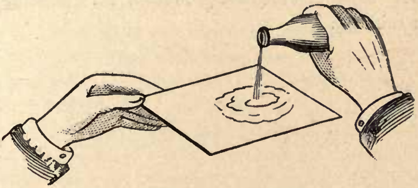
Scovill's Negative Drying Rack, made with either Wooden or Corrugated Zinc Rack.

If in haste, place it in the sun or near the stove; it will not dry, it will melt while wet, the gelatine in the film, and teach you the lesson that will prevent its repetition. Many have tried the experiment. The writer tried the sun experiment on the first gelatine plate he ever developed some years ago. Since then he has put his plates in a rack like the one below and waited.

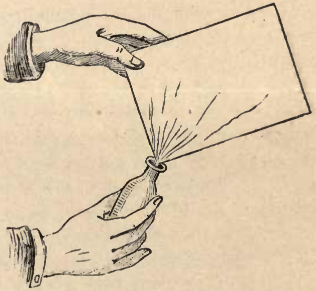
Next in order is varnishing.

The negative must be absolutely free from all moisture. This will be the case on the following day. If in doubt, hold near the fire to drive out all moisture for a few moments, or stand in the sun for a while; an operation that may now be performed, since the water no longer saturates the film. For amateurs, I do not think it necessary to varnish. With care, scores of prints may be made from the negative without damaging it in the slightest, but for those who may wish to varnish it is well to describe the process. Varnish can be had especially for this purpose; it is known as Scovill's Negative Varnish.

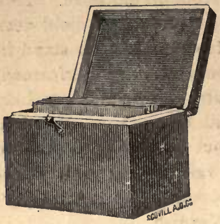
The plate being dry, seize it by the upper left-hand corner, as shown in the cut, holding it level and pouring from bottle on to



the film a small pool of the varnish Then slowly lower the end farthest from you, allowing the varnish to spread to the farther end; then depress the upper edge, flowing the varnish slowly along to the spot where your thumb is, then to the corner next to you, gradually raising until you reach the following position:



when the surplus is drained back into the bottle. While draining keep up a rocking motion to and from you to break up any tendency of the varnish to set in ridges; cork bottle and put plate in drying rack until the varnish hardens. This will take a couple of hours.



When a number of negatives have been developed and varnished, there are two methods of preserving them from the dust and from scratches. One is by putting them in envelopes made of stout paper, and called "negative preservers," which are sold to correspond to different sized negatives. Another way is by placing the negatives in boxes like the one shown. These are called "negative boxes," and are constructed to hold twenty-four negatives, which latter are slipped into the grooves at the two sides, and thus kept from rubbing.

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Lesson No. VIII.

INCREASING AND REDUCING INTENSITY.

It will sometimes happen that a negative will lack intensity, this from causes not at this time worth reciting. If you have a negative of a view which you cannot easily retake, and which has all the needed detail in the shadows, then it may be well to try some strengthening or intensifying process ; if you can duplicate it, do so ; if it has not the requisite detail, throw it away, for all the intensifying that can be done will but increase opacity ; detail you cannot add ; if the image is not upon the plate a ton of chemicals will not put it there. At its best, the operation is far from being satisfactory as a rule ; an intensified negative is never as fine as would have been the negative if *properly developed.* I copy formula recommended by Cramer ; in my hands it has acted as well as any. Prepare a saturated solution of bichloride of mercury in water and pour of this a sufficient quantity into a solution of iodide of potassium (one and a quarter ounce of iodide to six ounces of water), until the point is reached, when the red precipitate is not dissolved by shaking ; be careful not to add more mercury than just enough to leave a slight precipitate.

To this add one ounce of hyposulphite of soda in crystals, and add water to make twenty ounces.

For use, take in proportion of one ounce of above to three ounces of water, in this place plate to be intensified. Should the plate not have been well washed after the "fixing" process, yellow stains will appear from traces of hypo left in film. Be careful not to carry the operation too far; wash well.

If in the development you have gone too far and negative is too intense, it can be reduced by the following:

Red prussiate potash	1 ounce.
Water	16 ounces.
Hyposulphite of soda	1 ounce.
Water	16 ounces.

Pour out enough of the hypo solution to cover plate; to this add, say, four drops of potash solution to each ounce of the hypo solution. Mix well, and in this immerse negative; watch closely, removing from time to time, that you may know how the reduction proceeds. When reduced sufficiently, wash well and dry.

It is better in developing to err on side of too great intensity and then reduce, than to stop short in development and endeavor to intensify. The first will prove a success; the last, as a rule, will prove a failure.

FAILURES.

WITHOUT failures there would be nothing by which to measure success; we must make them, and note how we made them, that we may in future avoid them; they are valuable just in the ratio that we discover and note the cause.

It is always well to know that which should *not be done*, as well as to know that which *should be done*. Among the most common causes of failure are the following:

Transparent Spots: dust on the plate from dirty holders or camera, air bubbles on plate during development; sometimes from "hypo," which, falling on the floor, has been ground into fine powder, and, floating in the air, settled on the plate; keep holders, camera and dark room clean; dust plate before exposure, and before development.

Opaque Spots, either from an imperfect plate or developing solutions improperly made and filtered.

Lines Across Plate, from dusting with brush having coarse hair in it, and from sliding plate into or out of holder.

Weak Negatives, with plenty of detail in shadows: over-exposure; less time and longer development will increase the intensity.

Too much Intensity in High Lights without detail in shadows: unde -exposure; give time enough to impress detail on plate; stop development before negative becomes too black in high lights.

Foggy Negatives. By this term is meant, a veiled appearance, which dulls the brilliancy of the negative; due to light of the wrong kind in dark room, holder, and camera, during development, or before it has been "fixed." Examine each with care; find it you must; good work cannot be made until you do. Using "hypo" tray to develop in; old decomposed pyrogallic solution; these will cause a stain to cover the plate which might be mistaken for fog.

Crystallizations on Negative are due to imperfect washing out of the "hypo" after the "fixing," and so are brown stains.

Frilling. This is due to the swelling and bulging up of the film during development. Keep solutions below 70 deg. Fahr.; it may occur during washing if water is too warm (over 80 deg.), and by remaining too long in water.

The alum solution after developing will generally prevent this trouble if developer is kept below 70 deg. Fahr.

We have now traveled together over the photographic road from beginning to end, so far as the work of making the negative is concerned. The story has been told in as plain a way as the writer can tell it; more detail has been entered into than usual; methods have been described so fully that those who know nothing of the art can understand, at least such has been the effort. Confusing formulas have been avoided; methods only have been given which will produce good work. Speculations, theories, and experiments have been left for the student to work over after he has learned how to make a picture; if that which has been written is followed, success must and will be the result. Then, and not until then, try other formulas, after which most of my readers will be glad to return to the plain A B C sort of formula herein given, and leave to others the entangling formulas that are suggested without reason and used because somebody told you so.

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Lesson No. IX.

PRINTING ON ALBUMENIZED PAPER.

The Silver Solution.

The albumen paper that is sold by dealers has been soaked in an alkaline salt, and when such paper is floated upon a solution of silver nitrate, two compounds are formed; the organic albuminate of silver and silver chloride, both of which are sensitive to light.

A sixty-grain solution of silver nitrate is to be recommended, that is, one that contains sixty grains of silver to the ounce, although a much weaker one will answer the purpose tolerably well. As a matter of course the bath grows weaker with use.

Such a bath may be made as follows :

Water	64 ounces.
Silver nitrate	8 "
Ammonic nitrate	2 "
Magnesic nitrate	1 ounce.

To each ounce of the solution add one drop of strong ammonia.

By adding silver nitrate from time to time this solution may be kept up to the required standard. This may be ascertained by the argentometer; the figures at the surface of the bath in which the instrument is floating indicating the number of grains per ounce. The ordinary hydrometer will serve well enough, since we may add silver from time to time in sufficient quantity to keep the instrument at the same level when floated in the bath. We may indeed employ any glass tube closed at one end and open at the other. Cause the tube to stand upright in the liquid by dropping shot into the open end. The surface of the bath may be marked by a ring of thread, and this mark may afterward be made permanent by a three-cornered file. Of course the tube must always contain shot of the same number and size.

On account of the presence of ammonic and magnesic salts, the argentometer should read not sixty but eighty. Only silver nitrate needs to be added from time to time, as the solution is not depleted of the alkaline salts, except as the quantity of the liquid is diminished. The best way is to add a quantity of solution compounded as above, and then add silver nitrate to bring the whole up to the required reading on the hydrometer.

The silver bath should be kept in an alkaline condition by adding, occasionally, a few drops of ammonia. The tendency to become acid is due to the liberation of nitric acid from the silver nitrate.

During the floating of the paper some organic particles pass from the paper into the bath, when they soon decompose and discolor the solution. The bath may be cleared by shaking it up with a handful of china clay or kaolin, which adheres to the particles and carries them to the bottom. The bath may then be filtered, or, when used, it may be decanted, leaving the sediment behind. Or, better yet, the bath may be drawn from the bottle by two tubes, carried in one cork after the manner of the wash bottle that is much used in laboratories. One tube is a syphon that reaches to the bottom of the bottle, while the longer arm is outside the bottle and carries the solution into the tray. The other tube passes merely through the cork, and through this a current of air is blown, the pressure from which starts the syphon.

Floating the Paper.

This must be done in a glass, porcelain or wooden tray. If wood is used, the bottom and sides should be well shellacked. A convenient tray for amateurs is the "Waterbury" tray, of a size large enough to float a half sheet at a time.

Lift the sheet to be floated by two opposite corners, with the film side down, and let it touch the bath first near one end. Lower the rest of the sheet smoothly and quickly until it all rests upon the bath. Across each end lay a light piece of wood, until the curling of the edges has ceased. These edges may easily be kept down by breathing upon them. As soon as possible, each corner of the sheet should be lifted and bubbles of air adhering to the film should be broken with a glass rod, or blown away by a smart current of breath. No drops of the solution should be spattered upon the top of the sheet. The albumen paper commonly sold in the market should be floated about two minutes in winter, and a minute and a quarter or a minute and a half in summer. For printing with weak negatives, the floating should be somewhat longer.

Withdraw the sheet by grasping two corners with wooden clips and hold it over the bath to drain. It is an excellent plan to draw the sheet over a glass rod fixed across one end of the tray. This scoops all superficially adhering silver back into the bath. The sheet may now be pressed between sheets of blotting paper and hung up to dry, being hung by the clips to stretched twine or across wooden rods. The drying should of course take place in the darkness, or in extremely weak light.

The albumenized side of the paper, either before or after sensitizing, should not be handled more than is absolutely necessary in cutting it to proper size. The hands should be clean and dry. The sensitized paper soon becomes discolored and is seldom in its best condition after twenty-four hours. In cold, dry weather, however, it will keep well for several days.

Printing on Albumen Paper.

The word "printing," as used in Photography, is a misnomer. The word, as seen in its etymology, means, properly, to take an impression by some mechanical means. But photographic "printing" is a process of reproduction by a chemical change that is effected in a sensitized surface through the agency of light; and might therefore be more properly styled "copying," after the manner of the Germans. The only mechanical changes involved are such as serve to bring the sensitive surface into proper relation to the actinic power of the light.

Fuming.

The sensitized paper, after being thoroughly dried, by artificial heat or otherwise, should, before printing, be exposed for a time to the fumes of ammonia. The ammonia is useful in absorbing the free chlorine that is evolved during the exposure of the paper to the sunlight. To this end, secure an old box that is two or three feet long and half as wide and deep. Paste black or brown paper over the cracks and set the box on end. The front should be removable, and might conveniently work with a hinge. It should fit pretty accurately, and around the margins it would be well to tack a strip of cloth. Instead of this wooden front, a large piece of pasteboard or blotting paper might be used, it being crowded in at the edges and the whole box then covered with a cloth.

Provide the box with a false bottom placed about two inches above the real one. This may consist of a porous cloth stretched across, or of a perforated thin board or pasteboard. The perforations should be numerous.

The paper is placed in the box by putting two sheets back to back and hanging them, by means of clips provided with hooks, to twine stretched back and forth across the top of the box; or, the sheets, back to back, may be pinned through the corners to the sides and top of the box. A large number of sheets may be fumed at one time. When all are in place, put a shallow tray or plate containing strong ammonia under the perforated bottom, and close the front. The paper should fume about fifteen minutes in warm weather and nearly double the time in cold weather. After fuming, a short time should elapse before printing, to allow the paper that is moist with the fumes of ammonia to contract and resume its normal size.

The Printing Frame.

A frame that is at least one size larger than the negatives to be printed from is a great convenience. In the first place, in the larger frame the negative will be printed to the very margins; and in the second place, the larger frame will be a great help if you desire to vignette upon your print clouds from another negative. A clear glass plate of the same size as the frame may be used to support the smaller negative.

Place the negative in the frame, film up, and upon it lay the paper with the sensitive surface down, that is, next to the negative. Put the back of the frame in its place and press it down with the springs. The frame is now ready to be exposed to the light.

The Exposure.

The change effected by the light in the sensitive film may be expressed by the formula:

$$AgCl + \text{sunlight} = Ag + Cl.$$

We see that free chlorine is evolved and metallic silver deposited. It is this fine deposit of silver that constitutes, by its greater or less amount, the lights and shadows of the picture.

If the negative is very weak and flat, that is, lacking in contrast, it were better not to print by direct sunlight; otherwise the exposure may be made to the direct rays of the sun. To effect this, a wide board may be thrust out of a window having a southern exposure. It is better yet, however, to nail together three boards in the form of a right angle triangle, and so place the triangle in the open window that the hypothenuse should be perpendicular to the line of the sun's rays. Strips may be nailed across the board for supporting the printing frame.

The progress of the printing must be carefully watched. Withdraw the frame from time to time into the diffused light of the room, slip the spring, raise one end of the back, and examine the print. The print when ready to be taken out should be considerably darker than the finished picture is to be. This excess of blackness will disappear in the subsequent washing and fixing. Rather weak and flat negatives should be printed especially dark, as they lose more of their depth in subsequent operations. Experience alone will determine just how long to continue the exposure in order to secure the best results.

Washing the Prints.

The washing may be performed in a japanned or porcelain tray. Lay the prints one by one face down into the tray and press them beneath the water. Twenty-five or thirty may be washed at a time. After being placed in the tray they should be moved by slipping them from the bottom and placing them upon the top. After standing eight or ten minutes the water may be poured off and a fresh supply added. The same manipulation should be performed with each washing as with the first. Into the fourth wash, a quarter of an ounce of saturated solution of sodic bicarbonate and half an ounce of saturated solution of common salt may be placed. The soda will bring the prints into an alkaline condition that is favorable to the action of the toning bath. The prints should remain in this mixture not more than five minutes, and should then be well rinsed. They are now ready for the

Toning Bath.

The office of the gold toning bath is to substitute for the reddish, disagreeable color of the print a bluish or brownish black.

The chemical change involved is not at present very well understood

It is a prime requisite of any toning bath that it be slightly, but decidedly alkaline. It should be tested from time to time with litmus paper, especially if it does not act properly.

Many toning baths are in use and they differ somewhat in results. I will describe one or two.

Stock Solution.

Water	15 ounces.
Chloride of gold and sodium	15 grains.

To make up a toning bath for twenty prints, take

Water	10 ounces.
Sodic bicarbonate	3 grains.
Sodic chloride (common salt)	6 "
Stock solution of gold	3 ounces.

A good pinch of sodic bicarbonate and of sodic chloride will be sufficiently accurate. To this bath add three ounces of the stock solution cf gold that has first received three drops of a saturated solution of bicarbonate of soda. This last is to maintain the alkalinity of the bath.

Another excellent toning bath is as follows:

Stock Solution.

Water	15 ounces.
Chloride of gold and sodium	15 grains.

Pour three ounces of the stock solution into the toning tray and render it slightly alkaline by carefully adding a saturated solution of sodic bicarbonate. Then add a pint of water and about twenty grains of sodic acetate. After standing half an hour this bath will be ready for use.

Lay the prints in the bath one by one, face down, and move them continually, so as to avoid sticking together of the prints, and consequent unevenness of tone. Ten or twelve may be toned at one time, and as these are taken out, others may be added. If the bath becomes very weak and slow in its action, provided excessive cold be not the cause, more gold should be added.

In ten or fifteen minutes the reddish color should begin to disappear and be gradually succeeded by a rich purplish black in the shadows. The prints should not be withdrawn from the bath until this stage has been reached. On the other hand, they should never lie so long as to acquire a bluish or slaty color.

As heat accelerates chemical action, it is important that the bath be kept at about the same temperature as the room, sixty-five or sixty-six degrees. To effect this the toning tray may be set on a hot soapstone; or better yet, as some one has suggested, the tray may be set across a small open cask in the bottom of which stands a burning lump. The bath must not be overheated. The prints must be examined in strong enough light to enable the operator to judge accurately of the tone. After thorough rinsing the prints are ready for the

Fixing Bath.

The office of the fixing bath is to dissolve the silver chloride not acted upon by light; without which, the picture is subject to further light-action, will consequently not retain brilliancy and definition, and will in fact assume color all over.

One of the products of the fixing process is a double salt, the argento-sodic hyposulphite, which is again soluble in an excess of sodium hyposulphitê, and must be totally removed from the print by subsequent washing, to secure its perfect permanency.

The following bath is recommended:

Water	1 gallon.
Sodic hyposulphite	1 pound.
Sodic bicarbonate	1 tablespoonful.
Common salt	1 "

The prints should be placed in the bath one by one, enough of the liquid being used to cover them well. Move them frequently, as in toning, to prevent sticking together. They should lie in the bath not less than fifteen minutes. It is better to prolong the time to twenty minutes, if the bath is rather cool. The bath should be made up some hours or days beforehand, as the dissolving of the crystals lowers the temperature materially. The fixing bath should be thrown away after once using. The fixing tray should, under no circumstances, be used for any other purpose.

To insure against blistering, it is well to transfer the prints from the fixing bath into a strong solution of common salt, in which they may lie three or four minutes.

They are then ready for

Washing.

A limited number may be washed well enough in a tray. Rock the tray occasionally or move them by continually slipping out the bottom one and placing it upon the top. The water should be changed seven or eight times, and during the earlier part of the process the changes should be more frequent than during the latter part. A thorough elimination of the fixing solution is essential to the permanence of the photograph. There is little danger, therefore, of continuing the washing too long. Some even allow water to run over the prints all night. It is supposed by many, however, that an excessively prolonged soaking in water weakens the print.

The object of washing the print is to remove from it all sodic hyposulphite and the derivatives of the fixing process. A test for perfect elimination is the iodide of starch paper of dark purple color, which, when brought in contact with prints, or the water dripping from them, will bleach immediately if only a trace of hyposulphate be present.

To remove these last traces of the obnoxious salt, a tablespoonful of Flandreau's S. P. C. Hypo Eliminator, added to one quart of the last washing water, and allowing the prints to remain therein for a few moments, and then rinsing them off again with pure water, will effect a thorough elimination, without which albumenized paper prints will always be liable to turn yellow or to fade.

The eliminator should not be used in large proportions, as by too strong solutions the whole silver deposit might suffer.

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Lesson No. X.

Printing on Ready-Sensitized Albumen Paper.

We have been told in the previous lesson how to sensitize albumen paper, how to print upon it, and how to tone and fix prints which have been made upon it.

For the convenience of professional photographers as well as that of amateurs, a brand of paper albumenized and sensitized in the solution of nitrate of silver, quite ready for printing, is now in the market, and extensively used. This paper, being capable of giving universally good results, exempts the operator from annoyances often encountered when silvering paper, is of especial value to the student, and our undivided attention should therefore be given to the mode of working with it.

We have learned how to sensitize albumenized paper, and how to fume it in the vapors of ammonia preparatory to printing. With the paper before us, the first operation is dispensed with; the second, however, becomes an absolute necessity.

Before we advance any further, it is interesting to examine the reasons by which the photo-chemist has been induced to prepare ready-sensitized paper, and how it is done. The sensitive paper prepared in our own laboratories, notwithstanding its otherwise excellent qualities, does not keep in good working condition for a length of time, in fact through the influence of such adverse circumstances as heat, moisture in the atmosphere, or air tainted with certain gases, it will lose its brilliant whiteness, assume a yellowish tint, and will finally turn to a brown color, and thus become unfit for photographic printing. The theories upon which these changes are based, as well as those explaining the other processes connected with printing, we will consider in a future lesson; be it sufficient to say that the desire to obtain a more durable sensitive paper has resulted in the ready-sensitized paper before us.

When floating a sheet of salted and albumenized paper upon silver solution, the chloride in the albumen film converts the silver nitrate to a chloride, the decomposition of which substance, by light, gives us the photographic picture. When removing the sheet from the silver bath, much of the solution adheres to the paper, dries there, and assists afterwards considerably to make the print. This same silver prevents the paper from being durable or retaining its whiteness, and must be removed unless the paper be used the same day. This is done by washing it in water after the chlorification has been thoroughly effected. In that state we have upon the sheet a film of the organic silver albuminate, finely interspersed with silver chloride. To prevent a decomposition of these bodies by atmospheric influences or high temperature, the back of the paper is coated with other chemicals like citric acid, citrates, nitrites, sulphites, and carbonated alkalis; the latter being probably the most effective of all. Without this precaution the washing away of the excess of nitrate of silver, would be of no benefit to the paper, and it would be likely to turn color in time.

The ready-sensitized paper of commerce, as we purchase it from the dealer, may possibly give under a very strong and dense negative a tolerable good print, but to secure good impressions from comparatively feeble negatives, it is absolutely necessary to fume it in the vapors of ammonia. The effects produced by fuming, cannot be the same, as upon unwashed paper, as without the presence of free nitrate of silver, the respective combination cannot form, and the ammonia will act here only as an absorber of the chlorine gas, which, during printing, is liberated from the chloride of silver by the action of light.

The great amount of acid matter employed to make the paper durable, requires the aid of alkalis to establish that state of neutrality requisite in printing upon albumenized paper. Hence we will understand how fuming assists to gain the desired result, and the importance of fuming ready-sensitized paper cannot be too forcibly impressed upon the mind of the student.

If printed copies are well preserved from humid air, toning may be deferred to a convenient time or till a sufficient number of prints has accumulated.

Toning, Fixing and Washing

Does not differ from the processes described before, but it will be interesting to all if we describe the toning bath, which has been worked with good success in the practicing class of the Chautauqua School, and by which equally good prints have been made upon ready-sensitized and freshly-prepared albumen paper.

The washing of the prints before toning should be conducted with all possible care and attention. It is done either by subjecting them, for at least fifteen minutes, to a continuous stream of water, or to a half-a-dozen of changes of water in intervals of ten minutes. If towards the end of washing a slight amount of alkaline, say ordinary washing soda be added, the prints will be better disposed to receive the gold of the toning bath.

As a rule, ready-sensitized paper requires but a very slight overprinting, Long continued toning, possibly with a view to bleach out prints when too dark, is detrimental to the general tone ; it turns the whites to a sickly grey, depriving the print of its brilliancy.

After sufficient washing, toning can be commenced. The gold bath, to which experts have given the name "Chautauqua Toning Bath," is prepared about thirty minutes before use, and is as follows :

Make a stock solution of fifteen grains of chloride of gold and sodium in fifteen ounces of water, of which two ounces are poured into the toning tray ; best of a light material, porcelain or white agate ware.

Chloride of gold reacts acid, but as it does not tone in that condition, it must be rendered neutral or slightly alkaline. Test with blue litmus paper; acidity changes the color to red, alkalines restore the blue. Neutralize the acid gold solution by adding gradually, in small portions, a saturated solution of bicarbonate of soda, till the bluing of the litmus test paper indicates neutrality. When in that state, ten grains of acetate of soda are added, and when dissolved the solution must be diluted with not less than eighteen ounces of water, before prints can be subjected to its action.

No further remarks are necessary, all manipulations and phenomena appearing during toning are alike with those of freshly prepared paper.

Fixing, washing and hypo elimination are likewise the same.

Printing on Plain Paper.

The term "plain paper" signifies photographic positive paper, as it comes direct from the paper mills, without having undergone preparation for future use, as salting, albumenizing or extra sizing.

If photographs on paper are to be finely finished in aquarell, sepia, india ink or similar pigments, albumenized or otherwise prepared surfaces present to the artist a variety of difficulties, among which stands foremost its gloss and hardness, repelling the aqueous mixture of color substances to such an extent as to make it extremely difficult, even impossible in some cases, to wash in large surfaces, to blend colors into each other, or to build up intensity by repeated application of tones. Non-albumenized paper is therefore more pleasing to the artist, to whom the photograph serves as a sketch or base to work upon, and is much used by landscape, still-life and portrait artists.

Plain paper is also absolutely necessary when photographic half tones are to be reduced into a system of lines, stipple or cross hatchings for reproductions in high relief for mechanical printing methods, for a variety of transfers, and the photographic tracing processes, which will be considered further on.

Plain paper is, of course, subjected to somewhat different treatment than our old friend the albumenized paper, and of the great variety of methods practiced, we will select two which have been generally approved of by professional photographers.

No. 1. *A.*—Make a solution of 300 grains of chloride of ammonium in one gallon of water, and soak the paper in it for a minute or two, being careful to avoid air bubbles forming and settling upon the surface. Then hang up and dry.

B.—Dissolve one and a half ounce of crystallized nitrate of silver in fifteen ounces of soft or distilled water. Divide the solution into three parts; set one of them aside, and add to the two-thirds aqua ammonia fortior till the yellowish brown precipitate formed is redissolved in an excess of the precipitant, being careful to add only enough ammonia to render the solution perfectly clear again, and without exhibiting more than only a perceptible odor. To this ammonio-nitrate of silver solution add the third of the original solution set aside, which will cause a strong turbition of the liquid, but which will vanish by the addition of a few drops of glacial acetic acid. Then filter.

The salted paper may be floated upon this solution for two or three minutes, or what is preferred by most practitioners, the solution is spread over the paper, fastened with pins upon a clean board, either with a tuft of clean cotton wool, or a Buckle's brush. After the paper has been thoroughly sensitized and dried in the dark room, it may be cut to the required sizes and printed upon in the usual way.

Plain paper had best be toned and fixed in one operation, to secure vigorous and brilliant prints.

Dissolve fifteen grains of pure terchloride of gold in seven and a half ounces of distilled water, and add it drop by drop and by constant stirring up to a solution of two ounces of hyposulphite of soda in twelve ounces of distilled water. If properly prepared the solution remains perfectly clear and limped; if brown or yellow it is unfit for use.

Of this gold stock solution add three ounces to fifteen ounces of a ten per cent. hypo solution and mix well. Prints without a previous washing are immersed therein. It fixes and tones simultaneously, although it requires a much longer time to obtain neutral or black tones. Plain paper prints have shown with this method a great durability.

No. 2.—A printing method upon plain paper was given by Mr. Hardwich as early as 1856, but has for its extremely fine qualities been retained to the present day. Based upon the presence of citrate of silver in the sensitizer, any variety of warmer tones, almost to a positive red, can be obtained with it, and is therefore especially commendable to the use of the artist. Take

Pure citric acid	100	grains.
Chloride of ammonium	100	"
Gelatine, previously swelled in cold water	10	"
Water	10	ounces.

The gelatine is used to retain the layer of sensitive salt at the surface of the paper, but it does not affect the tint.

Dissolve the citric acid in a small portion of water, and neutralize with carbonate of soda; the quantity (of common washing soda) required for 100 grains of citric acid is 228 grains; add the alkali cautiously, with continual stirring, until the last portions produce no further effervescence, and the immersed litmus paper, previously reddened by the acid, begins to change to blue.

The best paper for this method is the "Papier Saxe," one side of which is to be floated for two minutes upon this salting bath. Owing to the gelatine it is preferable to heat it slightly.

Render sensitive upon a neutral solution of nitrate of silver, 50 grains to the ounce of water, allowing three minutes contact. The sensibility to light is somewhat less than that of albumenized, but greater than plain paper sensitized with ammonio-nitrate of silver.

When the proof is removed from the printing frame it is of a brown or purple tint, which becomes bright red when immersed into a plain solution of hyposulphite of soda. Red prints of this sort are very popular for certain engraving or photo-engraving purposes, but to make them adaptable for subsequent operations, they must be kept from the influence of the gold bath.

Toning and fixing in one operation, may be done with the previously described gold and hypo bath, but the prints should be first washed in water, to which a trace of common salt has been added, in order to remove all free nitrate of silver from them. Aqua ammonia, if substituted for the salt in the washing, prevents changing of tones when being dried. Any variety of tones, from rich violet purple to positive black, are easily obtained, and the pictures are especially distinguished by their brilliant whites.

The Chautauqua Toning Bath may also be employed for toning these plain prints. Gold acts upon them with great rapidity and it is therefore advisable to use the normal bath, in a diluted state. As weak gold gives invariably the best results, the dilution might be with plain paper in the proportion of 1 : 3.

Fixing plain paper, when toned in the alkaline bath, requires no further admonition; no other precautions than those with albumenized paper being required. Washing and hypo elimination are also the same; but it will be observed that hyposulphite of soda is much easier and sooner removed from plain paper prints than from albumenized paper.

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Lesson XI.

Cyanotypes or "Blue" Prints.

We have learned how to make photographic prints upon silvered paper, and we have received with those methods, tones of various colors, from a warm brown to a positive black. There is another kind of prints made, not with the aid of the salts of silver, but with that of a certain iron-combination, known by the name of red prussiate of potash, whose tones are of a beautiful and intense blue. They have gained immense popularity on account of the ease and the simplicity of the making.

The labor required to make silver photographs, even when printed upon ready-sensitized paper, consists of seven distinct operations before a print is ready to be mounted. "Blue" or Cyanotype paper requires but one; a simple washing in water.

The color of these prints, if properly made, is not unpleasant but, on the contrary, is quite attractive, and collections of photographs interspersed with them offer a very attractive variation.

Like the ready-sensitized chloride of silver paper, the cyanotype paper has become an article of trade, and is manufactured and sold in enormous quantities, cut up into sizes to correspond with the negative plates made with the cameras of the American Optical Company.

All that is necessary to procure a blue print is, to bring the prepared side of the paper into absolute contact with the negative, expose to light, and wash.

Besides being able to make a blue print, the student should learn how to prepare the paper, and become acquainted with the conditions required to produce a sensitive and durable article. In the first place, a paper of any fine texture, free from any chemical bleaching agents or their antidotes is wanted. There is none so well adapted for this purpose as the "papier Saxe" or the "Rives." Its sizing is quite important, and although the ordinary commercial paper answers quite well, it is advisable to give it a stronger body, by immersing it in albumen beaten to a froth, and allowed to settle again for the separation of the clear liquid. Four parts of water mixed with one part of the clarified albumen is a good proportion. After leaving the paper in this mixture for a minute, it may be hung up to dry spontaneously, and the albumen be coagulated by placing the paper in a steam chest or by hanging it up near a very hot stove.

For sensitizing the paper we prepare two solutions:

A.—Citrate of iron and ammonia	$1\frac{7}{8}$	ounce.
Water	8	"
B.—Red prussiate of potash	$1\frac{1}{4}$	ounce.
Water	8	"

Filter and keep separately in the dark room. Before use, equal volumes of these are mixed together and poured into a flat dish or tray. After all foam or air bubbles have disappeared, the paper is floated upon this solution for three minutes, observing the same precaution required in silvering albumen paper. Then hang up to dry.

All this is done in the dark room or a much subdued light. When dry, the paper is ready for printing at once, or it may be preserved for future use. If intended to be kept for a length of time the pieces of the required size are best brought into close contact with each other, wrapped up in waxed or paraffin paper and subjected to a slight pressure. This is done to prevent moisture or impure air from coming into contact with the sensitive surface, which would speedily change the original greenish-yellow color to a muddy greenish-blue, denoting a chemical decomposition. Paper having undergone such a change is not easy to print upon. It prints slow, for it has lost much of its sensitiveness, the shadow parts of the negative do not print out in detail, and to obtain pure whites is impossible.

The mode of printing being the same as that upon other sensitive substances, requires necessarily absolute contact. Printing in sunlight is admissible, and the operation is done quicker than upon silver paper, and should be carried far enough to give the darkest parts, that is those under the clearest parts of the negative, a decided reddish bronze color. When completed, the print is removed from the press and washed in pure water, till the picture is perfectly well developed, and stands out with a beautiful blue tone upon a white ground.

When the water dripping from it ceases to be of a yellow tinge, the operation is completed, and the result is a permanent and durable picture which is not effected by light and but little by atmospheric influences.

A few drops of hydrochloric acid intensifies the blue color, and a little sulphuric acid gives it a greenish tint. Ammonia gives it a purple color, and renders the picture lighter and can be used therefore to reduce a print if too dark.

Blue paper is extensively used for the reproducing of tracings and drawings. The copies are naturally negatives, that is the black lines of the original appear white upon a blue ground. Although the general effect of the picture is thus reversed, blue printing has found just in this particular line the most extensive employment.

The tourist anxious to see a proof of the negative made, can judge of its general qualities when printed upon cyanotype paper without resorting to the troublesome silver printing and gold toning, and many amateurs are so partially inclined to blue prints that they admit them to their albums.

Efforts have been made to convert blue prints into prints of other colors, especially those of dark brown or black shades, but they have, according to all reliable authorities, signally failed. An old method for changing color is to bleach the blue by means of a carbonated alkali, leaving upon the paper a deposit of sesqui oxide of iron, which is afterwards developed with tannic or gallic acid. Clear whites are almost impossible to obtain, and the general tone of the transferred print may be acceptable by some, but certainly is not to the general public.

Red prussiate of potash in substance or in solution is sensitive to light and should therefore be kept in the dark.

The citrate of iron and ammonia is very hygroscopic, and when exposed to air attracts so much moisture that it will be decomposed and reduced to a black pulpy mass. We must therefore keep it in well-stoppered bottles.

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Lesson XII.

Printing on Permanent Bromide of Silver Paper.

This paper, entirely different in its preparation from those we have already become acquainted with, is extremely sensitive to light, and requires, therefore, but short exposures. The mode of operating is not the same or similar to any of those sensitive papers we have considered before, and requires an essentially different treatment. The picture is not secured by a complete printing-out, but by development conducted as in the negative processes, and with chemicals not described in previous instructions.

The uses of the bromide paper are almost unlimited in their variety.

For making contact prints from negatives of all kinds, portraits, views, interiors, architectural and mechanical subjects, it is unsurpassed, either for quickness of execution or artistic effect. The pure, soft black and gray tones, and steel engraving effects obtained, and the absence of the conventional glossy surface, usual in photographs, are points in its favor that are appreciated by artists and connoisseurs of refined taste.

For copying patent office drawings, engineers' and architects' plans, it surpasses all other processes in quickness and quality of result. It is used by botanists for making copies of leaves, etc., by contact printing.

It is invaluable for use in meteorological and astronomical recording instruments. In making quick proofs from wet negatives, it enables the photographer to see his result without waiting for his negative to dry.

But perhaps the most important application of permanent bromide paper is to the process of enlarging, *i. e.*, the making of large positives from small negatives.

Owing to its great sensitiveness, it will receive and retain an image projected upon it by means of an apparatus similar in principle to a magic lantern, thus enabling the photographer to make prints of any size from small negatives. Such prints present the effect of fine crayon drawings, at the same time retaining the photographic fidelity of likeness and detail.

The exposure required for this extremely sensitive paper varies with the intensity of the negative and the quality and intensity of the light, but may be approximately stated to be, using as thin negatives as will make good prints, one-quarter second by diffused daylight, or ten seconds at a distance of one foot from a No. 2 kerosene burner. Very thin negatives should be printed by weak yellow light, like that obtained from a kerosene lamp turned down a little below the normal intensity. In this way a strong, vigorous print may be obtained from a negative that would otherwise be too thin and flat. Strong, intense negatives are best printed by daylight.

Permanent bromide paper is manufactured in various grades of sensitiveness and surface. For contact printing of proofs, for drawings, tracings, or those from ordinary negatives, the "A," with smooth surface, is best adapted; while for enlargements, especially when to be finished by the artist's hand, the "C," of rougher grain, is preferred. All of the different grades are sold cut in popular sizes and put up in light-tight packages, or in endless roles, well protected against the action of undue light. For contact printing the paper is laid in the printing frame upon the negative as heretofore described, and for enlargements is fastened against the easel, to be explained later on. Owing to its gelatinized surface, the edges of the paper curl up on the coated side, and to make the developer take freely to it, immersion in water becomes necessary before development. When perfectly flattened out, the water may be poured off and the developer applied.

Formula for Developer.

1.—Oxalate of potash .... 1 pound.
  Hot water .... 3 pints.
 Acidify with sulphuric or citric acid. Test with litmus paper.

2.—Protosulphate of iron .... 1 pound.
  Hot water .... 1 quart.
  Sulphuric acid (or citric acid, ½ ounce) .... ½ dram.

3.—Bromide potassium .... 1 dram.
  Water .... 1 quart.

These solutions keep separately, but must be mixed only for immediate use.

Take in a suitable tray: No. 1, six ounces; No. 2, one ounce; mix in the order given; use cold.

The image should appear slowly, and should develop up strong, clear and brilliant. When the shadows are sufficiently black, stop, pour off the developer and flood the print with the clearing solution, consisting of one-quarter of an ounce of citric acid to one quart of water. Repeat washing with the acid water three or four times, rinse well with pure water, and finally fix in hyposulphite of soda, three ounces of which is dissolved in one pint of water. When perfectly fixed, which takes about ten minutes, wash again, submit to the alum bath and final washing, which is greatly accelerated by the use of Flandreau's hypo eliminator, as in the case of other kinds of prints.

Remarks on Development.

The developer in use is termed by photographers the "ferrous oxalate" developer, and consists in reality of the ferrous oxalate dissolved in an excess of oxalate of potash. The mixture should present a clear, dark-ruby color. If turbid, too much of the iron solution has been added, and the iron oxalate formed is in excess of the power of the oxalate of potash present to keep it in solution, hence a part of the iron salt remains undissolved, and precipitates in the form of a bright yellow powder. Such developer is unfit for use.

Care should be taken to employ oxalate of potash only when in a perfectly neutral state, or when acidity is slightly prevailing. An oxalate, reacting alkaline, tends to make hard and chalky prints without half tones, effects erroneously ascribed at times to under-exposures. The only difficulty occurring with bromide prints, is a misjudged time of exposure. Over and under-exposures can be observed with the ferrous oxalate developer in the same way as the effects shown in the negative process with pyrogallic acid. Under-exposures give hard, black and white prints without any half tones or fine gradations.

For over-exposures we have remedies on hand by which we can counteract their effects. One of these is Bromide of Potassium Solution No. 3, which, when judiciously used, will restrain the forcible action of the developer, and modify the gray tone resulting without it.

Too much of it, however, tends to make a yellowish or olive green tone which is by no means agreeable. With a careless application of bromide of potassium there is danger of spoiling the print entirely.

A better restrainer is undoubtedly a developer prepared some time previous to its use, and when it has attained partly to a higher state of oxidation. Whenever an over-exposure may be suspected, it is advisable to commence development with this partly oxidized solution and when the general outlines and deeper shadows of the picture are fairly out, substitute for it a freshly-made preparation, and counterbalance its action, if too forcible, again with the old. The operation probably requires a little more nicety than the ordinary method, but the resulting tones are decidedly better and richer than those resulting from an excessive use of bromide of potassium.

The office of the acid clearing solution is to dissolve the iron salt that has entered into the pores of the paper supporting the gelatine film during the development. Without it the prints would be of a yellowish, muddy color, wanting in the brilliancy and clearness for which bromide prints are noted.

Permanent bromide prints should *not* be dried between blotters like albumenized paper, but should be hung over a line, or laid back down upon glass or clean paper.

Enameling.

Squeegee the wet print, face down, on a polished piece of hard rubber or ebonite ; when dry the print will peel off with a fine polished surface. The print should be slipped on to the rubber plate under water to avoid air bells.

Flexible Prints.

Permanent bromide prints soaked in a mixture of glycerine, five ounces, and water, twenty-five ounces, and dried, will not curl, and may be used for book illustrations unmounted. The heavier papers "B" and "C," are especially adapted for this purpose.

Straightening Unmounted Prints.

After drying, prints may be straightened by the scraping action of a sharp-edged ruler applied to the back ; the corner behind the ruler being lifted as the ruler is passed along.

The operation of enlarging on permanent bromide paper involves the same principles as those underlying the making of a negative ; it is simply photographing on a large scale the negative instead of the original. To avoid the necessity of using a large camera, the dark-room itself is made to take the place of the camera body, and the negative is placed in an opening in the dark-room shutter so that all the light will come through it to the lens. See Fig 1.

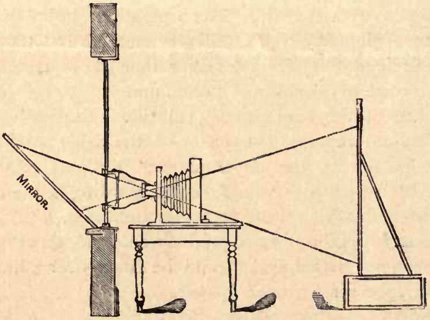

Fig. 1.

The above cut represents an enlarging apparatus that any photographer can improvise from ordinary apparatus and material, with the expenditure of a few hours' time. To construct it proceed as follows :

Cut a hole in the dark-room shutter two sizes larger than the largest negative to be enlarged from, fit into the opening a frame about two or three inches deep, glazed on the outside with a sheet of ground glass. On the inside edges of the frame, top and bottom, arrange grooves in which to slide the negative ; when the negative is in position it will be brilliantly illuminated against the ground glass. Now, on a table or shelf, adjusted in front of the negative box, place an ordinary camera having the ground glass removed, point the lens toward the negative, and connect the lens and negative box by means of a bag of opaque cloth, open at both ends and provided with elastic bands to close it tight around the lens and negative box. This will prevent any light coming into the dark room, except through the lens. See Figs. 1 and 2.

In this apparatus the camera body serves no useful purpose ; all that is required is to support the lens. In case a portrait lens is used it should be put in position so that the back lens will be next the negative instead of as shown in the cut.

The easel to hold the sensitive paper is the next requisite, and this may be constructed by fastening a large, flat board in an upright position, upon a box of suitable size to serve as a base, so that the whole may be moved to and fro to regulate the size of the enlargement. The face of the easel should be covered with white paper. Now, if the easel is put in position, facing the camera, the image can be focused on the screen by sliding the camera backward or forward on the shelf.

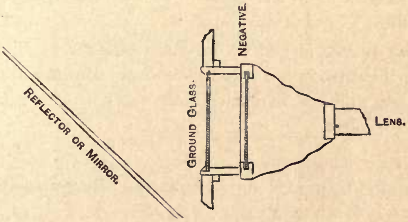

FIG. 2.

The size of the enlargement will depend upon the length of focus of the lens, and the distance the easel is set from the negative.

Any lens that will make a negative can be used for enlarging, and the proper size for the lens depends wholly upon the negative to be enlarged from, and not at all upon the enlargement to be made. If the lens will cover the negative, it will make an enlargement from it of any size.

For enlarging from negatives 5x8 inches and under, a half size portrait lens is suitable. It can be worked nearly wide open to heads, but will have to be stopped down for half and full length figures. Rapid rectilinear lenses are also suitable, but, of course, do not work quite as quick on heads as portrait lenses, because they have not as large aperture. For full and half length figures and views they are quite as rapid, because, for this purpose, the portrait lens requires to be stopped down as far as the rapid rectilinear.

Mealy Mottled Prints—Over-exposure and short development

Greenish Tones are obtained by over-exposure and too much bromide.

Forcing Development does not give good results for the above reason.

Face of Permanent Bromide Paper can always be distinguished by its curling *in*. Convex side is always the back.

Fixing—The operator can tell when a bromide print is fixed by looking through it or upon it in a good light, unfixed portions will be greenish yellow.

Yellow Prints—Prolonged development will cause yellow prints by depositing iron in the paper. The exposure must be correct, so as to allow of quick development.

Running Water is not so sure a means for washing prints as changing them from one tray to another, allowing them to soak at least ten minutes in each fresh water; twelve changes are sufficient; no less.

THE PERMANENCY OF PERMANENT BROMIDE PRINTS.

It should be understood that a print on permanent bromide paper is a very different thing from an ordinary photograph on albumen paper. In the first case, the image is produced by development upon a substance containing *no free nitrate of silver*. In the second case, the image is formed by light alone acting upon an organic compound of silver in the presence of free nitrate of silver; in this case the image is known to be unreliable as to permanence, while in the case of the permanent bromide, all the evidence points to as great permanence as can be desired.

Do not suppose that a permanent bromide print is liable to *fade* because the paper turns yellow. All paper will become yellow after exposure to light and air. For example, see any old engraving or etching. This yellowing or mellowing of the paper has nothing whatever to do with fading.

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LESSON NO. XIII.

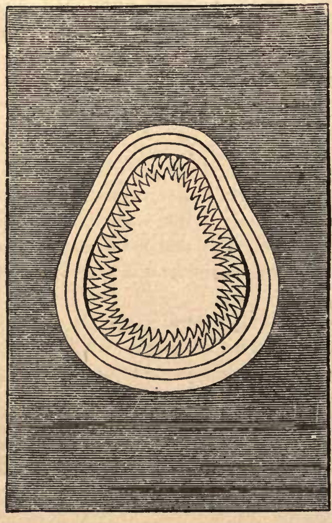
Artistic Printing.

IT is but a little while ago when the primitive amateur photographer thought his duty done by exposing his ready-made dry plates and leaving to a "professional" the labor of developing and printing. He has since discovered that his own developing and printing are as essential, and even more so, than the mere exposure, in order to reproduce the picture which he had in his mind's eye.

On the proper development of correctly and faulty exposures, former lessons have given instructions. The following remarks are intended for those who having mastered plain printing desire to have some knowledge of more artistic methods, viz.: I. Of Printing in Medallion Style; II. Vignetting; III. Flushing or Tinting the White Background; IV. Combining I. and II.; V. Printing-in Backgrounds; VI. Printing in Clouds.

I. In order to print portraits in *medallion* style it will be necessary to procure some metal oval and circle guides and a revolving Robinson print trimmer. It will be desirable to have at least two sizes of the guides for the carte de visite and two sizes for the cabinet form. Cut a suitable mask on orange post-office paper and paste it on the face of the negative. This will give you in printing an oval or circle with a white border. In order to tint the border, paste the cut-out oval on a clean glass of suitable size. Place your print on another glass, adjust the "cut-out" face down over it and expose to light, more or less according to taste. The tinted border may be ornamented in various ways, by a piece of tulle or lace stretched over it, etc. But the plain tinted border will be the most satisfying.

II. *For vignetting portraits*, it is desirable that the original should have been taken against a light (not white) background; if the background be too dark, it must be lightened artificially, as *f. i.*, by covering the glass side of the negative with ground glass varnish and darkening it with a stump and black lead, beginning close to the head. Next, cut out a mask close to the figure; for a portrait the pear shape will be found most suitable. Cut the mask not in straight but in irregular wavy lines, similar to the cut of Weymouth's vignetter. Cover your printing frame



with a stout card-board, into which a square or an oval opening is cut out, large enough to receive any size of masks. This opening is to be covered with a piece of tissue paper of even texture. Underneath this, paste your mask and back the whole on the printing frame, the tissue paper uppermost, next to the light. Adjust the negative in proper position, looking through against the light; if a greater number of prints of the same negative is desired, paste the negative in proper position by means of some strips of glued paper. If, after printing a proof, the gradations of the vignette should prove too abrupt, it may be remedied by (1), widening the space between the negative and the mask; (2) by painting on the glass side of the negative with Russian or indigo blue a contour in waving outlines according to taste; (3) by encircling the head with loose cotton wool, always on the glass side of the negative.

III. *Flushing or tinting* the white background of a vignette will be of advantage in prints from flat negatives. The dull lights in the print will be enhanced by subduing the extreme white of the background. The easiest and safest way to do this is to cut out a mask slightly smaller than the head and figure (omitting the shadows caused by the vignette printing). Place the print into a printing frame, and over the glass outside you mask and expose to light, moving with a darning-needle (which hardly throws any shadow), waxed at one end in order to get a tack on your cut-out mask, moving it slightly during exposure.

IV. *A combination* of the vignette, plain or tinted, can then be made with the medallion style, for which no further instructions need be given.

Taste and the quality of the negative must guide the printer which of the described ways of printing will show the subject to best advantages. A child's or a very young lady's head will show best closely vignetted on a white background, while a gray head with whiskers will be most effective on a plain dark background.

V. *Printing-in backgrounds* either natural or artificial, for portraits or groups is a more difficult subject, and will require some experimenting before attaining success. The mode of operation will consist (1) in obliterating any backgrounds of your figures by the use of any opaque color close to the figure or figures, and to print them in proper position; (2) in choosing a background which is lighted from the same side as the figures; (3) in cutting out masks of the figures slightly smaller than the originals. Now place your foreground negative into the printing frame and your figures over it and close. Cover outside of the glass of the printing frame the figures with your cut-out mask and expose to light, moving the mask as before directed. The degree of intensity of the background must be examined from time to time in order to get perfect harmony between the quality of tone between figures and background.

VI. *Printing-in clouds* into landscape photographs. A landscape photograph, be it ever so successful, with a clear blue (in photography, a white) sky, is but a half-finished picture. To give animation to the blank space, especially when the horizon is low, it will be necessary to enliven it with cloud-life.

Secure on a favorable day cloud negatives from some elevated point, tilting the camera upwards in order to get the greatest amount of sky on your plate. Avoid over-developing, as it is desirable to have quick-printing negatives. Mark them according to the exposure, scratching in some corner : S.M., south morning ; E E., east evening, etc. Do not hesitate to point your lens direct against the sun, especially on fine sunset evenings ; the transparent spot of the sun disc is easily blocked out by a circular cut-out opaque paper, somewhat larger than the sun disc, gummed on the glass side of the negative.

Having thus obtained a number of cloud negatives suitable in lighting for any of your landscapes, the difficult part remains of printing them into your picture without showing a dividing line. Proceed as follows : Make a mask of your landscape on some opaque paper (post-office paper will do), tracing the outlines of the horizon in a rough way, not minding single tree-tops rising above it. Place your print over the selected cloud negative in a printing frame, and your mask outside of the frame in position. Expose to the sun, constantly moving your mask up and down, also sideways ; never hold your mask too high above the horizon point, but rather move it an eighth of an inch or so below. As it is easy to observe from time to time the effect of your printing, you can manage the mask, raising it higher, lower, or cornerwise, according to requirement. The result will be, after a little practice, a perfect blending of the two negatives.

It will be advisable to secure cloud negatives on larger plates than those used for the landscape. By placing the print in different positions, a variety of cloud effects can be obtained from the same cloud negative.

In conclusion, let us warn the young photographers never to print the full size of their negatives when they use lenses of very short focus, as *f. i.*, the wide-angle lenses, for the reason that only about two-thirds of the center is in true perspective and the borders outrageously exaggerated. Even with negatives made with long focus lenses it will be advisable to make some sacrifice for the benefit of a more artistic result. The printing of landscapes in medallion and vignetted form gives a most charming effect, and many a faulty negative may give excellent results by this mode of treatment.

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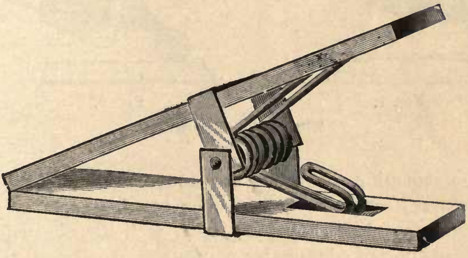
Lesson XIV.

Trimming and Mounting the Prints.

Trimming.—Albumen prints, having been thoroughly washed and the last traces of hypo having been eliminated from them, may be dried and trimmed or cut to appropriate sizes and shapes preparatory to mounting. For economical reasons, many photographers trim their pictures before toning and fixing, and collect the paper clippings containing small amounts of silver, to recover by chemical processes the precious metal.

Prints should be dried spontaneously and not by heat. They are hung up two by two and back to back with clips and strung on a line.



Lockwood's Clip.

The trimming of the photograph should always be neatly and carefully done. The edges should be untorn and the form or shape should be true. A knife is often used with a glass or metal form, but the invention of Mr. S. M. Robinson, known as the Robinson Trimmer, has almost displaced the knife. These trimmers are made in two forms, the one illustrated by Fig. 1 being constructed so as to revolve in a socket in order to follow accurately an oval or round-cornered metal "guide," and the other in Fig. 2, known as the "straight cut," is for trimming straight edges, a metal guide being used with it also, or a glass form.

The theory of these trimmers is that instead of cutting they pinch off the surplus paper, thereby giving a nicely bevelled edge to the print, and they are far superior to the knife or scissors if held and used as indicated by the drawings.

To trim the print well it must be laid upon a hard surface. Many use a glass, others again trim upon a sheet of zinc. With the former, the cutting tool is very soon dulled, and with the other, the metal is cut up and roughened so much that a clean cut soon becomes an impossibility. A better mode is to paste a sheet of well-sized paper on the glass, which when dry gives sufficient resistance to the trimmer without injuring its sharp edge, and the surface not being so slippery as glass allows the print to rest well upon it during the manipulation.

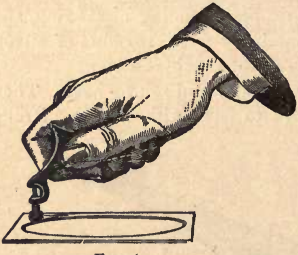


FIG. 1.

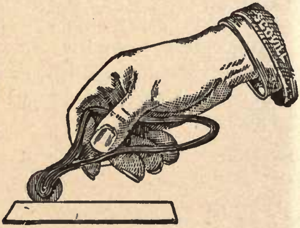


FIG. 2.

ROBINSON'S TRIMMERS.

Before mounting, the prints are wetted again in clean water, and when perfectly pliable laid upon blotting paper in several thicknesses face down, and piled upon each other in such quantities as to allow of comfortable pasting.

Mounting.—A very durable and adhesive mountant is the S. P. C. parlor paste.

Another good paste, easily made by anybody, is the following :

Take good laundry starch.....	1¾ ounces.
Sheet gelatine or white glue.................	80 grains.

Put the starch into a small pan, add one ounce of water, and mix thoroughly with a spoon or the ordinary mounting brush, until it is like a thick cream, then add fourteen ounces of water, and the gelatine, broken into small fragments. Boil for four or five minutes, set aside until partially cold, then add one ounce of alcohol and six drops of pure carbolic acid. We have now fifteen ounces of a very good and durable paste that will keep well in stoppered bottles, is smooth as cream, without lumps or grit.

Previous to applying the paste all superfluous water is squeezed from the pile of prints with a slight pressure between blotting paper, after which the mounting can be commenced. A flat bristle brush is dipped into the paste, and then drawn with slight force over the print laying on top of the pile. It is drawn several times and in opposite directions over the print without leaving more paste than necessary for adhesion. The print is then lifted up with the point of a knife, and placed in proper position upon the mount. With a stout piece of paper and an ivory paper cutter or similar tool, the print must be laid flat, all air bubbles expelled from under it, and when adhering uniformly to all parts of the mount, laid aside for drying, with the face side down. Care must be taken to apply not more paste than is needed to fasten the print to the mount. Highly glazed mounts, at present so much in vogue, are, on account of their greasy enamel, quite difficult to mount upon. To make photographs adhere to them uniformly, it is best to add and mix well with the fifteen ounces of paste one-half ounce of ammonia. A part of the ammonia saponifies the greasy matter, the rest evaporates. The method is very easy to work and not injurious to the picture.

Blue prints and photographs on plain paper are similarly treated, but do not require to be wetted ; and it is probably better to paste them when in a dry state.

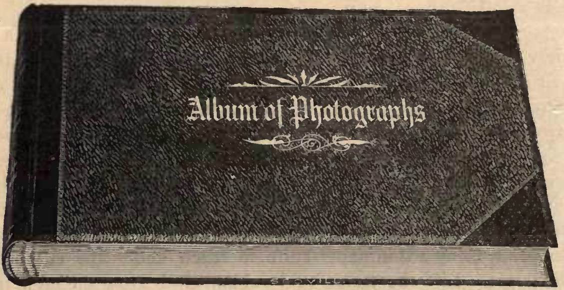
Permanent bromide prints may be mounted wet or dry ; the prints should *not* be dried between blotters like albumenized paper, but should be hung over a line, or laid back down upon glass or clean paper. To mount, brush over the back with thin starch paste, lay the print on the mount and rub into contact with a soft cloth.

For very large pictures, cover an artist's stretcher frame with a piece of common white muslin, by stretching it tightly while dry and tacking it on the outside edges. Give the cloth a coat of starch paste, rubbing it well in and avoiding streaks and lumps, lay over a smooth table a piece of rubber sheeting, lay the wet print on the rubber cloth, face down, and with a rubber squeegee scrape off the water. Give the back of the print, as it lies on the rubber cloth, a coat of paste, and then lay the stretcher, face down, upon it, and rub the muslin into contact with the back of the print, using a thin paper-knife to reach under the edges of the frame. Lift the frame and rubber cloth from the table together and peel the rubber off from the face of the print. This will leave the print on the stretcher smooth and flat. When dry it will be as tight as a drum head.

Albumenized and other paper photographs may be mounted on muslin similarly. Should it be required to mount them back to back with a muslin support between them, trimming had better be deferred until after mounting and drying. The muslin should, however, be well stretched.

To prevent mounted pictures of large dimensions from curling up, the mounts should be dampened before the pictures are laid upon them. They are then dried between blotting-paper and under a slight pressure, the blotting-paper being changed occassionally.

To mount in an album without cockling, let the photograph be ironed with a hot iron on the back till it is nice and smooth, then place it under pressure till quite flat. A large book answers the purpose admirably. To prepare for mounting, lay the flattened print face downwards on a smooth board or piece of glass, and upon it place a piece of clean, stiff paper, an eighth of an inch less all around than the photograph, upon the exposed edge of which rapidly and sparely brush some liquid glue (as little as possible) to cover it, Herein lays the secret. Avoid making the paper wet. The album being conveniently placed—the position the photograph is to occupy being previously marked with a pencil—carefully raise the photograph with a point of some kind; to avoid soiling the finger with the glued edge, making it non-adhesive in the parts where' such glue would be removed, and lay it down in the proper place. At once lay a piece of clean paper over it, and rub it down firmly with a soft rag and close the album. In half an hour the face will be dry and the print perfectly flat, and it will remain so.



THE ALBUM.

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LESSON XV.

SPOTTING AND BURNISHING THE PRINT.

Spotting.—Careless or excessive negative retouching, faults or impurities in the glass supporting the gelatine film, foreign matter having accidentally found ingress between negative and paper during printing, dirt upon the surface of the negative plate, and a variety of other causes, produce white spots of unexposed paper on albumen prints.

These faults or spots must be taken out or touched away by an operation termed "spotting" by photographers. It is the duty of the spotter to remove, that is, to make invisible, these white marks.

Simple as the operation may appear at the first glance, it requires nevertheless a steady hand, an eye well educated to judge correctly of color, and some mechanical skill. Only the white spot should be covered with the retouching medium, and its color must match strictly with the general tone of the photograph. If the spot is large, interrupting different shades, the touching up must be done in such a manner as not to break up harmony, or to present tones in variance with its surroundings. With "blue" prints or those on plain paper it is comparatively easy to do this. Albumen paper, on account of its gloss and hardness, repels aqueous colors and India ink, and the print or color must be prepared to work easily on the paper.

Take

Gum arabic	10 parts.
Glycerine	1 "
Alcohol	5 "
Water	34 "

Dissolve the gum in a mortar by rubbing it up well with the solvent, add the other ingredients, mix well, and keep in a well-stoppered bottle.

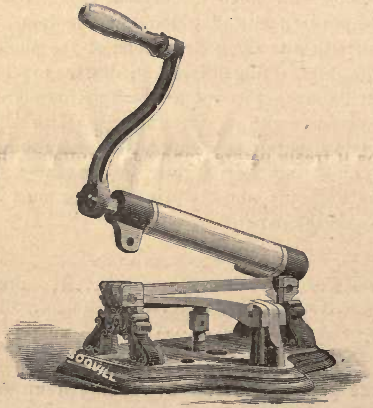
Take further a half-part of dried and pulverized oxgall and mix well with ten parts of the above solution.

A mixture of neutral tint, carmine and Prussian blue can be made to match any photographic tone. Such a mixture combined with the oxgall preparation is eminently useful for retouching or spotting out albumenized paper prints A fine camel's-hair brush slightly moistened with the color solution will do the work. For larger spots washing may be employed, but it is better to do the work by stippling.

Bromide prints are best spotted with a very soft lead pencil, Faber's BBB.

BURNISHING.—The very high polish on photographs, now so popular, is attained by propelling the picture over the heated burnishing tool, a little machine constructed especially for the purpose.

The burnishing tool should be uniformly heated, and it is done either with two or three alcohol flames, or with gas passing through a perforated tube, which is attached to the ordinary gas-burner by means of a rubber tube. Petroleum or oil lamps must never be used, as by any imperfect combination of the fuel, carbon is separated in the shape of smoke or soot, which will soil the picture and the hands of the manipulator.



BURNISHER.

Preparatory to burnishing, the mounted dried and spotted print is lubricated, to promote its free and uninterrupted passage over the tool. This is done by rubbing over its face an alcoholic solution of Venetian or Castile soap, or finely scraped solid soap.

A print to be burnished should not be dried too much, as the swell of the card bends the picture backwards. Let the picture dry until the contraction of the paper just commences to bend the picture forwards. It will be found that the picture in this stage is about three-fourths dry, and it is absolutely necessary that it should not be allowed to dry any more than this until after it has gone through the burnisher.

This is best done by arranging the pictures in one or two piles, and placing them under a weight. They should be carefully taken from the pile and spotted out, and immediately placed in another pile under a weight. The same precaution should be taken in applying the lubricator to the print. The reason for this method of procedure will be evident to anyone who has observed with what a number of irregular lines the surface of a picture becomes broken when allowed to become perfectly dry in the usual manner. When these checks have once appeared in a picture, there is no method of again uniting the broken surface. When burnished by the above directions, the picture will be found to be very compact and hard when cool, and neither alcohol nor water will destroy the gloss thus obtained. It is advisable to put, first, the picture through the burnisher lengthways, curling it up backwards around the roller, afterwards put it through sideways, thus straightening it, and thereby a much higher polish will be secured.

If occasionally a cabinet or card picture will not take the gloss, breathe upon it freely before running it through the burnisher. Should the enamel not be produced the first time, repeat the operation after the picture has become cool; the desired result will then be obtained.

It is imperative to keep the burnishing tool in a good condition. Rust or scratches are its greatest enemy, and if they should occur, a repolish can be given to the burnisher by rubbing it well with an oiled leather file and the finest emery flour.

Unmounted photographs are often required to be burnished. The trimmed and spotted picture is lubricated as usual, laid smoothly upon an ordinary card-board, larger than the print, just in the same position as if it had been mounted thereon, and passed over the tool. The manipulation does not differ from that of mounted prints, but care must be taken not to allow the print to slip from its position.

When mounted on muslin, the burnishing of prints is quite easy, but it is advisable to place a card-board between the rough roller and the print, so as to prevent an impression of the corrugated surface of the muslin. When burnishing prints that are mounted back to back, either with or without paper, or muslin support between them, the card-mount protector must also be employed, burnishing the one side of the double print first, then the other in the usual manner. Often pictures are seen presenting a much higher and more beautiful gloss than can be obtained with the burnisher. These are called "enamels" or "glacés." The method of enamelling is a little more complicated, but nevertheless is quite easy. It is done in the following manner :

ENAMELLING.—Sprinkle the surface of a glass plate with powdered French chalk, rub it evenly over the surface with a tuft of cotton wool, continuing to lightly rub it until the chalk is all removed, then coat the glass with the following

COLLODION :

Soluble gun cotton....	48 grains.
Alcohol....................................	4 ounces.
Sulphuric ether................	4 ounces.

As soon as the collodion is well set lay upon it the print, previously soaked in a warm solution of one-half ounce gelatine in ten ounces of water, to which a few drops of glycerine have been added. Expel all air bubbles from beneath the print and squeegee it into absolute contact with the collodionized glass.

After drying, the print can be peeled off from the glass and the face will present a polish almost as high as the surface of the glass from which it has been removed. The print is then ready to mount, as follows : Moisten the face of the mount with a damp sponge and lay upon it the pasted print ; rub down with a soft cloth and put under pressure to dry.

The addition of five per cent. of glycerine to the paste will prevent the print peeling off the glass as it dries.

For enameling bromide prints the same collodion substratum as mentioned above may be employed.

As soon as the collodion is well set, slide the plate face up into a tray of water, in which is floating, face down, the permanent bromide print, which has just been fixed and washed ; grasp the plate and print by one end and lift together from the water, avoiding bubbles and draining the water from the opposite end ; squeegee the print into contact with the plate and set away to dry. Before the print is quite dry apply a coat of starch paste to the back.

Another method is to squeegee the wet print, face down, on a polished piece of hard rubber or ebonite ; when dry the print will peel off with a fine polished surface. The print should be slipped on to the rubber plate under water to avoid air bells.

Cyanotypes and plain paper photographs do not assume gloss so readily under the burnisher as do albumen prints, but they too may be enameled to a considerable extent.

Great richness of tone and depth, transparency and detail in lights and shadows can be given to them with encaustic paste ; securing also their permanency thereby, this paste being a preventative against the action of moisture and injurious gases.

The formula for the paste is as follows :

Pure virgin wax	500	grains.
Gum elemi	10	"
Benzole	200	"
Essence of lavender	300	"
Oil of spike	15	"

Melt the whole on a water bath thoroughly, and strain through muslin. A simpler plan is to dissolve the elemi in the solvents as described, and after filtering, mix with the melted wax, as the filtration, which is chiefly intended for the gum elemi, is more easily managed before the wax is present. This, when finished, forms a stiff paste. By increasing the proportion of essence of lavender, it can be made thinner, which in winter may be desirable. The encaustic paste is put on the print in patches in three or four parts, and then rubbed with a light, quick motion, with a piece of clean flannel, until a firm, fine surface is obtained. If a rich, thick coating of the encaustic be desired, a very light pressure in rubbing is necessary, so that a polish may be acquired without rubbing off the paste in the operation. If a print is retouched, more care must be taken to use the hand lightly in applying the paste.

Finishing a photograph properly is of as much importance as the developing or printing of it. A badly mounted, spotted or burnished picture may spoil all the good work previously done, and the tyro must therefore never neglect to give the final manipulation his undivided and careful attention.

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LESSON XVI.

Portraiture.

THIS important and most difficult branch of photography can hardly receive sufficient attention within the short space of a Chautauqua lesson. A mere outline only can be given to the student in describing the construction of the studio, or the uses of backgrounds and accessories, the lighting and posing of subject, or the arrangement of groups, although this should be considered in more detailed form. It is impossible to give concisely all that upon which innumerable artists have written volumes with more or less success.

Before any degree of proficiency can be attained, art-photography requires much practical exercise, close observation, and diligent reading. The superintendent and instructor of the School, therefore, urgently advise that the study of this lesson be followed by that of a good book on the subject.*

* The Studio, and What to Do In It. By H. P. Robinson (Scovill Manufacturing Co. Price, 75 cents).

The studio or skylight room must be of first consideration. It is well to have plenty of space to move about in and to contain the necessary furniture, apparatus and accessories. The length may be partly determined by the size of the pictures intended to be made, and it will be found that if the room is to be long enough to allow a cabinet portrait to be taken of a full length standing figure with sufficient space for background, camera and contingencies, twenty-eight feet will be quite sufficient. In width, if we allow enough space for furniture, head-rests, additional cameras and utensils, fourteen feet will give room enough to work comfortably in.

Various opinions exist among experts as to the best shape and position of the skylight. There are certain rules and facts, however, which should not be disregarded. Contrast between light and shade is a point of the utmost importance, and the results deriving from their management are obvious. If all the light comes from one point, the contrast will be too violent, whereas two lights, equally strong from opposite directions, would place the subject to disadvantage, destroy contrasts, produce flat pictures, without roundness and solidity in the effect. The light thrown on the subject should be diffused and soft. The direct light of the sun must be avoided. It is well to remember that, if the skylight faces east, the rising sun will stream in; a southern light admits the sun immediately before and after noon, while a western light is equally objectionable on account of the afternoon sun. It is only from the north, then, that the sunlight can be avoided; hence every skylight should face the north.

It must be borne in mind that a skylight suitable for one style of work is not always the best for another class. Thus a low light is generally better for standing or entire figures, and gives brilliancy to all parts of the picture, while a higher light is better suited for head and bust pictures, it being softer and more subdued. Therefore, it is an essential point to so construct a skylight as to adapt it as near as may be to the producing of general work. When it is impracticable to have a side light, the top light should have considerable slope, and thus give different heights, but when it is practicable, top light should be combined with a side light. The side light should rise in an elevation from thirty to thirty-five inches above the floor, be not less than six feet and not more than eight feet high, and not less than fen feet and not more than twelve feet long. The top light, rising from the side light in an angle of thirty-five degrees, should be of the same length as the side light, or one-fourth more.

At certain periods of the year, when the sun stands at a high elevation, its rays will be apt to intrude themselves through the top light, to avoid which to a certain extent two poles may be erected, furnished with cross bars, along which a canvas curtain may be drawn.

The sashes should be glazed with white glass, and the panes be as large as practicable to avoid too often repeated lappings.

To regulate light effects at the will of the operator, to concentrate it in some points, to exclude it or subdue it in others, we resort to movable screens or shutters. A plan to be recommended is to provide two or three shades on spring rollers, whose combined widths are the width of the top light, the spring rollers being attached to the highest point of the top light. These may be made of some stiff material, and of a light neutral color ; and if a double set of curtains is preferred, the other can be of thin white muslin. The side light may be curtained similarly, but movable from side to side.

The color of the interior of the studio had also best be of a light neutral tone. The floor should be level and steady ; it may be painted of a light-brown or other suitable color.

Carpets and oilcloth are objectionable for several reasons.

Backgrounds are essential parts of the studio, and should be properly selected. If plain and uniform in tone, the effects produced by them are plain and uniform. A carefully graduated background relieves certain parts of the picture, and contrasts well with others ; thus the lights in the figure should be relieved by the darker shades in the background, and vice versa. Fancy painted backgrounds are always a dangerous experiment, except in the hands of an expert. Asolutely avoid heavy columns, pedestals or balustrades ; they rarely contribute to the beauty of the picture. The introduction of a gracefully falling curtain, with good taste and in keeping with the subject, may occasionally be permitted to relieve what otherwise might appear too monotonous, or to form a balance line, which might be requisite.

In the introduction of accessories, such as rocks, stumps, gateways, shrubbery, etc., these should be faintly but distinctly reproduced to give life and harmony to the background, representing a landscape or garden scene, with graduated sky of delicate and broken clouds.

For interiors, the background might be in panels of graduated tints ; if painted to represent the light streaming in from a casement, be very careful that the light falls on the sitter from the same direction.

The nearer the subject is to the light the stronger will be the shadows. A reflecting side screen will subdue excessively strong shadows on the face. It should be covered with very light-gray material, and be placed obliquely towards the sitter, and at a distance to soften the shadows, but not near enough to destroy them entirely.

How to light the sitter can be treated in general terms only. Lighting the subject in general and special cases is a question which can be solved by the operator alone when the subject is before him. He must see that light and shade fall so as to produce the most agreeable effect before the sensitive plate is exposed, and with the capacity of seeing this, the power of modifying is usually accompanied.

As a general principle, a high side light a little in advance of the sitter is the best direct light; excess of vertical light is in most cases to be avoided; nevertheless, it may be useful at times in giving form and brilliancy to flat commom-place faces. But where the sitter has heavy brows, sunken eyes, or prominent features, the least possible vertical light should be employed, or these features will look more marked and heavy. With such faces the side light, well in advance of the sitter, will give the most soft and harmonious effect without risk of flatness. The top front light will generally serve to illumine sufficiently the shadow side of the face without having to resort to the reflecting side screen, which, however, under some circumstances, will not only be useful but necessary. As a rule, a mild and soft light is what is required. Strong illumination produces light and shadows of much intensity, giving black and white pictures.

There are other influences besides the amount of space through which light is admitted. The aspect of the day, the period of the year, the quality of light, the situation of the studio, and the quality of the plate; for a very sensitive plate seems to require a greater contrast of light and shade than a slow one.

The true test of good lighting is roundness. This can only be got by securing delicacy in the half tones, there should be no broad patches of light and shade, but gradation everywhere. The operator must educate himself to see these half tones and he must see them in his model without looking at the ground glass. Get the right effect in nature and the rest will follow.

A few remarks on the imperfections of the human face might now be appropriate.

Every face has, artistically speaking, two distinctly different sides, and it is for the operator to select for a portrait the best view. With gentlemen, as a general thing, the hair is parted on one side, and that side is usually preferred, if there be no reason for doing the reverse. Often the head is rather bald towards the beginning of the parting ; in such cases perhaps the opposite side would be preferrable. Light yellow or red hair should be powdered, unless a color sensitive plate is to be exposed.

In cases of a too high forehead, the latter may be foreshortened by raising the camera. Blue and light eyes should, as a general rule, be turned from the light. Deeply sunken eyes require considerable front and very little top light. Where the eye is defective, you will, of course, turn that side away from the camera as much as is necessary, to lose sight of the defect ; or even a profile may be taken. Where one eye is smaller than the other, it is generally preferrable to take the larger more prominently. Where one eye is higher than the other, if no other objection offer, take the higher eye. In the case of small and partially closed eyes, make them look upwards, or if desired that the portrait look at you, depress the chin a little. For very large and staring eyes make them look lower.

In a full face the eyes may look straight forward, being careful to turn the body to one side more or less ; never have chest and head presented perfectly full to the camera.

The direction of the eyes is important. Never allow the head to turn in one direction and the eyes in the opposite ; nothing can be worse than this. If the head be turned to the right, make the eyes turn a trifle more so in this direction ; when the head turns to the left, turn the eyes also a trifle more in the same direction. In the case of short-sighted persons wearing spectacles, beware of false reflections. An improperly placed side screen will reflect so much light that the eyes are perfectly obliterated.

In but very rare cases do we find a perfectly straight nose. If it turn to the left or right, the two sides of the face will appear materially different ; when twisted towards the left, and a view taken from that side, it will shorten the nose apparently, whereas the opposite result takes place from the other side. If the nose be very long take the face rather full. In the case of a turned up nose, raise the camera as high as possible, to avoid looking up the nostrils ; with a round and rather flat or fat nose, take it pretty well from the side.

For high cheek bones with hollow cheeks, be very careful of too strong top light, and take the face rather full, well lighting up the cheeks. In frequent cases the profile is the better view.

Should one cheek be swollen, perhaps it would be better to avoid that side; if not practicable to do so, rest the cheek upon the hand.

Old and wrinkled faces require a strong front light without much shadow, and are generally best taken in full front views.

Small and narrow mouths may be taken rather full, pursue the opposite course with large mouths and fat lips.

It is very difficult to secure pictures of large open mouths with protruding teeth. Closing the lips by force distorts the chin and all chance of obtaining a good likeness is lost. Engage the sitter in conversation and expose the plate when mouth, chin and cheeks are in the most favorable position.

Full or three-quarter length figures are more difficult to manage than a head and bust. A pictorial background may then be employed, and furniture or other accessories appropriate to background and the costume of the sitter are admissible.

For a lady there is nothing better than a simple attitude, without attempting to pose artificially ; let the hands join in front, or, for variety's sake, rest one upon a chair or other suitable piece of furniture. Throwing one hand behind the back gives in some positions very pretty effects. When furniture is used to assist in making the position, a piece of lace or nicely folded drapery is of great value to conceal some parts or bring others into better relief. Sitting figures are more easily posed than standing ones; more action can be brought into the picture, and employment be given to the hands, thus obtaining life and expression for the whole composition. A fan lends itself admirably to the purpose, so does a book, sewing, writing, or similar employment.

No difficulty occurs with greater force in portraiture than the posing of hands. Arms and hands should be rather retired, both in position and tone ; if they must come in the picture, endeavor to turn the edge of the hand towards the camera, and avoid leaning the arms to heavily against anything which will distort the natural form. Care should be taken that the fingers curve gracefully and the hands do not look like claws. Hands appear frequently too large, and to prevent that they must be placed in a plane with the face. In some positions a hand looks much larger than in others, especially so when its broad back is seen. When the fingers are interlaced the effect is similar.

A well-formed hand is a beautiful object, and while in the composition of a portrait, first consideration is given to the head as the principal object, the second place the artist must necessarily give to the hands.

Group pictures are likewise not easily made, and none present as many difficulties as the family group, in which, frequently, three generations are represented, offering thus material of various kinds, from which to compose a whole, harmonious in all respects. It is in all cases demanded that each individual of a group gives an equally well-lighted portrait and perfect likeness, and while one of the first art-principles and good taste tell us that one or more of the component parts of a picture should be given prominence, and others be subdued in light-effect, a variety of difficulties must naturally occur. Groups should always be arranged in pyramidal form, and in such a manner, that the *tout ensemble* appears to be composed of several minor pyramids. The same refers to smaller groups of but a limited number of persons. For two, let one stand. the other sit ; while in a group of three, two had better be sitting and one standing By no means should the persons composing a group stare at the camera; let every one of them select a point to look at, according to the turn of the head, and on a level with the eye.

Out-door groups frequently represent a mass of figures, without any attempt of artistic arrangement. This latter disposition is caused by the impossibility of getting assistance, from the nature of the ground or place, where the photograph is taken ; but it is the operator's task to utilize to best advantage the material offered. He should look out for, and take advantage of, any spot that would afford him aid to break up monotony, and to give variety to the general form. A picturesque set of steps gives such aid to a high degree. More tasty appear groups, when a motive for the gathering of many persons is represented in the picture ; prominence should be given to the most important persons, and action thrown into each individual and the whole.

In selecting a background, it should be endeavored to secure one with a broad expanse of light, if not too blank. Much detail is objectionable, as it interferes with the figures. The worst background, but the one that is oftenest used for out-door groups, consists of foliage of large, shining leaves. The effects of the white spots caused by the glittering leaves, especially when out of focus, is very disagreeable.

The introduction of animals is in most cases objectionable. A cat or a dog have often totally spoiled an otherwise quite perfect group.

The photographing of children was, with the old slow processes, the *bete noir* of the operator. Thanks to the rapid emulsion plate, the small members of society are comparatively quite easily managed now. Posing and lighting them, however, requires, under all circumstances, much patience and perseverance, a tranquil mind, and a certain self-possession, which, unfortunately, are not always displayed by the operator, when a young babe is placed before his camera.

To make portraits with our own limited amateur outfits, and in our own homes, with the command of light emanating from one window only, is easily accomplished. Place your sitter at an oblique angle toward the one window of the room, allowing its full force of light to illuminate the subject. To avoid a confusion of light-effects, screen the other window or windows, with a white-muslin shade or tissue paper, by which means harmony is established, and sufficient illuminating force secured. If the shadows cast are too abrupt or too opaque, reflect light from the opposite side; a clothes-horse, covered with a sheet or table-cloth, answers quite well for the purpose. Our single achromatic lenses, with which we have learned to make landscapes, require a long time of exposure, to make portraits in an ordinarily-lighted room. Still, a few seconds only are needed when a Carbutt special, or "lightning" plate is to be exposed, while the "B," our favorite for timed landscape work, would require from ten to fifteen, and, in most cases, probably even more seconds.

For photographic portraiture, a different kind of lens is constructed, possessing more luminous power, and consequently working more rapid than the single landscape lens. Of these however, we will treat in the lesson on lenses.

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Lesson XVII.

RETOUCHING THE NEGATIVE.

Negatives of portraits, and in frequent cases of landscapes, too, require certain corrections before satisfactory prints can be made from them. In faces there are wrinkles and heavily shaded folds to be subdued, warts or scars to be removed, freckles obliterated, broad shadows lightened, and very often whole features to be remodelled. In landscapes, we also assist with pencil and brush to establish better harmony ; we lighten up shadows, correct broken lines, add or remove objects, either wanted in the picture or objected to, introduce high lights, strenghten up distances, and, when practical, introduce a clouded sky.

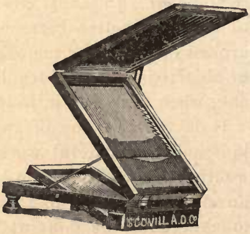
It is the function of the retoucher to improve negatives by judicious and careful work, to give them artistic effects when wanted, but not to overdo his task and merely smooth the plate down mechanically, like the joiner planes down a board. Retouching must be done well, if the effects aimed at cannot be reached, it will be far better to print from an unretouched plate, with all the objectionable features in it. The retoucher should be a photographer ; that is, he should be able to judge of the quality of the negative to enable him to know where to employ the pencil and where not. He can make a work of art from an average good negative, but he will never be able to render a positively bad negative serviceable for printing. Retouching is an aid in photography, but should never be considered of main importance when making negatives ; nor should the operator rely upon the pencil to supply wants that plate and camera have refused to give.

Therefore, it cannot be laid down too clearly that retouching, even when done by a real artist, should be considered only as a necessary continuation of very careful work ; not that the part of the retoucher is inferior to that of the operator, but that the two should work so well together that the final result will be arrived at through the cleverness of both.

It is not everybody who can retouch well. It is a work requiring a great deal of taste, lightness of hand, close application, and great patience, all of which qualities few people possess. But every photographer is capable of correcting in his negatives some faults which may occur, no matter how skilled the operator may be.

Materials Necessary for Negative Retouching.

The first thing wanted is an easel on which to work. This should be a piece of fine ground glass in a frame, on which the negative is placed. The bottom of this frame has hinges as well as the top, which retain a cover of wood kept open by means of small supports, which are lying on the sides of the frame of the ground glass. The necessary slant is given to this by means of two other supports, entering at will into some notches on the edges of the surface of a flat and square box, of which the middle is covered by a looking glass reflecting the light under the negative. Several carriers, same size as the ordinary photographic glasses, and fitting one into the other, stop completely the light round the negative. A little movable rule goes up and down in front of the ground glass, and serves as a rest for the hand of the retoucher. This easel should be put upon a table before a window with a north aspect. As there should be no light except what illuminates the negative, a black blind should be thrown over the top, and to fall down each side. There are easels sold on purpose, and provided even with wooden shutters, which are kept open by hooks fitting into the top shutter. The retoucher is thus inclosed in a box, and gets no light except what comes through the negative.



The choice of pencils and brushes is very important, and we may now describe the pencils to be used—the great desideratum being one with a tough texture, and capable of taking a fine, hard point. Such a one is the best octagonal black-lead pencils of Faber, which in contrast with many are, as a retoucher once observed to us, "almost capable of doing the retouching themselves."

It is desirable to have three or four different degrees of hardness of pencil, so as to suit every class of work, the HH, H, F, and HB being the most suitable. The H is for general work; the HH (the hardest of the four), for very fine and delicate execution and where little labor is required. The F and HB are suitable for heavier pencilling when the shadows are heavy and considerable opacity is needed. It is customary to point them in a manner quite different from what one is usually accustomed to. The lead is laid bare to the extent of almost an inch, and a more or less fine point given to it, according to the negative under treatment.

The brushes should be sable, and very soft. It is very difficult to get good brushes, so they should be chosen with great care. They must be pretty thick, not too long, and with a very good point. All this will be easily found out by dipping them in water and bending them about. If a brush, then, at once makes a fine point, it is a good one.

The two colors most required in negative retouching are Indian ink and light blue. The first is the most opaque color, but as the tint is the nearest to the negative, it will permit of finer work.

Finally, stumps of different sizes, and a very soft camel's-hair brush for dusting the surface during the operation, will complete the list of necessary implements for the retoucher.

Gelatine negatives can be retouched upon without being varnished, although a varnished surface is often preferred. In either case, the film requires a previous preparation, to allow the pencil to take. This is done by rubbing over the parts to be retouched a few drops of the S. P. C. retouching fluid, either with the finger or a small tuft of cotton wool. The fluid should be rubbed in well, but not to complete dryness, allowing a slight cuticle of it to remain, which, after an hour or two will be dry enough to work upon. After a negative has been varnished, the same application can be made, provided the varnish is dry.

The method of deadening the varnish gloss by rubbing over it finely-powdered cuttle-fish bone has been entirely abandoned, as upon such surface the pencil works gritty and irregularly. After having retouched upon the gelatine film, the negative may be varnished, and if, as it occurs at times, certain parts have not attained sufficient opacity, the varnished plate can be retouched over again.

The negative being placed on the frame, as described, the light should be regulated according to its density—the greater the density of the negative the stronger the light required—taking care always to use the lowest degree of illumination consistent with the complete visibility of all detail and half tone. If too strong a light be used, the retouching will show more forcibly than appears in the negative, and would ruin its delicacy. The aperture in the retouching easel should not be too large, or there will be a flood of light running into the eyes that will not only dazzle and tire them, but render the lighter and more delicate tones invisible.

The pencil is to be pointed in the manner described, the final "sharpening" being best given by a piece of emery paper or cloth not too fine, a little care being necessary to avoid breaking the long and fine point. The easiest and surest mode is to work the point by repeated strokes away from the body, and not to rub it sideways or backward and forward. This hint will be found very useful, as the breaking of half an inch of point is very irritating.

First take out of faces all freckles and marks, blotches of unequal color, etc., and then very carefully make the smallest possible amount of alteration in what is usually termed the "modeling"—that is, softening very heavy shadows and increasing the prominence of some of the leading lights. This is done by delicate "dabs" or dots, so to speak, with the point of the pencil, which must be made of the right intensity at once, as the depth cannot be increased by successive washes of color, as in painting, though if the retouching be done in very fine dotting or stippling, extra depth may be got by carefully filling in between the first pencilings.

The terms "stippling" and "hatching," as they are often employed, may be briefly described as dotting and lining respectively. When there are transparent parts requiring a considerable amount of intensity given to them, it will be found next to impossible to do it at once, and then the only plan is to make a first retouching upon the unvarnished negative as deep as possible, varnish, and retouch again. After the spots are all taken out by stippling, the modeling may be done by hatching, making small lines only, as regular in size and distance apart as possible, and as much as can be done causing them to follow the lines or contours of the features, or those particular facial developments that are being worked upon. It is important that the hatching should be done in a regular manner, or a very scratchy and uneven effect will be produced. Great care must be taken to avoid crossing the lines, or making two strokes touching one another, this being a fertile source of "lumpy" or "scratchy" work, as it is forcibly called.

It will be found of great use, if not an actual necessity, to have a magnifier for especially delicate work—not to be made use of from beginning to end, but merely for particular portions of the work, and to aid a general scanning of the whole when completed, so as to pick out any unevenness or roughness. If used all through it causes the work, strange as it may appear, to be less real and flesh-like, and, we may almost say, less delicate. The glass should be of good width, so that both eyes can be used, and it is better if it can be affixed to a permanent support which will hold it at one distance from the negative; and this will materially lessen the fatigue of the eyes in using it.

The hatching may be suitably begun at the forehead and finished at the lower part of the face, working from the highest lights so the shadows, and not *vice versa.* Every face will impart hints as to the leading lights and shadows under varying modes of illumination.

We conclude by pointing out some alterations which may be made or avoided with advantage. One of the commonest faults of a photograph is the stern or "cross" expression so frequently seen, which is caused by a too strong light, or it is the natural expression of a face at rest. One of the chief seats of this expression is between the eyebrows. It is not caused by the perpendicular line or lines, more or less pronounced, always seen there in persons somewhat advanced in life, but is produced by the contraction of the eyebrow, which at the end nearest the nose will be found, when under this expression, to have taken an angular form, and produced a decidedly darker shadow underneath in the orbit. If the corner of this angle be taken off, and the heavy, dark shadow be slightly lessened, the effect at times is almost magical; and yet any one can see, by looking at a retouched negative, that very few retouchers are aware of this simple expedient, it being generally thought that the upright furrows cause the frown.

The portion of the cheek nearest the nose should be most carefully and thoughtfully done; there is often a delicate shadow which is liable to be taken out by the unskilled retoucher with the effect of producing a swelled cheek. The line often found running down from the wings of the nostrils should be carefully lightened with the aid of the knowledge which would be obtained by a slight study of the artist's own face in a mirror. The difference between a smile and a sneer is caused by an almost imperceptible difference in the shading of this furrow that cannot be conveyed in words.

Finally, there is the corner of the mouth, where much may often be done if it be borne in mind that in a smile the corner of the lip is slightly turned up, and with a serious, grave or crying expression it takes an opposite direction. The hands may often be improved by taking out the swollen veins they frequently present in the photograph, though it often happens that this can only be done on each individual print.

In landscape negatives, as well as in other negatives, all hard shadows should be softened, and the lights strengthened ; but all the work should be done on the back of the glass. In the foliage negatives taken with a bright sun, the nearest trees are often wanting in detail, while the more distant ones are quite sharp. Prints from these negative have an unpleasant effect, the different lines of distances being too distinctly marked ; this may be improved by touching with a brush, not too pointed, and Indian ink or blue, representing some leaves according to the lights which are already indicated. It is impossible to distinguish the trees retouched in that way from the others finely obtained on the negative.

Finally, if there are any strong lights to be put on negatives for obtaining effects of snow, it is best done on the back of the negative, either on tissue paper or white varnish.

The same thing may be done in negatives of clouds which are sharply lighted by sunlight. If the shadows are too transparent, and the lights too hard, put in some half tones, and remove the varnish from the lights. If, on the contrary, the light parts are weak, strengthen them either with a stump or brush, and remove the varnish from the shadows. For positives and enlargements the same work has to be done, and always in the same way.

It will be seen, then, that in the art of retouching negatives it is only in the first step that any difficulty is to be met with, because, being the most important, all the rest follows from it, and is, so to speak, only the same thing differently applied. Therefore, with the knowledge of these few various methods, and a little taste and use, one may always be certain of getting good results.

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Lesson XVIII.

PHOTOGRAPHING INTERIORS.

During the cold months of winter, when the earth is covered with snow and the trees are devoid of their foliage, the landscape photographer finds fewer attractive subjects for his camera than in the seasons when nature wears brighter garments and presents more varied scenes. There are frost and snow pictures, to be sure, and many of exquisite beauty; but they are difficult to find with the camera, and, when discovered, require a peculiar skill in the photographer to be justly reproduced on his plate. At this season of the year, then, to what shall we turn our attention?

Portraits and in-door groups, copying, and the photographing of interiors, at once suggest themselves as suitable and pleasant work for the winter months; and of all these, the photographing of interiors can be pursued with perhaps the greatest real satisfaction and pleasure.

Few are the homes that have not, at least, one room that will make an attractive photograph when properly lighted and arranged. Indeed, the pleasant mystery often is, how so pretty a photograph could be made of "our very plain library." But in a photograph even an ordinary appearing room acquires a certain dignity, and we instinctively think of palace halls and stately mansions.

Especially attractive do one or more rooms appear when seen through doorways or arches, with portiere draped back. And then there are so many corners in a house, mantels and fire-places that make pretty vignette photographs. Not only are such photographs of the greatest interest to the owner when made in his own home; but those of churches, theatres and famous buildings, and even of private dwellings, possess not a little architectural value.

The first requisite for making interiors is a good, perfectly rectilinear, wide-angle lens, and of as short a focus as will perfectly cover the plate used. A forward-focus camera is very convenient sometimes in photographing interiors, for often it is necessary to crowd well up into a corner in order to get a good field. Use always as quick a plate as can be obtained, for with the room properly lighted, and using a small diaphragm so as to obtain the greatest amount of detail possible, the exposure is long enough, even with the quickest plate, to satisfy the most obstinate advocate of slow emulsions.

The lighting is, perhaps, the cause of most failures. No direct sunlight must be admitted, but as much diffused light as possible, and the more the better. If possible, light the interior from the rear and sides; but if it is impossible to avoid a window in front of the lens, it must be carefully closed with its shutters and a curtain drawn over them. If this precaution is not taken, "halation" is sure to follow—"that appearance of halo—dark in the negative, light in the print—which makes its appearance round very bright objects in photographs," which Burton describes. When the sun shines directly through the rear or side windows, its light can be diffused by drawing the shades over the windows, if they be white; if not, white sheeting or even paper answers well. But an overcast day, if it be not too dark, is the best for photographing interiors.

Halation is also caused by light which is reflected from the back of the plate. The greater part of the transmitted light strikes the back of the plate. That travelling in a direction at right angles to or forming a large angle with the back of the glass, is transmitted through it; but those rays which strike the back of the glass at the angle of total reflection are sent back to the front surface, where they pass into the emulsion.

The means of avoiding the objectional appearance caused in this way is, of course, to back the plate with some substance which absorbs light. Bitumen answers well for this purpose, also black carbon tissues moistened with glycerine. Plain paper of a dead black surface, cut into the proper size, does very well and is easy to obtain and adjust.

By the use of paper films, instead of glass plates for making interiors, one cause of halation is largely removed; but even with them an even and harmonious light is absolutely necessary in order to be perfectly free from this annoyance.

Do not strive after effects of chiaro-oscuro. We must depend on our arrangement and the development of the negative alone for artistic effect in the work. With a soft, even light over the entire room the best and only successful interiors can be made.

The exposure must be ample. An over-exposed plate on an interior can be treated with far greater chances for success than one which has been under-timed; indeed, an under-exposed negative had best be thrown into the waste pile, and the developer, time and patience of the operator saved for less hopeless attempts. No definite time can be given as the correct one for an exposure on an interior, for so much depends on the amount and degree of light, which is ever changing. By experience one acquires the judgment which is necessary to decide the proper length of exposure, and the illumination on the ground glass soon becomes a sure sign to the practiced eye.

Development, fixing and washing is proceeded with in the usual manner, and, if the exposure be correct, will be found to present no new difficulties. In this, as in everything else, "practice makes perfect," and by practice alone can we hope to attain perfection.

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Lesson XIX.

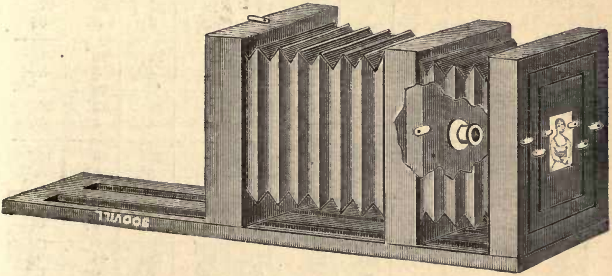
Reproductions and Photographing Inanimate Objects.

Photographers are almost daily called upon to copy not only photographs, but also paintings in oil or water colors, engravings, and the like. The mode of operating does not differ much from that heretofore described, but several important points must be observed, to which our attention has not yet been directed, and without which, this work will give but little satisfaction.

Reproductions are made either in the natural size of the original, enlarged or reduced. In any case the proportions of the original must be preserved. To do this the apparatus must be placed directly opposite the object to be photographed, and in right angles to it. Obliquity between them results in incorrect results, no matter how superior the lens may be. The object to be copied should receive a direct front light. If the work is to be done under the skylight, camera and object may be placed upon an elongated platform, movable upon a pivot with ball and socket arrangement, so as to place the original in a position oblique to the floor, but parallel with the skylight. If the object be very large, side screens may be required to reflect light, or to subdue it before a uniform illumination can be attained.

We have seen in practice that the farther away the object is from the camera the smaller the picture will be, and by reversing the axiom we will find that a very much enlarged picture can be made only by bringing the camera quite close to the object to be copied. The lesson, "Printing on Bromide Paper," speaks of enlargements; the principles laid down there may be adhered to in all other modes of enlarging. For portraits, when the central part of the picture, the head, is the main object, an ordinary portrait lens may be used; while landscapes, architectural views, drawings, or engravings, of which equal sharpness all over the picture is demanded, rectilinear lenses must be used like the Morrison copying lenses, the Wale "Universal," the Gundlach rectigraph, or the Steinheil aplanat.

A new apparatus, the Scovill Enlarging, Reducing, and Copying Camera, is well adapted for the work. Its form of construction is made apparent by the illustration here given:



It is principally intended for the copying of negatives or glass positives, but by removing the kits in the front, the lens can be inserted into the same opening, rendering the apparatus capable of copying other objects as well. To copy a negative in the natural size, place it in the kit on the front of camera and button it in. Attached to the centre frame of the camera is a division upon which, on the side towards the camera front, a lens is mounted. Suppose this to be a quarter-plate portrait lens, the focal length of which we will suppose to be four inches: draw back the centre frame and the lens to twice the focal length of the lens, slide the back frame with ground glass the same distance from the centre frame. To enlarge with the same lens to eight times the size of the original, the centre of the lens must be four and one-half inches from the negative, and the ground glass be thirty-six inches from the centre of the lens. To reduce in the same proportion, reverse and have thirty-six inches from the centre of the negative, and from centre of lens to ground glass four and one-half inches. These examples will furnish a key to the following table :

TABLE FOR ENLARGEMENTS.

Copied from the "British Journal Almanac for 1882."

Focus of Lens.	Times of Enlargement and Reduction.							
In.	1 In.	2 In.	3 In.	4 In.	5 In.	6 In.	7 In.	8 In.
2	4 4	6 3	8 $2\frac{3}{4}$	10 $2\frac{1}{2}$	12 $2\frac{2}{5}$	14 $2\frac{1}{3}$	16 $2\frac{2}{7}$	18 $2\frac{1}{4}$
$2\frac{1}{2}$	5 5	$7\frac{1}{2}$ $3\frac{3}{4}$	10 $3\frac{1}{3}$	$12\frac{1}{2}$ $3\frac{1}{8}$	15 3	$17\frac{1}{2}$ $2\frac{11}{12}$	20 $2\frac{6}{7}$	$22\frac{1}{2}$ $2\frac{13}{16}$
3	6 6	9 $4\frac{1}{2}$	12 4	15 $3\frac{3}{4}$	18 $3\frac{3}{5}$	21 $3\frac{1}{2}$	24 $3\frac{3}{7}$	27 $3\frac{3}{8}$
$3\frac{1}{2}$	7 7	$10\frac{1}{2}$ $5\frac{1}{4}$	14 $4\frac{2}{3}$	$17\frac{1}{2}$ $4\frac{3}{4}$	21 $4\frac{1}{5}$	$24\frac{1}{2}$ $4\frac{1}{12}$	28 4	$31\frac{1}{2}$ $3\frac{15}{16}$
4	8 8	12 6	16 $5\frac{1}{4}$	20 5	24 $4\frac{4}{5}$	28 $4\frac{2}{3}$	32 $4\frac{4}{7}$	36 $4\frac{1}{2}$
$4\frac{1}{2}$	9 9	$13\frac{1}{2}$ $6\frac{3}{4}$	18 6	$22\frac{1}{2}$ $5\frac{5}{8}$	27 $5\frac{2}{5}$	$31\frac{1}{2}$ $5\frac{1}{4}$	36 $5\frac{1}{7}$	$40\frac{1}{2}$ $5\frac{1}{16}$
5	10 10	15 $7\frac{1}{2}$	20 $6\frac{2}{3}$	25 $6\frac{1}{4}$	30 6	35 $5\frac{5}{6}$	40 $5\frac{5}{7}$	45 $5\frac{5}{8}$
$5\frac{1}{2}$	11 11	$16\frac{1}{2}$ $8\frac{1}{4}$	22 $7\frac{1}{8}$	$27\frac{1}{2}$ $6\frac{7}{8}$	33 $6\frac{3}{5}$	$38\frac{1}{2}$ $6\frac{5}{12}$	44 $6\frac{2}{7}$	$49\frac{1}{2}$ $6\frac{3}{16}$
6	12 12	18 9	24 8	30 $7\frac{1}{2}$	36 $7\frac{1}{5}$	42 7	48 $6\frac{6}{7}$	54 $6\frac{3}{4}$
7	14 14	21 $10\frac{1}{2}$	28 $9\frac{1}{3}$	35 $8\frac{3}{4}$	42 $8\frac{2}{5}$	49 $8\frac{1}{6}$	56 8	63 $7\frac{7}{8}$
8	16 16	24 12	32 $10\frac{2}{3}$	40 10	48 $9\frac{3}{5}$	56 $9\frac{1}{3}$	64 $9\frac{1}{7}$	72 9
9	18 18	27 $13\frac{1}{2}$	36 12	45 $11\frac{1}{4}$	54 $10\frac{4}{5}$	63 $10\frac{1}{2}$	72 $10\frac{2}{7}$	81 $10\frac{1}{8}$

It is assumed that the photographer knows exactly what the focus of his lens is, and that he is able to measure accurately from its optical centre. The use of the table will be seen from the following illustration :—A photographer has a *carte* to enlarge to four times its size, and the lens he intends employing is one of six inches equivalent focus. He must, therefore, look for 4 on the upper horizontal line, and for 6 in the first vertical column, and carry his eye to where these two join, which will be at

30—7½. The greater of these is the distance the sensitive plate must be from the centre of the lens and the lesser, the distance of the picture to be copied. To *reduce* a picture any given number of times the same method must be followed, but in this case the greater number will represent the distance between the lens and the picture to be copied ; the latter, that between the lens and the sensitive plate. This explanation will be sufficient for every case of enlargement or reduction.

If the focus of the lens be twelve inches, as this number is not in the column of focal lengths, look out for 6 in this column and multiply by 2 ; and so on with any other numbers.

Reproductions require proportionally much longer time of exposure than portraits or landscapes, and in this particular point frequent errors are made, generally towards over-exposures. The operator must learn by practice how much time to give, probably with the loss of a few plates, before the required experience can be attained.

As with the full aperture of the lens, enlarged pictures will appear upon the ground glass with a want of definition, small stops become necessary to retain the original sharpness.

Oil paintings demand almost invariably a direct front illumination. If from the glossy varnish reflections occur, they must be counteracted by a dark side screen ; naturally with loss of much light. Aquarelles or pastelles appearing brighter are easier to copy.*

Daguerreotypes or pictures under glass must, on account of their reflective properties, be placed so that reflections of light are overcome. Daguerreotypes often show buff marks from polishing the metallic plate. It is better to copy them by direct or reflected sunlight. Photographs when highly burnished or enameled receive the same treatment as other pictures with glossy surfaces. Ordinary photographs generally copy very well, with the exception, perhaps, of those very much enlarged, when the grain of the paper shows rather too strongly.

Plates may be developed as described in Lesson No. VI., or with any other of the standard formulæ for developers.

For line work, when a negative in black and white only is desirable, and when no half tones or modulations are to be preserved, we resort to the ferrous oxalate described in the Lesson on " Printing on Permanent Bromide Paper." For that class of

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* The copying of paintings will receive more detailed consideration in the Lesson on " Orthochromatic Methods.

work, time of exposure is even more important than with ordinary copying, as by a probable reinforcing, or long continued developing, the sharpness of lines is often considerably damaged, making the negative utterly worthless if a relief plate is to be made from it. Referring to the formula described before, we take three ounces of the solution of oxalate of potash and add to it one ounce of the solution of sulphate of iron. If more iron is used, the mixed solution will turn turbid and separate a yellow precipitate; in such state it should not be used. The perfectly clear and transparent red solution is poured over the plate, and the appearance of the image closely watched. If the image comes with anything like rapidity, pour the developer off, wash slightly, and flood the plate with a solution of pure oxalate for a minute or two, pour off, and without washing continue with the original developer. If the effects of over-exposure are still apparent, restrain with

Iodine..	15 grains,
Alcohol..	$3\frac{1}{4}$ ounces,

to which, after being dissolved, three and a quarter ounces of water are added.

From fifteen to twenty drops of this compound added to the developer will secure the intensity and clearness of the lines desirable in black and white negatives.

Whenever legal documents, autographs, commercial papers, etc., are to be reproduced, the above method will prove to be perfectly reliable.

Photographing Inanimate Objects.

A variety of mercantile articles, machinery, inventor's models, etc., are often brought before the photographer. A few hints regarding the treatment of objects more frequently occurring will also be mentioned in this Lesson.

Fabrics, Paper Hangings, Embroideries, etc.—If it is the object to photograph them for commercial purposes, they should be stretched upon a plain board or screen, in order to present a plane surface. The nature of their colors invariably demands orthochromatic plates.

Laces should be placed similarly, but in order to show the delicacy of the structure quite well, they should be placed upon a ground of well contrasting color. White upon black, or *vice versa.*

Glassware.—Ornamented or cut plates are copied against a dark ground, to make the transparent parts appear black upon the photograph.

Hollow Glassware, Cut or Engraved, may be either filled with a colored opaque liquid, or as in the case of globes or lamp-shades, be lined with dark muslin. They should receive such an illumination as to produce distinct lights and shadows, without which the photograph will not be plastic.

Porcelain or Delft should be similarly lighted. The objects being generally white and glossy, a proper exposure is important to obtain brilliant lights and fine shadows.

Bronzes.—On account of their non-actinic color and high gloss, lighting requires a good judgment. To obtain a good general effect, a slight over-exposure is not only admissible but sometimes necessary.

Silver or Plated-ware.—Owing to their high polish these articles can be photographed only in very subdued light. To avoid inartistic reflections, skylight or windows should be covered with a thin white fabric or white tissue paper, and side screens be used to subdue or control light. In order to do away with the reflected image of camera and operator, often quite visible upon larger objects, a screen of neutral color should be placed immediately in front of the camera, allowing merely an aperture for the lens.

Machinery, when taken out of doors, is quite easy to manage, but much trouble occurs when the object is to be photographed in the shop, store or warehouse, whose light is generally poor, and the distance from the position the camera can occupy but insufficient. All available light should then be admitted, and as heavy machinery cannot be moved at the will of the operator, he should be provided with several lenses of different focal length.

Models.—The inventor directs from what point they are to be taken, and he knows exactly what he wants to show in the photograph. The United States Patent Office prescribes a particular size, 7x11 inches, with sufficient margin. Only this size is acceptable.

Plaster of Paris Cornices, Centre Pieces, Brackets, etc., must be fastened to a white ground, and be placed in a light falling obliquely upon them, to secure distinct and transparent shadows and brilliant high lights.

Marble Statuary and Similar Works of Sculpture require illumination very much as portraits do, allowing, however, for their white color. The technical part offers no difficulties, but it is highly important to preserve a good balance between lights and shadows.

Furniture and Cabinet Articles.—The photographer is always inclined to place them in a perspective position, never quite suitable to the manufacturer, whose demands should be respected at least in this respect. The difficulty occurring here is to make the quality of the wood show distinctly as well as the upholstery and form.

Flowers and Leaves, when nicely arranged, make very interesting and beautiful photographs. As a correct representation of color values is one of the first conditions, we invariably photograph them upon orthochromatic plates.

All these and kindred objects must be perfectly sharp ; very small stops must therefore be employed when photographing them. Besides, they must be correctly exposed and carefully developed, for they are satisfactory only when free from blemishes.

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Lesson XX.

Orthochromatic or Color-Sensitive Photography.

When we subject photographs to critical examination, and compare the effects which colors have produced upon our plate, with their appearance of brightness or value of tone in the original, we find that our reproduction is very far from a correct representation of what the eye has seen. While form, light and shade have photographed in perfect correspondence with the original, colors have not been so reproduced. Our plates copy the bright yellowish green of vernal foliage quite dark, and the far-distant blue mountains in a landscape so extremely light, that most careful development is not capable of rendering them with justice to the general aspect. The bright scarlet flower of the geranium copies alike with the green leaves of the plant, the crimson tulips, seamed with yellow, shows no color contrast, and the dark blue hyacinth appears nearly white in the ordinary photograph.

The cause of this paradox in photography was well understood by the earliest experimenters, they knowing very well why different effects could not be expected.

All light does not act upon a photographic surface, but only certain parts of it do, while others remain inactive.

The force or power that causes photographic, or photo-chemical action, scientists have called *actinism*, and the active rays actinic.

Actinic rays are those found on one end of the spectrum, the violet and blue, called most refrangible by spectrum analysts. Red, orange and yellow, at the other end of the spectrum, do not act at all, or but very little. These rays do not deviate so much from the path of undivided light, like blue and violet do, and are, therefore, called less refrangible.

If we expose an ordinary photographic plate at the solar spectrum, these effects will show to perfection how differently the two ends of the spectrum work. Violet and blue will give very pronounced impressions, but they will diminish more and more until at the other end, no effect is visible.

This is exactly what we notice in every-day photographs. Yellow and orange copy much too dark, some reds do not impress the plate at all ; and blue and violet, no matter how dark they may be, come invariably too light ; and the variety of colors in fabrics, embroideries, paintings, and many natural objects have thus given endless dissatisfaction to the photographer.

For many years it was considered as impossible to remedy these defects, as we now think it to be out of the question to photograph colors themselves.

With orthochromatic or color-sensitive plates we overcome these anomalies, and produce effects nearly correct in their value of brightness.

An immense amount of practical work and labor had to be done, before anything worthy of interest was attained, but we cannot deny that the discovery of the process is based absolutely upon theories, and has been established by experiments in spectroscopy. These experiments were based again upon one principle, that is, the addition of some substances, possessing the power of absorbing, and converting into chemical energy those rays which upon an ordinary plate have no effect.

For this purpose, a large number of dye-stuffs were found to be most effective. They are themselves sensitive to light, for they bleach when exposed to it. Bleaching action was found to be strongest on the red end of the spectrum, which has no effect on ordinary plates. The most generally adopted theory on this occasion is, that the energy absorbed in bleaching the dye, is transmitted to the silver haloid of the plate, upsetting its equilibrium, and rendering it capable of development.

Of the many dyes that have been experimented with, only a few have been retained for their excellent activity, although many more are being added, according to the researches constantly made. It is true, not all of these colors sensitize alike, or for several colors at the same time, and as the spectrum photographer proposes to examine distinct spectrum-regions with distinct media, so does the practical photographer select colors that give the best general effect.

Some colors, known by the name of eosines, answer admirably, but many of them do not, and all of them refuse to reproduce red, beyond a certain point. A very happy combination of colors, belonging to another class, has been made, which show sensitiveness far into the regions of the spectrum red, by which pigment colors are rendered exceedingly well. This action is due to one of its ingredients, cyanine, or chinoline blue, the most red sensitive substance known.

To obtain the best general effects in pigment colors, we employ another color, the erythrosine, also an eosine, or belonging to that group, With it the most practical results can be obtained, for it sensitizes to perfection up to orange, yellow and green, giving at times quite correct reproductions of red, when not perfectly pure and partly mixed with other colors. And we find but rarely pure red in pictures, fabrics or embroideries, hence erythrosine has been selected pre-eminently as a sensitizer for commercial plates, or every-day work.

Occasionally, cyanine, in small portions, is added to the erythrosine to obtain better red-sensitiveness, and it acts then very satisfactory in that combination.

Violets and blues will, even with those plates, exercise a very violent action, and, to suppress it, a ray filter, principally of a pure yellow color, is employed, it being placed between the objective and sensitive plate.

At first, the color itself was incorporated with the emulsion, and with that the plates were coated. Practical work, and Mr. Pleuer, with his centrifugal machine, showed how that but an extremely small quantity of color was requisite to give effects. In fact, after an emulsion had been colored, he separated from it the bromide of silver, re-emulsified it, and, with the infinitessimal amount of color combined with the silver, obtained the same effects. All this led to the redemption of an almost-forgotten process, the staining of ready-coated plates to color-sensitize them.

This way of working has become more popular than any other method, and although color-sensitive plates, colored in the emulsion, have become an article of commerce, stained, or bath-plates, as they are commonly termed, seem to be preferred by most operators.

For general work erythrosine has been found to be the most effective, and a preparation known as the S. P. C. Flandrau Orthochromatic Solution carries it as chief ingredient.

With this solution any photographer may make his own orthochromatic plates, and any good plate may be successfully rendered orthochromatic, by simply bathing it with the erythrosine.

When orthochromatic plates are used for reproductions or landscape work, it is advisable to color sensitize plates of only moderate rapidity. The Carbutt "B" and the Cramer, of lower grade, answer very well for this purpose, while for shorter exposures the Eastman Special is very well adapted.

The formulas are as follows:

PRELIMINARY BATH.

Aqua ammonia	1 dram.
Water	7 ounces.

COLOR BATH.

Erythrosine	1½ drams.
Aqua ammonia	2 drams.
Water (distilled)	5½ ounces,

and the directions are simple.

Immerse a plate of medium sensitiveness in the preliminary bath and allow it to remain therein for three minutes. After removal, drain well, and without washing, plunge the plate in the coloring bath, rocking it gently to secure uniform contact with the solution. The plate should not remain in the color bath longer than seventy-five seconds, as a long-continued exposure to the color solution will depress the general sensitiveness, without increasing that for colors. If a large number of plates are prepared with the same solution it is advisable to add, after the eighth or tenth plate, about ten or twenty drops of erythrosine. The colored plates must be well drained, reared upon blotting paper, and dried in the ordinary closet.

Colored plates may be exposed while still wet, and the general sensitiveness is somewhat decreased thereby. If, however, the object to be photographed requires a very long exposure, it is better to use a dried plate.

Developing erythrosine plates offers no serious difficulties, but it must be remembered that the plates being so sensitive to color especially yellow, the process must be carried on either in the shadow of a subdued ruby lantern, or a light obscured by several thicknesses of brown tissue paper.

To suppress the violent action of blue and violet, a yellow screen is placed between the sensitive surface and the objective; the best method being to fasten the screen on the back of the front bearing the lens. It being difficult to obtain glass of pure yellow color, photographers prepare these screens themselves, by coating a very thin and white plane parallel glass, with xanthine collodion, in a similar manner as we have learned to varnish our negatives.

The yellow color imparted to the collodion is sensitive to light, and plates prepared with it, will fade when exposed unnecessarily.

With the interposition of the yellow screen, which is absolutely necessary for the copying of objects in which blue and violet predominates, the time of exposure must be increased from three to six times that of an ordinary plate.

With artificial light of sufficient force the yellow screen can be dispensed with, a yellow cylinder globe or shade placed over the source of light answering equally well.

The yellow glass should be very thin ; if unnecessarily thick the time of exposure becomes longer. Focus should be taken with it, as a refraction of light may occur, making a perceptible difference.

The reproduction of oil paintings, aquarells, fabrics, and other articles, colored highly in various shades does not require any particular precautions. When much red is present, the exposure should be lengthened ; with the absence of blue the yellow screen may be dispensed with, neither is it required for general landscape work.

Artificial light, rich on yellow and orange light, allows work without the screen.

The developing process must be carried on in weaker light than generally is used. As a formula giving very good results we may adopt :

1.—Granulated sulphite of soda.	3 ounces.
Water	1 quart.

In this solution dissolve :

2.—Pyrogallic acid	½ ounce.
Granulated carb. of soda	2 ounces.
Water	1 quart.

For normal exposure add I ounce of water to 1 ounce of each of No. 1 and No. 2.

All orthochromatic plates should receive a full exposure, if too much time has been given, restrain with bromide of potassium, not with bromide of ammonium.

Development had better be commenced in total darkness. After the expiration of two minutes, when the color-stuff has been partly washed away the plate may be examined in a weak red light, and the process may therein be continued. Fixing, washing, intensifying or reducing is accomplished in the same way as with ordinary plates. With some emulsions the color is difficult to wash off the plate ; when this is the case a little alcohol will remove it more effectually than water.

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Lesson XXI.

Transparencies and How to Make Them.

There are various methods and processes for making transparencies, many of which have passed into history, and, as the object of this lesson is to place before the reader the latest method, combining simplicity of manipulation with perfection of result, it will be only necessary to enumerate the various methods of the past, without entering into a detailed description of them. They comprise the albumen, collodio-albumen, collodio-bromide, bath dry plate, in which a bromoiodised collodion plate is sensitized in a solution of silver nitrate, and, after washed and coated with a preservative, collodio-chloride, wet collodion process, which is still used by professional slide makers, carbon process and Woodbury process.

At the present time two processes are in use only in America, viz., the old wet collodion process, and the new gelatine dry plates, the first limited in use by those making lantern slides mainly for advertising purposes, while the new gelatine dry plate, of the special kind made for producing transparencies, known as Carbutt's Gelatino-Albumen Plate, is universally used by amateurs and the professional portrait and landscape photographer; and it is in the use of these plates we now proceed to describe how to produce from your negatives what is conceded the finest positive obtainable.

The requisites for contact printing are a deep printing frame, a size larger than the negative to be used, with a flat glass bottom free from scratches; crystal plate is best; some thin red enameled label paper for masks, a Carbutt Multum in Parvo Lantern, or other artificial light, and transparency plates of suitable size; those for lantern slides are made on thin crystal glass of the now accepted standard size, 3¼x4 inches; for the larger size transparencies they are now made on fine-ground glass, which has the advantage over the clear glass. That the image is rendered in its right position, when made by contact with the negative, just as a silver print would be, the obscured side of the glass being back of the image, it only remains to cover it with a clear cover glass and mount in a suitable sized metal frame sold for that purpose. The transparency need not be confined to the size of the negative ; the image can be enlarged or reduced to suit taste and circumstances ; nor is it absolutely necessary, for the purpose of enlarging or reducing the image, that a camera for that purpose be provided, if the use of a small room can be commanded, and the light shut out all but one light in the lower sash; over this light must be placed, and covering the entire surface, a light of fine ground glass which will give an even defused light, passing through the negative ; beneath this a support for the negative should be placed. The same camera and lens, used in making the negative, can be used for making the transparency—providing the image is to be *reduced* in size, and the negative can be held upright in one of the plate-holders, removing the septum and dark-slides, and placing the holder with the negative on the support before the light passing through the ground glass. The camera itself may be supported on a board, raised to such a height that the lens will centre with the centre of the negative, care being taken in adjusting it that the side of the camera and the face of the plate-holder, holding the negative, forms a perfect right angle. If it is desirable to make an enlarged transparency, say from a 4x5 or 5x8 negative to an 8x10 plate, the same camera and lens may be used, but the ground glass of the camera removed, allowing the magnified image to pass *through* the camera into the sensitive plate, supported in an upright position at the distance found to be correct ; to ascertain this the camera with its lens should slide easily between two strips, for, unless your camera is provided with a front rack movement, you will have to move the camera, and with it the lens to obtain a focus, using a light of glass on which is stretched a piece of white paper on which to obtain a focus, and placed against a support on the board carrying the camera, and at right angle with the base of it. This is supposing you are working in a room in which *all* light, except that passing through the negative, is excluded before placing the negative in the holder or support, if it is desirable to have a margin on the transparency ; then cut out a mask from the thin red enameled paper or tin-foil, and place on the face of the negative, being careful to see that the margin shows equally around the large plate or focusing screen.

Now, while the above description will enable any one to produce enlarged or reduced transparencies from their negatives, it is but a makeshift, and will be found to entail great loss of time and uncertainty in working, all of which can be avoided by using a properly constructed camera, such as that made by the Scovill Manufacturing Co.* The writer of this article has had one in use for years. The end holding the negative, has adjustments for centering the image, and the extended range of adjustment of the lens enables a lantern transparency to be made from an 8x10 negative, or vice versa, a 8x10 transparency from a 34x44, or other intermediate size negatives.

Having explained the tools required, we will now proceed with describing the chemicals required and the making of the transparencies.

Of chemicals it will require the following :

Neutral oxalate of potash	1 pound.
Sulphate of iron	1 pound.
Hyposulphite of soda	5 pounds.
Alum	1 pound.
Citric acid	¼ pound.
Liquor ammonia	4 ounces.
Plain collodion varnish	8 ounces.

Too much stress cannot be laid in procuring chemicals of the greatest purity, and known to be made for use in photography ; especially is it necessary that the first two articles named should be pure. Many have been disappointed in their efforts at transparency making by applying to the country druggist for oxalate of potash, and have been supplied with bin-oxalate of potash ; be careful, therefore, to procure the chemicals from a reliable dealer in photographic materials. In compounding the solutions, first prepare, by a thorough cleansing, suitable sized bottles ; for the bulky solutions, nothing is better than the ordinary glass preserve jar, and for labels, a safe plan is to cut from the circular accompanying the plates you are to use, the formulas, and paste them on the glass jar to contain the solution it describes. Next in importance is, the water, clear soft river or spring water, melted ice or distilled as most convenient, but not hard water containing lime in solution.

We will now describe a very excellent plan we have used for years in dissolving large crystals that does away with the use of a pestal and mortar, and after filtering for the A solution of following formulas, choose a one-half gallon glass preserve jar, and for B solution a quart jar. Measure into each one the quantity of water required, except that in the B solution a few ounces of the water may be reserved until after solution of the iron salt and then added, to dissolve the salts so as to need no after filtering,

* Described minutely in Lesson XIX.

take a common domestic salt bag, washed to free from salt, in this place the crystals and suspend it in the water so that the bulk of the salt is just covered by the water, immediately a stream of denser liquid will be seen falling to the bottom of the jar, much in appearance as when pouring glycerine into water ; this will continue until the whole of the salts are dissolved and a clear solution, remove the bag, give the bottle or jar a shake, and the solution is ready ; the same method is to be employed in dissolving the iron and hyposulphite of soda, using a separate bag for each one, and completing one before commencing on another. Having everything ready, carefully weigh out by avoirdupois weight the chemicals, and make solutions as per following formula :

Carbutt's Improved Developer for Transparencies.

A.—Oxalate of potash	8 ounces.
Water	30 ounces.
Citric acid	60 grains.
Citrate of ammonia solution	2 ounces.
B.—Sulphate of iron	4 ounces.
Water	32 ounces.
Sulphuric acid	8 drops.

C.—*Citrate of Ammonia Solution.*—Dissolve 1 ounce citric acid in 5 ounces distilled water, add liquor ammonia until a slip of litmus paper just loses the red color, then add water to make the whole measure 8 ounces.

Developer.—Add 1 ounce of B to 2 of A, and ½ ounce water and 3 to 6 drops bromide solution.

In the making of transparencies, the first requisite is a good negative, and every effort and care should be taken when producing it, to insure its freedom from imperfections as possible, the second requisite is a suitable artificial light for use when making exposures by contact, and we know of none better than Carbutt's Multum in Parvo Lantern, designed especially for this class of work, it has a safe light in front, used when developing negatives or transparencies, has two side doors, that to the left when opened emits clear white light, and the reflector attached to the revolving lamp, throws parallel rays towards the printing frame holding the negative and sensitive plate, the door on the right, when opened reveals a light of opal glass, through which the soft white light allows the negative or positive to be examined, the third requisite is suitable sized developing dishes; these should be of porcelain or the enameled iron ware, and can not be used with the pyro developer without risk of staining the transparencies, as we use for them the ferrous-oxalate developer only. Having now provided ourselves with the necessary requisites for the work, we will proceed with the making of transparencies, beginning with the popular lantern slide; for convenience of exposing the plate the lantern should be hung in front of the operator so that the bottom is about twelve inches from the work-bench, to the left and in line with the bottom of lantern should be fixed a bracket shelf, so that the printing frame can be supported at a distance of about twenty inches from the lamp flame. We now place our negative glass in contact with the glass in a deep printing frame, a suitable size is 6½x8½, then it answers for 5x8 and under, over this place one of Carbutt's thin crystal transparency plates, so as to cover the portion of the negative desired, lay a piece of dark felt or other soft material over it, close down the back, next turn the lamp of the lantern by the knob underneath, so that the reflector faces to the left door of the lantern, and allow the clear light to act from ten to fifteen seconds, close the door of the lantern, remove the plate from printing frame, place in a 4¼x5½ porcelain dish, and flow over sufficient of the developer to well cover the image, if correctly time should appear slowly, taking two or three minutes to complete, allow the development to continue until the blacks look quite strong, and detail plainly showing in the high lights, to allow for reduction of intensity in the fixing bath, wash off the developer, and immerse in a fresh solution of the hyposulphite of soda, (pyro developed negatives should not be fixed in same solution) made by dissolving 8 ounces of the salt in 40 ounces of water, in the same manner as directed for dissolving the iron salt. Let the transparency remain in the fixing bath, three to five minutes after the white bromide seems cleared from the plate, wash for half an hour in running water, then immerse for five minutes in the

HARDENING SOLUTION.

Water	36 ounces.
Pulverized alum	3 ounces.
Citric acid	¼ ounce.

Afterwards wash for twenty minutes to half hour, then carefully go over the surface with a tuft of absorbent cotten, while water is running over it, give a final rinse, and place in drying rack to dry spontaneously, then varnish with plain collodion.

COLLODION VARNISH.

Alcohol	4 ounces.
Pyroxaline	30 to 40 grains.
Sulphuric ether	4 ounces.

When, after shaking, the cotton is dissolved, filter and flow the plain collodion over the dry transparency, the same as when using varnish ; then dry, cover with matt and a crystal cover glass, and bind with binding strip.

Transparencies for window and door decoration should be made on plates somewhat larger than the negative, so that a suitable margin may surround the image. To do this, cut a mask with rectangular or other opening out of the thin red enameled paper ; for an 8x10 transparency from a 6½x8½ negative, take a piece of the mask paper 9x11 with two sides cut to right angle ; make a line with pencil and ruler 1¼ inches from two sides; from the side line measure 5¼ inches, and from the cross line measure 7¼ inches; cut on these lines with a sharp knife through the paper laid on glass or zinc, and remove the blank ; make a x mark on left upper corner, to denote register corner, place this mask in a 10x12 deep printing frame, let it register close to the left-hand upper corner, lay the negative film side up and under the mask ; adjust the negative so as to show in proper position through the opening ; over this place a Carbutt A transparency plate 8x10, letting it register in the same corner as the mask ; lay over a pad of black canton flannel, close the printing frame, expose to the lamp or gas-light 10 to 15 seconds or more, according to density of negative. Develop as directed for lantern slides, and in every other respect proceed the same.

The tone, both of lantern and large transparencies, can be varied from a warm brown to a velvety black. Increased exposure and weaker developer (adding water) with more bromide gives warm brown tones. Short exposure and stronger (undiluted) developer gives dark tones.

CHAUTAUQUA UNIVERSITY.

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CHARLES WAGER HULL,

Supt. of Instruction, C. S. of P.

Lesson XXII.

Landscape Photography.

It has been said by those engaged in the instruction of youth that they often find it far more difficult to indicate from the mind of a pupil the errors of previous training then it is to impart and render permanent such knowledge as is properly presented. A false start on the road to knowledge may soon lead to discouragement and finally to overwhelming disaster. And this is especially liable with older as well as young students in the technical science and art of photography. Few, if any student, in any department of art has attained a prominent position in his or her profession without beginning with the rudiments and thoroughly mastering the first principles.

First lessons may seem uninteresting and to the beginner appear unnecessary—a waste of time and material. But, if neglected, it is *more* than probable that far *more* time and greater expense will be demanded for correction of the mistake, besides the worry and regret which is sure to come with the conviction that the beginning has been too hurried and its details too lightly passed over.

Do not expect to at once produce results equal to those of workers who have grown gray in the same field of labor, and if you do have such expectations, do not get discouraged by a few failures.

One student in photography yet has a vivid remembrance of his early experience in the use of a 14x17 outfit with which a learned professor had started him out to make his first pictures.

It is well to begin with a fixed determination that *quality* should be the first and most important, and *quantity* a secondary or unthought of factor. A good picture of a single tree, shrub or even leaf, a small picture of a corner in the garden, a field or bit of water, is far more satisfactory, instructive and valuable than a so-called *fair* picture, however broad the space shown may be. Do not try to photograph everything you see ; select your subject after consideration, execute your work with deliberate care, and you may afterward take pleasure in exhibiting the results to your friends.

First secure good apparatus. Do not define the word good as here used to necessarily mean high price; very fine work is often done with comparatively cheap tools. Safety of expenditure is best secured by intrusting orders to a well-known and reliable firm, such as ——————————————. Otherwise, purchases of apparatus should be made under the counsel or by advice of some competent person who has been made acquainted with the requirements and conditions of the buyer.

Good, *cheap* apparatus may be found if properly sought for. But a great deal of apparatus is sold which is dear at *any* price, having less real value than the raw material from which it has been constructed.

After determining to procure an outfit, begin study for its use. Select subjects and study them from various points of view and under different lights of morning, noon, or later in the day. Observe the effect under various conditions of illumination. Some of the finest photographs of American landscapes have been made under a clear or partially clouded sky just before the morning sun appeared above the horizon. The light reflected from such a sky is soft and yet brilliant, while the air usually has less motion than at any other time of day, and the dewy sparkle of the foliage is found only in the early hours.

In broad expanse of field and detached woodland the brighter light of later hours is often most desirable on account of the well defined shadows which serve to break up the monotony and give brilliancy to such scenes. A herd of cattle or a flock of sheep—which add much to the beauty of landscape pictures—are less likely to be in motion, and are oftener found in picturesque groups then in early morning. No landscape of any considerable breadth should be photographed without the introduction of animals or familiar figures.

If animal life is represented in the picture, do not have it in the immediate foreground, unless it is to appear the important feature of the scene. Whether the figures used are biped or quadruped, they should be placed at such a distance as will prevent their blocking out other important objects, or giving the appearance of crowding. Many beautiful landscape pictures may be secured in the late afternoon hours, even up to within a short time of the sun's disappearance below the western horizon. This is an especially favorable time of day for fine cloud effects. In scenes made up of large masses of foliage, it will be found necessary to give considerably longer exposure. This increase of exposure is very important in heavily wooded mountainous districts. The absorption of actinic force and the low power of the reflected green rays are such, that considerable care is necessary for producing fine work under such conditions.

Care should be exercised in setting up the camera for field work. In most instances it is advisable to place the camera horizontal and level, and to make any desired change in the boundaries of the picture by a proper use of the sliding front or swinging back of the instrument. For more or less sky or foreground, lower or elevate the sliding front or lens board of the box, and, for side changes, utilize the side swing back. This last named motion is very important when a long stretch of shore, river or street view is under treatment. By swinging the end of the ground glass focusing screen, showing the near objects back or further from the lens, and the end showing the distant objects nearer to the lens, much finer rendering of details is secured.

When the body of the camera is much tipped up or down, the result is likely to be greatly distorted, and gives a false character to the picture It is seldom advisable to photograph landscape scenes from the shadow side. The shadow, unrelieved by illuminated portions, produces a somber effect in the work.

The proper rendering of distant views is best secured in clear, bright weather. Even a slight veil of fog or smoke is quite sufficient to prevent good results, under otherwise most favorable conditions. By clear weather, a cloudless sky is not necessarily meant, but rather such conditions as show the air to be free from smoke or fog, which give to distant objects a dim or hazy appearance. A sky partially obscured by thin, light, fleecy clouds, reflects an excellent light for fine landscape work. The pleasant weather immediately after a heavy rain is very favorable.

At such times the floating particles have been precipitated or washed from the air, and the dust with which foliage has become coated in dry weather no longer absorbs the light or prevents reflection from smooth surfaces.

When illustrating a scene including any considerable expanse of water, choose some point of view from which the surface of the water does not present a broad, brilliant sheet of unbroken white. This is sometimes difficult if there is neither a fresh breeze nor a flowing current; and if either of these conditions exist, the picture is apt to be unsatisfactory unless made by instantaneous exposure, and such short exposures often result in hard or inharmonious prints, when considerable expanse of woodland or heavy foliage is included.

A field of waving grain or the long majestic swing of tall forest trees in a heavy gale of wind are beautiful objects to look upon, but are as yet beyond the reach of photographic illustration, because the light, at such times as these scenes are presented, is usually too weak for the rapid exposure required for satisfactory results with moving objects.

Beginners, and in fact old workers, are apt to commit errors in time of exposures in the open air. This is not mainly due from lack of ability to judge of the amount of illumination, but rather to disregard of the *color* of the light.

During long periods of dry weather the air becomes filled with particles of floating matter, which gives the light a yellow non-actinic tone, requiring much longer exposures in the camera.

It is advisable to keep full notes of all work done in the field, as such records often prove valuable in after work of the same class. Field books for such records may be had from most dealers in photographic materials. Plate makers and chemical manufacturers are many times blamed for faulty results which are due to lack of judgment, or its proper exercise when the materials are used.

Greater care should be used to prevent light from reaching the inside of the plate-holder or camera box, except such as passes through the lens, while the exposure is made. It should be remembered that the light under an open sky is much stronger than it is inside a room, and a small leak which would be scarcely noticeable in the latter, may be in the former sufficient to illuminate the entire inside of the camera box or plate-holder. A cloth or opaque cover is advisable for shading the camera during exposure in the field.

Some have recommended enveloping the entire camera box in a shield of some light opaque material made up in the form of a bag sufficiently large to admit of drawing and replacing the slide without removing or opening the box.

Every record of field work should state the focus of the lens used and the exact diameter of the stop or diaphragm. To state that you used for certain results Mr. S——'s lens with number 3 stop really conveys no information to the listener unless he is familiar with these. But when you say I used Mr. S——'s 8-inch focus lens with ½-inch diaphragm, your listener can at once understand the conditions under which the picture described was made.

The development of a landscape plate should theoretically not be different from that of other work, but when we consider the variety of influences bearing upon the work, among which are principally the varying conditions of light, it will readily be understood that a different procedure must be adopted.

It may be taken as a rule, that for timed landscape work no better plate can be found in the American market than our favorite, the Carbutt B, with which we have become familiar, and the fine qualities of which we have had ample opportunity to observe. Time of exposure depends in landscape photography, as well as in any other branch of the art, first upon the degree of sensitiveness of the plate, the quality of light, the time of day, and the color of the object. So, for instance, will dark green wooded scenery require a much longer time than a view on the lake shore or ocean beach ; a white marble palace or a white frame cottage much less than a brick or brown-stone-front house.

The results of the practicing class, 1886, of C. S. P., encourage us to continue, for that class of work, with the Chautauqua developer.

A.—Bromide of ammonium		2 drams.
	Water	8 ounces.
B.—Aqua ammonia		1 ounce.
	Water	7 ounces.
C.—Pyrogallic acid		1 dram.
	Water	12 ounces.
	Nitric acid	5 minims.

For properly timed exposures take of

A	40 minims.
B	20 minims.
C	½ ounce.
Water	2 ounces.

For over-exposures restrain the action by adding to each ounce of the mixed developer from 3 to 5 minims of *A*, and for under-exposures accelerate with a few drops of *B*, being careful not to use it excessively, for then green fog will invariably result.

For instantaneous exposures, when but rarely the proper time can be approximately estimated, the mode of operating requires a variety of modification.

We return here to the original developer as described in Lesson No. VI.

When, on account of weak light or extremely rapid speed of the shutter, under-exposure may be reasonably suspected, a good method is to bathe the plate in a diluted alkali solution before proceeding with the development.

The alkali solution No. 2, of Lesson No. VI, may be mixed with three volumes of water. After the plate has soaked in this for two or three minutes, it is removed, washed, and placed in diluted developer of the normal composition. The strength of the developer may be increased as the process goes on, until a proper amount of detail and density is obtained.

In our opinion the finest results can be effected by merely modifying the developer. When a plate shows signs of under-exposure, the normal developer must be at once removed and a quantity of pure water poured into the tray in which the plate remains while the operator is mixing a new developer to suit the peculiar case.

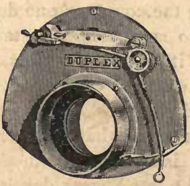
All authorities and the most successful practitioners advise the employment of a weak developer in cases of under-exposure, at the commencement of the operation. Often it becomes necessary to change the developer several times in the course of one development, each solution being prepared to suit the exact state of the plate in which the previous one left it. Old developers, that is, those which have been used once or twice, are very serviceable for starting the action on an undertimed plate.

As the process progresses, it will be seen what treatment is necessary, and a fresh developer, which is rather weak in alkali, perhaps, will be used in place of the old one. A weak developer, if used to the end, will yield but a feeble negative; it must be strengthened as the development continues. Of course, it requires a much longer time to complete development when a weak developer is employed and the process is stopped from time to time to prepare new and slightly stronger solutions; but the result is reasonably sure. With the proper amount of time and patience, a fair printing negative can be produced by this method of procedure from a plate that was apparently under-exposed.

Never force an under-timed negative by increasing the amount of alkali in the developer; it can only result in failure. A developer which is very strong in soda or potash frequently causes a plate to frill, besides yielding a hard and glassy negative. If too much ammonia is used, the result is green fog. Forcing an under-timed plate almost invariably results in a foggy negative. The temperature, too, is an important condition to be observed when preparing a developer. In summer and warm weather considerably less alkali is needed than in colder weather.

When over-exposures may be reasonably suspected, which quite frequently occurs with highly sensitive plates and in good conditions of light, the above method may be reversed, and development commenced with a diluted solution of pyrogallic acid, No. 1, Lesson No. VI. Alkaline solution is then added as the plate demands, and the proportions of pyro increased accordingly.

The drop-shutter—an indispensable instrument for instantaneous exposures—explains itself by the simple mode of construction and easy way of attachment.



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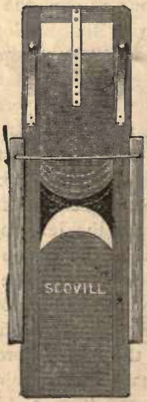

SCOVILL'S
UNIVERSAL SAFETY SHUTTER.

A more complicated arrangement is found in the Prosch "Duplex."