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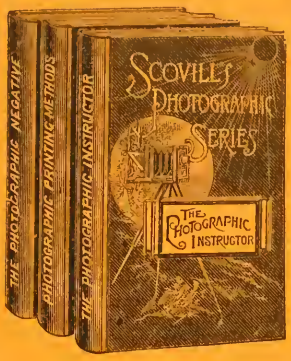

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A DICTIONARY

OF

PHOTOGRAPHY

FOR THE

PROFESSIONAL AND AMATEUR PHOTOGRAPHER.

BY

E. J. WALL

CONTAINING CONCISE, EXPLANATORY ARTICLES, ILLUSTRATED BY SPECIALLY PREPARED DIAGRAMS.

NEW YORK:
THE SCOVILL & ADAMS COMPANY,
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1889.

PREFACE.

WHEN the worker in photography is desirous of teaching himself the art, he naturally turns to the standard text-books in order to prevent frequent failures and mistakes. Many of the books published upon photography are too far advanced to be of any service, except to those who are well versed in chemistry and optics. It was to override this great difficulty that at the instance of the Editor of the *Amateur Photographer* I contributed to that paper the DICTIONARY OF PHOTOGRAPHY. It was published through a series of numbers, and, at the earnest request of many subscribers, the Editor prevailed upon me to issue the DICTIONARY in book form.

As far as possible the information has been brought up to date; it is written throughout in the plainest language at my command, and is, I trust, practically a complete encyclopædia of photography.

I shall feel grateful if those finding errors in calculations or formulæ will communicate with me through the publishers, in order that in subsequent editions corrections may be made.

I have to thankfully acknowledge help and advice from many workers in the art-science of photography, and I confidently leave the result of my labours and their co-operation to await the verdict of the public, and dedicate the DICTIONARY to all who

"Hold as 'twere the mirror up to Nature."

E. J. WALL.

LONDON, 1889.

DICTIONARY OF PHOTOGRAPHY.

Aberration. A term applied to the lens to denote the variation between the foci of rays of light which are transmitted through the centre of the lens and those which are transmitted through or near its margin; also to denote the separation or decomposition of light by the surface of a lens, so that the constituent rays are not all brought to the same focus. The first is called Spherical, the latter Chromatic aberration. To spherical aberration is due that fuzziness or want of sharpness near the margins of the focussing screen in uncorrected lenses. To the latter is due the annoying defect of lenses when the chemical and visual foci do not coincide, when the camera, after focussing, must be racked in towards the lens—from one-thirtieth to one-fortieth of the focal length is the usual run—before the plate is exposed. Both are corrected by combining lenses differing in form and in the kind of glass of which they are made.

Accelerator. A term applied to any substance which is used to shorten the duration of development and to obtain the impression of the slightest impact of actinic light. Thus, in alkaline pyro development the alkali is the accelerator, and with ferrous oxalate, hyposulphite of soda, common salt, perchloride of mercury have been recommended. A few drops of a weak solution of hypo have a wonderful effect in bringing up detail in an instantaneous negative. Common salt has also a beneficial effect, especially with positive bromide papers, bringing up the detail evenly and gradually before the shadows can become blocked. The addition of hypo and chloride of soda to ferrous oxalate developer is stated to materially shorten the time of exposure, but it is doubtful whether the action is not rather limited to producing a visible image of every ray of light, which may not be the case with ordinary development.

Achromatic, when applied to a lens, signifies that it has been corrected for chromatic aberration, and that the images projected by it are unaccompanied by fringes of various colours. The correction is usually effected by combining two glasses having differing refractive powers, as, for instance, a convex crown-glass lens, with a concave flint glass, or by enclosing a flint meniscus between two concavo-convex. There are several methods, but the latter is the usual method employed for the rapid class of lenses now so much in vogue (see LENS). For the theory involved in rendering lenses achromatic, see DECOMPOSITION OF LIGHT.

Acids may be defined as compounds of hydrogen whose atom or atoms of hydrogen are replaceable by metals, or by radicles having metallic characteristics, and the compound resulting from such substitution is termed a salt.

ACETIC ACID. Formula, $HC_2H_3O_2$; molecular weight, 60; synonym, purified pyroligneous acid. Prepared from wood by destructive distillation and subsequent purification. There are three commercial strengths.

Glacial Acetic Acid contains 99 per cent. of acid and 1 per cent. of water. Its specific gravity varies from 1·065 to 1·066. When cooled to 34 degs. F. it solidifies into a mass of crystals, and remains solid till the heat is raised to 48 degs. From this property is derived the term glacial. Care should be exercised in handling this, as it is a powerful escharotic; if any should by chance be spilt upon the naked skin, an alkali should be immediately applied. It is, of course, a poison, by reason of its escharotic properties—the obvious antidote is chalk, lime, or other alkalies. It is miscible with water and alcohol in all proportions. It is a solvent of pyroxyline.

Acetic Acid. This is one-third the strength of the glacial acid, containing but 33 per cent. of real acid. It can be conveniently prepared from the stronger acid by mixing with it twice its own quantity of distilled water. It is sometimes known as "Beaufoy's Acetic Acid." Specific gravity, 1·044.

Dilute Acetic Acid. Made by mixing 1 part of acetic acid and 7 parts of distilled water. Specific gravity, 1·006. It contains but 3·63 per cent. of acid. The impurities in the acetic acids may be either sulphurous acid or tarry matter, both of which may be

detected by the addition of a few drops of solution of nitrate of silver. A white precipitate denotes sulphurous acid, and the darkening of the solution in light indicates tarry matter. Their uses in photography are limited to a clearing bath for Bromide Papers (*q.v.*), and for the formation of salts known as acetates.

Carbolic Acid. $C_6H_5HO = 94$. Synonyms: Phenic Acid, Phenol, Phenylic Alcohol, Hydrate of Phenyl. A crystalline substance, which is not a true acid, obtained from coal tar by fractional distillation. It is a powerful antiseptic and preservative, for which purpose it is added to albumen and certain mountants. Solubility: 1 in 15 of water, 5 in 1 of alcohol, 4 in 1 of ether.

Citric Acid. $H_3C_6H_5O_7H_2O = 210$. A crystalline acid prepared from the juice of lemons and the lime fruit. It is used as a preservative of pyrogallol in solution and sensitised paper; it is also used in conjunction with chloride of silver for quick printing paper. It forms salts termed citrates. Solubility: 10 in 7·5 of cold water, 10 in 5 of boiling, 1 in 1·15 of alcohol (specific gravity, ·820); insoluble in pure ether. Seventeen grs. of citric acid will neutralise 35 grs. carbonate of soda; 17 grs. of citric acid will neutralise 15 grs. carbonate of ammonia; 17 grs. of citric acid will neutralise 20 grs. carbonate of potash.

Formic Acid. $HCHO_2 = 46$. An acid liquid prepared by oxidation from starch, but was originally obtained from ants, whence its name. This has been recommended as a preservative of pyro, and the writer has found that half an ounce of dilute formic acid will preserve 1 oz. of pyrogallol even when exposed to light and air for over two months, and it has the advantage over all other preservatives in that it is in itself a slow developer. (See DEVELOPER.)

Gallic Acid. $H_3C_7H_3O_5 = 170$. Is used in the preparation of pyrogallol and in some of the old collodion processes, but otherwise of little interest to gelatine workers. Solubility: 1 in 100 of cold water, 1 in 3 of hot water, 1 in 5 of alcohol.

Hydrobromic Acid. $HBr = 81$. Is made in several ways, by decomposing bromide of potassium with tartaric acid, passing sulphuretted hydrogen through bromine water. It forms salts termed bromides, in which form alone it is used in photography.

Hydrochloric Acid. $HCl = 36·5$. Made by roasting salt in furnaces with sulphuric acid. Its specific gravity is 1·160. It combines with alkalies and basylous radicles to form chlorides.

Its use is limited to the Clearing Bath (*q.v.*), and when mixed with nitric acid is known as aqua regia for preparing Gold Perchloride (*q.v.*).

Hydriodic Acid. HI = 128. Made in a somewhat similar method to hydrobromic. It forms salts called iodides.

Nitric Acid. $HNO_3 = 63$. Synonym: Aqua fortis. Prepared by distillation from Chili saltpetre (nitrate of soda) and sulphuric acid. Specific gravity, 1·45. A heavy colourless liquid fuming in the air. It is extremely poisonous, having a most powerful corrosive action; 2 drms. is the smallest fatal dose known—the antidote, any alkaline earthy carbonate, as chalk, lime, magnesia.

Nitro-Hydrochloric Acid. Synonym: Aqua regia. A mechanical mixture of 3 parts of hydrochloric acid with 1 part of nitric acid; the oxygen of the latter combines with the hydrogen of the former, setting free chlorine, and forming water $2HCl + HNO_3 = H_2O + Cl_2 + NO_2$. It is used to dissolve gold for the preparation of gold perchloride, the principal agent for which purpose being the free chlorine.

Oxalic Acid. $H_2C_2O_4$, $2H_2O = 126$. Prepared by oxidation of sugar or sawdust by nitric acid. It is recommended for acidifying the oxalate of potash solution for ferrous oxalate developer, but its chief use is in the preparation of oxalate of potash, ferric oxalate, and other stable salts. It is extremely poisonous (60 grs. being sufficient to cause death); its antidote, magnesia, chalk, or lime in any form, with which it forms insoluble oxalate of lime. Solubility: 1 in 15·5 of cold water, 1 in 1 of boiling; sparingly soluble in alcohol.

Pyrogallic Acid. $C_6H_6O_3 = 126$. Is not actually an acid, its proper chemical name being pyrogallol; it is prepared by sublimation from gallic acid. In the presence of alkalies in solution it absorbs oxygen from the air, turning black, a carbonate and acetate of the alkali used being formed. It is a powerful deoxidiser and reducing agent, and is more extensively used than any other agent for developing. As pyro is very easily oxidised it is extremely difficult to preserve in solution, many substances being recommended for that purpose; the following are some of them, which are enumerated in the order of their value for that purpose:—A mixture of glycerine and alcohol, formic acid, metabisulphite of potash, sulphite of soda, citric acid.

Solubility: 1 in 2 of water, the resulting solution measuring $2\frac{1}{2}$; 9 in 10 of alcohol; it is also soluble in glycerine and ether.

Salicylic Acid. $HC_7H_5O_3 = 138$. Occurs naturally, but is prepared commercially by heating carbolic acid with caustic soda and passing carbonic acid into the mixture. Solubility: 1 in 700 of cold water, 1 in 9 of boiling water, 1 in 4 of alcohol: 20 grs. with 20 grs. of borax or acetate of potash will dissolve in one ounce of water. It is but rarely used in photography; as a preservative it is added to some mountants, and as salicylate of soda is recommended to give increased sensitiveness to dry plates.

Sulphuric Acid. $H_2SO_4 = 98$. Is prepared by roasting iron or copper pyrites and oxidising the products. Specific gravity, 1·845. It is used in photography as a clearing agent, and for preserving solution of ferrous sulphate. It forms soluble salts called sulphates. It is extremely corrosive and caustic. When taken undiluted internally it is poisonous, the antidotes being the same as for nitric acid. It is miscible with water in all proportions. Great heat is evolved when thus mixed, the water being raised to nearly boiling point; great care, therefore, should be used in mixing it, or the measure or vessel may be broken.

Sulphurous Acid. $H_2SO_3 = 82$. Prepared by deoxidising sulphuric acid with charcoal. It is a colourless liquid, with pungent sulphurous odour, and contains 9·2 per cent. of sulphurous anhydride, SO_2. Specific gravity, 1·040. It should be freshly prepared, as it changes by keeping into sulphuric acid. It is recommended for preserving pyrogallol, and forms one of the ingredients of Beach's Developer (*q.v.*). Care should be exercised, in handling this, not to inhale the fumes, which are extremely poisonous.

Tannic Acid. $C_{27}H_{22}O_{17} = 618$. This is not a true acid, but a glucoside obtained from galls. Solubility: 10 in 8 of water, 10 in 8 of alcohol, sparingly soluble in ether, its photographic use being limited almost, if not entirely, to the old collodion process.

Tartaric Acid. $H_4C_4H_2O_6 = 150$. Prepared from the impure cream of tartar in the lees of wine by precipitation by chalk and subsequent addition of sulphuric acid. Solubility: 1 in ·66 of cold water, 1 in ·5 boiling water; soluble also in alcohol and ether. Its use in photography is limited, being sometimes used instead of citric acid, and for preserving sensitised paper.

Actinic applies to that portion of light which effects chemical change, in distinction to those portions which furnish light and heat. The actinic portion of the spectrum may be said to be confined to the ultra-violet, violet, indigo, blue and green; not, as might be supposed, to that portion which appears to us to be the most powerful—viz., the yellow. But the division is entirely arbitrary, as it depends solely upon the substance exposed as to which rays are actinic or non-actinic.

Actinic Focus of Lens. See Focus.

Actinograph—Actinometer. Any instrument which measures the actinism of the sun's rays. It usually consists of sensitive paper, which can be exposed to the light in small portions at a time; and the time which it takes to darken to a standard tint will be found to bear a distinct relation to the necessary exposure required for a sensitive film, whether upon glass or paper, due allowance being made for the presence of any object of importance near the foreground of picture. An actinometer can be made by any amateur by soaking a strip of gelatino-bromide paper in a 2 per cent. solution of nitrite of potash, drying the same in the dark. When dry it should be rolled up small and placed in the inside of a box which is light-tight, and from which the paper can be drawn in small pieces, to allow of its exposure to light and comparison with a standard tint, which can be obtained by exposing a plate on a subject the exposure of which is known, and at the same time exposing the actinometer and noting the time of the darkening of the paper to a certain tint. Supposing the correct exposure of the plate to be 3 secs., and it is found that the paper takes 30 secs. to darken, it is obvious that dividing the actinometer time by 10 will give the correct exposure, with a certain stop and class of picture, from which the others can be calculated. Ordinary albumenised paper, which owes its darkening properties to chloride of silver, is sometimes used, and, although the results, with certain modifications, are some guide, it is obviously unfair to calculate the exposure of bromide of silver from the action of chloride. The term Photometer (*q.v.*) is sometimes, but erroneously, applied to such an instrument.

Aerial Perspective. An artistic term used to denote the idea of distance in a landscape or photograph of the same, which

depends upon the fact, that the more remote the object the less forcibly the visual rays are perceived by the retina of the human eye. This feature, which lends so much beauty to photographs, can only be obtained by the use of long-focus lenses, or by the use of as large a diaphragm as possible. (See FOCUS and DIAPHRAGM.)

Agent. That which has the power of acting or producing effects upon anything else—*e.g.*, light is the agent which impresses the image upon a sensitive plate, and the developer the agent which makes such image apparent.

Alabastrine Process. An old wet-plate process for improving the colour of glass positives. It can be applied to gelatine negatives in the following manner (absolute freedom from stains and hypo being a *sine quâ non*):—Soak the negative in clean water till thoroughly moist, and then in following solution: perchloride of mercury, 40 grs., dissolved in pure hydrochloric acid, 1 drm.; chloride of sodium, 20 grs.; sulphate of iron, 20 grs.; distilled water, 2 ozs. Allow it to soak till thoroughly bleached; wash, dry, and varnish with matt black varnish, or back with black velvet.

Albertype. See COLLOTYPE.

Album. Literally anything white. Now used in the sense of a blank book, either with openings for the reception of photographs, or blank pages to which they may be affixed.

Albumen. An organic principle found in both the animal and vegetable kingdoms. The purest form in which it can be obtained and the one in which it is used photographically is the white of egg, its chief use being the preparation of albumenised paper.

Albumenised Paper. Paper coated with albumen and salt. This has now become so necessary an article that it is prepared commercially so cheaply and in such perfection that the ordinary amateur had much better buy it already prepared. The following short directions will give some idea of the method of procedure:—Absolutely fresh eggs must be used. Crack each egg into a separate cup or measure before mixing with the bulk, so that in case of the yolk breaking the whole of the albumen

not be spoilt. Take out the germ of each egg. Every fair-sized egg will yield about 7 drms. of albumen.

Albumen	6 ozs.
Chloride of ammonium	60 grs.
Rectified spirit	96 mins.
Distilled water	14 drms.

Dissolve the salt in the spirit and water, add to the albumen, and beat with an egg-whisk for fifteen minutes, allow it to settle and filter it through a tuft of cotton-wool, previously well washed with distilled water. This is sufficient for a quire. The paper should be either Saxe or Rive. Put the albumen into a large flat dish; take the paper by two opposite corners, and bring the hands close together, so as to make the paper bow out in the middle; lay the middle of the paper on the surface of the albumen, gradually lowering the ends till it rests on the albumen. When the paper has floated for a few seconds, bubbles will be shown by the numerous puckers; lift the paper, and wet the bubbles with a camel's-hair brush; allow the paper to float for eighty seconds—not longer, or the albumen will sink into the body of paper—then gradually raise by one corner, and suspend from two corners to dry; when thoroughly dry, roll between steel rollers, and keep flat. Double albumenised paper is made by coagulating the first layer of albumen by steam, and treating in the same way again.

Alcohol. $C_2H_5HO = 34$. Synonyms: Rectified Spirit, Ethylic Alcohol, Hydrate of Ethyl, Spirits of Wine. It is prepared by distillation from fermented saccharine solutions, or any vinous fluid. There are three strengths—

Absolute Alcohol. Contains but 1 or 2 per cent. of water. Specific gravity, ·800.

Rectified Spirit. Contains 16 per cent. of water, and is what is termed 56 degs. over-proof. Specific gravity, ·838.

Proof Spirit. Made by diluting five parts of rectified spirit with three of water.

Methylated Alcohol. Rectified spirit to which 10 per cent. of wood naphtha has been added to prevent its use internally. It is useful as a preservative of pyro, and for drying negatives quickly, preventing frilling, and in the manufacture of varnishes.

Alkali. This is the antithesis of an acid. Alkalies tur

litmus paper blue which has been reddened by an acid. They precipitate metals from acid solutions, as oxides or hydrates. Their chief characteristic, however, is their readiness to unite with acids to form salts. The three true alkalies are potassium, sodium, and ammonium.

Alkaline Development. See DEVELOPMENT.

Alum. $K_2SO_4Al_2(SO_4)_3 + 24H_2O = 948$. Is found native in some places, but is usually made from aluminous clay. It is used for rendering the films of gelatine less liable to mechanical injury, by hardening them, and also clears them from stains (see CLEARING BATH). It has also been recommended as a Hypoeliminator (*q.v.*), but its action and benefit is doubtful. Solubility: 9·5 in 100 of cold water, 10 in 8 of boiling water, insoluble in alcohol and ether.

Amber. A fossil resin, from an extinct species of pine. It is used for preparing a Varnish (*q.v.*).

Ammonia. $NH_3 = 17$. Is an extremely volatile pungent gas, but is only known to photographers as a solution in water, termed liquor ammoniæ fortissimus. Specific gravity, ·880, containing about 35 per cent. of NH_3. It should be kept in stoppered bottles, as the gas is freely evolved at ordinary temperatures, and carbonic acid being absorbed from the air, forming carbonate of ammonia. It is used in alkaline development as an accelerator for pyrogallol. The fumes are extremely suffocating, causing sudden contraction of the glottis and consequent death. Its use in ill-ventilated dark-rooms is said to cause permanent irritation of the mucous membranes of the throat, nose, and eyes. There is a weaker strength, known as liquor ammoniæ. Specific gravity, ·936, only one-third the strength of the liq. ammon. fort.

Ammonium Bichromate. $(NH_4)_2Cr_2O_7 = 888·4$. Made by neutralising chromic acid with ammonia. It is used occasionally instead of the potash salt in photo-mechanical printing.

Ammonium Bromide. $NH_4Br = 98$. Made by neutralising hydrobromic acid with ammonia, or by double decomposition from bromide of calcium. Its chief use is as a Restrainer (*q.v.*), but it is sometimes used in the preparation of gelatino-bromide emulsion. Solubility: 1 in $1\frac{1}{2}$ of cold water, 1 in 13 of alcohol.

Ammonium Carbonate. $2(NH_4HCO_3)NH_4CO_2NH_2 = 342$. Made by sublimation from chalk and sal-ammoniac. It is used occasionally for development, but is not so suitable as liquor ammoniæ. Solubility: 1 in 4 of cold water, sparingly in alcohol.

Ammonium Chloride. $NH_4Cl = 53{\cdot}5$. Synonym: Muriate of Ammonia, Hydrochlorate of Ammonia, Sal-ammoniac. Is prepared by neutralising ammoniacal gas liquor with hydrochloric acid and subsequent purification. It is principally used for salting albumenised paper, and for preparing chloride emulsion. Solubility: 1 in 3 of cold water, 1 in 55 of alcohol.

Ammonium Iodide. $NH_4I = 145$. Made by neutralising hydriodic acid with ammonia. It is much used for making Iodised Collodion (*q.v.*). Solubility: 4 in 3 of water, 1 in 4 of alcohol, also soluble in ether.

Ammonium Oxalate. $(NH_4)_2C_2O_4 = 124$. Made by neutralising oxalic acid with ammonia. It has been recommended lately for preparing the paper for platinotype printing. Solubility: very soluble in water, more sparingly in alcohol.

Ammonium Sulphocyanate. NH_4CNS 76. A compound of sulphocyanic acid and ammonia. It is used now for toning gelatino-chloride printing-out papers. It has also been recommended as a fixing agent instead of hypo, but from its comparatively high price, without any increased advantages, it is hardly likely to come into general use. It is a very deliquescent salt, soluble also in alcohol.

Angle, Wide. Applied to certain forms of lenses, which embrace a larger amount of view than the usual run of lenses. The width of angle of view of a lens is determined by the relation of its focal length with the size of the image, which the lens will define. The shorter the focus the wider the angle. To increase the width of angle necessitates the reduction of the aperture, and reduction of aperture means loss of illumination, and, consequently, wide-angle lenses are, as a rule, less rapid than the rectilinear type. Wide-angle lenses exaggerate perspective most painfully, increasing the apparent size of near objects entirely out of all proportion with those more distant. As the angle of view of the human eye does not exceed about 50 degs., no lens for general work should be employed which would include a greater angle than 50 degs. The following tables may

help the amateur to measure the width of angle of any lens which he may desire to buy.

Rule for Finding Width of Angle. Divide the base line of the plate by the equivalent focus of the lens.

If the quotient is—	The angle included is—	If the quotient is—	The angle included is—
·5	28 degrees.	1·155	60 degrees.
·517	29 ,,	1·178	61 ,,
·536	30 ,,	1·2	62 ,,
·555	31 ,,	1·225	63 ,,
·573	32 ,,	1·25	64 ,,
·592	33 ,,	1·274	65 ,,
·611	34 ,,	1·3	66 ,,
·631	35 ,,	1·32	67 ,,
·65	36 ,,	1·36	68 ,,
·67	37 ,,	1·375	69 ,,
·689	38 ,,	1·4	70 ,,
·708	39 ,,	1·427	71 ,,
·728	40 ,,	1·45	72 ,,
·748	41 ,,	1·48	73 ,,
·768	42 ,,	1·5	74 ,,
·788	43 ,,	1·53	75 ,,
·808	44 ,,	1·56	76 ,,
·828	45 ,,	1·59	77 ,,
·849	46 ,,	1·62	78 ,,
·87	47 ,,	1·649	79 ,,
·89	48 ,,	1·678	80 ,,
·911	49 ,,	1·7	81 ,,
·933	50 ,,	1·739	82 ,,
·954	51 ,,	1·769	83 ,,
·971	52 ,,	1·8	84 ,,
1·0	53 ,,	1·833	85 ,,
1·02	54 ,,	1·865	86 ,,
1·041	55 ,,	1·898	87 ,,
1·063	56 ,,	1·931	88 ,,
1·086	57 ,,	1·965	89 ,,
1·108	58 ,,	2·	90 ,,
1·132	59 ,,		

Example: Given a lens of 13 ins. focus, required the angle of view included on a 10 by 8.—10÷13 = ·77, corresponding to 42·5 degs.

Angular Aperture is the relation borne by the working diameter of a lens to its focal length. The wider the angular aperture the less the depth of focus and covering power of the lens. This is well seen in a portrait lens.

Aperture of a Lens, Working. By this term is meant such a part of the surface of the lens which is actually utilised in impressing the image on the plate. Many amateurs suppose that the working aperture of the lens is the diameter of the diaphragm, others that the whole surface of the lens is always utilised; but this is not so. The following method will prove the working aperture of any doublet lens, which varies with each separate diaphragm:—Rack the camera out to the true equivalent focus of the lens; replace the focussing screen by a sheet of cardboard, in the exact centre of which is a minute hole (a pinhole will do); behind this, exactly level, place a strong light, such as a paraffin lamp, and it will be found on looking at the lens that when a diaphragm is inserted in the slot a central portion only of the lens is illuminated. This can be easily seen by breathing upon the lens surface. It should be accurately measured, and this area will be the true working aperture of the lens with the diaphragm used. This area of illumination will be found to differ in geometrical proportion with each separate diaphragm.

Aplanatic. A term applied to a lens to denote that spherical and chromatic aberration have been totally eliminated so far as is practicable; it is impossible to do it theoretically. Rays of light diverging from a point parallel to the axis of an aplanatic lens passing through it, though suffering refraction, are brought to a definite focus at a point which is the true focus of a lens. Practically it means that a lens will give reasonably sharp definition with its full aperture.

Apparatus. The materials used in producing photographs, such as lens, camera, stand, slides, etc., which will be severally described under their various headings.

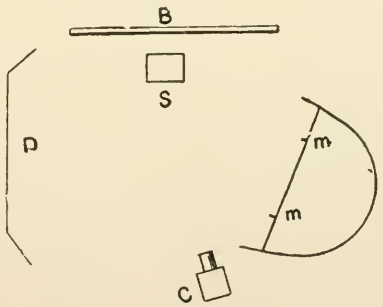
Aristotype. A particular kind of gelatino-chloride printing-out paper, which has been reintroduced by Dr. Liesegang.

Artificial Light. Under this heading it is proposed to describe the various methods of producing negatives by artificial light. The usual lights used are those of electric light; gas; lime-light; magnesium, in the form of ribbon, as a flashing powder, and as a compound powder; and paraffin or other mineral oil.

Electric Light. This has been frequently used for the last

thirty years, and is fairly common amongst professionals. The usual method is to have large electric lights placed in the focus of parabolic reflectors (*q.v.*), shaded by screens of opal glass or linen, or ground glass to diffuse the light. The lights are situated as a rule about 45 degs. above the sitter, one on each side, one being near, the other smaller and farther off, with screens of varying thicknesses, to light up the shadow side of the face, and prevent too great a contrast. As electric lights sufficiently powerful to be of any service must be driven by dynamos, the motive power of which must be derived from gas or steam engines, the cost would deter any ordinary amateur from using it.

Gas may be used by any photographer, provided he has sufficient burners, without any extraordinary outlay. Any room in which a chandelier of three or more lights is fixed can be utilised. The arrangement may be somewhat similar to that described above, and if necessary an oil lamp may be used for lighting up the shadow side. The best plates to use for taking photographs by artificial light are the Isochromatic (*q.v.*). The exposure on ordinary plates being about six or eight times that required for diffused daylight, with the isochromatic the exposure will be about doubled.



Magnesium Ribbon Magnesium wire should never be used. Two strands of ribbon about 8 ins. long should be burnt on one side, and a reflector of white paper, or cloth, placed on the other. From the rough diagram given above a better idea of the relative positions of the requirements can be formed. *m m*,

the magnesium ribbon attached to a strand of wire stretched across the focus of a large tin parabolic reflector; S, the sitter; C, the camera; D, the screen, a clothes-horse with a sheet thrown over it. The exposure continues as long as the ribbon burns, both pieces being simultaneously ignited. B, the background.

Magnesium as a Flashing Light. This is used in three or four different ways:—

(1) By the following powder:—

Magnesium powder	3 ozs
Chlorate of potash	6 ,,
Sulphide of antimony	1 oz.

About 100 grs. of the powder being ignited upon an iron or porcelain dish.

(2) By a mixture of

Ma nesium powder	4 ozs.
Gunpowder	1 oz.

About 30 grs. is sufficient.

(3) By a mixture of

Magnesium powder	15 grs.
Gun-cotton or pyroxyline	7 ,,

This is sufficient for one exposure.

(4) By blowing some magnesium powder through a small gas or spirit flame.

Lime Light. For production of this, see OXYHYDROGEN LIGHT. This may be used as a very good substitute for daylight, the exposure being about doubled.

Lamp Light. The more powerful and the more lamps used the better. The exposure is much lengthened, being sometimes increased as much as five times the usual, but it varies, of course, with intensity of light used. For lamp light isochromatic plates may be considered a *sine quâ non.*

Artotype. See COLLOTYPE.

Astigmatism, or Astigmation. A defect in lenses, due partly to their spherical form, from which vertical and horizontal lines near the margin of the lens cannot both be accurately focussed at the same time. It is especially a defect in portrait lenses. It is also a defect of the human eye, but few people being free from it.

Astro-Photography, or Astronomical Photography. For convenience of description, this fascinating branch of photography will be divided into three portions—viz., solar, lunar, and stellar photography.

Solar Photography. The image projected by the telescope within the reach of the ordinary amateur is so small as to be practically of no value at all. It is, therefore, unnecessary to enter into the minutiæ of working. A siderostat is used, and the camera is usually a tube 40 ft. in length; the image of the sun is projected from the mirror of the siderostat through the camera to sensitive plate. For further instructions see Abney's "Text-Book of Science" (Macmillan).

Lunar Photography. It is not necessary to have telescopes of large size for this work, 2 or $3\frac{1}{2}$ ins. being quite large enough. It is necessary to remove the eye-piece, and attach a very light camera in its place, the operation of focussing and exposing being the same as usual manner, using very rapid plates, and giving exposures of about $\frac{1}{2}$ or 1 sec.; longer than this will cause blurring of the image, due to the combined movements of the earth and moon.

Stellar Photography. This is entirely beyond the reach of amateurs, the necessary instruments being extremely costly. At a Convention of astronomers lately held in Paris it was decided to make photographic charts of the whole heavens—a gigantic scheme which will require about ten years to complete, entailing the manufacture of special instruments, and the most careful and painstaking work on the part of the operators. With exposures of some hours, stars and nebulæ impress their image upon the plate, which the human eye, though aided by the most powerful telescopes, is utterly unable to trace.

Autotype Process. See CARBON PROCESS.

Background. Anything used, as the name implies, as subordinate to or behind the principal figure or figures or objects in a photograph. There are many kinds—natural, artificial, interiors, exteriors, or plain. Natural backgrounds when properly used are the most pleasing, and as these cannot be made to order, the intelligent amateur will choose his own. The artificial background is too well known from the work of the professional to need much description. A pleasing plain background can be made with a

workhouse or dark brown blanket, or with one of the ordinary kind. An ordinary white sheet, or even brown paper of the kind used for placing under carpets, may be pressed into service in place of better material. The following directions for making a movable background may be of service to some:—Make a frame of inch deal 6 ft. high and 4 ft. 6 ins. wide. It can be made to take to pieces by using iron pins at the corners. At the top have two projecting iron rods, about 4 ft. long, at an angle of 135 degs. This to be made extendable at will. Side-shades should be made in the same manner. Unbleached calico can be used, which should be freely painted over with the following distemper:—

Common whiting	1 lb.
Glue powder	¼ „
Treacle	½ pint
Water	½ gall.

Mix the above thoroughly, and add

Ivory black	1 oz.
Ultramarine	½ „
Red ochre	¼ „

ground down into a very fine cream with water. It can be darkened or lightened according to amount of colour added; the colour is lighter when dry.

Backing Plates consists of coating the backs of plates with some black or dark-coloured substance to prevent Halation (*q.v.*) when photographing interiors and other subjects having very great contrasts of light and shade. The essentials of a perfect backing are that it should reflect no rays of light—or, at least, only those that are non-actinic—and that it should be in absolute optical contact with the back of plate. Several methods have been recommended, coating the back of the plate with collodion stained with aurin or any non-actinic dye being a method which is easier advised than done in the dim light of the dark-room. The following, if spread upon brown paper and damped before applying to the plate, answers well:—

Powdered burnt sienna	1 oz.
Gum	1 „
Glycerine	¼ „
Water	10 ozs.

Or—

Gelatine	50 grs.
Glycerine	¼ oz.
Water	1 „
Indian ink or ivory black	30 grs.

The best backing, however, that the author has used is made by smearing a drop or two of glycerine over a special black enamel paper (sometimes called bronzed purple), which can be had from most stationers, and squeegeeing on to the back of plate. Whatever backing is used, it must be removed before developing.

Balance. A term used in composition to denote the proper relation of lines and lights and shadows, so as to secure harmonious and symmetrical pictures. The subject is much too comprehensive to treat of here, H. P. Robinson's "Pictorial Effect in Photography" being the best guide on the subject.

Bath. Any vessel used to contain a liquid whilst operating, but it is now used to include the solution used in a bath.

Beach's Developer. Named after its inventor, Mr. F. C. Beach, of New York. It is unnecessarily complicated in formula, but has been widely used. It is made as follows:—

Pyro Solution.

Hot distilled water	2 ozs.
Sulphite of soda	2 „

When cold add

Sulphurous acid	2 ozs.
Pyrogallol	½ oz.

Potash Solution.

Carbonate of potash	3 ozs.
Sulphite of soda	2 „
Water	7 „

Dissolve the salts separately and mix. For a plate having the normal exposure, mix the pyro and potash solutions in equal proportions, using 1 dram of each to every 1 oz. of water; for under-exposure, use more of the potash solution, and *vice versâ*.

Beechey's Emulsion Process. See COLLODION.

Bellows. Too well known to need much description. There are two shapes, the square and conical or Kinnear pattern; the latter is the lighter, but the former the more generally useful. The best material for making bellows is leather, and the length of pull or measurement when stretched out to their fullest extent should be at least three times the longest side of the plate for which the camera is intended. This enables long-focus lenses to be used, and the camera will be found more useful for enlarging, copying, etc. The inside of the bellows must be blackened, and no ray of light should be able to penetrate through the body. When in constant use the interior should be carefully dusted out at short intervals, to prevent the accumulation of dust in any quantity, as the action of pulling or racking out would disturb the dust, tending to produce pinholes by settling on the sensitive film, making the lens slow by stopping the transmission of light, and causing fog by the particles reflecting light.

Biconvex. See LENS.

Binocular Camera. Another name for Stereoscopic Camera (*q.v.*).

Binocular Vision. Solid objects, when viewed by both eyes, project different perspective figures upon each eye, and by this means we are enabled to judge of the distance of an object, and also to perceive its solidity. This principle is taken advantage of in the Stereoscope (*q.v.*).

Black Varnish. See VARNISH.

Blacking. The interior of all cameras, dark slides, and lens tubes should be coated with a dead black to prevent the reflection of light and consequent fog on the plate. A good black can be made by grinding lamp or ivory black into a paste with japanners' gold size. Another method is by coating the wood, etc., with a solution of sulphate of iron, and, when dry, applying a solution of tannin or decoction of logwood, two or three successive applications being sometimes necessary. For blackening lens mounts, two or three different methods are employed. Where the mount will not be touched by the fingers, drop-black ground up with weak glue and water may serve, but a better method and more lasting one can be made by mixing fine lampblack with lacquer, and applying it in two or three successive coats to the heated mount; but where the mount will be fingered, it is

obvious that some other method must be employed. We have the choice of two, one of which results in a bronze colour, the other is an absolute dead black. For the former colour, solution of perchloride of platinum acidulated with nitric acid is used. This method is especially useful where any soldered joints exist; where solder is not used, an absolute dead black can be obtained by dipping the article, heated fairly hot, into a solution of nitrate of copper, made by dissolving copper wire in dilute nitric acid; it is then heated over a Bunsen burner or spirit lamp, the green colour of the copper first showing, and at the proper temperature a fine dead black appears.

Blanchard's Brush consists of a piece of swan's-down calico, doubled and fastened by means of an india-rubber band round a strip of glass 2 ins. wide and 6 ins. long. It was used for coating plates, etc., with substratum for the collodion process.

Blisters. One of the worst troubles of an amateur, whether on plates or paper. On the former, it is usually the precursor of a general Frilling (*q.v.*). Blisters invariably make their appearance on prints, either in the fixing bath or the first washing after. It is more generally a fault with papers that are heavily charged with albumen and salt, and in this case it is most likely due to exosmose action between the water and the fixing solution, the albumen acting as a septum. The remedy is to plunge the prints immediately after fixing into a saturated solution of salt, and use all solutions at the same temperature. Blisters are frequently caused also by an accumulation of gas behind the film of albumen, and in this case it would seem to be the action of hypo upon a partially decomposed albumen. A cure for this is to dip the print on the first sign of blistering into a bath of methylated spirit. In the case of some kinds of gelatino-bromide papers, which seem particularly liable to blisters, a bath of chrome alum 2 grs., water 1 oz., methylated spirit 1 oz., will be found efficacious. When a sample of paper, despite all efforts to the contrary, still persists in blistering, it should be discarded for some other brand.

Blue-Printing Process. See CYANOTYPE.

Blue Tones in Prints. A sure sign of over-toning, due to too great a deposit of gold (see TONING), or to sulphuration, due to an acid toning bath.

Blurring. Any image possessing an indistinct or double outline is said to be blurred, and may be caused either by movement of the object or the camera. When photographing in a high wind, a loop of stout twine, tied to the bottom of the tripod, and hanging down to within 6 ins. of the ground, in which the foot can be placed, will be found to steady it. (See also HALATION.)

Books on Photography. Whilst a complete catalogue of all the books on this subject would be impossible, the following may be considered as standard text-books of the science and art:—

Abney's "Instruction in Photography," 7th edition, 1887. (Piper and Carter, 3s. 6d.)

Abney's "Photography with Emulsions," 3rd edition, 1887. (Piper and Carter, 3s. 6d.)

Abney's "Treatise on Photography," 5th edition, 1888. (Longmans and Green, 3s. 6d.)

Burton's "Modern Photography," 6th edition, 1886. (Piper and Carter, 1s.)

Burton's "Photo-Printing and Photo-Mechanical Process," 1888. (Marion and Co., 4s.)

H. P. Robinson's "Pictorial Effect in Photography" and "Picture-Making." (Piper and Carter, 2s. 6d. each.)

Spiller's "Elementary Treatise on Photographic Chemistry." (Piper and Carter, 1s.)

Hardwich's "Photographic Chemistry," 9th edition, edited by Traill Taylor. (J. and A. Churchill, 6s.)

Sawyer's "A B C Guide to Autotype Process." (Autotype Company, 2s. 6d.)

Monckhoven's "Photographic Optics." (Hardwicke, 6s.)

For serial literature:—

The *Amateur Photographer*, weekly, 2d.

The *British Journal of Photography*, weekly, 3d.

The *Camera*, monthly, 6d.

The *Photographic News*, weekly, 3d.

The "Photographic News Almanac," annual, 1s.

The "British Journal of Photography Almanac," annual, 1s.

Brilliancy. A term applied to negatives to denote that the lights and shadows are harmonious, each having their due pro-

portion of deposit, and there being no fog; the resulting prints are in an equal way perfect in their power of rendering light and shade, distance and effect. This can only be obtained by careful attention to exposure and all the subsequent manipulations.

Broken Negatives. When such an unfortunate accident as the breakage of a negative occurs, and the film is uninjured, it may be removed as described under Stripping Film (*q.v.*); but should the film be broken, lay the negative, film downward, upon a perfectly level surface, carefully place the fractured pieces together, and apply strips of gummed paper along the edges of the negative. When thoroughly dry, turn the negative over, and apply some strips of paper along the edge on the film side; allow it to thoroughly dry, and varnish the film. To print from broken negatives, suspend the frames from an ordinary roasting-jack, or place the frame at the bottom of a box without a lid about 18 ins. deep.

Bromides. See RESTRAINER.

Bromide Paper. Paper coated with an emulsion of bromide of silver in gelatine—a formula for making which will be found under the head of Emulsion. There are several kinds in the market, which are offered in three grades: smooth surface and thin paper, smooth and thick paper, rough surface and thick paper. The latter is most suitable for enlarging for portraits, giving the appearance of a crayon drawing; the thin is useful for mounting and small prints; whilst the thick is useful for book illustrations, a blank or safe edge being used. The method of development is the same for all kinds. A long exposure and weak developer, strong in bromides, tend to greenish-black tones, whereas a short exposure and strong developer produce absolutely black tones. Good plucky negatives, full of vigour and brilliancy, are more suitable than weak ones. The following may be considered as the standard of development:—

I.

Neutral oxalate of potash	2,880 grs.
Distilled water	25 ozs.

II.

Ferrous sulphate	1,080 grs.
Sulphuric acid	3 drops
Distilled water	7½ ozs.

III.

Bromide of ammonium	480 grs.
Distilled water	30 ozs.

Add 1 oz. of No. II. to 6 ozs. of No. I. and 1 drm. of No. III. After exposure soak the paper in water till limp, then drain off the water, apply the developer, and continue the development until the shadows are black enough, then immerse without washing in the following clearing solution:—

Acetic acid	1 drm.
Alum	8 ozs.
Distilled water	32 ,,

Allow it to remain in this for two or three minutes, then immerse in a fresh quantity, and after soaking for another short time, use a fresh quantity of clearing solution, wash well, and immerse in the fixing solution:—

Hyposulphite of soda	1 oz.
Water	6 ozs.

Fix for at least five minutes, wash thoroughly for some hours. Should any discoloration appear, immerse in the following for a few minutes:—

Sulphuric acid	1 oz.
Chrome alum	2 ozs.
Water	20 ,,

and again wash for half an hour. The print must not be washed after developing and before being cleared. Absolute cleanliness and freedom from pyro, hypo, or silver is a *sine quâ non*. The prints should not be touched by the fingers. Yellowness of the whites is due to insufficient acid in the clearing bath, or insufficient washing between the clearing bath and fixing solution. If exposure and development are correct, the print will be rich,

vigorous, and full of half-tone. If over-exposed, a flat grey image of sunken-in appearance, or else a completely black print, will be the result. If under-exposed, the high-lights will be chalky and without detail, and the shadows inky. Over-printed bromide proofs, however, can be reduced by immersion in chlorine water, or a solution of cupric chloride. Platinum may be substituted for the silver image by the following process:—The resulting prints are sepia-coloured, and are composed of a mixture of platinum and silver; the latter may be entirely removed by cupric chloride. The prints must be very much over-printed. Soak the prints in the following bath until the desired tone is obtained :—

Platinum perchloride	15 grs.
Distilled water	70 ozs.
Hydrochloric acid	1 oz.

To prove the substitution of platinum for silver, soak the prints in cupric chloride solution; a sepia-coloured image of platinum is left, and the silver may be redeposited by redeveloping with ferrous oxalate, the print after redevelopment having a fine bluish-black colour.

Bronzing. A peculiar metallic lustre seen on looking at the shadows of some prints at a certain angle. It only makes its appearance on paper sensitised on a very strong bath, and with negatives showing very bold contrast. It usually disappears in the fixing bath.

Buckle Brush. A convenient little instrument, made by drawing a piece of silver wire bent in half through a piece of small glass tubing, a tuft of cotton-wool being caught in the arch of the wire, the great advantage of this little dodge being that, when dirty, the cotton-wool can easily be replaced.

Burnishing is the operation of *drawing* prints over the surface of a heated roller, the print being brushed over with a lubricator made by dissolving five grains of Castile soap in an ounce of methylated spirit. This should be rubbed over the face of the print with a piece of flannel, and allowed to dry before burnishing. The hot bar of burnisher should be just hot enough to be comfortably held in the hand. No stoppage must occur in the movement of the print whilst on the burnisher, or a line

will be caused across the finished print. Should the bar of the burnisher become scratched at any time, it should be repolished with the finest emery ground into a paste with oil.

Cabinet. A special size of the commercial photograph, which measures about 6 by 4 ins.

Calcium, Chloride of. $CaCl_2 = 111$. Made by dissolving chalk in hydrochloric acid, and evaporating the solution. The salt is met with in two forms, as a crystalline substance and also in the form of white agglutinated masses.

Calorific Rays of the Spectrum. Those rays of the spectrum which produce or emit heat. They are found at the red end of the spectrum, the most powerful being situated beyond the visual rays. Professor Tyndall proves this in the following manner:—The rays of the spectrum are conducted through a solution of iodine, which absorbs all visual rays, but allows the heat rays to pass; these can be brought to a focus by certain means, and in this focus magnesium ribbon will catch fire, and platinum be brought to a white heat. Taking 100 as the maximum intensity of the heat rays, the following table will give the values of the colours of the spectrum as heat-producers:—

Violet	0
Green	2
Yellow	14
Red	21
End of visual spectrum	45
Ultra red, or invisible rays	100

Bodies which have the power of transmitting heat rays are said to be *diathermanous*, those which do not possess this power *athermanous*. Glass being comparatively poor in diathermanous power, photographic lenses, unless pointed at the sun, allow but few heat rays to pass to the sensitive film.

Calotype, or Talbotype. A process named after its inventor, Fox Talbot, ut little used now, but interesting from its being the first paper negative process used. The following is a short *résumé* of the process:—Stout paper, of an even surface and as grainless as possible, is brushed over with a solution of iodide of silver in iodide of potassium. It is, when partially dry, washed

twice or three times in distilled water to remove the iodide of potassium, and dried, and it can be kept for some little time in this state, as it is but faintly sensitive to light. When required for exposure it is brushed over with a solution of gallo-nitrate of silver or aceto-gallo-nitrate, and exposed wet; the exposure required for an open view is about six minutes. In all cases a faint image of sky-line should be apparent. The image is developed with a solution of gallo-nitrate of silver in excess of gallic acid. The negative is then well washed, fixed in hypo, and washed and dried in the usual way, then waxed or oiled to render it translucent.

Cameo. Photographs to which, by means of dies and press, a slight convexity is given of differing shapes.

Camera. Too well known to need much description, but the following may be considered as some of the essentials of a perfect instrument:—It should be light in weight, yet of substantial workmanship; easily and quickly set up, and containing no loose parts; it should possess a reversing back, and also a Swing Back (*q.v.*), some such arrangement as a movable front by means of which two or more lenses can be used without unscrewing their flanges; it should be absolutely light-tight, and should have a rising and falling front.

Camera Lucida. An old-fashioned apparatus for projecting the images of objects upon the walls, or a screen, whether in daylight or at night; so named in opposition to the Camera Obscura (*q.v.*).

Camera Obscura is actually a dark chamber into which the image of external objects may be projected by means of a convex lens, and a mirror placed behind it at an angle of 45 degs. Portable camera obscuras were made, by means of which the images of external objects were projected upon a sheet of white paper, and the outlines traced by means of a pencil. From this was conceived the idea of the present camera, with certain modifications to allow the action of light to portray more faithfully and easily what the hand had done.

Camera Stand. See TRIPOD.

Canvas, Printing on. See PRINTING.

Cap. The cover used at the time of exposure to open and

close the lens. It is also a protection against accidental injury. The author has a cap made for both ends of the lens for greater protection of the glasses. To prevent accidental losing or mislaying of the cap, it should be attached to the lens mount by a piece of string.

Carbon or Autotype Process. One of the most permanent of all photographic printing processes. Is based upon the fact that a mixture of gelatine with any alkaline bichromate is rendered insoluble in water by the action of light. By incorporating certain colouring matters consisting of carbon with various other pigments, an image in these colours can be obtained by exposure under a negative. The chemical action which takes place is as follows:—The chromic acid of the bichromate is reduced to a lower chromic oxide by the action of organic matter, gelatine, and light, and this combines with the gelatine to form a kind of leather. The process of preparing the tissue is tiresome and dirty on a small scale; the prepared and sensitised paper can be bought at about the same rate as ordinary sensitised paper. When sensitised, the paper will keep only fourteen days, but as the process of sensitising is comparatively easy, it is better to buy the unsensitised tissue, and sensitise in small quantities as wanted. The colours are warm black, engraving black, standard brown, standard purple, portrait brown, portrait purple, sepia, red chalk, and special transparency tissue for lantern slides. The paper, or tissue, as it is called, is sensitised in the following bath:—

Bichromate of potash	1 oz.
Liq. ammon fort. ·880	5 drops.
Distilled water	20 ozs.

The tissue is *immersed* in this for two minutes in hot weather and three minutes in cold. It must be dried, and kept protected from light, air, and damp. From the colour of the tissue it is evident but little, if any, image can be seen; therefore the duration of exposure is judged by means of an actinometer of ordinary chloride albumenised paper, and according to the density of the negative the tissue is exposed whilst the actinometer registers one, two, or three tints. The action of light continues in the dark. Allowance must, therefore, be made for this fact if the

tissue is not to be developed at once. As the exposure to light renders the gelatine insoluble (and as the action of development is to remove the unacted-upon gelatine), it is obvious that it will be useless to try and develop the picture upon the face, as the gelatine is insoluble there. It must, therefore, be transferred to some support, so as to enable the gelatine to be dissolved away from the back, for which purpose the paper must be removed, and as this transfer would reverse the print—*i.e.*, make the right hand of the picture the left—when a negative taken in the ordinary way is used, a temporary support is used, from which the developed print is again transferred to its correct position. This temporary support may be either a mulled zinc plate, glass, or a specially prepared paper, according to the surface desired. From the temporary support again the print may be transferred to any substance—viz., paper, opal glass, porcelain, metals, ivory, terra-cotta, stone, wood, etc. The special transfer paper or temporary support is a tough, smooth paper coated with shellac and rolled, and then when required for use it is waxed to prevent the gelatine film from adhering permanently to it, the following solution being used for that purpose:—

Yellow resin...	36 grs.
Yellow wax	12 „
Turpentine	2 ozs.

Melt the wax, add the resin and turpentine. The writer has found the substitution of ether for turpentine a decided advantage, as the temporary support can be used immediately, as when turpentine is used at least six hours must elapse after the waxing solution has been applied to the paper, which is done with a tuft of cotton-wool, or flannel, and a fresh tuft of wool being used to polish. The printed tissue and the waxed temporary support, of whatever nature it may be, are immersed in cold water, till the tissue begins to uncurl and float flat; it is brought into contact, film side downwards, with the temporary support, and both raised together from the water, and then the squeegee is used to bring them into optical contact. They are then placed between blotting boards for five or ten minutes, and then immersed in a bath of water at a temperature of 105 degs. or 110 degs. F., and when the pigmented gelatine begins to ooze out at the edges of the paper, strip off the paper upon which the gelatine was spread,

and keep washing the print with the hot water by throwing the hot water on to it with the hand, or by means of a cup or soft broad brush, or a small sponge. As this is done it will be found that the gelatine, unacted upon by light, will be dissolved away with the colouring pigment, leaving the print in all its beauty. As soon as development is complete it is plunged into a bath of cold water to set the gelatine, and then it is placed in a bath of the following :—

Powdered alum	1 oz.
Water	20 ozs.

This not only fixes the print by hardening the gelatine, but it also discharges the yellow colour of the bichromate salt. It is allowed to remain in this bath for about ten minutes or till the colour is entirely discharged from the whites of the picture, and finally rinsed twice or three times in clear water. The print is now ready for transferring to its final support, of whatever nature that may be; but before this transfer can take place it is necessary that the final support should be prepared to receive it, for which purpose it is coated with the following :—

Nelson's gelatine	1 oz.
Water	20 ozs.

Soak the gelatine in the water for an hour or till soft, and then dissolve by the aid of a gentle heat. When dissolved, add to it gradually 12 grs. of chrome alum dissolved in 1 oz. of water. The commercial final support, which is a stout paper, is already prepared, and merely requires soaking in alum solution, $\frac{1}{2}$ oz. to the pint, an hour before using. The print on its temporary support and the final support, whether freshly prepared or not, are brought into close contact under the surface of water, and optical contact obtained by means of a squeegee, and are then placed in blotting boards, or hung up till perfectly dry, when the temporary support can be stripped off, leaving the print in its proper position. It is advisable for any amateur who may wish to work in carbon to obtain Sawyer's "A B C Guide to Autotype Printing," in which everything will be found most explicitly explained. The disadvantage of this process is the necessity for the use of reversed or film negatives or the employment of a temporary support. The advantages are the absolute per-

manency of the pictures, the easy manipulations of the process, and the fact that prints of almost any colour may be transferred to any material, and the resulting pictures can be retouched, spotted, or otherwise worked up with the brush in the same colour. The process is very easy and simple, and the materials so cheap, that every amateur should number this amongst his photographic processes.

Carte de Visite. Usually the smallest size of the professional photograph, measuring about 4 by 2½ ins.

Ceramic Photographs. See ENAMELS.

Changing Box. A contrivance by means of which exposed plates may be changed in the field for unexposed ones without the use of a dark-room. There are also changing bags, which are, as the name implies, for the same purpose. These are usually made of some non-actinic medium or fabric, with yellow or ruby glass let in to enable the operator to see inside the bag.

Chiaroscuro. An artistic term to designate the distribution of the lighter or darker shades in a picture. In photography the terms light and shade are more general.

Chloride of Lime. See LIME.

Circle of Least Confusion. An optical term to denote the nearest approach to an absolute focus of an oblique pencil of light after refraction.

Clearing Bath. Any solution used to clear or cleanse a negative or positive from the stains of development is thus termed. The following are those in most common use:—

Alum	2 ozs.
Citric acid	1 oz.
Water	20 ozs.

Or

Chrome alum	1 oz.
Citric acid	1 „
Water	20 ozs.

The latter is the author's favourite, the chrome alum having a special tanning action on the film much superior to ordinary alum. The addition of a little ferrous sulphate has been recommended, but without any increased benefit. When plates are developed

by pyrogallol and soda, a very non-actinic yellow colour is given to the film, which protracts the operation of printing most inordinately. By use of the chrome alum bath this colour is changed to fine olive green, which does not protract printing. In the case of ferrous-oxalate development the same bath is useful for clearing off the deposit of oxalate of lime due to the use of hard water, whether on negatives, positives, opals, or paper.

Cliché. A term applied to the negative and moulds used in photo-mechanical printing.

Collodion. The vehicle used in wet-plate processes for holding the haloid salts necessary for the information of the sensitive salts of silver. It is prepared by dissolving Pyroxyline (*q.v.*) in a mixture of equal parts of alcohol and ether. It is a transparent glutinous liquid, which, when poured upon any surface, leaves, by the evaporation of the solvents, an attenuated film of pyroxyline absolutely transparent and structureless, well adapted for the purpose for which it is required. The usual strength is as follows :—

Pyroxyline	5 grs
Alcohol, ·820 sp. gr.	½ oz.
Ether, ·725 sp. gr.	½ „

Methylated alcohol and methylated ether may be and are chiefly used on account of their cheapness. The following collodion the author has found answer well both for negative and positive work :—

Ammonium iodide	40 grs.
Cadmium bromide	12½ „
Pyroxyline	50 „
Methylated alcohol, ·820	5 ozs.
„ ether, ·725	5 „

The pyroxyline should be dissolved in the ether and half the alcohol, and the haloid salts in the remaining half of the alcohol The former is labelled "Plain Collodion," the latter "The Sensitiser." One part of sensitiser is added to three parts of plain collodion. This collodion may be used after the sensitiser

has been mixed twenty-four hours. The following is especially useful for ferrotypes and positives:—

Ammonium iodide	30 grs.
Sodium „	10 „
Cadmium „	20 „
„ bromide	20 „
Pyroxyline	50 „
Methylated alcohol, ·820	5 ozs.
„ ether, ·725	5 „

The following is a useful and satisfactory collodion for Enamelling Prints (*q.v.*):—

Pyroxyline	6·5 grs.
Methylated alcohol	½ oz.
„ ether	½ „

For further information as to the wet-plate process, the amateur is referred to Jabez Hughes' "Treatise on Photography," Abney's "Instruction in Photography," or Hardwich's "Photographic Chemistry."

Collotype, Lichtdruck or Heliotype. A mechanical printing process founded upon the action of a bichromated gelatine film. The bichromated gelatine film is exposed under a negative, and then soaked in cold water, and it is found that the gelatine absorbs water proportionately as it has been shielded from light. The film is laid upon a glass plate, and the back of it exposed through the plate to the sun, which renders it tough and insoluble. We have thus an insoluble film of gelatine raised into relief upon a bed of tough gelatine. This film is then inked by means of rollers with two greasy inks of different degrees, one hard and the other soft; these inks only adhere to those portions of the gelatine acted upon by light, and which have not absorbed water. From this inked film prints can be taken in the usual way with a hand-press. The best manuals upon the subject are Burton's "Photo-Mechanical Printing" and Wilkinson's "Printing Processes."

Colour, Photography in Natural. Many processes have been from time to time brought out, and "Photography in Natural Colours" declared to have been accomplished; but up to the date of this work the realisation appears as far distant as ever.

Colour, Effect of, in Photography. See APPENDIX, ISOCHROMATIC PHOTOGRAPHY.

Colour of the Film. This exercises a great effect upon the subsequent operation of printing. The yellow-stained film is the most non-actinic and slowest, the olive-greenish-black being the quickest and giving the most brilliant prints.

Colouring Photographs. An operation that requires considerable artistic skill and ability. The subject is much too comprehensive to be treated fully here. Water-colours have a decided objection to adhere to the glossy surface of an albumenised print, but they may be made to do so by applying a weak solution of inspissated and purified ox-gall.

Combination Printing. See PRINTING.

Composition. An artistic term denoting the grouping of the materials of a picture so as to form a pleasing and harmonious whole. It can be well said of the majority of photographs taken by amateurs that there is but little composition in them; most are but a faithful portrayal of subjects as they are found naturally. But whilst the photographer does not possess that power of composition which is the backbone of the artist's work, he can at least modify to some extent the scenes, etc., ready found to his hand. The amateur who desires rather to produce pictures than faithful photographs is recommended to obtain Robinson's "Pictorial Effect in Photography" and "Picture Making by Photography," in which the subject is most ably treated at great length. These two books should form part of the library of every one practising photography.

Concave. A term applied to lenses when the surfaces are hollowed out like the inside curve of an arch.

Concave, Concavo-concave, Concavo-convex Lens. See LENS.

Condenser. Any lens or number of lenses used to condense or collect and bring to a focus the rays of light through any transparent or upon any solid object which it is required to copy or reproduce. The usual form is that of two plano-convex lenses mounted in a brass or metal cell with their plane surfaces outside, and convex surfaces nearly touching one another. A

better form, suggested by Mr. Traill Taylor, when two lenses are employed, is that of one plano-convex or slightly meniscus lens in conjunction with a biconvex lens; or a further improvement on this, due to the same authority, is to use a third lens of meniscus form placed much nearer the light, but not of such large diameter as those of the second form; by this means nearly double the amount of light is obtained. For further information and sketches of the best forms of condensers the worker is referred to the "British Journal Photographic Almanac," 1888, in which will be found an able summary of the whole subject of enlargements, condensers, etc., by Traill Taylor. It may be asked, Why will not one plano-convex lens answer? The answer to this is self-evident on a little thought. The amount of spherical aberration would be so great as to make a sharp focus absolutely impossible.

Conjugate Foci. See Focus.

Contact, Optical. Any two substances brought into mechanical union one with the other, so as to absolutely join, and made to present but two instead of four surfaces, are said to be in optical contact. A familiar example is the common mirror, where the amalgam and glass are in absolute optical contact.

Contrast. The placing of the light and shade and objects in a photograph that they may give due value the one to the other.

Convex. The opposite to concave, *i.e.*, formed on the exterior into a spherical or round form.

Copying. The operation of copying negatives is comparatively easy, and it can be done by contact printing or in the camera, the result being, of course, a positive. To copy prints, oil paintings, or engravings, special precautions, however, must be observed. The subject to be copied should be placed opposite a window, and the camera placed in front of it, and a black or non-actinic curtain should be hung in front of the camera, so as to exclude all but the top and side lights. Oil paintings should be lighted from the same side as in the picture, and slow or medium rapidity isochromatic plates should be used. A yellow screen is also of great assistance, and improves the result with ordinary plates. The exposures vary so much with the colour of the subject, the actinic power of the light, and the

rapidity of the plates used, that experiment alone can determine this. The process of development is precisely the same as ordinary work.

Curvature of the Field is a defect due to the shape of the lens, and is seen when focussing any object. The marginal image on the focussing screen will not be sharp when the centre is, this being due to the fact that the image given by the lens is not plane, but rather a portion of a hollow sphere. The field of a lens is flattened by the combination of different kinds of glass in the lens, and by the judicious use of the diaphragms. For testing a lens for curvature or flatness of field, see LENS.

Cutting Prints. This is trimming off the unnecessary part of the print till of the desired size. It should always be done prior to toning, to save the waste of gold in toning unnecessary matter. It should always be done whilst the print is dry. Plate-glass cut, with polished edges, to certain sizes can be obtained commercially, but any old negative glass or flat ruler will do. Numerous shaped knives are sold for this purpose; but the author has found a leather-cutter's knife, termed a clicker's knife, the most convenient, and the price is but a few pence. Too many amateurs consider that the finished print should be exactly the full size, when much more pleasing pictures can be produced by trimming off certain portions of the print.

Cyanotype. A process discovered by Sir John Herschel, which depends upon the reduction of red prussiate of potash by light to Prussian blue. It is extremely useful for taking rough proofs, and for copying engineers' or architects' plans. The process of manufacture is as follows:—Herschel's original process—

Ammonio-citrate of iron	2½ ozs.
Distilled water	10 „

Dissolve, and coat plain drawing paper with the solution by aid of a buckle brush or tuft of cotton-wool. When dry, expose under a negative, and develop on a solution of ferricyanide of potash. Wash in dilute hydrochloric acid, and then in water, and dry. The exposure required for this is very long, and various modifications have been suggested. Another method, giving blue lines on a white ground, is as follows:—

Potassium ferricyanide	600 grs.
Distilled water	5 ozs.
Ammonio-citrate of iron	600 grs.
Distilled water	5 ozs.

Dissolve the two salts separately, and mix the solutions, and keep in the dark. Coat the paper as above, and when dry it must be kept for four days before use. The paper is printed in the usual manner, and merely washed in water till the drippings are colourless. The fully exposed print should show all detail, and have a bronzed-greenish appearance where the light has acted, before washing. The exposure is usually double that for ordinary silver paper. The following are great improvements, as the duration of exposure is much shortened :—

Ferric chloride	480 grs.
Tartaric acid	480 „
Distilled water	20 ozs.

Coat the paper as above, and dry quickly. Expose to direct sunlight for about three or five minutes. No image is visible, therefore experiment alone can determine the time, and develop on following :—

Potassium ferricyanide	480 grs.
Distilled water	7½ ozs.

When sufficiently developed, wash well, and dry. By the following process positives may be obtained direct from positives :—

Gum arabic	720 grs.
Ferric chloride	480 „
Tartaric acid	240 „
Common salt	240 „
Distilled water	12½ ozs.

The paper is coated in the same manner as before, dried, and exposed as usual, and developed by floating on a one-in-ten solution of potassium ferricyanide ; then immerse in a clearing bath of hydrochloric acid, one in ten, wash, and dry. Several methods have been proposed for obtaining black lines instead of blue, but at present none are satisfactory—soaking in tannic or gallic acid solution, floating on nitrate of silver, chloride of gold, or perchloride of platinum.

Daguerreotype. The oldest process for obtaining any permanent picture; discovered by Daguerre. A sensitive surface of silver iodide and bromide was formed by exposing a silvered copper plate to the direct action of the metalloids. After exposure, which was inordinately prolonged, the development was effected by exposing the plate to the vapour of metallic mercury, which was deposited on the plate as an amalgam of silver and mercury. The unacted-upon iodide and bromide were then dissolved by cyanide of potassium or hyposulphite of soda, and the image toned by the sel d'or. (See GOLD HYPOSULPHITE.)

Dallastint. A secret process of photo-mechanical printing, famous for its rendering of half-tone.

Dammar. A tasteless, odourless, whitish resin obtained from the Amboyna pine, whose habitat is the Malay Archipelago. It is used in varnish-making, for which purpose it is usually dissolved in turpentine, or benzole.

Dark-Room. The room in which all operations requiring actual handling of the sensitive plate must be conducted. It is usually lighted by daylight filtered through some non-actinic glass or medium. It was the custom but a year or two back to utilise none but the deep ruby glass for this purpose, but now some equally non-actinic colours giving much more general illumination are used. A good, safe light can be obtained by using what is termed cathedral green glass, with one thickness of canary medium. The author invariably uses artificial light from a paraffin lamp, as by this light, which is constant, a much better idea of the progress of development can be obtained than by such a variable quantity as daylight. Whatever light is used, it should always be tested by placing a sensitive plate upon the developing table with some opaque substance, such as a piece of black cardboard, upon it, and left for three or four minutes, and then the plate carefully developed should show no image of the card. The general arrangements of the dark-room must be left entirely to the amateur, but the following may be considered to be some of the principal features:—A shelf or table on which to develop. This should be of a convenient height, to allow the operator to sit comfortably at his ease whilst developing. It should be covered with some non-absorbent material, such as sheet lead or zinc, and the edge of this should be turned up

about a quarter of an inch to prevent any solution which might be spilt from running over. There should also be a sink, with a tap and a good supply of water. Shelves should be placed at convenient heights for the storing of bottles, printing frames, boxes, etc. The room and developing table should be kept scrupulously clean, and after operations all solutions spilt and the trays, measures, etc., should be cleaned and put away.

Dark-Tent. A portable dark-room, but little used now, but of absolute necessity in the old days of the wet process.

Decomposition of Light. White light on passing through a prism is decomposed or separated into its constituent rays. All lenses being formed on the principle of a prism, it is evident that light passing through a lens would be decomposed and give rise to chromatic aberration, but this is obviated by combining a lens of different shape and glass, so as to recombine the scattered rays. (See SPECTRUM and LENS.)

Definition is the accurate concentration by the lens of the light from a point in an object to the corresponding point in its image without spreading to adjacent parts. Perfection of definition depends chiefly on the rapidity of the lens, on the composition of the glass employed, the relative positions and forms of the surfaces and their proper grinding, the centering of the elements of a combination, and, in a doublet, the centering and due separation of the combinations.

Deflection. An optical term used to denote the swerving from its straight course of a ray of light when passing very near an opaque object, the ray being deflected towards that body.

Density—literally opacity—and in this sense correct density is an attribute of a good negative. It should be just sufficient to give due relation to the shadows, and yet allow the detail in the high-lights to print. Almost all plates differ in the value of the deposit of metallic silver, of which density or opacity is formed, and the correctness of the judgment necessary in this particular is one of the best tests of a good worker—it can only be obtained by experiment with every brand of plate used. With some the development must be pushed till the high-lights just show on the back of the film, and the whole surface of the plate is becoming blackened; whilst with others, especially those containing iodide or those having a film rich in silver, the test

of the blackening of the surface of the plate will usually be sufficient. The colour of the deposit of silver affects the result in a great measure. If, when the negative has been fixed, the amateur finds that his judgment has not been correct, he has, fortunately, methods of increasing or decreasing the density, as described in the operations of Intensification and Reduction (*q.v.*).

Depth of Focus. See Focus.

Detail. The definition of each minute part or parts of the material of a picture, whether in the negative or print therefrom.

Developer. The agent which renders the latent image visible on the sensitive surface. There are two principal kinds : alkaline pyrogallic and ferrous oxalate. In the former the image is rendered visible by the reducing power of pyrogallol assisted by an alkali ; in the latter the reducing property of ferrous oxalate is utilised. Many other kinds have been recommended—viz., hydroquinone, hydroxylamine, acetate, citrate, tartrate, phosphate, succinate and lactate of iron ; and of these hydroquinone and citrate of iron are the only two of any importance. It would be impossible to give all the formulæ for alkaline pyro developers recommended, and one or two will be given as samples. It is usual to keep the pyro in solution ; but it can, of course, be kept in the dry state, and weighed out as required. The essentials of a good developer may be considered to be as follows :—That the solutions shall be of a convenient and definite strength with regard to the principal ingredients ; that the solutions of pyro, restrainer, and accelerator shall be separate, so that greater control over the process of development can be obtained ; that if the pyrogallol is kept in solution, the preservative of the same shall be of such a nature as to have none or little effect upon the process of development, and that its preservative effect shall not be lost by the action of time, light, or the atmosphere ; that the alkali used shall be of stable definite composition, irrespective of temperature or the action of time or atmosphere. (For the action of the different restrainers, see Restrainer).

No. I.

Pyrogallol	480 grs.
Sulphite of soda	1,920 ,,
Sulphuric acid (pure)	60 mins.
Distilled water, to make 10 fluid ozs.	

The disadvantage of this developer is that the preservative is not a stable salt, and that some free acid is present, which neutralises some of the alkali used. The action of light and air upon this is decidedly injurious; it cannot, therefore, be considered either a desirable or perfect developer.

No. II.

Pyrogallol	480 grs.
Metabisulphite of potash	480 „
Distilled water, to make 10 fluid ozs.	

This is a great improvement upon No. 1, but it is far from perfect, this preservative being an acid salt, yet its preserving properties are much superior to that in No. 1.

No. III.

Pyrogallol	480 grs.
Dilute formic acid (Sp. Gr., 1·060) ...	240 mins.
Sulphurous acid	60 „
Distilled water, to make 10 fluid ozs.	

This is by far the best of the three, as the formic acid is in itself a developer, and therefore has no negative action upon the alkali, and its preservative powers seem almost unlimited. The formulæ for Restrainers are very simple.

No. I.

Ammonium bromide	48 grs.
Distilled water, to make 1 fluid oz.	

No. II.

Potassium bromide	48 grs.
Distilled water, to make 1 fluid oz.	

For the accelerator the volatile and unstable alkali ammonia may be used, or preferably the fixed alkalies potash or soda, or a combination of the two, the latter combination being decidedly the best, as giving more density and detail with less chance of fog.

Ammonia Accelerator.

Liquor ammoniæ ·880	1 fluid oz.
Distilled water	9 fluid ozs.

The disadvantage of this is, first, the fumes; and, secondly, its unstable character, as the extraction of the stopper of a bottle of solution of ammonia weakens it, and also admits carbonic acid, which unites to form carbonate of ammonia, a less energetic accelerator.

Potash Accelerator.

Potash carbonate (K_2CO_3) ... ... 480 grs.
Distilled water, to make 10 fluid ozs.

Soda Accelerator.

Sodium carbonate (Na_2CO_3) ... ... 480 grs.
Distilled water, to make 10 fluid ozs.

Both these are an improvement upon the ammonia; but the soda accelerator, when used with plain pyrogallol, is conducive to a very non-actinic yellow stain.

Potash and Soda Accelerator.

Potash carbonate ... ... 480 grs.
Potash ferrocyanide ... ... 480 „
Sodium carbonate ... ... 480 „
Distilled water, to make 10 fluid ozs.

This accelerator, which is a modification of the American standard developer of the Amateur Society of New York, is the author's favourite. It is always reliable, stable, handy, and certain in action; no fumes and no stains. The action of the ferrocyanide of potash will be described under the heading of that salt. The quantities of each which are required for development will be better explained under that article (*q.v.*).

Ferrous Oxalate. This is usually compounded in two solutions; but the author has used successfully for some time a one-solution developer.

Two-Solution Formula.

No 1.

Neutral oxalate of potash ... ... 480 grs.
Distilled water, to make 4 fluid ozs.

No. 2.

Ferrous sulphate ... ... 108 grs.
Sulphuric acid ... ... 1 drop.
Distilled water, to make 6 fluid drms.

The restrainer is the same as for pyro developers. To make the developer, add 1 part of No. 2 to 7 parts of No. 1, and add a few drops of restrainer. In no case must the order be reversed, as ferrous oxalate will be precipitated. This developer often turns muddy in using, and it is due to the fact that ferrous oxalate is soluble in excess of solution of oxalate of potash, not in water. Care should be taken, therefore, to keep the potash in excess. But if the strength given above be adhered to, no deposit will occur, though half a dozen plates or prints be developed with it.

One-Solution Formula.

Neutral oxalate of potash	2,600 grs.
Ferrous sulphate	975 „
Citric acid	100 „
Boiling distilled water	20 ozs.

About 2 drms. of this diluted with 6 drms. of distilled water, or preferably with the same quantity of the following solution, will be about equal in strength to that made by first form.

Solution for Diluting Concentrated Developer.

Neutral oxalate of potash	120 grs.
Distilled water	4 fluid grs.

Hydroquinone Developer. Hydroquinone (*q.v.*) is gradually creeping into favour, and certainly the results seem to bear out all that can be said in its favour. It is a slow developer, an enormous amount of detail is obtained where pyro and ferrous oxalate are powerless. There does not seem to be quite so much latitude of exposure as with pyro. The other developing agents are but little used; it is, therefore, only considered necessary to give their names now. One or two may be mentioned under the headings Bromide Papers, Transparencies, Opals (*q.v.*).

Development. As the developer is the agent which renders the latent image visible, so the operation of using the developer is termed development. As has already been stated, it may consist of two principal kinds, and it is proposed to give rational directions for the use of alkaline pyro development, irrespective of the alkali used. It is, of course, absolutely necessary that the operations should be conducted in the dark-room, or the latent

image would be obliterated in a general reduction of the silver salt. First measure out sufficient solution of pyro, and dilute with water. About 2 grs. of pyro are sufficient for quarter-plate, 4 grs. for half-plate; and about 6 drms. of water for quarter-plate, and about 10 drms. for half-plate. Place the plate in the developing dish, and flow the diluted solution of pyro, to which some restrainer has been added, evenly over it; brush the plate with a soft flat camel's-hair brush, to remove any minute air bubbles or particles of dust. Now measure out into a clean measure the full quantity of alkali (about 2 drms. of a 10-per-cent. solution of ammonia, or the same quantity of the potash and soda solution, will be most likely sufficient), and pour one-fourth of the alkaline solution into the measure or developing cup used for the pyro solution; pour the solution from the developing dish into the alkaline solution, lift the plate at one end, and pour the mixed solution into the dish and lower the plate, or else pour the solution in one even wave over the plate. If it be poured upon the plate at one particular spot, the silver may be reduced at that spot first, causing a fogged patch. Now gently rock the developing dish, so as to cause the developer to flow backwards and forwards over the plate for about five minutes. If there is no sign of an image, pour another portion of the alkaline solution into the cup as before, and pour the developer into it, proceeding as before. Now rock the plate again for another five minutes, and if the image should not appear or show but faintly, proceed again as before, and it will then be found that the image will gradually gain in density or opacity. Now examine the plate by holding it up to the red light, and also examine the back (see DENSITY); and if the required density is not considered to be obtained, add another quantum of alkaline solution, and proceed as before, when it will be found that the plate will gradually acquire the necessary density, if correctly exposed, in a very short time. When this desired point is reached, rinse the plate thoroughly in water, so as to remove the developer. The author has found that a short soaking at this point in a bath of methylated spirit is extremely useful, as it removes the last traces of developer, and thus prevents stains. Now place in the Fixing Bath (*q.v.*) for ten minutes, rinse, and place in a fresh fixing bath for another ten minutes. This second fixing bath may be considered unneces-

sary; but the author is convinced from experience that with a second fixing bath there is more chance of the negative being properly fixed, and therefore is more permanent. The plate may be now put into the washing tank, or washed in any way which the operator generally uses. (See WASHING NEGATIVES.)

Ferrous Oxalate Development. There is less control in development by this method than with alkaline pyro, but the developer can be mixed with about half the amount of iron solution recommended in the article DEVELOPER; and should the development lag, the other portion of iron solution may be added to obtain the required density. The process of fixing and washing is precisely the same as for pyro development. In this case the development must be pushed much farther than with the alkaline development, as the density obtained is much more deceptive. The chemical theory of alkaline development may be considered to be as follows:—The latent image is sub-bromide of silver, which is split up into bromine and metallic silver, which is deposited to form the image; the bromine is at once absorbed, to form bromide of the alkali or some more complex compound, the pyrogallol being oxidised at the same time; but if the action were to cease at this point, the image would be very faint, but the metallic silver and the bromide of silver react, forming fresh sub-bromide of silver, which is again reduced to metallic silver; the action is therefore continuous.

$$2NH_4HO + C_6H_6O_3 + {}_2AgBr = C_6H_6O_3O + Ag2 + 2NH_4Br + H_2O$$

(Ammonia + pyrogallol + silver bromide = pyro oxidised + silver + ammonium bromide + water).

In ferrous oxalate development the action seems to be as follows:—Ferrous oxalate and silver sub-bromide react, forming ferric oxalate, ferrous bromide, and metallic silver—

$$3(FeC_2O_4) + 2(Ag_2Br) = Fe_23C_2O_4 + FeBr_2 + Ag_4$$

(Ferrous oxalate + silver sub-bromide = ferric oxalate + ferrous bromide + silver).

Ferric oxalate is a powerful retarder and destroyer of the latent image, and ferrous bromide is also a restrainer; therefore the addition of a small quantity of hyposulphite of soda as an

accelerator is useful, by reducing the ferric oxalate to ferrous oxalate, hyposulphite of iron and sodium oxalate being also formed; the ferrous bromide is also reduced to hyposulphite of iron, and the milder retarder, sodium bromide, is formed. In developing over-exposed plates, when such is known or expected to be the case, it will be found that the smaller quantity of alkali will suffice; but as this is added gradually no ill effects will ensue, as might be expected. For under-exposure an increased quantity of alkali may be required; but by this tentative method the slightest impact of actinic light will be taken advantage of. When under-exposure is actually known to exist, the restrainer may be reduced in quantity or omitted altogether. For instantaneous work it has been recommended to give the plate a preliminary soaking in alkali, and in some cases there is not the slightest doubt that it is of great advantage; but it does not answer in every case. The writer has endeavoured to show lately in the *Amateur Photographer* that many cases of so-called over-exposure are due to the use of excessive quantity of alkali, at first causing a partial reduction of the silver sub-bromide over the whole surface of the plate, causing fog before detail and density can be obtained; and further experiments by other amateurs have fully borne out this statement. The following short explanation of the action of the different ingredients of the mixed developer may not be out of place here. Pyrogallol gives density and strength of image. This is actually the developing agent; and were plain pyro used the development would proceed, but at a very slow rate. The alkali gives speed in development, and in excess flatness or too much half-tone, or want of density due to general fog. The restrainer gives control over the development, and clearness of picture, preventing the too forcible action of the developer allowing the detail to appear; but it must be remembered that were the restrainer applied to the plate alone for a sufficiently long period, the latent image would be destroyed. From the above it will be seen that the author recommends slow development; but in all cases the amateur must mix his developer with his brains, and in certain cases slow development is a positive evil. For instance, in developing a plate which has been exposed upon a person whose face is covered with freckles, slow development would unnecessarily heighten the effect of these by allowing every little detail

to appear, whereas a moderately quick development would enable density to be gained before the freckles become obtrusively apparent; and again, in the case of interiors or other subjects in which Halation (*q.v.*) may be expected, slow development would make the worst of this evil, whereas a quick developer would lessen it. It has been stated as an argument against slow development that blurring of the image would result, consequent upon the lateral spreading action of the developer; but this seems to be a fallacy, as proved by the following experiment:—Two plates were exposed upon a subject in which lateral development would be very evident, viz., black lines upon a white ground. One plate was given three times the normal exposure, and the other a correct exposure calculated from an actinometer. The plate given the abnormal exposure was then carefully developed, and the development prolonged for upwards of an hour; the one given the short exposure was then flashed up, and development completed in three minutes; and, after the usual operations of fixing and washing, the resulting negatives were examined and measured under a microscope by means of a micrometer; but only the slightest trace of such lateral action was found, certainly not sufficient to be of any consequence, the chief difference being found in the size and colour of the molecules of metallic silver. With the slow development the molecules were of infinitesimal proportions, whereas with quick development they were found to have the appearance of grains of sand. This then is another argument in favour of slow development, the finer deposit rendering half-tone much better than the coarser. The defects due to development are numerous, but they may be thus briefly described:—Curved irregular lines of different density are due to stoppage in the flow of a strong developer. An opaque spot is due, as stated above, to pouring the developer upon that spot —this must not, however, be confounded with Flare (*q.v.*). Flatness and want of contrast may be caused by over-development, or by the use of too strong a developer; harshness and want of detail due to premature arrest of development. In conclusion, it may be stated that in warm weather development proceeds with more activity than in cold; therefore an increase of restrainer or diminution of the alkali will be found necessary, and the contrary in cold weather, or the use of water raised to a temperature of about 70 degs. F.

Deviation. An optical term to denote the alteration of the course of a ray of light when it is refracted or reflected from the surface of or when passing through anything.

Dextrine ($C_{12}H_{10}O_{10}$) is made by heating starch until it loses its gelatinous property, or by heating it in the presence of a dilute acid, when it becomes soluble in hot and cold water. It is usually a pale buff powder, and is used as a substitute for gum. (See MOUNTANTS.)

Diactinic. A term applied to any medium through which the actinic rays of light can pass. Substances which allow only non-actinic rays to pass are termed *adiactinic.*

Dialyser. This is sometimes used in the washing of emulsions, and can be prepared as follows:—Take a tin with a tightly fitting lid, knock out the bottom and top, stretch over one end of the tin a piece of parchment paper, and fit the rim of the lid over it, so as to clasp it tightly down. It is used by floating it in a vessel of distilled water, and the materials to be dialysed are placed in the tin. All bodies which will crystallise will pass through the *septum* of parchment paper, leaving those which will not crystallise in the dialyser. In the case of emulsions the unnecessary salts, such as nitrate of potash, etc., pass through the *septum*, leaving the *colloid* gelatine holding the sensitive silver salt.

Diameter. Any straight line passing through the centre of a circle and touching the circumference at opposite points is thus termed. If the diameter of a circle is known, multiplying that by 7·22 will give the circumference, and *vice versâ;* and the diameter squared and multiplied by ·7854 will give the area of the circle, and the cube of the diameter multiplied by ·5236 will give the solid contents of a sphere.

Diaphragms are usually metal plates perforated with a central aperture, ranging in diameter in geometrical proportion to the focus of lens. They are used to prevent the transmission of any but those rays which are parallel to the axis of the lens—they increase the definition by their action on the marginal rays, and reduce spherical aberration and increase the focal depth (see FOCUS) by lengthening the pencils of light. For decrease in the diameter of the diaphragm increase in the time of exposure

is requisite, due to the decrease in illumination or quantity of light admitted. Diaphragms are very often termed *stops;* but this is not quite correct, as a stop is placed *in contact* with the lens, and a diaphragm some distance from it. For single lenses the diaphragm is usually placed from $\frac{1}{4}$ to $\frac{1}{7}$ of the focal length in front of the lens, in which position it limits the diameter of the pencils of light, and causes them to cross the axis at the aperture of the diaphragm, before refraction. (See DISTORTION.) The distance of the diaphragm is in many instances when placed in front of the lens the cause of Flare (*q.v.*). This can be obviated by altering the position, one-eighth of an inch either way being generally sufficient to obliterate it. In all symmetrical doublet lenses, the proper position of the diaphragm is equidistant between the two combinations; in unsymmetrical combinations, the position is proportionate to the foci of the combinations. For general use the following maxims should be remembered:—*A large diaphragm gives a bolder picture than a small one; focus with the largest aperture, then insert the smaller diaphragms till sharpness is obtained over the whole screen. The smaller the stop the longer the exposure, also the flatter the field of the lens, and the greater the depth of focus.* The diaphragms should always be numbered with what is termed their focal value—*i.e.*, by the number which expresses their diameter as the fraction of the equivalent focal length of lens. This is usually expressed as f/x. To find this number divide the focal length of the lens by the diameter of diaphragm—*e.g.*, Focal length of lens, $8\frac{1}{2}$ ins.; diameter of diaphragm, $\frac{3}{4}$ in.; $8\frac{1}{2} \div \frac{3}{4} = 11{\cdot}3$; number of diaphragm, $f/11{\cdot}3$. The Photographic Society of Great Britain number the diaphragms, however, in rather a different way, taking $f/4$ as the standard, which they call No. I. This system is termed the "Uniform Standard," or U. S. No., and the U. S. number for any diaphragm marked on the f/x system may be found by the following rule:—Divide the focal length of lens by diameter of diaphragm to f/x, square the result, divide by sixteen, and the result will be the U. S. No. Ex.: Find U. S. No. of diaphragm marked $f/11{\cdot}3$. $11{\cdot}3 \times 11{\cdot}3 = 127{\cdot}69$; $127{\cdot}69 \div 16 = 7{\cdot}98$, or practically 8, U. S. No. The following table, showing at a glance the U. S. No. for all diaphragms, may be of some assistance:—

F.	U. S. No.
1	$\frac{1}{16}$
$1\frac{1}{4}$	·097
1·414	$\frac{1}{8}$
1·5	·140
1·75	·191
2	$\frac{1}{4}$
2·25	·316
2·5	·390
2·828	$\frac{1}{2}$
2·75	·472
3	·562
3·25	·660
3·5	·765
3·75	·878
4	1·0
4·25	1·12
4·5	1·26
4·75	1·41
5	1·56
5·25	1·72
5·5	1·89
5·656	2
5·75	2·06
6	2·25
6·25	2·44
6·5	2·64
6·75	2·84
7	3·06
7·25	3·28
7·5	3·51
7·75	3·75
8	4
8·25	4·25
8·5	4·51
8·75	4·78
9	5·06
9·25	5·34
9·5	5·64
9·75	5·94

F.	U. S. No.
10	6·25
11	7·56
11·31	8
12	9
13	10·56
14	12·25
15	14·06
16	16
17	18·06
18	20·25
19	22·56
20	25
21	27·56
22	30·25
22·62	32
23	33·06
24	36
25	39·06
26	42·25
27	45·56
28	49
29	52·56
30	56·25
31	60·06
32	64
33	68·06
34	72·25
35	76·56
36	81·0
37	85·56
38	90·25
39	95·06
40	100
41	105·06
42	110·25
43	115·56
44	121·0
45	126·56
45·25	128

F.	U. S. No.	F.	U. S. No.
46	132·25	66	272·25
47	138·06	67	280·06
48	144	68	289
49	150·06	69	297·56
50	156·25	70	306·25
51	162·56	71	315·06
52	169	72	324
53	175·56	73	333·06
54	182·25	74	342·25
55	189·06	75	351·56
56	196	76	361
57	203·06	77	370·56
58	210·25	78	380·25
59	217·56	79	390·06
60	225	80	400
61	232·56	81	410·06
62	240·25	82	420·25
63	248·06	83	430·56
64	256	84	440
65	264·06		

Lately a new kind of diaphragm, termed the Iris diaphragm, has been introduced, which consists of thin flat tongues of metal fastened to a ring in the lens mount, by means of which the aperture of the diaphragm may be enlarged or diminished by turning the ring backwards or forwards, causing the tongues to contract or enlarge the opening, the use of which obviates all chance of losing or misplacing the diaphragms, but increases the chance of flare, as the friction of the metal tongues wears off the blackening, and causes the edges to become bright. The diaphragms of the ordinary or Waterhouse pattern can be pinned together by a brass rivet just by the tongue, on which the numbers are stamped, thus lessening the chance of losing them.

Diffraction or Inflection. An optical term used to denote the bending of the rays of light when such rays pass by the edges of an opaque body. The effect of diffraction on the waves of light is exactly the same as that peculiar property of running water of curving round behind an obstacle.

Diffused Light. Generally, in opposition to direct light. It

is the only light which should be used for Portraiture (*q. v.*). Diffused light in the camera is generally taken to mean any actinic light other than that passing direct on to the plate from the lens. It is a certain producer of fog.

Dish. One of the most necessary articles of an amateur's outfit. It is made of various materials; glass, earthenware, vulcanite, metal, and wood are the most usual. It is only necessary to say it should be kept scrupulously clean, being occasionally scrubbed with a stiff brush and some strong acid. One dish should be kept specially for each operation, and used for that only.

Dispersion. An optical term used to denote the separation of a ray of heterogeneous light by refraction into its component rays of different refrangibility. Different transparent media have different dispersive powers, or different powers of widening the angle between the red and violet rays, and it is owing to this difference in dispersive power of different kinds of glass that chromatic aberration is eliminated.

Dissolving Views. See MAGIC-LANTERN.

Distance. The objects in a landscape farthest from the eye, forming a background to the scene; and, in an artistic sense, the representation of objects rendering an idea of remoteness, obtained by the due observance of the rules of perspective, etc. (See AERIAL PERSPECTIVE.)

Distilled Water. $H_2O = 18$. Absolutely pure water obtained by vaporisation in a still or retort and subsequent condensation of the vapour. It should be used in all operations of photography, especially in the manufacture of emulsions and ferrous oxalate development.

Distortion. When the image formed by the lens upon the focussing screen does not coincide with the rules of perspective, it is said to be distorted. Distortion may be said to be of two kinds—one in which certain objects are exaggerated in dimensions, with respect to others, contrary to the rules of true perspective. An example of this is seen when using wide-angle lenses, near objects being greatly increased in size, to the disadvantage of distant objects. The other kind of distortion is seen in most single lenses, due to the refraction of the oblique

excentrical pencils of light by the margins of the lens. When the diaphragm is placed in front of the lens, the distortion near the margins of the picture takes the form of a barrel—*i.e.*, straight lines are curved outwards. When the diaphragm is placed behind the lens, the distortion is the opposite or pincushion shape—*i.e.*, the lines are curved inwards. It is obvious that by using two symmetrical lenses, and placing the diaphragm between, the distortion of the one is cured by the distortion of the other, and hence rectilinear or straight lines are the result. It is frequently considered that the distortion caused by single lenses is very apparent; but such is not the case unless the focus of the lens is very long. Practically, for ordinary single lenses for the smaller size pictures distortion may be disregarded. It would be only fair, however, to state that Mr. J. H. Dallmeyer has lately introduced non-distorting or rectilinear single lenses of long focus—a great advance in photographic optics. (See LENS.)

Divergent Rays in optics are those which continually recede farther and farther from one another, being the opposite to convergent. All concave lenses are divergent. (See LENS.)

Dodging Negatives. Under this heading it is proposed to give a few hints for the improvement of the printing from negatives. For a hard chalky negative with great contrasts, printing in the sun is a great improvement. For a weak or flat negative wanting in due contrast, printing in the shade, or even under tissue paper, or coating the back of the negative with yellow varnish, or using matt varnish on the film side, and touching up the high lights with a stump crayon or yellow dye, may be of service. If from some cause one end of the negative is thinner in density than the other, placing the printing frame in a deep lidless box with the denser end placed uppermost against the side will equalise the light. (For instructions for printing-in clouds, combination printing, etc., see PRINTING.)

Doublet Lens. See LENS.

Drachm. See WEIGHTS AND MEASURES.

Drop Shutter. See SHUTTER.

Drying Box. A light-tight box used for drying plates, etc., coated with a sensitive film. There are many different kinds, but the following will answer well:—Make a box of half-inch

deal, 2 ft. long by 1 ft. wide and 1 ft. deep, with a door opening at one side, with a deep fillet to prevent the ingress of light; at the bottom pierce about twelve holes, and have a second bottom made, but with openings at the side. In the centre of the top have a two-inch gas or zinc pipe fixed with an elbow joint, and in the bend of the joint insert a small gas burner, so as to cause a draught of air when lit. Anhydrous chloride of calcium may also be placed upon the bottom of the box. The interior may be fitted with stout wire, or glass shelves, about three inches apart.

Dry Plates. Glass of particular size coated with a film of gelatine in which a sensitive salt of silver is emulsified. These are to be bought, commercially, so perfect in preparation that but few amateurs will be tempted to coat their own, but the formulæ given under Emulsion will be found all that can be desired. Of the commercial brands, the amateur should eschew those cheap productions which are obviously coated with a minimum quantity of emulsion, but poor in silver—the gain in the resultant pictures on the thickly coated plates amply repaying an extra outlay of capital.

Dusting in Process. See POWDER PROCESS.

Eau de Javelle is used for eliminating the last traces of hypo from the film, and also for reducing over-dense negatives, its action being due to the free chlorine evolved. It can be made as follows:—

Chloride of lime	2 ozs.
Carbonate of potash	4 „
Water	40 „

Mix the lime with 30 ozs. of water, dissolve the potash in the remainder, boil and filter.

Ebonite. A modification of india-rubber made by heating it with sulphur under pressure. It is used for making dishes, instantaneous shutters, etc., and, though brittle and affected by heat, answers well, from its great lightness and hardness.

Edging. See FRILLING.

Elemi. A concrete resinous exudation from *Canarium commune*, a native of Malay. It is sometimes used in the preparation of Varnish (*q.v.*).

Eliminator, Hypo-. Any salt or solution of salt used to get rid of the last traces of hypo from the films or prints. Many so-called eliminators have been recommended, as peroxide of hydrogen, eau de javelle, alum, acetate of lead, hypochlorite of zinc; but opinions seem to be about equally divided as to the benefit of their action. But Hypochlorite of Zinc or Soda (*q.v.*) act quite satisfactorily, provided the film or print is fixed again in ammonia and salt, the chemical action being the conversion of the hyposulphite into sulphate of silver, free chlorine being evolved, and that attacks the sulphate, forming chloride of silver.

Emulsion. Photographically, a mechanical mixture of any sensitive salt of silver in extremely minute division, held in suspension in any viscous vehicle, such as gelatine or collodion, which, when spread upon any transparent medium, shall present a perfectly homogeneous appearance when viewed by transmitted light. It would be unnecessary and impossible to write a thoroughly comprehensive account of the emulsion processes; for such a work the amateur must consult Abney's "Photography with Emulsions;" but a few well-proved formulæ will be given. The material upon which the emulsion may be spread may be either glass, paper, or any special substance desired. The emulsion may be either for the production of negatives, transparencies, or positives, lantern slides, for development or printing out.

Bromo-Iodide Emulsion for Negatives. An emulsion for negatives may consist of pure bromide or a bromo-iodide, the latter being decidedly preferable, as giving more latitude of exposure, and less chance of fog from defective manipulation. Weigh out separately—

1.	Potassium iodide	10 grs.
2.	Potassium bromide	135 „
3.	Nelson's No. 1 photo-gelatine	30 „
4.	Silver nitrate	180 „
5.	Nelson's gelatine	160 „
6.	Heinrich's gelatine	80 „

Dissolve No. 1 in 1 drm. of distilled water, and No. 2 in 12 drms.; to No. 2 solution add 1 drop of pure hydrochloric acid, and sufficient iodine to give it a deep sherry colour. Soak

No. 3 in 1 oz. of distilled water for ten minutes, and dissolve by the heat of a water bath. Dissolve No. 4 in ½ oz. of distilled water, and heat to about 120 degs. F. The following operations must be conducted in the dark-room:—Add No. 2 to No. 3, and shake for twenty minutes; add half No. 4 solution, and shake for ten minutes; add No. 1 solution, shake for five minutes; add half the remainder of No. 4, shake for five minutes; then add the remainder of No. 4, shake for five minutes. Now place the bottle containing the emulsion in a saucepan half filled with water, and place at bottom of saucepan underneath the bottle three or four folds of paper to ensure even boiling. Bring the water to the boiling-point, having first covered over the emulsion so as to prevent any stray light from reaching it; stir at intervals of five minutes, and take out a drop of emulsion on stirring-rod, and place the drop of emulsion on a plate; examine by transmitted light from a gas flame. When the emulsion shows a blue colour, turn out the gas; or if an extra rapid emulsion is required, boil for a longer period. Now soak Nos. 5 and 6 in 2 ozs. of distilled water for about half an hour, and dissolve by a gentle heat; the temperature must not be raised above 100 degs. F. When both solutions have cooled to about 70 degs. F., mix and shake thoroughly for ten minutes, allow it to stand for a few minutes, and pour out into a flat dish to set. When thoroughly set, break it up into small pieces with a silver or china spoon, put all into a piece of coarse canvas, previously well washed, and squeeze into a basin of distilled water; stir it up for about ten minutes, collect on a filter of washed chamois leather, and drain slightly; repeat the washing twice; now collect the emulsion, and allow it to drain thoroughly. Another convenient method of washing is as follows:—Squeeze the emulsion through canvas into a deep beaker or jar, and pour upon it about a pint of pure methylated spirit; stir frequently for ten minutes, and drain. Whichever method of washing is used, the following operations are identical:—Remelt the emulsion at 120 degs. F., add half a grain of chrome alum dissolved in 1 drm. of distilled water, and add also 6 drms. of absolute alcohol; filter the emulsion through a piece of chamois leather, previously well washed with caustic potash and water, and, lastly, in distilled water till free from alkali about 10 ozs. of good emulsion should be the result. For a plain bromide

emulsion the above formula may be used, omitting the iodide, and an equivalent of nitrate of silver. Another method of making emulsions, which has found much favour on account of its simplicity and good results, is by the ammonia process, which is here given:—Use the same ingredients as before, and dissolve in the same way; but the silver solution must be cold, and the gelatine nearly so. To the silver solution add just enough liq. amm. ·880 to redissolve the precipitate of oxide first formed, and add the bromide and gelatine solutions previously mixed to the solution of ammonio-nitrate of silver, shaking thoroughly; now add Nos. 5 and 6, dissolved as before, but cooled down. Shake the whole for fifteen minutes, pour out into a dish to set, and keep it for twenty-four hours, covered over and protected from dust and light; then wash by either method described above, remelt, and filter the emulsion. This is an extremely economical method, as the emulsion prepared in this way will coat far more plates than when prepared by the boiling process.

Gelatino-Chloro-Bromide Emulsion for Transparencies.

Solution No. 1.

Nitrate of silver	154 grs.
Citric acid	154 „
Distilled water	28 drms.

Solution No. 2.

Chloride of sodium (pure common salt) ...	54 grs.
Potassium bromide	39 „
Gelatine	62 „
Distilled water	28 drms.

Mix both solutions together, with constant shaking, at 140 degs. F., and then add

Nelson's gelatine	124 grs.
Heinrich's gelatine	248 „

previously swollen and dissolved by heat in

Distilled water	11 drms.

The operations of washing, etc., are the same as given above. This formula, with a slight alteration—viz., the substitution of 16 drms. of glycerine for the 11 drms. of water in the latter part

of the process—will give an emulsion which will serve admirably for a rapid contact paper for development.

Gelatino-Chloride Emulsion for Lantern Plates.

No. 1.

Sodium chloride	80 grs.
Nelson's No. 1 gelatine	30 „
Hydrochloric acid (pure)	5 mins.
Distilled water	12 drms.

Soak the gelatine in the water, and dissolve by a gentle heat, then add the other ingredients.

No. 2.

Silver nitrate	200 grs.
Distilled water	4 drms

No. 3.

Nelson's No. 1 gelatine	30 grs.
Distilled water	8 drms.

Soak for half an hour, and dissolve by heat.

No. 4.

Heinrich's gelatine	80 grs.
Nelson's „	40 „
Distilled water	16 drms.

Soak for half an hour, and dissolve by heat. Mix Nos. 2 and 3 at 100 degs. F., and add gradually, as described under Bromo-Iodide Emulsion No. 1; when nearly cold, add No. 4; shake thoroughly for ten minutes. This is rather a slow emulsion, but greater rapidity can be obtained by boiling the emulsion for half an hour before adding No. 4. The above is a good form for lantern plates or transparencies, but much superior slides can be obtained by the following processes:—

Collodio-Bromide Emulsion.

No. 1.

Methylated spirit (·820)	24 drms.
Methylated ether	20 „
Pyroxyline or celloidin	60 grs.

No. 2.

Ammonium bromide	65 grs.
Citric acid	5 „
Distilled water	90 mins.

Dissolve and add

Methylated spirit	8 drms.

No. 3.

Silver nitrate	100 grs.
Citric acid	5 „
Distilled water	2 drms.

Mix in the dark-room, Nos. 1 and 2, and add No. 3 with constant agitation; keep for twenty-four hours, pour out in a flat dish to allow the solvents to evaporate, break up when set with a silver spoon, wash by stirring in three or four different lots of distilled water, collect and drain, and stir in about 3 ozs. of methylated spirit; drain, and repeat this operation twice to remove all the water, drain thoroughly, and dissolve the emulsion in

Methylated spirit	4 fluid ozs.
Methylated ether	4 „ „

Shake thoroughly till dissolved, and filter.

Beechey's Unwashed Emulsion Process. This answers admirably for preparing lantern plates.

No. 1.

Cadmium bromide	20 grs.
Methylated alcohol	4 drms.

Dissolve and add

Hydrochloric acid (pure)	4 mins.

Add

Methylated ether (·725)	9 drms.
Pyroxyline	12 grs.

No. 2.

Dissolve by the aid of a gentle heat

Silver nitrate	40 grs.
In methylated alcohol (·820)	8 drms.

Add No. 2 gradually to No. 1, shaking between each addition. Keep for twenty-four hours to ripen, when the emulsion will be found thick and creamy. The plates, which must receive a substratum, or Edging (*q.v.*), can be coated in the usual way, the emulsion being shaken once or twice half an hour prior to using. When set, immerse the plates in a dish of distilled water till water flows easily over it; then drain slightly, and immerse in a bath of

Pyrogallol	1 gr.
Beer	1 oz.

and dry in the usual way. Pyrogallol should be used for developing them. For a rapid printing-out paper similar to aristotype the following formula answers well:—

Silver nitrate	12 grs.
Distilled water	13 drms.
Gelatine	460 grs.

Soak the gelatine in water, and dissolve by the aid of heat, and add the silver nitrate. Dissolve

Lithium chloride	2 grs.
Tartaric acid	2 „
In distilled water	2 drms.

and add gradually to the silver solution with constant agitation. In all the formulæ given above it will be noticed that the silver nitrate is recommended to be dissolved in water or spirit; but, as pointed out by Mr. W. K. Burton, exceedingly fine emulsions may be obtained by powdering the silver salt and adding it to the bromised gelatine or collodion in the solid state, with constant agitation. This seems to be a great advantage, especially in the case of collodion emulsion, as silver nitrate is so sparingly soluble in alcohol.

Enamelling Prints. This consists of coating the finished print with a film of collodion to give it a brilliant surface, which gives greater protection and more softness and depth. The following is the method of procedure:—Clean a glass plate—an old negative glass or a cutting shape will do—with French chalk, and polish thoroughly; now coat the plate with enamel collodion (see COLLODION), and, having made a solution of gelatine 10 grs. to the ounce of distilled water, slip the

collodionised plate and the print carefully into the solution of gelatine, avoiding air bubbles; bring the print face downwards into contact with the coated plate, remove from the solution, and squeegee into optical contact, and allow to dry. When thoroughly dry, raise one corner with a knife, and the print will strip from the glass, bearing the collodion film with it.

Enamels are photographic images burnt into porcelain, and coated with a glaze, rendering them absolutely permanent. The complete directions for the preparation of these charming pictures are too copious to give here, but the following *résumé* of the process, abstracted from the article on the same by Mr. N. K. Cherrill in the "Photographic Year-Book" of 1886, will give a general idea of the subject, which is above the scope of most amateurs. A glass plate is coated with three coats of positive collodion; it is then sensitised into a 30-grain bath of nitrate of silver, and exposed on the negative to be reproduced in the copying camera. The positive is then developed with a developer of pyrogallol and acetic acid. The development is pushed till the deepest shadows begin to be blocked up with deposit. After washing, the picture is fixed with cyanide of potassium, and thoroughly washed. When the washing is completed, a corner of the film is broken off, and a stream of water directed to that point, which gradually detaches the collodion film from the glass, and the film is now floated on to a clean glass plate, and all unnecessary parts of the film removed. The film is again washed and floated into clean water, and then removed to a toning bath composed of chloride of iridium and gold; the film is thoroughly toned till it appears of one uniform tint. It is then washed, given a bath of ammonia, and floated on to the porcelain tablet, spread carefully on the same by means of a soft camel's-hair brush, and allowed to dry. It is then introduced into a muffle furnace and heated to a white heat, which destroys the collodion, leaving the silver image intact. Ceramic colours are now applied, and the enamel reburnt. When examined at this stage, it will be found that there is but a dull, lifeless-looking result, and to improve and make the same pleasing and permanent, a glaze, sold specially for the purpose, is dissolved in alcohol, and mixed with some plain collodion, and applied to the enamel, which is again fired.

For the best results, this operation must be repeated five or six times, when the process is complete. From the above the reader will deduce the fact that the image consists of pure metallic silver, gold, and iridium in an extremely fine state of division on the surface of an imperishable and generally an impermeable substance, protected by an equally impermeable and permanent glaze.

Encaustic Paste. A paste used to give a brilliant surface to the finished print without the use of hot rollers or of collodion. There are several formulæ; but the following, proposed by Salomons, is decidedly the best:—

Pure white wax	500 grs.
Gum elemi	10 „
Benzole	4 drms.
Essence of lavender	6 „
Oil of spike	1 drm.

Melt the wax and elemi, add the benzole and other ingredients, and allow to cool, stirring frequently. Smear a little of the paste over the face of the print with a tuft of cotton-wool, and polish with a clean piece till the surface is free from markings. It increases the depth of shadow and general beauty to a large extent. A more simple paste can be made as follows:—

Dr. Eder's Cerate Paste.

Pure white wax	100 grs.
Dammar varnish	40 mins
Pure oil of turpentine	100 „

prepared and used as above described.

Enlarging is the operation of obtaining a larger image of a negative or positive upon some sensitive surface. There are several methods of doing this either by the use of daylight or artificial light, which will be severally described. But it is first necessary to make a few remarks upon the negative used for this purpose. Absolute sharpness of focus is a *sine quâ non;* for supposing a quarter-plate negative taken in the ordinary way is to be enlarged, it may be considered that the discs of confusion appear as points of less than $\frac{1}{100}$ of an inch in diameter, a point inappreciable to the human eye; but if these said discs of con-

fusion are enlarged, they will become of appreciable size—viz., enlarge a quarter-plate to 12 by 10, or nine times, and these discs of confusion will be enlarged in the same ratio; therefore they will be about $\frac{1}{10}$ of an inch in diameter, and will be easily seen. Again, the negative should be plucky and with good but not too great contrasts, and of accurate density.

Daylight Enlarging. There are what are termed solar cameras, by means of which sunlight is concentrated by condensers; but as these entail considerable outlay, the following plans, equally as effective, may be used by any amateur:—Block out the whole of a window with the exception of a small space, sufficiently large to take the negative to be enlarged; put the negative into the rabbet slide of the focussing screen, or into the dark slide, both shutters of which must be withdrawn, and insert the dark slide into its proper place; fix the camera close up to the hole left uncovered in the window, so as to exclude all light but that which comes through the negative, the lens being turned into the room; should any stray particles of actinic light find their way in at this place, wrap the focussing cloth round the back of the camera. Outside the window must be placed a white card or mirror, at an angle of 45 degs., so as to reflect the light through the negative; at the proper distance is placed the easel or board to receive the enlarging paper or plate. The following sketch (fig. 1) will show the disposition of things in general:—

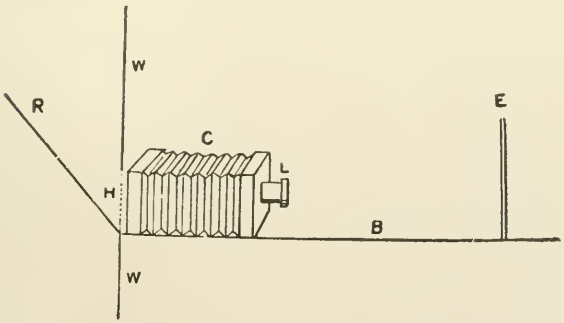


Fig. 1.—*w w*, window; H uncovered space for negative; R, the card or mirror as a reflector; C, the camera; B, table or board upon which camera rests; E, easel or board supporting the sensitive paper.

Another method is to reverse the camera, pointing the lens towards the negative, the ground-glass being of course removed; in this case the lens and negative must be enfolded by the focussing cloth to shut out all intervening actinic light. This method is useful when the focussing screw is at the back, as by this means it can be easily got at. The following are a few general rules for enlarging:—When looking through the un-

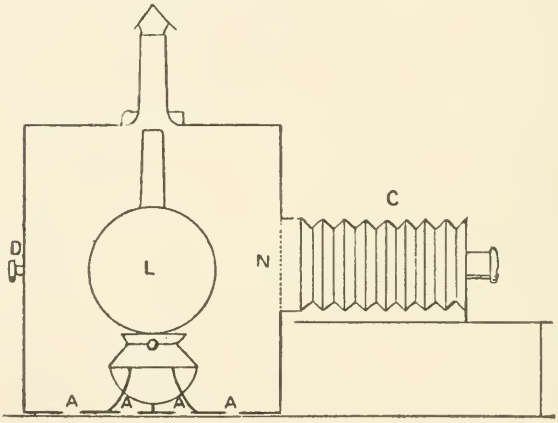


Fig. 2.—C, camera or specially made bellows; D, door; L, lamp; *aaaa*, air holes; N, negative in position.

covered space H fig. 1, from the position of the lens the edges of the reflector must not be seen. Any lens will do for enlarging by; the best for the purpose is the one with which the negative was taken. A stop is not necessary unless to improve marginal definition, and the largest possible stop should be used. The farther from the lens the sensitive surface is, the larger the image, and *vice versâ*. Be careful to place the negative film side inwards, so as to present the picture in the correct position on the paper. Fine focussing should be done by the camera screw if possible. The distance (approximate) between the lens and the sensitive surface can be found by adding 1 to the number of times the negative is to be enlarged, and multiplying by the focal length of lens. Example: Find the distance between lens and

easel, when a quarter-plate negative is to be enlarged to 12 by 10 with a $4\frac{1}{2}$ in. focus lens.

$$12 \times 10 \div (4\tfrac{1}{4} \times 3\tfrac{1}{4}) = 120 \div \tfrac{17}{4} \times \tfrac{13}{4} = 9$$

(practically). The distance will be then

$$(9 + 1) \times 4\tfrac{1}{2} = 10 \times 4\tfrac{1}{2} = 45 \text{ ins.}$$

To find the distance between the lens and negative: Divide the number of times of enlargement plus 1 by the number of times of enlargement, and multiply by focus of lens. Example: To find distance between lens and negative for above case—

$$(9 + 1) \div 9 \times 4\tfrac{1}{2} = 5 \text{ ins.}$$

The appended table (page 64) is given, however, to show at a glance the distances required; reference will be made to it again under the article Reduction (*q.v.*). To use this table it is only necessary to know the focus of the lens, and the number of times it is required to enlarge, then B = the distance of the sensitive paper from the centre of the lens, and A = the distance between the negative and lens. To find the required distances when it is desired to enlarge a negative five times, with a lens of $8\frac{1}{2}$ ins. focus, carry the eye down the column under 5, till it meets with those figures opposite to $8\frac{1}{2}$, when the numbers 51 and $10\frac{1}{6}$ will be found. 51 is the required distance between the lens and paper; $10\frac{1}{6}$ the distance between lens and negative.

Artificial Light Enlarging. The possessor of a magic-lantern can proceed in the very simple manner of inserting the negative in the slit provided for the insertion of the slides, upside down and film side towards lens, and after obtaining the relative distances by means of above table, or by shifting the lantern backwards and forwards, till the desired size is obtained, and sharp focussing can be done by aid of the screw in the usual way; but the usual size lantern has condensers of but 3 or $3\frac{1}{2}$ ins. diameter; it is obvious that a portion of a negative only can be enlarged unless it is reduced to the regulation lantern slide size. The following size condensers are necessary for the usual negatives: —For quarter-plate, 5 ins.; half-plate, 8 ins.; whole-plate, 10 ins. If it is desired to know what size condenser is required for any intermediate size plate, it is only necessary to measure the diagonal of the plate from corner to corner, when that will give the diameter of condensers required; but as these condensers are

TABLE OF ENLARGEMENT OR REDUCTION.

Focus of Lens in Inches.	Reduction.	1.	2.	3.	4.	5.	6.	7.	8.	Enlargement.
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	
2	A	4	6	8	10	12	14	16	18	B
	B	4	3	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{2}{5}$	$2\frac{1}{3}$	$2\frac{2}{7}$	$2\frac{1}{4}$	A
$2\frac{1}{2}$	A	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	$17\frac{1}{2}$	20	$22\frac{1}{2}$	B
	B	5	$3\frac{3}{4}$	$3\frac{1}{3}$	$3\frac{1}{8}$	3	$2\frac{11}{12}$	$2\frac{9}{7}$	$2\frac{13}{16}$	A
3	A	6	9	12	15	18	21	24	27	B
	B	6	$4\frac{1}{2}$	4	$3\frac{3}{4}$	$3\frac{3}{5}$	$3\frac{1}{2}$	$3\frac{3}{7}$	$3\frac{3}{8}$	A
$3\frac{1}{2}$	A	7	$10\frac{1}{2}$	14	$17\frac{1}{2}$	21	$24\frac{1}{2}$	28	$31\frac{1}{2}$	B
	B	7	$5\frac{1}{4}$	$4\frac{2}{3}$	$4\frac{3}{4}$	$4\frac{1}{5}$	$4\frac{11}{12}$	4	$3\frac{15}{16}$	A
4	A	8	12	16	20	24	28	32	36	B
	B	8	6	$5\frac{1}{4}$	5	$4\frac{4}{5}$	$4\frac{3}{7}$	$4\frac{4}{7}$	$4\frac{1}{2}$	A
$4\frac{1}{2}$	A	9	$13\frac{1}{2}$	18	$22\frac{1}{2}$	27	$31\frac{1}{2}$	36	$40\frac{1}{2}$	B
	B	9	$6\frac{3}{4}$	6	$5\frac{5}{8}$	$5\frac{2}{5}$	$5\frac{1}{4}$	$5\frac{1}{7}$	$5\frac{1}{16}$	A
5	A	10	15	20	25	30	35	40	45	B
	B	10	$7\frac{1}{2}$	$6\frac{2}{3}$	$6\frac{1}{4}$	6	$5\frac{5}{6}$	$5\frac{5}{7}$	$5\frac{5}{8}$	A
$5\frac{1}{2}$	A	11	$16\frac{1}{2}$	22	$27\frac{1}{2}$	33	$38\frac{1}{2}$	44	$49\frac{1}{2}$	B
	B	11	$8\frac{1}{4}$	$7\frac{1}{3}$	$6\frac{7}{8}$	$6\frac{3}{5}$	$6\frac{5}{12}$	$6\frac{2}{7}$	$6\frac{3}{16}$	A
6	A	12	18	24	30	36	42	48	54	B
	B	12	9	8	$7\frac{1}{2}$	$7\frac{1}{5}$	7	$6\frac{6}{7}$	$6\frac{3}{4}$	A
$6\frac{1}{2}$	A	13	$19\frac{1}{2}$	26	$32\frac{1}{2}$	39	$45\frac{1}{2}$	52	$58\frac{1}{2}$	B
	B	13	$9\frac{3}{4}$	$8\frac{2}{3}$	$8\frac{1}{8}$	$7\frac{4}{5}$	$7\frac{7}{12}$	$7\frac{3}{7}$	$7\frac{5}{16}$	A
7	A	14	21	28	35	42	49	56	63	B
	B	14	$10\frac{1}{2}$	$9\frac{1}{3}$	$8\frac{3}{4}$	$8\frac{2}{5}$	$8\frac{1}{6}$	8	$7\frac{7}{8}$	A
$7\frac{1}{2}$	A	15	$22\frac{1}{2}$	30	$37\frac{1}{2}$	45	$52\frac{1}{2}$	60	$67\frac{1}{2}$	B
	B	15	$11\frac{1}{4}$	10	$9\frac{3}{8}$	9	$8\frac{3}{4}$	$8\frac{4}{7}$	$8\frac{7}{16}$	A
8	A	16	24	32	40	48	56	64	72	B
	B	16	12	$10\frac{2}{3}$	10	$9\frac{3}{5}$	$9\frac{1}{3}$	$9\frac{1}{7}$	9	A
$8\frac{1}{2}$	A	17	$25\frac{1}{2}$	34	$42\frac{1}{2}$	51	$59\frac{1}{2}$	68	$76\frac{1}{2}$	B
	B	17	$12\frac{3}{4}$	$11\frac{1}{3}$	$10\frac{5}{8}$	$10\frac{1}{5}$	$9\frac{17}{12}$	$9\frac{5}{8}$	$9\frac{15}{16}$	A
9	A	18	27	36	45	54	63	72	81	B
	B	18	$13\frac{1}{2}$	12	$11\frac{1}{4}$	$10\frac{7}{8}$	$10\frac{1}{2}$	$10\frac{2}{7}$	$10\frac{1}{8}$	A
$9\frac{1}{2}$	A	19	$28\frac{1}{2}$	38	$47\frac{1}{2}$	57	$66\frac{1}{2}$	76	$85\frac{1}{2}$	B
	B	19	$14\frac{1}{4}$	$12\frac{2}{3}$	$11\frac{7}{8}$	$11\frac{2}{5}$	$11\frac{1}{12}$	$10\frac{6}{7}$	$10\frac{13}{16}$	A
10	A	20	30	40	50	60	70	80	90	B
	B	20	15	$13\frac{1}{3}$	$12\frac{1}{2}$	12	$11\frac{2}{3}$	$11\frac{3}{7}$	$11\frac{1}{4}$	A
$10\frac{1}{2}$	A	21	$31\frac{1}{2}$	42	$52\frac{1}{2}$	63	$73\frac{1}{2}$	84	$94\frac{1}{2}$	B
	B	21	$15\frac{2}{3}$	14	$13\frac{1}{8}$	$12\frac{3}{5}$	$12\frac{3}{4}$	12	$11\frac{13}{16}$	A
11	A	22	33	44	55	66	77	88	99	B
	B	22	$16\frac{1}{2}$	$14\frac{2}{3}$	$13\frac{3}{4}$	$13\frac{1}{3}$	$12\frac{5}{6}$	$12\frac{4}{7}$	$12\frac{3}{8}$	A
$11\frac{1}{2}$	A	23	$34\frac{1}{2}$	46	$57\frac{1}{2}$	69	$80\frac{1}{2}$	92	$103\frac{1}{2}$	B
	B	23	$17\frac{1}{4}$	$15\frac{1}{3}$	$14\frac{3}{8}$	$13\frac{4}{5}$	$13\frac{5}{12}$	$13\frac{1}{7}$	$12\frac{11}{16}$	A
12	A	24	36	48	60	72	84	96	108	B
	B	24	18	16	15	$14\frac{2}{5}$	14	$13\frac{5}{7}$	$13\frac{1}{2}$	A

usually rather costly, the following ingenious arrangement, which dispenses with them altogether, may be utilised; it is suggested by Major Barrington Baker, in the *British Journal of Photography* for 1888. Fig. 2, on page 62, is a rough reproduction of Major Baker's diagram, and the following *précis* is given of his directions. The case is made of half-inch deal, with a hole, N, $6\frac{1}{4}$ by $4\frac{1}{2}$ for negative, or made the size desired. L, a Belge lamp of 42-candle power, is placed in the case through the door D, half a dozen holes (A A) being bored in the bottom of box for ventilation. An opal globe is used to diffuse the light; the negative is placed film side outwards in a rebate at N, and held in its place by two small turn-buckles; the camera may be used, or a specially made pair of bellows. The exposure is, of course, prolonged with rapid papers, being from ten to fifteen minutes. The author would suggest as an improvement upon this that the case be lined throughout with tin, and a sheet of ground glass or opal be placed before the negative, and that a parabolic reflector be used. Some of the modern cameras will be found utterly useless for enlarging, the pull of the bellows, or the greatest distance they will stretch, being very short; then the following arrangement, now always used by the author, will take their place:—Obtain some black twill, one yard in width and length, and cut it into four pieces in the following manner (it is better to cut a paper pattern first, in case of error):—Fold the cloth in half, and again in half, so as to give four pieces 9 ins. wide and 36 ins. long; now cut two slanting strips from each, commencing at 2 ins. wide, and narrowing down to the other end; this will give four pieces of cloth 36 ins. long—9 ins. wide at one end, and narrowing to 5 ins. at the other. Have these sewn together by the edges, so as to form a conical sleeve, which will take the place of bellows 36 ins. long. At the wide end nail a frame of wood large enough to take the negative, and at the narrow end a piece of wood to take the lens, or the camera front may be utilised for this purpose. It will not be necessary to pleat it like bellows, but it can be finely pleated at intervals, and safety pins used to hold the pleats together when required to shorten the distance, so the pleats can easily be let out when required, or pieces of elastic can be run along the edges to serve the same purpose. It is absolutely necessary that all actinic light be excluded, and attention should be paid to this when using the

ordinary magic-lanterns, as they are never made sufficiently light-tight. In this case they should be enclosed in an outer box of deal. For placing the sensitive film into position after the final focussing, which obviously must be done on a sheet of plain paper, a sheet of orange or ruby medium may be hung over lens, or a temporary cap of cardboard made with a piece of ruby glass let in it. With regard to exposure but little can be given as a guide, the duration of the same varying so much with the intensity of the light, density of negative, etc.; but remember *the exposure varies as the square of the distance between the lens and the film*, so that it is longer the greater the enlargement we wish to make. It is always better to give a test exposure on a small piece of bromide paper first. The process of development is precisely the same as when Bromide Paper (*q.v.*) is used for contact printing. Where many enlargements of one negative are required, it is better to make an enlarged negative, which can be done either by making a transparency by contact printing, and enlarging from that, so as to obtain an enlarged negative, or by enlarging the negative and making a second negative from the enlarged transparency by contact (the former is preferable). The operations are precisely the same as for enlarging on paper, substituting a sensitive plate for it.

To Vignette Enlargements. A vignetting shape must be cut, preferably from black cardboard, much smaller than that usually used for quarter-plates (this applies whether the negative to be enlarged is quarter-, half-, or whole-plate), and move this shape backwards and forwards between the lens and sensitive surface; the nearer the lens the larger the vignette, and *vice versâ*.

Equivalent Focus. See Focus.

Ether. $C_4H_{10}O=74$. Synonym: Sulphuric Ether. A volatile, inflammable, colourless liquid, prepared from alcohol by distillation with sulphuric acid, and subsequent purification. It has a peculiar, strong, sweet odour, and a hot burning taste, evaporating quickly on exposure to the air, and when applied to the skin leaving a feeling of considerable coldness. It boils below 105 degs. F., and gives off at ordinary temperatures a heavy inflammable vapour. Water takes up about one-tenth of its volume of ether, and *vice versâ*; should it absorb more, it proves the presence of too much alcohol. It unites in all

proportions with alcohol. Specific gravity should be about ·735. It is a solvent of all fixed and essential oils, iodine, bromine, and sparingly of sulphur and phosphorus. It dissolves most resins and balsams, also india-rubber and caoutchouc. It contains about 8 per cent. of alcohol.

Pure or Absolute Ether is prepared from above by shaking it with half its weight of distilled water, which dissolves the 8 per cent. of alcohol, and decanting the supernatant ether and distilling it with chloride of calcium, which extracts the small amount of water absorbed by the ether. Specific gravity, ·720.

Methylated Ether is prepared precisely as above, but from methylated spirit. It is, if pure and free from methyl, quite as satisfactory for the preparation of collodion as that from rectified spirit. To test whether a sample be suitable for preparing collodion, put one drop of tincture of iodine into an ounce of methylated ether, and expose to daylight. If the colour is discharged after a few hours, the sample should be rejected Ether, whether prepared from rectified or methylated spirit, is liable to become ozonised, or acid, by exposure to light, in which condition it is unfit for the preparation of collodion. This state can be tested for by agitating it with an alcoholic solution of iodide of potassium. When acid, the iodine is liberated, and the solution is coloured the characteristic yellow colour of free iodine.

Exposure. Placing any sensitive surface under the action of light, either in the camera or in a printing frame. Of the latter but little need be said, as the result is, in the case of sensitised paper, visible; and in the case of bromide and other papers and opals for development instructions will be found under those headings. Of the former but little can be said here; whole volumes might be written without affording much material aid. Many tables have been published which have been useful to many in the past, but as they all require considerable arithmetrical calculation their practical utility has been limited; but all amateurs should welcome with gratitude "The Practical Index of Photographic Exposure," by A. R. Wormald, which, to quote from his preface (that in itself is worth reading for numerous valuable hints, the outcome of the experience of a practical worker), will "supply a want that it is believed has hitherto remained unsatisfied, one that every beginner in photography must experience—namely, the want of a ready means of knowing

(without calculations, or with as little as possible) the duration of exposure likely to produce a good negative with a given stop and plate. The practical index table will be found to indicate in a clear and simple manner, and at a glance, the duration of exposure for every month of the year, every hour of the day, and every stop generally in use." I have used hitherto certain exposure tables, and also certain actinometers, and have tested Wormald's tables against their results, and find the latter perfectly accurate.

Fabric, Golden. A translucent cloth dyed golden or yellow, used for the dark-room window. It should always be tested to see whether actinic light filters through, as described under Dark-Room (*q.v.*). A convenient and ingenious way, suggested to me by an amateur of some standing, for utilising this fabric is as follows:—Make a frame of wood sufficiently large to cover the window, and on to this frame paste or nail a sheet of fabric, smear the inside of sheet all over with vaseline, and squeegee another sheet of fabric to it. The vaseline fills up the minute pores, and causes the two sheets to adhere, making an absolutely safe medium with a maximum of light.

Fading. The worst of all ills to which negatives and prints are subject.

Negatives fading. This is solely due to insufficient washing or fixing, and the consequent action of hypo on the delicate image of silver.

Fading of Prints. The cause of this may in every case be traced in some way or other to sulphur, or its compounds. Albumen itself contains a minute trace of sulphur, and consequent decomposition may give rise to the formation of some compound of sulphur and silver. Again, insufficient fixing may form the insoluble variety of hyposulphite of silver, and insufficient elimination of the fixing salt itself may supply the unlooked-for result. Hypo is used as an anti-chlor in the manufacture of some mounts, and this should be tested for as described under the head of Sodium Hyposulphite (*q.v.*). An acid or decomposing mountant, or absorption by an hygroscopic mountant of the aqueous vapour from the atmosphere holding in solution certain acids, may also cause it. To prevent any such action, great care should be taken to completely eliminate the

fixing salts, and the use of encaustic paste is likewise a protection from the aqueous vapour.

Fahrenheit. See THERMOMETER.

Falling Front. See RISING FRONT.

Ferrotypes. Positives on thin iron plates taken by the wet process, but little used now; for full instructions see Hardwich's "Photographic Chemistry," or Jabez Hughes' "Manual of the Wet Process."

Field of a Lens is the illuminated space given on a screen by any lens with full aperture.

Film. The thin pellicle or skin of gelatine on plates or paper.

To Remove Old Films. Nothing is better than glacial acetic acid made into a cream with pumice-stone powder and applied with a tuft of rag, the acid instantly dissolving the film, and the pumice powder acting as a mechanical means of removing it.

To Clean the Film from the Back of Plates. Few plate manufacturers coat their plates so carefully but what some small smears of emulsion get on the back of plate. To remove this, when the plate is thoroughly dry, place it face downwards upon a pad of blotting paper, and use a little salt with a moistened rag.

Film Photography. A term applied to photography in which flexible films instead of glass plates are used. These are now so well known that but a short description will be given here. The whole process consists of spreading the sensitive emulsion upon any substance such as paper, or an insoluble film of gelatine: the latter being decidedly preferable, as in the case of paper it must either be removed, or else rendered translucent before coating, by treating it with certain gums and resins in solution, or after development and fixing by oiling or waxing it; or the film bearing the image must be stripped from its temporary support, and affixed to a glass plate or skin of gelatine to allow of printing. The advantage of films over glass is their extreme lightness and portability, with no chance of breakage, freedom from halation, together with the power of being able to print from either side—an advantage of great importance to the carbon or photo-mechanical printer. (See also PAPER NEGATIVES and STRIPPING FILMS.)

Fixing. The removal of any sensitive salt unacted upon by

light or by the developer, thus rendering the negative or print unalterable by the further action of light. The usual method of effecting this in the case of the silver salts is by the solvent action of Hyposulphite or Thiosulphate of Sodium (*q.v.*); cyanide of potassium, sulphocyanide of potassium or ammonium, and sulphite of sodium have also been recommended. Neither sulphocyanide of potassium or ammonium nor sulphite of soda are likely to come into general use, as their fixing powers are not so good as those of hypo, and their price is greater. Cyanide of potassium is more powerful than hypo, but its action on the image is so great as to completely destroy the half-tones occasionally; its use should never be countenanced for dry plates or prints. Hypo, then, is our sole resource; and, whilst it is much abused, there is no doubt of its being at present the best salt for the purpose. The difficulty of completely eliminating, however, is its great drawback, and this will be treated of under Washing Negatives and Prints (*q.v.*). The author, in conjunction with an amateur photographer, has been for some time engaged in experiments as to a new fixing salt, and although these are not yet complete, fair hope is given that at no distant date a new fixing agent will take the place of hypo equally as efficacious and yet much more amenable to reason, and at almost as cheap a rate. For fixing negatives the author recommends the use of two fixing baths, the strength being about 4 ozs. to the pint of water in each, the negative being allowed to remain for ten minutes in the first, and for about five minutes in the second; by this a more thorough fixing of the negative is effected. For fixing prints the strength generally recommended is about half that for negatives—that is, about 2 ozs. to the pint—and sufficient liquor ammonia or carbonate of ammonia should be added to make the solution smell faintly of ammonia. This neutralises any free acid which may be present in the solution, and prevents any loss of tone in fixing. The author always uses, however, the same strength as for negatives, with the addition of ammonia, and uses the bath at a temperature of 70 degs. F., and from some lengthened experience the results prove the increased advantage of doing this, as fixing is completed in half the time, and there is less chance of loss of tone.

Flare. A fogged central patch on a developed plate, or seen as a circular patch of light on the focussing screen. It is said to be

an image of the aperture of the diaphragm, or in some cases of the lens itself. The surface of the lens reflects the opening of the diaphragm, and forms a distinct image of it, and when this coincides with the focus of the lens this image is seen as a flare spot. Again, others, and amongst them Monckhoven, in his "Photographic Optics," states that it is due to too close an adherence to the globular form by the optician who constructed the lens. Others, again, state that it is due to the edges of the diaphragm aperture being worn bright, and this no doubt is a general cause for its sudden appearance in a lens. The Iris diaphragm, but lately introduced for photographic objectives, seems to be particularly liable to this, from the friction of the tongues of metal of which it is formed; others state that when the lenses are mounted in cells which are not blackened, a flare is almost certain to make its appearance. All lenses should be examined for this most annoying defect, which can rarely be wholly eradicated. It is very often a defect in portrait lenses when such are used for outdoor work where any portion of bright sky is included in the background, and in this instance it is clearly an image of the lens by reflection from the surfaces. The remedies are not by any means satisfactory, as whatever is done at its best the flare spot is but distributed over the whole plate instead of being localised. When the diaphragm edges are worn bright they should be blackened, and the cells in which the lenses are mounted should also be attended to. It can be eliminated partially, as stated above, by altering the position of the diaphragm slightly; but as this is used to reduce distortion to a minimum, the remedy may be worse than the disease by introducing this defect. Slightly altering the relative positions of the two lenses will also efface it, but, as said before, only by distributing it.

Flatness. A want of vigour and contrast in the negative and resulting prints, due to under- or over-exposure, or to the use of too strong or too weak a developer.

Fluorine. F = 191. A non-metallic element never met with in a free state, and usually obtained from fluor-spar, a fluorine of calcium, CaF_2. It is of little practical photographic use; but its compound, hydrofluoric acid, has been recommended lately for detaching the negative film from glass plates, for preparing a

film negative. (See STRIPPING FILM.) Fluorine has only this year been obtained in a free state.

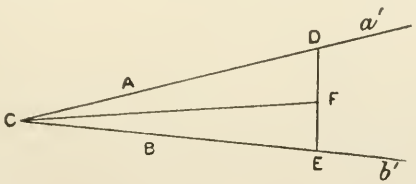
Fluorhydric, or Hydrofluoric Acid. HF 192. Is obtained by heating fluor-spar with sulphuric acid in a leaden or platinum retort, connected with a receiver of the same metal. It is a colourless gas, very soluble in water, and condensing at 20 degs. C. into a mobile fuming liquid, which boils at 59 degs. F. It has the peculiar property of dissolving glass and other silicates, and for this reason leaden or platinum vessels are used to prepare it, and the aqueous solution is stored in india-rubber bottles. Extreme care is necessary in handling it, as even when dilute it causes very painful ulcers when applied to the skin, and dissolves the nails.

Focus. The focus of a lens is that point at which parallel rays of light from any object converge and form a distinct image of that object.

Actinic Focus. As has been stated under chromatic aberration, the actinic focus is not actually coincident with the visual focus, unless the lens be rendered achromatic. To test whether this be the case, the following ingenious little instrument should be used:—In a piece of wood about six inches long make six little slits about half an inch apart, sufficiently deep to retain cards upright when placed in them, and number these cards from 1 to 6, and place them in the slits, arranging them in the shape of a fan, slightly behind one another. Now focus sharply as possible on No. 3, expose a plate upon it, and on developing see whether No. 3 is the sharpest; if not, it will be evident that the actinic focus is not coincident with the visual. Or place opposite the lens, but not quite upright, leaning a little away from it, a long strip of newspaper or cardboard, having several lines of large letters printed upon it. Now focus for one particular line of lettering, and proceed as before. All modern lenses are corrected for this, therefore the above remarks will only apply when it is found that sharp negatives are not obtained when using an old lens.

Depth of Focus is the power of defining upon a plane surface, with sufficient definition to satisfy the requirements of artistic ideas, the images of objects situated at varying distances. The use of diaphragms increases it; the smaller the aperture the greater the depth of focus.

Equivalent Focus. A term applied to a compound or doublet lens, and it is the focus of parallel rays entering the lens, and is thus called from the fact of an image formed at that point equalling in size that formed by a single lens. The true point to measure this focus from is actually situated between the diaphragm slot and the back combination; but it is always measured from the slot itself, and is found sufficiently accurate for all practical purposes by focussing any object over 150 yards distant, and measuring the distance between diaphragm slot and focussing screen. The following, however, are methods of obtaining the true equivalent focus of any lens, the first being recommended by Grubb, the optician:—On the ground-glass of the camera draw two pencil lines about an inch from the margin at each side. Now set up the camera preferably upon some flat surface, such as a table, upon which is spread a sheet of white paper, before a window, and focus for some distant scene about 150 or 200 yards off, in which there is some distinct feature, such as a church spire or tall chimney. Make the image of this fall upon one of the pencil marks on the focussing screen, and with a pencil draw a line upon the paper along the side of the camera; now bring the image of the chimney or spire upon the other line, when draw another line upon the paper also along the side of the camera; remove the camera, and with a flat rule continue these lines till they cut one another, so as to form an angle, across which draw a line so as to form a triangle, which line must be exactly the same length as the distance between the two pencil marks on focussing screen. Find the centre of this base accurately, and connect the junction or apex of the angular lines with the centre of the base. This line will then be the true equivalent focus of lens:—



The lines A*a′*, B*b′*, are those traced on the paper by the sides of the camera extended till they meet at C. DE is the base, being

the exact distance apart of the two pencil marks; F its centre, and CF the true equivalent focus of lens. Another method is thus briefly stated:—Multiply the foci of the two combinations together, and divide by the sum obtained by adding them together and subtracting the distance of separation. The result is the exact equivalent focus of the two lenses combined. Example:—Find the equivalent focus of lens, the front combination having a focus of 12 ins., the back 10 ins., and the distance of their separation being 2 ins.—$12 \times 10 \div [(12 + 10) - 2] = 120 \div 20 = 6$ ins., the true equivalent focus.

Focussing Glass, or Compound Focusser. A small telescopic magnifying eye-piece, used to obtain microscopic sharpness of focus upon the ground-glass, and it should be invariably used by every amateur, especially those who desire to enlarge the resulting negatives. It is composed of two plano-convex lenses equal in every respect, mounted in a tube with their plane surfaces outwards, at a distance apart equal to two-thirds of the focal length of the lenses. Different forms are used; the one mentioned is termed Ramsden's eye-piece.

Focussing Screen. The ground-glass upon which the image formed by the lens is seen. The best glass to use for this purpose is patent obscured plate, obtained by grinding patent plate with very fine emery. To make a screen of ground-glass, coarse emery powder should be made into a paste with water, and lightly rubbed over a piece of glass, using a small painter's muller, or any other convenient flat surface for grinding till the surface begins to show signs of abrasion, when the coarse emery should be completely washed off, and the finest emery obtainable used till the glass is obscured enough. Two pieces of glass can be ground at the same time by fixing a small cork, or anything that will serve as a handle, on to one piece of glass, with a piece of cobbler's wax or pitch, and using the one to grind the other. Should the focussing screen be accidentally broken, a piece of plain glass dabbed over with putty, or coated with a paste of flour and water, or at a pinch a fine cambric handkerchief, may be used. The following solution spread on glass has been suggested as a substitute for the ground-glass:—

White wax	120 grs.
Ether	1 oz.

Or the following matt varnish:—

Sandarac	18 grs.
Mastic	4 „
Ether	200 mins.
Benzole	80 to 100 „

The more benzole the finer the matt surface obtained. Or an ordinary negative varnish, containing one per cent. of tartaric acid; or a very good substitute may be obtained by soaking

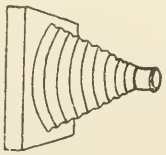
Gelatine or glue	60 grs.
In water	4 drms.

and adding

Boiled milk	2 „

melting by the aid of a gentle heat, and flowing over the glass.

Focussing Cloth. The well-known black cloth used for shutting out extraneous light when examining the image on the focussing screen. Almost any material that is impervious to light may be used. The best is either black velvet or black twill. The cloth should be made of a good size, sufficiently large to entirely enfold the camera and operator's head if required; about 36 ins. square is a fair size. There should always be one or two loops and buttons, so as to enable the cloth to be securely fastened round the camera in a high wind. An ingenious substitute for the focussing cloth can be made by fixing to the camera back a spiral frame of wire tapering to the end, and covering the same with black cloth. At the apex affix the com-



pound focusser. This arrangement will close up to a very small space, and add but little to the weight.

Aids to Focussing. Oiling the screen renders the grain of the glass but very little perceptible. Or a better expedient still for use with the compound focusser is a microscopic covering glass cemented to the ground surface of the screen with a drop of

Canada balsam. This will enable absolute sharpness to be obtained.

How to Focus. Having set the camera up and racked out to about the equivalent focus of the lens, which should be always marked on the baseboard of the camera, adjust the focus by means of the rack and pinion or screw provided for that purpose for some object about midway in the middle distance of the view. It will then be found that the image of nearer objects will be indistinct and fuzzy. Insert the stops in the order of their size, commencing with the largest, till the whole of the image is distinct and clear. Another method, recommended by Captain Abney, is to use a fairly large stop—for landscape work, say *f*/16—and focus with that, and then insert the stop of half that diameter, in the case we have supposed *f*/32.

Conjugate Foci. The distance between any point in any object and the lens, and the distance between the lens and the image of that point, are said to be the conjugate foci of the lens. These foci are of great importance when enlargement or reduction of any print, engraving, or negative is required. The rules for finding the conjugate focal distances are given under Enlargements (*q.v.*), and a table of same, to save any calculation.

Point beyond which Everything is in Focus. As this is sometimes required for instantaneous work, the rule for finding the same will be here given:—Multiply 2·7 by the square of the focal length of the lens and by the fraction expressing the diameter of the diaphragm aperture. Example: Required the nearest point in focus with a lens 4¼-in. focus, *f*/10 diaphragm. 2·7 × 4½ × 4½ × $\frac{1}{10}$ = 2·7 × 20·25 × ·1 = 5·46 yards. The following table will give approximately the point in yards beyond which all is in focus with a given lens and stop:—

Equiv. Focus.		Stop *f*/8.	Stop *f*/11·1.	Stop *f*/16.
3 ins.	...	3	2¼	1½
3½ „	...	4¼	3	2
4 „	...	5½	4	2¾
4½ „	...	6¾	4½	3¼
5 „	...	8½	6	4¼
5½ „	...	10	7½	5
6 „	...	12	9	6

Fog is one of the commonest of all faults with gelatine negatives, and is seen as a veil over the whole negative, and is a deposit of silver upon the shadows more or less dense according to the greatness or slightness of the fog. There are two great divisions of fog—chemical and light fog. The former is caused by errors in the manipulation of the plate manufacture; the second by the impact of light, as through some crevice in the camera or dark slide, or through over-exposure.

Chemical Fog, from errors in manufacture may be traced to several causes, the chief being an abnormal excess of silver nitrate in the emulsion, and also by decomposed gelatine, caused by too long stewing, when the emulsion is made by the boiling process. If the fog is very bad, there is no cure for it, but when slight the emulsion may be squeezed through coarse canvas or muslin, as described under Emulsions (*q.v.*), into a solution of bichromate of potash, ten grains to the ounce, and allowing it to stand for one hour, then washing for two hours in running water, or the addition of a few grains of cupric chloride or auric chloride will generally effect a cure. Chemical fog is often seen as iridescent green stains near the edges of plates, and is likely to make its appearance with an ammonia developer; it is less likely to ensue with the fixed alkalies, potash and soda, and never with ferrous oxalate. The obvious remedy for this evil, with a brand of plate known to be liable to green fog, is the use of potash and soda or ferrous oxalate; but where it does exist it can be eliminated by treating the plate after fixing and washing with

Ferric chloride	50 grs.
Potassium bromide	30 „
Distilled water	4 ozs.

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

Light Fog makes its appearance generally all over the plate, and, as has been stated above, may be due to three causes. When the fault is supposed to lie in the camera (and the reason to suspect this is to find the edges of plate covered by rabbet of

slide free from fog), cap the lens, remove the focussing screen, cover the head with the focussing cloth, and carefully examine the interior of camera to see if any stray thread of light is admitted. The plate may be fogged in the dark slide, and the effect will be seen on development by certain streaks and bands of fog making their appearance, a very usual place being at the leather hinge which allows of the shutter of this slide to be folded back, and this fog seems to be not only due to light, but in many cases is actually induced by the material or something used in making the hinge. It may also make its appearance at the side where the manufacturer places the small slips of cardboard to separate the plates, and in this case it is due to some impurity in the paper used. Stray actinic light or an imperfect non-actinic light in the dark-room may also cause general fog, and if this be suspected the light should be tested as described under DARK-ROOM.

Frilling. By this is meant the gelatine leaving the plates in folds or wrinkles. It usually begins at the edges, and occurs chiefly when fixing, but often during development or washing. The causes are numerous, but as most of these are but slightly under the control of the operator they will only be enumerated, and the possible cures given at length. The chief cause is the use of a gelatine of too horny a nature, and possessing but little tenacity. Again, long-continued boiling of an emulsion especially tends to this evil; an improperly washed plate, unequal drying, and excessive slowness of the emulsion in setting, due to the use of a soft gelatine or the heat of the weather, or by allowing too forcible a stream of water to impinge upon the edge of a plate, or the use of an exceeding strong developer, or the differing temperatures and densities between the developing, fixing, and washing fluids. The remedies to some causes are obvious; but with the ordinary run of amateurs, who are not plate-makers, when a batch of plates purchased is found to be subject to frilling, they should, if possible, be kept for two or three months, when the fault will be nearly, if not completely, eradicated; but where this remedy is impracticable, or, by reason of the number of the plates being but small, is hardly desirable, the following immediate steps may be taken. The plate, before development, may be coated with collodion made as follows:—

Pyroxyline	6 grs.
Alcohol (·820)	½ oz.
Ether (·735)	½ „
Castor oil	4 drops.

When this is used, the plate, after being collodionised, must be well washed with clean water till it no longer repels water from the surface of the film. When the plate is collodionised, it is advisable to add about 10 per cent. of methylated alcohol to developer. Soaking the plates in the following for five minutes is an absolute cure, but it prolongs development:—

Chrome alum	2 grs.

Dissolved in

Water	1 oz.

Add

Methylated spirit	1 „

But the author has found the following an unfailing remedy, and by its use development is not so much prolonged:—Have by the side of the developing or fixing bath a dish of methylated spirit, and if the slightest sign of frilling or blisters, which are but localised frilling, makes its appearance, immerse the plate immediately in the spirit till the frill disappears, then proceed with development or fixing. Some plates frill at the edges only; for these an edging of grease or india-rubber solution is the remedy. When plates are found to frill in the fixing, but not in developing, an intermediate soak in the chrome alum Clearing Bath (*q.v.*) will prevent it.

Fuming. The process of subjecting silver albumenised paper to the vapour of ammonia. It is claimed for this that it renders the prints more brilliant, and that the paper prints quicker; one effect, however, is to make the tones of the finished print purple, without much trouble. Many elaborate boxes have been designed for this purpose, but the simplest and a really efficient plan is to use an old cardboard plate-box, and, having cut the paper to the required size, pin it by the four corners face downwards to the lid, and on the bottom inside sprinkle a few drops—about ten or fifteen—of liquor ammonia ·880, put on the lid, and leave it for ten minutes in hot and fifteen in cold weather. Paper when once fumed should be used within two or three days, or

the good effect will be lost. Fumed paper is more liable to discolour than ordinary. The after-operations of washing, toning, and fixing are precisely the same as usual.

Gallon. See WEIGHTS AND MEASURES.

Gamboge, or Camboge. An orange-coloured gum resin, from the *Garcinia Morella*, a native of Siam and Cochin China. The finest is that called "Pipe Gamboge," which is collected in bamboo canes. The inferior is called cake gamboge. It is almost entirely soluble in alcohol, and when rubbed down with water forms a thick emulsion of a brilliant yellow colour. It has but little taste, and no smell. It is used but rarely in photography, being sometimes the colouring matter of varnishes and lacquers. The action upon human beings when taken internally is that of a most drastic and hydragogue cathartic.

Gaslight. See ARTIFICIAL LIGHT.

Gelatine. An animal substance obtained by boiling bones, hoofs, horns, and other animal substances. It contains about 15 to 20 per cent. of water at ordinary temperatures, and in cold water swells up and absorbs from five to ten times its weight. Good samples will absorb sufficient water to dissolve them when the temperature is raised above 90 degs. F., the solution setting again to a jelly on cooling. The continued application of heat for some time destroys this setting power, a new compound called metagelatine being formed. Gelatine will keep indefinitely in the dry state, but in the presence of water it soon putrefies, turning first acid and then alkaline, and at this stage ammoniacal vapours are given off. Alum, alcohol, carbolic, salicylic, and boracic acids, thymol, and the salts of zinc act as antiseptics. Acetic, hydrochloric, sulphuric, and oxalic acids dissolve gelatine even in the cold—acetic acid the most readily. Carbolic acid and alcohol precipitate it from aqueous solutions when they are in excess. Silver nitrate exposed to sunlight in contact with gelatine produces a red colour, due to a compound of gelatine and suboxide of silver. The alkaline dichromates in solution of gelatine render the latter after exposure to light insoluble and incapable of absorbing water, this action being the basis of the carbon and nearly every photo-mechanical printing process. Chrome alum and tannin render it insoluble, but capable of absorbing water. Ordinary alum raises the melting point, but

does not render it insoluble. The composition of gelatine varies with the source from which it is obtained, but the following may be taken as the percentage composition :—

Carbon	50·1
Hydrogen	6·6
Nitrogen	18·3
Oxygen	25·0
Sulphur	0·12

The selection of a gelatine suitable for emulsion making is a most important point, but the following leading characteristics of a suitable kind may be of service to the amateur plate manufacturer:—The weight of the ash left after incineration should never exceed 2 per cent., proving the absence of earthy or mineral matter. The amount of water it will absorb should in no case exceed ten times nor be less than five times its weight. For emulsion making by the boiling process it should give an acid reaction, and its solubility should not be effected at a lower temperature than 70 degs. F., nor higher than 110 degs. F. Another most important test is its expansive power, for upon this depend to a great extent its frilling or non-frilling properties. The following table of the chief characteristics of the best commercial brands will be of practical use; but it may be stated that the best film can, as a rule, be obtained by a mixture of one part of hard and two parts of soft gelatine :—

Name.	Character.	Ash. Per Cent.	Water Absorbed. Times its Weight.
1. Coignet's gold label	hard ...	1 ...	7½
2. „ special ...	„ ...	1 ...	7½
3. Nelson's No. 1 photographic	soft ...	2 ...	6
4. Nelson's opaque ...	hard ...	2 ...	8¾
5. „ amber ...	soft ...	1 ...	4⅜
6. Swinborne No. 2 isinglass	„ ...	1 ...	6¼
7. Russian isinglass ...	„ ...	1 ...	2¾
8. Simeon's Swiss ...	hard ...	1 ...	8¾
9. Heinrich's	„ ...	1 ...	8¼

Nos. 1, 3, 8, and 9 are the best to use.

It is always better to make a small batch of emulsion first, with a sample of gelatine, to test its suitability, rather than have a large batch spoilt by finding the gelatine used totally unsuitable. Gelatine has a great affinity for bromine, chlorine, and iodine. and upon this fact depends the preservation of gelatine plates, and to a great extent their increased sensitiveness over collodion plates.

Glass. A transparent brittle substance, now of universal occurrence and application. Its origin is uncertain. It was known to the Egyptians 5,000 to 6,000 years ago. The earliest specimen known is a small tablet in the British Museum, of about 1445 B.C., of Egyptian make; it is opaque and coloured. There is also a goblet found at Nineveh, of about 700 B.C., the earliest piece of any size. The manufacture was gradually improved, till, in Italy, 58 B.C., the theatre walls in some towns were ornamented with mirrors, and at Pompeii windows which were glazed have been found intact. About A.D. 674 the art of glass making was introduced into England, and it is now carried on at Newcastle, Liverpool, Bristol, Birmingham, Leeds, and London, Glasgow, and other places. Some of the lens glass is imported from abroad. There are many kinds of glass, but only one or two of any interest to photographers. Crown and flint are the kinds used for lenses, whilst for the best dry plates an inferior plate is used. Crown glass is composed of a mixture of silicates of potash (K_2O3SiO_2), lime (Ca_2O3SiO_2), and alumina (Al_2O3SiO_2). It has specific gravity 2·487. Flint glass is a mixture of silicates of potash, alum, and lead (Pb_2O2SiO_2). It has specific gravity 3·5. It is much more refractive than crown. Crystal glass is an extremely pure variety of flint, and is the one usually used for the finer lenses. Glass can be coloured by fusing metallic oxides with it. Gold and copper give red, silver or iron green, uranium yellow, cobalt blue colours. When the glass is coloured throughout, it is called "pot metal." Another method of colouring is by attaching an extremely thin sheet of pot metal to white glass, when it is known as "flashed glass." Opal glass is made by fusing with the metal one of the oxides of tin or zinc. In the manufacture of crown, flint, and crystal glass for optical purposes extreme care is taken to make the resulting glass non-hygroscopic, or non-absorbent of water, to which some glass is

particularly liable, also to obtain it absolutely free from bubbles and striæ, the latter being lines due to imperfect mixing of the molten metal. (See LENS.)

Glycerine. $C_3H_8O_3 = 92$. A peculiar sweet viscid liquid obtained from oils and fats by saponification and subsequent purification. Specific gravity, 1·260. It is extremely hygroscopic, and cannot be dried by heat without decomposition. Its non-drying properties are taken advantage of in photography to prevent the too rapid drying of some substances, and it is also used as a preservative of pyro. It is miscible in all proportions with water and alcohol.

Gold. Au = 196. The characteristics of this precious metal are too well known to need much description. It is only used in photography in combination.

Gold, Chloride of. $AuCl_3 = 302·5$. Synonyms: Terchloride or Perchloride of Gold, Auric Chloride. A convenient and economical method of making this is as follows:—Mix two drachms of pure nitric acid with eight drachms of hydrochloric acid, and place in the mixture a new sovereign, or an equivalent weight of pure gold; gently heat the mixture in a sand or water bath. Copious volumes of gas will be evolved, and the gold will gradually disappear, a solution of perchloride of gold in excess of acid resulting. The solution may be evaporated in a sand or water bath till the solution crystallises; the crystals must be preserved in hermetically sealed tubes or a tightly stoppered bottle, as the crystals are very deliquescent; but as it is necessary to use the salt in solution, it is preferable to keep the salt in solution and save the trouble of crystallisation. It is absolutely stable in solution if kept in the dark. To the solution, therefore, when the coin has disappeared add five ounces of distilled water and common chalk or carbonate of soda till nearly all the acid is neutralised; filter and make the solution measure 178 drachms by washing the filter with successive portions of distilled water. The resulting solution will contain one grain of perchloride of gold in every drachm. The salt as met with in commerce should be in reddish orange, needle-like crystals extremely deliquescent, soluble in alcohol and ether. A solution of ferrous sulphate precipitates metallic gold as a purplish brown powder, and is used for recovering gold from old toning baths. There is

another salt of gold which is the true chloride (AuCl), but which is of no interest photographically. Some commercial samples of chloride of gold, so-called, are a mixture of chloride of gold and common salt, the latter being sometimes quite 50 per cent. of the whole, and it is obvious their toning properties are limited.

Gold Hyposulphite. $Au_2S_2O_3 = 506$. Synonym: Sel d'Or. This salt is formed by adding hyposulphite of soda in solution to solution of gold perchloride, and was used in the old daguerreotype process for toning the image on the silver plate. It is a very unstable salt, and is unfitted for toning albumenised prints, as it soon becomes decomposed, the sulphur of the sel d'or combining with the silver and giving very pleasing but very evanescent tones of a rich purple. It has been recommended lately, however, for toning the quick printing chloride emulsion papers, for which it is more suitable. (See TONING.)

Grain. See WEIGHTS AND MEASURES.

Gramme. See WEIGHTS AND MEASURES.

Green Fog. See FOG.

Ground-glass. See FOCUS.

Group. An assemblage of figures or other subjects. The art of posing figures in groups is one in which the amateur is as a rule sadly deficient. The standard work on composition is H. P. Robinson's "Pictorial Effect in Photography."

Gum Arabic. A gummy exudation from the stems of various species of acacia. It is of peculiar bland taste, odourless, insoluble in alcohol and ether, but entirely soluble in water, in which form it is used as a mountant (*q.v.*).

Gum Dammar. See DAMMAR.

Gum Dragon. See TRAGACANTH.

Gum Guaiacum. A resinous exudation from *Guaiacum officinale*, a native of San Domingo and Jamaica, soluble to the extent of 90 per cent. in absolute alcohol, and when triturated with water forms a mucilage of pale greenish hue. It is used in some of the old collodion processes.

Gun-cotton. See PYROXYLINE.

Half-plate. The size of dry-plate 6½ by 4¾. The true half-plate is 6½ by 4¼.

Halation. A blurring of the image and an encroachment of the high-lights upon the surrounding shadows or darker portions. It is but too well known as the defect of photographing an interior in which a brilliantly lighted window appears; or again, when photographing landscapes in autumn or winter, halation is very likely to make its appearance when the leafless boughs of the trees appear against a bright sky, or in any case where extreme contrasts of light and shade exist. It is caused by reflection from the back of the plate. The rays of light are scattered by the particles of silver salt, and, obeying certain laws of reflection, are reflected from the surface and back of plate. The remedies are Backing the Plate (*q.v.*), the use of thickly coated and matt-surfaced plates and plates containing iodide of silver, the latter being an almost certain preventative of halation, chiefly because the iodide emulsion is more opaque than a bromide; but if an emulsion could be obtained absolutely transparent, there would be practically no halation. When photographing interiors, it has been recommended to cover the window with some slightly opaque substance, such as pale yellow linen or unbleached calico, so as to reduce the intensity of the light; and, again, it has been recommended to cut small shapes of black velvet, and hang on wires in front of the camera, so as to exclude the windows themselves from the focussing screen, removing them only a short period before the close of exposure. When halation does exist in a negative, local reduction (*q.v.*) may be resorted to. (See also DEVELOPMENT.)

Head-rest. An apparatus used for maintaining an exact position and steadiness of a sitter during exposure. Great prejudice exists in the minds of most people against it, due to its use having been abused to such an extent as to become an absolute instrument of torture. In all cases the head-rest should be brought to the sitter's head, and applied gently, so as to give sufficient support without giving any idea of rigidity.

Hectogramme. See WEIGHTS AND MEASURES.

Hectolitre. See WEIGHTS AND MEASURES.

Hectometre. See WEIGHTS AND MEASURES.

Heliochromy. A title given to photography in natural colours.

Heliotype Process. See COLLOTYPE.

High-lights. The brightest parts of a picture, which are represented by the greatest density or opacity, as the face in portraits, the sky and other bright portions in the landscape.

History of Photography. See PHOTOGRAPHY.

Hydrogen. H = 1. A gaseous element of very frequent occurrence in nature in a combined state, especially in the form of water. It is taken as the unit of atomic weights. It is used for the production of the lime-light.

Hydrogen Peroxide. $H_2O_2 = 34$. Synonym: Hydroxyl. Made by passing carbonic acid gas through water in which barium dioxide (BaO_2) is suspended. Barium carbonate is precipitated, hydroxyl being formed in solution: $BaO_2 + CO_2 + H_2O = BaCO_3 + H_2O_2$. It is a powerful oxidiser and bleaching agent, and is used to free prints and negatives from the last traces of hypo, which it does by oxidising it into sulphate, but it must be used very weak (about 2 drms. to 5 ozs.), or the density of the negatives and the tones of the prints will be reduced and sulphur deposited.

Hydroquinone. $C_6H_6O_2 = 110$. Synonyms: Hydrokinone, Hydrochinone, Pyroquinole. Is prepared commercially by oxidising aniline sulphate with bichromate of potash. It is soluble in water, ether, alcohol, and glycerine, and has been lately recommended as a universal developer, as it answers admirably for dry plates, bromide paper, opals, and lantern slides. It is one of the best developers extant. The amount of detail brought out by hydroquinone is extraordinary. It gives extreme latitude in exposure, and is under easy control, being rather slow in action. It is met with commercially as pale buff or nearly white needle-like crystals, which darken if kept exposed to damp and light. In solution it rapidly oxidises and turns reddish brown; the solution instantly reduces a solution of nitrate of silver to the metallic state, and strikes a purplish black colour, instantly changing to reddish brown with solution of perchloride of iron. It can be preserved in solution with alcohol and glycerine, and may be used either with ammonia or the fixed alkalies potash and soda as accelerators. The following are two such solutions:—

Hydroquinone	8 grs.
Glycerine	1 drm.
Methylated spirit	7 drms.

Keep in stoppered bottle excluded from light.

Hydroquinone	8 grs.
Citric acid	8 „
Distilled water	8 drms.

The use of a preservative such as sulphite of soda or metabisulphite of potash is, however, a great advantage, as by their aid many plates can be developed in the same bath without any chance of stain or discoloration of the developer.

I.

Hydroquinone	60 grs.
Metabisulphite of potash	100 „

Distilled water to make 8 ozs.

II.

Carbonate of soda	240 grs.
Carbonate of potash	240 „

Distilled water to make 8 ozs.

Developer.

Solution I.	1 oz.
Solution II.	3 ozs.

This gives a rich black colour, and two or three dozen plates may be developed in the bath without discoloration.

I.

Hydroquinone	48 grs.
Sodium sulphite	100 „

Distilled water to make 5 ozs.

II.

Carbonate of soda	480 grs.

Distilled water to make 4 ozs.

Developer.

Solution I.	120 mins.
Solution II.	200 „
Distilled water	1½ ozs.

for developing half-plate. This darkens much quicker than the first, but several plates may be developed in the same bath.

One-Solution Hydroquinone Developer.

Hydroquinone	5 grs.
Sodium sulphite	10 „
Lime water	1 oz.

This will keep clear three or four weeks, and is especially recommended for lantern plates. Ninety-six minims of above diluted with an ounce of water will develop many lantern plates. For ordinary plates it should be used double the strength. Hydroquinone should soon take the place of ferrous oxalate for enlargements and small work on bromide and Alpha paper, and opals, as very fine warm tones are obtained and no clearing is required. One grain of hydroquinone will do considerably more work than two grains of pyrogallol.

Hydroxylamine Hydrochloride. $NH_3OHCl = 69{\cdot}5$. Prepared by the reduction of nitrate and nitrate of ammonia. It is very soluble in water and alcohol; it has been recommended as a new developing agent; but its price is at present decidedly against it, besides there being few, if any, advantages over hydroquinone and pyrogallol. The following is the form recommended by Messrs. Egli & Spiller:—

I.

Hydroxylamine	32 grs.
Citric acid	15 „
Distilled water	1 oz.

II.

Carbonate of potash	480 grs.
Carbonate of soda	480 „
Distilled water	10 ozs.

Developer.

Solution I.	30 mins.
Solution II.	120 „
Distilled water	1½ ozs.

Sufficient for half-plate. It is especially recommended for chloride plates, bromide and Alpha papers.

Hypo. An abbreviation of Hyposulphite of Soda (*q.v.*).

Image. An optical term denoting the appearance of any object made by reflection or refraction, and in this sense applied to the reproduction of an object upon the ground-glass.

Image, Latent. The action of light upon the sensitive salts of silver has always been a moot-point with scientific photographers, and it would be impossible within reasonable limits to give all the arguments *pro* and *con*. For some considerable time past and even now a few photographers hold that the action of light upon the sensitive salts is to set up a vibratory motion, which the developer takes advantage of, reducing these vibrating molecules to a metallic state. This theory, however, has been shown, and it is generally considered most conclusively so, by Captain Abney and Dr. Armstrong, and more lately by Carey Lea, of New York, to be erroneous. The latter scientist has written most exhaustive papers upon this point (*Photographic News*, June and July 1887), and has been enabled to prepare chemically salts identical in composition and action with those formed by the action of light; these he calls photo-salts, and they would seem to be compounds of a lower haloid salt, with the normal haloid in varying proportions. In all cases there seems to be an evolution of the haloid element, and the action has been thus chemically expressed—

$$\underset{\left(\begin{smallmatrix}\text{Silver}\\ \text{bromide}\end{smallmatrix}\right)}{2AgBr} + \text{light} = \underset{\left(\begin{smallmatrix}\text{Silver}\\ \text{sub-bromide}\end{smallmatrix}\right)}{Ag_2Br} + \underset{\left(\begin{smallmatrix}\text{Bro-}\\ \text{mine}\end{smallmatrix}\right)}{Br.}$$

It seems unlikely that all the molecules of haloid salt are reduced; on the contrary, but a very minute portion is. But, as shown in the article on Development, the action set up by the impact of actinic light is continued by the developer. It has been stated that when the action of reduction by light has once begun, it continues indefinitely in the dark; but the arguments in favour of this statement are very weak, as it has been shown, on the other hand, that the action of light may be obliterated by keeping.

Incidence, Angle of. Is the angle made by a ray of light, passing through any point or line of a surface, with the perpendicular to that line or surface drawn through the point in question, or to the tangent of a circle in the case of spherical curves. The angle of incidence and the angle of reflection are always equal.

Indian Ink. A black pigment obtained from China. It is an exceedingly fine lampblack, said to be produced by burning

oil of sesame, mixed with some vegetable gum, and dried till it turns into a solid cake.

Ink Process. A convenient method of obtaining ink pictures, possessing all the delicate detail and gradation of a silver picture. Immerse good writing paper in a nearly saturated solution of bichromate of potash, and dry in the dark; expose under a negative until all detail appears as a brown image upon a yellow ground, then wash in running water for two hours; the print is permanently fixed when the ground of the paper appears white. Immerse in an aqueous solution of ferrous sulphate (5 grs. to the oz.) for a few minutes, then immerse in a weak hydrochloric acid bath for fifteen minutes; wash in running water for two hours. Now immerse in a strong solution of tannin (20 grs. to the oz.), when the image will turn black; wash well and dry. Another method much used by artists and draughtsmen is to take a print on plain salted paper in the usual way, and as soon as the most important details appear they are traced out with a pen and ink, and when dry the print is bleached in a solution of perchloride of mercury and fixed.

Insensitiveness. When, by reason of faulty chemicals or manipulations, the sensitive surface refuses to record any action of light.

Instantaneous Lens. Almost any lens may be used for instantaneous work, but the rapid rectilinear is without doubt the best, next the wide-angle rectilinear, and lastly the achromatic landscape. Portrait lenses are now made of such aperture as to be capable of taking portraits of children in a studio or well-lighted room in the fractional part of a second. A so-called instantaneous lens is suitable for instantaneous work, not from any peculiar inherent property, but simply because it works with a large aperture, and all lenses which have sufficiently large diaphragms, whether singlets or doublets, are instantaneous.

Instantaneous Photography is the obtaining of negatives by exposures of the fractional part of a second. To such a pitch has this now been brought that images of bullets projected from guns have been obtained showing the head of air driven in front of the bullet, and the waves of air taking the place of that displaced, perhaps the only authentic record of the air being seen. Photographs of birds and animals in motion are now of common

occurrence. The following tables and rules for instantaneous work may be found useful:—

An object moving—

1	miles	per	hour	moves	...	...	1½	ft.	per sec.
2	,,	,,	,,	...	...	...	3	,,	,,
3	,,	,,	,,	...	...	...	4½	,,	,,
4	,,	,,	,,	...	...	...	6	,,	,,
5	,,	,,	,,	...	...	...	7½	,,	,,
6	,,	,,	,,	...	...	...	9	,,	,,
7	,,	,,	,,	...	...	...	10½	,,	,,
8	,,	,,	,,	...	...	...	12	,,	,,
9	,,	,,	,,	...	...	...	13	,,	,,
10	,,	,,	,,	...	...	...	14½	,,	,,
11	,,	,,	,,	...	...	...	16	,,	,,
12	,,	,,	,,	...	...	...	17½	,,	,,
13	,,	,,	,,	...	...	...	19	,,	,,
14	,,	,,	,,	...	...	...	20½	,,	,,
15	,,	,,	,,	...	...	...	22	,,	,,
20	,,	,,	,,	...	...	...	29	,,	,,
25	,,	,,	,,	...	...	...	37	,,	,,
30	,,	,,	,,	...	...	...	44	,,	,,
35	,,	,,	,,	...	...	...	51	,,	,,
40	,,	,,	,,	...	...	...	59	,,	,,
45	,,	,,	,,	...	...	...	66	,,	,,
50	,,	,,	,,	...	...	...	73	,,	,,
55	,,	,,	,,	...	...	...	80	,,	,,
60	,,	,,	,,	...	...	...	88	,,	,,
75	,,	,,	,,	...	...	...	110	,,	,,
100	,,	,,	,,	...	...	...	147	,,	,,
125	,,	,,	,,	...	...	...	183	,,	,,
150	,,	,,	,,	...	...	...	220	,,	,,

To find the distance moved by the image of an object on the ground-glass, multiply the focus of the lens in inches by the distance moved by the object in 1 sec., and divide the result by the distance of the object in inches. Example: Find the displacement of image on ground-glass of an object moving 55 miles an hour, when a lens of 8½-in. focus is used, and the object is 200 yds. distant:—

$$8\tfrac{1}{2} \times 960 \div 2{,}400 = \frac{17 \times 960}{2{,}400} = 3\tfrac{2}{5} \text{ ins. per sec.}$$

To find how quickly a shutter must act to take an object in motion that there may be a circle of confusion less than $\frac{1}{100}$in. in diameter, divide the distance of the object by 100 times the focus of the lens, and divide the rapidity of motion of object in inches per second by the result, when you have the longest duration of exposure in fraction of a second. All measurements in inches. Example: Required the speed of shutter to take a train moving 50 miles per hour 50 yds. off, with an 8½-in. focus lens:—

Train moves 876 ins. per sec.

1,800, distance in ins., $\div (8\tfrac{1}{2} \times 100) = 1{,}800 \div 850 = \frac{36}{17}$.

876, speed of object per sec., $\div \frac{36}{17} = \frac{876 \times 17}{36} = 413 = \frac{1}{413}$ sec.

And knowing the rapidity of shutter and moving object required to find the distance to place the camera to give an image with a circle of confusion less than $\frac{1}{100}$ of an inch, multiply 100 times the focus of the lens in inches by the space through which the object would pass during the exposure, and the result is the nearest distance in inches between lens and camera. Example: A shutter working at $\frac{1}{50}$ of a sec., object moving 50 miles per hour; how near must camera be placed with lens 8½-in. focus?

An object moving 50 miles per hour moves 876 ins. per sec.

∴ an object moving 50 miles per hour moves 17·52 ins. in $\frac{1}{50}$ sec.

$8\tfrac{1}{2} \times 100 \times 17{\cdot}52 = 8{\cdot}5 \times 100 \times 17{\cdot}52 = 14{,}892$ ins. = 413 yds.

Instantaneous Shutters. The names, styles, and prices of these are legion; but the simplest, and perhaps one of the best, is the old-fashioned drop-shutter. As a so-called instantaneous shutter is usually part of the outfit of every amateur, it will be unnecessary to enter further upon the subject; but we have yet to welcome the ideal shutter which shall comprise in itself portability, lightness, cheapness, reliability, with the minimum chance of disorder and vibration, and the maximum. even lighting of the sensitive surface, the exposure commencing and closing absolutely simultaneously for the whole plate.

Intensification means the increasing of the deposit or the density of a negative. This is done in many ways: first, by

merely increasing the deposit of silver; secondly, by partial substitution of another metal for it. The following are reliable methods for each process, but of these the author has decidedly a weakness for I. A and II. B:—

I. *By Increasing the Deposit of Silver.*

A.

Perchloride of mercury	100 grs.
Bromide of potassium	100 „
Distilled water	10 ozs.

Dissolve, and label "Bleaching Liquid—Poison."

Silver nitrate	100 grs.
Distilled water	10 ozs.

Add sufficient cyanide of potassium in solution to nearly dissolve the precipitate first formed on adding the cyanide. Label, "Silver Cyanide Solution—Poison." Soak the plate in the bleaching liquid till the image appears quite white by reflected light on both sides, wash for fifteen minutes, and then immerse in the silver cyanide solution till thoroughly blackened; wash, and dry. Care must be taken that the plate is not allowed to remain too long in the cyanide solution, or the image will be reduced. Allowance must also be made for the fact that the negative looks denser when wet than when dry. The following is an intensifier which has lately been recommended by Mr. Farmer, which has found much favour on the Continent:—

Solution 1.

Silver nitrate	480 grs.
Distilled water	12 ozs.

Solution 2.

Potassium bromide	360 grs.
Distilled water	2 ozs.

Add No. 2 to No. 1, collect the precipitate, wash thoroughly, and mix in following:—

Sodium hyposulphite	960 grs.
Distilled water	6 ozs.

The mixture is thoroughly stirred, allowed to stand for a few hours, and filtered, and sufficient distilled water added to make the solution measure 16 ozs. Label, "Silver Solution." The plate

is soaked in this solution for five minutes, drained, and a ferrous-oxalate developer applied; washed, and dried. Or the following may be used:—

Pyrogallol	4 grs.
Distilled water	2 ozs.
Silver solution	60 mins.

Add immediately before use 30 minims of 10 per cent. solution of liq. ammonia ·880.

II. *By Substitution.* 1st, with Mercury.

Mercury perchloride	100 grs.
Potassium bromide	100 „
Distilled water	10 ozs.

Soak the plate in this till thoroughly bleached, then rinse, and immerse in a solution of

Sodium sulphite	480 grs.
Distilled water	8 ozs.

Mr. Dresser has recommended the use of an old hydroquinone developer instead of the sodic sulphite, and the resulting intensification is all that can be desired.

B.

Uranium Substitution.—Soak the plate for ten minutes in a solution of uranium nitrate 50 grs., distilled water 1 oz.; drain, and soak in a solution of same strength of ferridcyanide of potash till dense enough; wash, and dry. All negatives, whether wet, dry, or varnished, glass or films, can be intensified by any one of these methods; but, except in the case of Mr. Farmer's new intensifier, they must be absolutely free from hypo. If the negative has been varnished, it must be soaked in methylated spirit, and the varnish removed with a tuft of rag or cotton-wool. Negatives that have been allowed to dry should be soaked in a bath of distilled water previous to applying the intensifiers, as the action is thus rendered more even.

Iodine. I 127. One of the halogen elements. Is obtained from seaweed, and appears commercially in metallic bluish grey scales. Solubility: 1 in 7,000 of water, 1 in 12 of alcohol, 1 in 4 of ether; very soluble in a solution of any alkaline iodide. 30 grs. of iodine and 30 grs. of potassium iodide will dissolve in

1 drm. of distilled water. The metalloid itself is of little use, but when in combination as iodide is much used for preparing emulsions, etc.

Iridescent Stain. See Fog.

Iron, Ammonio-Citrate of. Is prepared by dissolving ferric oxide in citric acid, and adding liq. ammonia till neutral. It should be in small transparent scales of a deep reddish brown colour, and peculiar mousey odour. Solubility: 1 in 0·5 parts of water; almost entirely insoluble in alcohol. 5 parts dissolved in 7·5 parts of water make 10 parts of solution. It is used in the ferro-prussiate process.

Iron, Ammonio-Sulphate of. $Fe(NH_4)_2SO_4 6H_2O = 328$. A double salt of iron and ammonium proposed as a substitute for ferrous sulphate, but its action is much feebler, though the salt and its solution are more stable. 1 oz. of ferrous sulphate is equal to 1½ ozs. of the double salt. The author has found it, however, a good but slow developer for bromide papers. Solubility: about 1 in 5 of cold water; liable to decompose in hot water; insoluble in alcohol.

Iron, Oxalate of. $FeC_2O_4 = 144$. Synonym: Ferrous Oxalate. Prepared by decomposition of sulphate of iron and oxalic acid. It is but rarely used dry, being generally prepared as wanted in solution by double decomposition by adding solution of sulphate of iron to solution of oxalate of potash. (See Developer.) It is sparingly soluble in water, more soluble in a solution of any alkaline oxalate. It is the developing agent of the ferrous-oxalate developer, which has rather more adherents on the Continent than in England.

Iron, Sesquioxalate of. $Fe_2(C_2O_4)_3 = 376$. Synonym: Ferric Oxalate. Is usually prepared in solution by dissolving ferric oxide in oxalic acid. It is very soluble in water, and is used in the platinotype process, the action of light reducing it to ferrous oxalate. Ferric oxalate can be made from old used ferrous-oxalate developers by adding solution of sulphate of iron till the mixture turns very muddy, then add saturated solution of oxalic acid till clear again. Set the solution aside in a cool dark place to crystallise. The ferric oxalate crystallises out as bright emerald green crystals, which should be

dried quickly between blotting paper, and preserved from the action of light and air.

Iron, Sulphate of. $FeSO_4 7H_2O = 278$. Synonyms: Ferrous Sulphate, Protosulphate of Iron, Copperas, Green Vitriol. Prepared by dissolving iron wire in dilute sulphuric acid, evaporating and crystallising. The crystals should be of a fine bluish green colour, free from any adherent brownish rusty powder, which is caused by the action of the oxygen of the air, the product being an oxy-sulphate: to this action is also due the deterioration of solutions of this salt. When this change in colour of a solution is noticed, it should be rejected and fresh solution used. The solution may be preserved for some time by the addition of a crystal of sulphate of copper whilst fresh Solubility: 1 in 1·5 of water; insoluble in alcohol and ether.

Iron, Perchloride. $Fe_2Cl_6 = 325$. Synonym: Ferric Chloride. Can be made by digesting hydrochloric acid with excess of peroxide of iron or by dissolving iron wire in dilute hydrochloric acid, and adding nitric acid, which converts the ferrous into ferric chloride. Commercial solutions as a rule contain considerable excess of hydrochloric acid. The solid chloride is extremely deliquescent and very soluble in alcohol.

Isinglass. The purest form of gelatine known, obtained from the swimming bladder or sound of the sturgeon. The finest is exported from Russia.

Ivory. The teeth and tusks of the elephant and walrus. Photographs can be obtained on ivory by coating with an emulsion or by transfer as in the carbon process.

Ivory Black. Make by calcining ivory in close crucibles; used as an ingredient for black varnish, etc.

Japan Varnish. See VARNISH.

Kaolin. Synonym: China Clay. A very fine hydrous silicate of alumina containing about 14 per cent. of water. It is a decomposition product from natural decay of felspar. It is used for cleaning plates, and was used in the old wet process as a mechanical purifier of the silver bath.

Lac. See SHELLAC.

Lamp. Well known as the source of artificial illumination in the dark-room. All lamps should be fitted with one or more

screens of ruby or orange glass, so as to decrease or increase the light as desired. As some amateurs may desire to rig up a temporary lamp whilst on tour, the following suggestions may be useful:—Every amateur should comprise amongst his travelling paraphernalia one or two square feet of ruby or golden fabric; by means of this a lamp may be improvised from an ordinary candle, or night-light, or a Chinese lantern, or the side may be knocked out of a cardboard hat-box. The author has before now changed plates when away from home by the aid of this little piece of ruby cloth by placing a candle in the empty fire-grate, and the ruby cloth over the bars.

Lampblack. The very light form of carbon produced by burning pitch, resin, or any other smoky substance with limited access of air, and collecting the soot formed.

Landscape Lens. See LENS.

Lantern, Optical. See MAGIC-LANTERN.

Lantern Slides. See TRANSPARENCIES.

Latent Image. See IMAGE, LATENT.

Latitude of Exposure. It is frequently a fallacy with novices, and even with some more advanced workers in the photographic art, that unless an exposure which is correct to the infinite fraction of a second, according to some mathematical tables or actinometer reading, is given to a plate, the resulting negative cannot be and is not a success; but this I have endeavoured to prove is wrong in an account of some experiments which appeared in the *Amateur Photographer*, and for the special purpose of this article the following trials were made. Different brands of commercial plates were obtained.

1.	Bromo-iodide,	thickly	coated	extra rapid.
2.	Bromide,	thinly	„	„ „
3.	„	„	„	ordinary.
4.	„	thickly	„	extra rapid.
5.	„	„	„	ordinary.
6.	„ extra	„	„	slow.

Four of each kind were exposed on a given subject—a landscape with a strong foreground of a cottage and garden—in a brilliant light about noon. The exposure was found to be, for the ordinary plates, *f*/22 diaphragm, 5 secs.; for the rapid ones

barely 2 secs. The exposures were arrived at by certain exposure tables in common use, and were checked by an actinometer. The conditions of the experiment were so far the same as any ordinary amateur would work under; the exposures were timed by a chronograph. The exposures given were—For the ordinary plates Nos. 3 and 5, $\frac{1}{2}$ sec. with *f*/8 diaphragm; 5, 10, and 40 secs., *f*/22. For the extra rapid Nos. 1, 2, and 4, $\frac{1}{2}$ sec. with *f*/8; 2, 4, and 20 secs. with *f*/22. For No. 6 the exposure was found to be 7 secs., and these were given 7, 14, 28, and 70 secs., *f*/22. All were most carefully developed as described under DEVELOPMENT, and the results were as follows:—No. 1, all good negatives; more detail in the longer-exposed ones. No. 2, with the instantaneous exposure, a thin, poor negative was obtained; fair presentable ones with 2 and 4 secs., but 20 secs. gave considerable halation and fog. No. 3, with $\frac{1}{2}$ sec. exposure, gave a much under-exposed negative, fogged from forcing; with 5 and 10 secs., good negatives; with 40 secs., showed marked halation. No. 4, all good negatives; the longer-exposed ones with more detail. No. 5, same as No. 3; no halation. No. 6, the shorter exposures all gave good negatives, and with the 70 secs. exposure no halation, no fog, and an enormous amount of detail. Sufficient has now been said to prove the extreme latitude of exposure which most plates possess. With a full exposure, infinitely more detail can be obtained without the sacrifice of any pluck or vigour, and a better rendering of colour is obtained. Any photographer can perform a few experiments for himself without any great outlay by exposing one half of a plate for the correct time, the other half for double on the same subject, and after careful development comparing the result.

Lead. Acetate of. $Pb(C_2H_3O_2)_2 3H_2O = 379$. Synonym: Sugar of Lead. Made by dissolving carbonate of lead in dilute acetic acid or impure vinegar, and subsequent purification and crystallisation. It has been recommended as a hypo-eliminator, but the benefit of its action is doubtful. Solubility: 10 in 25 of water, 12 in 100 of alcohol.

Least Circle of Aberration. Is the smallest possible section of the cone of rays of light emergent from a lens. Practically, it is the nearest approach to a perfect focus that parallel rays of light can have.

Lens. An optical term given to discs of glass bounded by two spherical surfaces, or by a plane and a spherical surface. A true lens is one which has the form shown in fig. 1, *a*; but the name now includes many other shaped glasses or combination of glasses from the analogy of their action upon light. The first mention of the use of a lens which I have been enabled to trace out is by the Chinese moralist Confucius, 748 B.C., who says, "As we use a glass to examine objects, so must we look to the present for futurity." But in the Western classics, about A.D. 40, mention is made by Seneca, Aristophanes, and other writers for the first time of globes of water and globes of glass; but of a true lens absolutely no mention is made, and it is even doubtful whether they were more than conversant with the burning powers of the above globes. There is, however, in the Assyrian Section of the British Museum a piece of rock-crystal of plano-convex form, which Sir David Brewster states was designed for magnifying. It has been shaped oval, evidently by a process of chipping and grinding, and both plane and convex surfaces have been partly polished. It seems more likely, however, that it was used as an ornament. The date of this is about 720 B.C. There are also in the British Section several antique glass bosses, which have been evidently polished and cut to a wonderfully true curve. These, however, it is supposed, were used for ornamenting shields, sword handles, etc.

The first lenses that we can find any really reliable record of are of those of spectacles, and these are mentioned by Giordano da Rivalto in 1305, as having been invented only "twenty years ago." This will fix the date at 1285, when they were invented by Salvino d'Armati, a Florentine; but, like some of those who have followed in his footsteps in the present day, he desired to make his fortune by this invention or discovery by keeping the same secret; but the patent laws, unfortunately for him, were not quite so well developed as at the present time; and a scientist of Pisa, Alessandro della Spina, having seen some of Armati's spectacles, made some for himself, and published the method of manufacture.

The gradual and perhaps accidental deepening of the curves of these lenses produced shorter foci, till, by the accidental placing at some distance apart of a concave and convex lens by some children of a Dutch spectacle maker, the telescope was

discovered, and from this origin all lenses of the present day have been evolved. All lenses are made of crown or flint glass, the former being free from and the latter containing lead, being slightly more refractive than the former. The sectional forms of the various lenses are here given :—

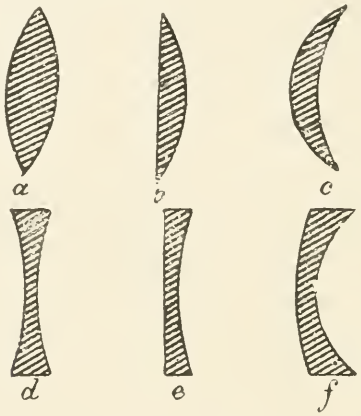


FIG. 1.—*a*, double convex; *b*, plano-convex; *c*, concavo-convex or converging meniscus; *d*, double concave; *e*, plano-concave; *f*, divergent meniscus.

The first three, *a*, *b*, *c*, which are thicker at the centre than at the margins, are convergent or positive; and the second three, *d*, *e*, *f*, are divergent or negative. All lenses are formed by the union of prisms, and therefore have to a great extent the properties of prisms. Fig. 2 will show the way in which the prisms

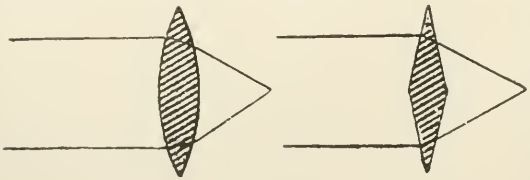


FIG. 2.

are united to form a biconvex lens, and the concentration of the rays of light by such prisms or lens.

Fig. 3 is the representation of the prisms forming a double

concave, and the divergent action of such prisms or lens upon the rays of light.

It is obvious that by combining the two lenses the convergent or positive action of the one may be counteracted by the divergent

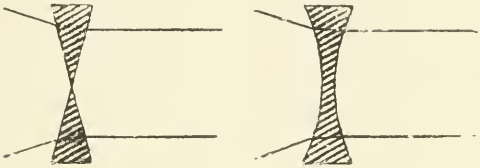


Fig. 3.

or negative action of the other. It is upon these principles that the whole of the modern lenses are calculated. As soon as it was announced in 1839 by Daguerre and Fox Talbot that they had been enabled to obtain a comparatively permanent image in the camera obscura, the ability and skill of mathematicians and opticians were brought into play to produce lenses which should be free from the objections common to the double convex lens which was the only one used in the camera obscura in those days.

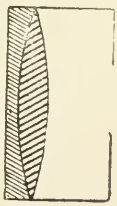


Fig. 4.

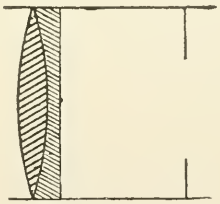


Fig. 5.

The single lens was replaced by the achromatic combination of the telescope. This was eventually reversed, and the plane side presented to the object, as in fig. 5.

Then Wollaston's meniscus (fig. 6) came to be recognised as a means of extending the definition; and in 1840, Chevalier, a Paris optician, still further improved it by a different method of achromatising the lens.

But in the following year, through the agency of Voigtlander, a practical optician, a lens designed by Professor Petzval, a

mathematician of Vienna, was made and introduced commercially in 1841. This was the portrait lens; and it is a remarkable fact that it is the model for the finest portrait lenses of the present day. The following (fig. 7) is a sketch of Petzval's original portrait

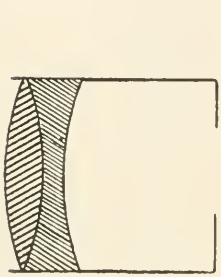


FIG. 6.

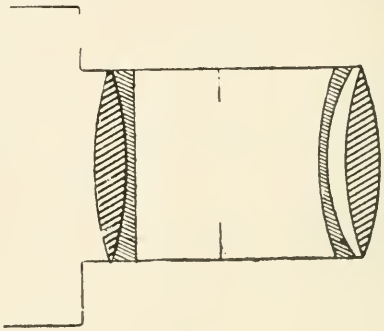


FIG. 7.

lens:—The dark shaded parts are crown, the light shaded parts are flint glass, and, as will be seen, the front combination exists of a double convex crown cemented to a double concave flint, and the back of a flint concavo-convex separated from a double convex lens of crown glass, the flint concavo-convex having such a negative refractive power as to completely balance the

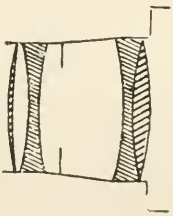


FIG. 8.

positive aberration of the whole combination. This has been modified by Dallmeyer, by Grubb, and the noted American optician Morrison; but all are constructed on the principle of above lens (fig. 7). Professor Petzval calculated at the same time a landscape lens (fig. 8), which was not introduced commercially till 1857.

and an English optician, in 1858, introduced a lens having a concave glass in place of the diaphragm to lengthen the focus and flatten the field, and Dallmeyer introduced his famous triplet (fig. 9), which at the present time is much used and admired.

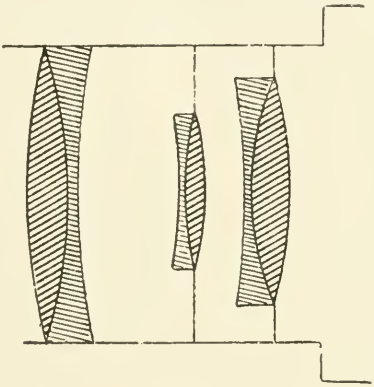


Fig. 9.

Single lenses were first of all of the kind shown in fig. 4, with which extremely small diaphragms are necessary to reduce

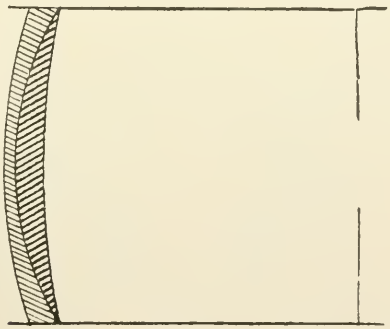


Fig. 10

spherical aberration and distortion. This was improved on by Grubb, and his lens is shown in fig. 10, in which a crown-glass lens of meniscus form is presented to the object, and is cemented

to a flint meniscus. This gave a much flatter field, and spherical aberration was much reduced, allowing the use of larger diaphragms.

Dallmeyer introduced his single lens (fig. 11), which consists of a negative flint enclosed between two positive crown-glass lenses. This enabled a much larger aperture to be employed,

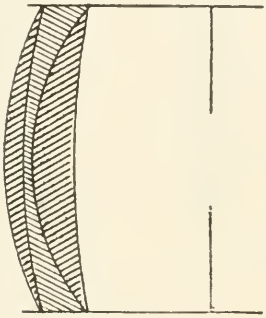


FIG. 11.

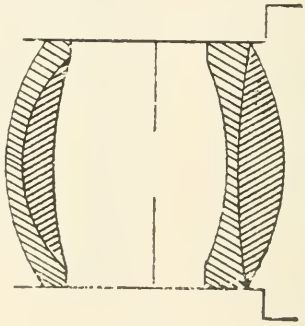


FIG. 12.

and totally eliminated spherical aberration. Marginal definition and flatness of field were both improved.

To obviate distortion, many doublet lenses were introduced, that of Mr. Ross being shown in fig. 12. This instrument possesses a wide angle, giving splendid definition, without any distortion or aberration.

In all doublets, the diaphragm being placed between the com

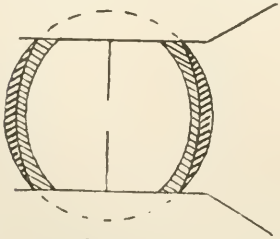


FIG. 13.

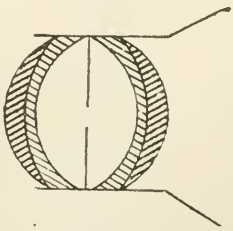


FIG. 14.

binations, the distortion of the one is cured by the distortion of the other. In 1860 Harrison, of New York, introduced his globe

lens (fig. 13), which had an extremely wide angle, but which, from too close an adherence to the globe form, gave a flare.

Busch improved upon this with the pantoscope (fig. 14), and Dallmeyer introduced his wide-angle rectilinear (fig. 15).

Steinheil introduced what he called his periscopic lens (fig. 16), which consists of two uncorrected meniscus lenses of crown

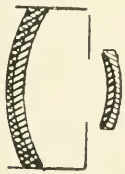


FIG. 15.

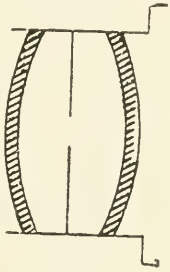


FIG. 16.

glass; and chromatic aberration not being eliminated, the focussing screen had to be brought nearer to the lens after focussing and before exposing, by $\frac{1}{40}$ of the focal length of lens.

Mr. Sutton's panoramic lens (fig. 17) consisted of two concavo-convex lenses, with spherical curvatures and a hollow space

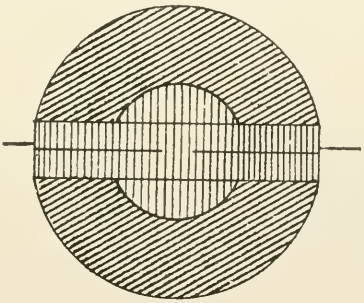


FIG 17.

between filled with water. This possessed a wide angle, and gave no, or practically no, spherical or chromatic aberration, but from its peculiar construction, and the necessity of using curved plates, has never come into general use.

In figs. 18, 19, and 20 are shown some lenses by Steinheil, fig. 18 being an aplanatic rapid rectilinear, and figs. 19 and 20

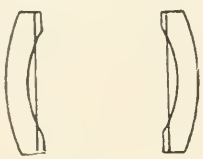


FIG. 18.

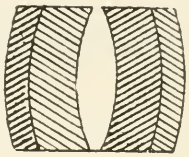


FIG. 19.

wide-angle aplanats, some of the finest lenses of the day; and in figs. 21 and 22 are shown two more of Steinheil's lenses, which work at *f*/2·5, No. 21 being for groups, No. 22 for portraits.

In fig. 23 I am enabled, by the kindness of Messrs. Perken, Son, & Rayment, to give a sketch of the Euryscope lens, which

FIG. 20

is composed of two symmetrical combinations of flint glass, and works at an aperture of *f*/6, a great gain for rapid work. These lenses are perfectly free from spherical and chromatic aberration

FIG. 21

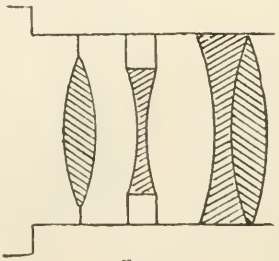


FIG. 22.

and distortion, and for such a large aperture have a wonderful depth of focus, with an extremely flat field. Within the last few months Mr. Dallmeyer has introduced a rectilinear or non-

distorting single lens, which works at a large aperture, which is absolutely free from distortion, without astigmatism, and a very flat field (fig. 24).

Thus far I have endeavoured to give some slight sketch of the

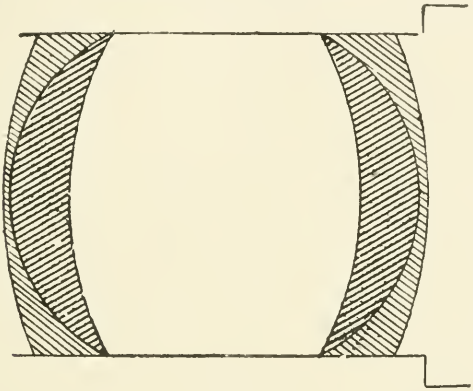


Fig. 23.

leading and fundamental forms of all lenses, and whilst numerous modifications exist which may be considered advantageous by some, they are all made on the principles involved in one of the above.

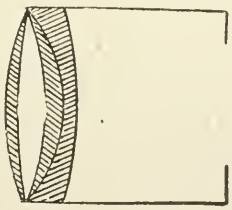


Fig. 24.

A lens, or rather a doublet lens, is said to be symmetrical when both combinations are precisely alike and possess the same optical properties. In all such combinations the diaphragm is placed midway between the two. Non-symmetrical lenses are those in which one of the combinations is the more powerful in

some way or other, in which case the diaphragm is placed at the exact proper distance as calculated by the optician. To enable the amateur to select a lens for his own use, several considerations are necessary, and although he may be to some extent guided by the vendor of the lens, the following may be of some assistance:—

The lens should be absolutely free from striæ; these can be detected by placing the eye at the focus of a lens before a strong light, such as gas or a lamp; bubbles can also be seen, but too much stress need not be laid on the presence of one or two bubbles, as when not present in very large numbers they may be disregarded. For what purpose is the lens required? For ordinary landscape work, architectural subjects, interiors, or portraits. For landscape work pure and simple there are few lenses to equal the achromatic single landscape lens, which gives brilliant negatives; and although distortion is present it may be disregarded, as it is practically unnoticeable in small views except by mathematical measurement. Some of these lenses are now made to work aplanatic with an aperture of *f*/8, and are therefore of nearly the same rapidity as the rapid rectilinear, which is, however, the lens *par excellence* for amateurs, as its use is practically unlimited, especially as some are now made to work at almost as large an aperture as a portrait lens. Few amateurs will require a portrait lens, as they are not only difficult to use properly, but are exceedingly limited in action and also expensive. The question of how much view to include on a plate is another important consideration which should not be lost sight of (see ANGLE, WIDTH OF); for ordinary work it should never exceed 50° to 55°, and 45° is decidedly better, as this is about the angle included by the human eye. If a much greater angle be included, the resulting pictures have a distorted appearance, because it is extremely unlikely that the eye will be placed at the focal length of the lens from the picture. The glass of which lenses are made should be absolutely colourless; this can be tested by laying the lens upon a sheet of white paper and looking down through it. Some of the cheaper lenses are made of glass which is not colourless; and any colour, especially brown or yellow, will make the lens slow.

As stated under the article GLASS, it is absolutely necessary to obtain it perfectly homogeneous, free from striæ, colourless

and transparent; bubbles, lines, and opaque particles in lenses merely obstructing a certain amount of light, but striæ prove imperfect and unequal mixture of the substances composing it, and will therefore give different refractions. The glass is made in the following manner:—Crucibles of fire-clay of particular form are raised to a white heat in a furnace, and when the fuel ceases to give off smoke, they are charged with the materials, and the heat is continued for eight or ten hours. The crucible is now raised to a white heat for four hours, and the mixture stirred with a bar of potter's clay. Six times from hour to hour the mixture is stirred. The heat is then reduced, that the bubbles may rise, and again at the end of two hours the heat is raised to make the glass fluid; again stirred for two hours, and the crucible and the openings of the furnace closed and left for eight days to cool. The crucible is taken out and broken, and the glass is removed and divided into pieces. The divided glass is examined and sorted, the finest being retained for astronomical purposes, the second quality for photographic lenses, and the third for ordinary magnifying glasses, the rest being waste, which is added to the next melting. The pieces are then softened in a muffle furnace, and formed into plates about two or two and a half inches thick. Sometimes the plates are then cast, after being softened by heat, into rough moulds of clay or iron coated with sand so as to give them a rough form; but the best opticians prefer grinding, as striæ and bubbles are not so liable to be formed, except with condensing lenses in which striæ and bubbles are not of so much importance. The rough-shaped glasses have now to be made into perfect lenses, for which purpose extreme care is absolutely necessary, approximate forms being given by grinding with wet sand in concave or convex tools of cast iron. It is in the following operations that the greatest skill and care of the optician are required:—The roughly shaped lens is now to be ground with emery in spherical tools of brass or iron, which tools are made either by casting or by rough casting and subsequent work in a lathe. These are given the necessary curves by means of extremely accurate gauges of copper. The roughly fashioned glass or lens is fixed to a plate of brass by means of pitch, and is then worked in the tool with rough emery moistened with water; when the glass is found to touch the tool at all points, finer emery is used and it is worked a little more, the gauge being now

frequently applied to the tool, to see that the radii of curvatures are not altered; then finer kinds of emery still are used, till at last some degree of polish begins to show; fine pumice-stone powder is then substituted for emery, and the polishing is begun. The operation of polishing is really the test of a good optician, as this process may alter the sphericity or the radii of curvature of the lens to such a degree as to completely alter the character of the lens. The lens is fixed on to a block of wood by means of a pitchy cement, and a tool is coated with a resinous mixture, and fine rouge is sprinkled on the tool when cold, and the polishing finished entirely by hand.

When two lenses are required to be cemented together so as to present one common surface, they are slightly warmed, and a drop or two of Canada balsam is applied, and the two lenses pressed forcibly together, so as to squeeze out excess of balsam. When cooled, they present the appearance of one single piece of glass, and cannot be separated without heat. When two lenses have not a common surface, three small pieces of tinfoil are introduced at equal distances apart between their margins, or when the separation is greater, as in most portrait lenses, a ring of brass is used for the same purpose. When the lens is fixed in its brass ring, so that it cannot be taken out without raising the bent edge of the brass, it is said to be set.

Under the article Focus will be found numerous rules and tables, which may be of some service. The following, however, were not given then, and are, therefore, here introduced:—In portrait lenses, and some rapid rectilinears, when the latter are used at more than their equivalent focus, it is often desirable to know what depth of focus a lens possesses: depth of focus may be both before a given point and also behind it. The following rules are then required:—

Having focussed any point, to find the distance in front of that point which will be in focus (all measurements to be in inches, and the distance of object to be measured from the optical centre of lens)—

1. Multiply the focal length by the diameter of the stop, and the result by the difference between the focal length and the distance of the object.

2. Multiply the focal length by the diameter of the stop, and add $\frac{1}{100}$ part of the distance of the object.

3. Divide the first product by the last, add the focal length, and subtract the result from the distance of the object, when the result will be the distance sought for in front in inches.

To find the depth of focus behind a given point—

1. Multiply the focal length by the diameter of the stop, and the result by the difference between the focal length and the distance of the object.

2. Multiply the focal length by the diameter of the stop, and subtract $\frac{1}{100}$ part of the distance of the object.

3. Divide the first product by the last, add the focal length, and deduct the distance of the object; the result is the distance behind in inches.

Example :—Find the depth of focus when focussing an object 15 ft. distant with a lens of 7 in. focus, working at *f*/5.

$f/5 = 1\frac{2}{5}$ ins. 15 ft. = 180 ins.

$7 \times 1\frac{2}{5} = \frac{49}{5}$.

$180 - 7 = 173$.

$\frac{49}{5} \times 173 = \frac{8477}{5}$ (1).

$7 \times 1\frac{2}{5} = \frac{49}{5}$.

$\frac{49}{5} + \frac{180}{100} = \frac{49}{5} + \frac{9}{5} = \frac{58}{5}$ (2).

$\frac{8477}{5} \div \frac{58}{5} = \frac{8477}{58} = 146$.

$146 + 7 = 153$ $180 - 153 = 27$ ins. (3).

The depth of focus in front = 27 ins.

To find the depth behind. *Example* :—

$7 \times 1\frac{2}{5} = \frac{49}{5}$ $180 - 7 = 173$.

$\frac{49}{5} \times 173 = \frac{8477}{5}$ (1).

$7 \times 1\frac{2}{5} = \frac{49}{5}$.

$\frac{49}{5} - \frac{180}{100} = \frac{49}{5} - \frac{9}{5} \quad \frac{40}{5}$ (2).

$\frac{8477}{5} \div \frac{40}{5} = \frac{8477}{40} = 210$.

$210 + 7 = 217$ $217 - 180 = 37$.

The depth of focus behind = 37 ins.

Levelling Slab. A perfectly even piece of glass, slate, or any

other material sufficiently thick not to bend when placed upon the levelling stand, which is preferably of a triangular form, having a fine screw at each corner to allow of the height being altered as required. The slab of glass, or slate, is placed upon the stand and accurately adjusted by means of a spirit level.

Lichtdruck. See COLLOTYPE.

Light is that principle which emanates from all luminous bodies, and the luminosity of such bodies is due to intensely rapid molecular vibration, which vibration is propagated in a supremely subtle elastic medium termed the luminiferous ether, and light waves radiate from a body in all directions and from all points of that body. Light always travels in straight lines, unless deviated from its course by the action of some body through which it passes. All substances are either transparent (not hindering sight), translucent (hindering sight), or opaque: transparent substances allow light to pass through them, but deviate the course of the rays of light; translucent bodies, whilst allowing some rays of light to pass through, reflect others; whilst opaque bodies reflect some rays and absorb others, but the rays passing on each side of the opaque substance still continue their course, and leave behind the body a space which is not illuminated, or only partially so. This space is termed shadow. Shadows, however, are not rigidly defined, as the shadow cast by the interception of rays from the top edge are partly illuminated by the rays from the lower edge, and *vice versâ*, and the shadow is always partly illuminated by neighbouring rays. The velocity of light is about 186,830 miles per second. The intensity of the light varies in inverse proportion to the square of the distance from the source of light. If rays of light fall upon a body which is opaque, and the surface of which is unpolished, certain portions of such light will be absorbed or enter to a certain depth, the remaining portion being reflected in all directions; but certain bodies absorb only certain of the constituent rays of light, and reflect one or more of the others, and thus we arrive at the colours of objects. For example, an object which absorbs all the primary colours but red will appear red, one that absorbs all colours black, and one that absorbs none white, and so on. A ray of light is reflected from a polished surface at the same angle with a line drawn perpendicular to the surface of mirror that the

ray striking the mirror makes—*i.e.*, "the angle of incidence is equal to the angle of reflection." When a ray of light strikes a plane reflecting surface, it will, after reflection, so diverge from a point situated similarly behind the mirror—*i.e.*, the image of an object 10 ft. away from a mirror will be reflected from a point seemingly 10 ft. behind the mirror. When light passes from one transparent medium to another transparent medium, unless perpendicular to the surfaces of both, it is refracted or bent aside to a greater or less degree. This power of refraction differs for every different substance, but remains the same at all times for the same substance. It is only at the surfaces of transparent media that refraction occurs. The power of refraction possessed by each body is termed its "index of refraction." A ray of light refracted through a medium with parallel surfaces will have the same direction after leaving such medium as when entering; and a ray of light traversing two media having parallel external surfaces, but differing refractive indices, will emerge in a direction parallel to the incident ray. When a ray of light is refracted, it also suffers what is termed dispersion—*i.e.*, it is separated into its constituent rays. (See DECOMPOSITION OF LIGHT and the SPECTRUM.)

Light Fog. See FOG.

Lime, Chloride of. $CaCl_2O_2,CaCl_2 = 251$. Synonym: Chlorinated Lime, Calx Chlorata. The chemical composition of this substance is a moot-point, but as most commercial samples have been kept some time, and as it absorbs carbonic acid gas very freely from the atmosphere, some carbonate of lime or calcium is usually present, as well as some undecomposed hydrate of calcium. It is made by passing chlorine gas into slaked lime (hydrate of calcium, Ca2HO) until no more is absorbed. It is used for preparing Hypochlorite of Zinc (*q.v.*) for hypo-eliminator. It is also useful for preparing chlorine gas—as good samples should contain 30 per cent. of chlorine, which is eliminated on the addition of any acid—and for Toning (*q.v.*).

Lime Light. See OXYHYDROGEN LIGHT.

Liquid Glue is made by dissolving

Shellac	...	...	...	...	120 grs.
In methylated spirit	...	...	...		1 oz.

by the aid of heat. It is sometimes used as a mountant.

Lithium. Li = 7. A widely diffused metal, but always occurring in small quantities. It is the lightest solid body known.

Lithium Bromide. LiBr = 87. Made by direct combination between the elements. Used occasionally for preparing bromide emulsions. It is extremely soluble in water and alcohol.

Lithium Chloride. LiCl = 42·5. Made by dissolving lithium or the carbonate in hydrochloric acid. Solubility: 65 in 100 of water. Very soluble in alcohol.

Lithium Iodide. LiI = 134. Made in a similar way to the bromide. Very soluble in water and alcohol. All the lithium salts are used because of the large amount of haloid elements they possess in comparison with the other haloid salts.

Litmus. A blue colouring matter obtained from a species of lichens (*Procella tinctoria*) by fermentation with potash. It occurs commercially as small cakes, being made into a mass with chalk. It is used to indicate the presence of an alkali or an acid, the latter turning the solution red, and alkalies restoring the colour. It is usually met with in the form of small books made by steeping unsized paper in tincture of litmus.

Liver of Sulphur. See POTASSIUM SULPHIDE.

Loss of Tone in Fixing. See TONING.

Lunar Caustic. See SILVER NITRATE.

Luxograph. A term used to denote certain methods of artificial lighting.

Macro-photography. A term used to denote the enlargement of the negative

Magic-lantern. An apparatus used to project a magnified image of a positive upon a white screen in a darkened room. Practically it consists of a tin box, in which is placed a lamp in the focus of a silvered reflector, the light being condensed by a pair of plano-convex lenses, and the positive being placed close to the condensers, and a special photographic lens being placed at the focus of the condensing lens which produces a magnified image. Usually a three- or four-wick lamp is employed to give the illumination, the edges of the flames being presented to the condensers, which should be as close as possible to the flame without danger of cracking them. The negative should be placed upside-down, and film side outwards, as close as possible to the

condensers, the magnifying lens, which is usually rovided with a rackwork movement to ensure easy and accurate focus, being placed at the focus of condensers.

Magic Pictures. A process discovered by Sir John Herschel, which is more of an ingenious toy than of any practical use. The process is as follows:—Print as usual on albumenised paper, fix without toning and wash thoroughly, immerse the prints in a saturated solution of perchloride of mercury until the image is thoroughly bleached and disappears, wash and dry. To make these invisible images appear at the word of command, as if by magic, place over them a wetted sheet of blotting paper, which has been previously soaked in a saturated solution of hyposulphite of soda, and pass the hand over them, when the image will start up with more than its original vigour.

Maglip, or Meglip. An artist's material, made by mixing boiled linseed oil with mastic varnish. It is used for thinning oil colours and for glazing on delicate tints on finished oil paintings.

Magnesium. Mg = 24. Occurs in large quantities as dolomite or mountain limestone—an impure carbonate. The metal is silvery white in colour, and is met with commercially in the form of wire, ribbon, and powder. It is now of common use for producing negatives by night (see ARTIFICIAL LIGHT), as the metal burns at a comparatively low temperature, giving an extremely actinic and brilliant light.

Magnesium Sulphate. $MgSo_4 7H_2O = 246$. Synonym: Epsom Salts. Occurs naturally in certain springs, but is usually made by dissolving dolomite in dilute sulphuric acid, and subsequent purification and crystallisation. It has been recommended as a preventative of frilling, but its action seems to be purely mechanical.

Manganese Binoxide. $MnO_2 = 86$. Synonyms: Manganese Dioxide, Black Oxide of Manganese. Occurs native as the ore of manganese as a black crystalline powder, and is used for the production of oxygen for the limelight.

Manipulation. A term used to express the conduct of any photographic operation or process.

Masking Skies. See PRINTING.

Masks and Discs. Pieces of opaque paper used in photo-

graphic printing, usually with albumenised paper. In the opaque paper shaped openings are cut, and the piece cut out is termed the disc, the margin being called the mask. The mask is placed between the negative and the paper, when it is obvious a print will result of the form given by the opening of the mask, and the margin where covered by the mask will be white. The print may be finished off at this stage, or the disc may be carefully and accurately placed over the print, and the margins exposed to light till they darken to the required tint. A good effect is sometimes given to portraits with light backgrounds by printing under a mask, and then using a disc and blackening the margin, enamelling the print, and giving the centre portion a convexity, as described under CAMEO.

Mastic, or Mastich. A resinous exudation from the stems of *Pistacia lentiscus*, grown in the island of Scio. It is usually met with in the form of whitish or yellowish white drops or tears, about the size of small peas. Insoluble in water; almost entirely soluble in alcohol, ether, chloroform, oil of turpentine, and benzole. It is used for preparing certain Varnishes (*q.v.*).

Mealiness of Prints. A peculiar mottled appearance on the surface of prints, due to a weak paper sensitising bath, and as this is also the cause of lack of vigour, contrast, and brilliancy, the term is frequently used to denote all these.

Measles. A peculiar defect in prints, which shows, when they are held up to the light, as opaque blotches, which are due to imperfect fixation and non-solution of the insoluble hypo-sulphite of silver. On keeping, these spots turn yellow, due to formation of sulphide of silver, whence the name, from a fancied resemblance to the human ailment.

Measures. See WEIGHTS AND MEASURES.

Meniscus. See LENS.

Mercury. Hg = 200. Occurs native, but is chiefly obtained by roasting the ore cinnabar, which is an impure sulphide, which is obtained from China, Spain, California, and America. Mercury, at ordinary temperatures, is a brilliant silvery white metallic liquid, becoming solid at 39° F., and volatilising below the heat of visible redness. Specific gravity: 13·5. It has now but little photographic interest, but was used in the old daguerreotype days to develop the image.

Mercury, Perchloride of. $HgCl_2 = 271$. Synonyms: Mercuric Chloride, Bichloride of Mercury, Corrosive Sublimate, Sublimate, Muriate of Quicksilver. Can be prepared by heating mercury in an excess of chlorine, but it is prepared commercially by sublimation from a mixture of mercuric sulphate and common salt. It is usually met with in commerce in extremely heavy colourless prismatic crystals or as a white powder. Specific gravity: 5·43. Solubility: 1 in 19 of cold, 1 in 3 of hot water, 1 in 5 of rectified spirit, 1 in 6 of ether. It sublimes without decomposition, and melts at 509° F. It is used for Intensification (*q.v.*). Its solution in water is liable to decomposition; but any soluble chloride prevents this, and nearly all chlorides increase its solubility in cold water, a compound salt being formed. It is a most powerful poison, 3 grs. being the smallest fatal dose known. The antidote is albumen, or white of egg, with which it forms an insoluble compound, followed by emetics. As the salt is absorbed readily by the skin, it is advisable not to dabble unnecessarily in it.

Mercury, Subchloride of. $HgCl = 235·5$. Synonyms: Chloride of Mercury, Calomel, Mercurous Chloride. A dull white or yellowish white powder. Insoluble in water, alcohol, and ether. Of no interest photographically beyond the fact that the bleached image in intensification is composed partly of chloride of silver, and mercurous chloride, which is changed by the addition of ammonia into black mercurous ammonium chloride, NH_2HG_2Cl. When sodic sulphite is used instead of ammonia, the silver chloride is dissolved, and metallic mercury is formed.

Metallic Spots. These sometimes occur on albumenised paper, and are due to impurities, usually metallic iron, in the substance of the paper itself.

Methylated Ether. See ETHER.

Methylated Spirit. See ALCOHOL.

Metric System. See WEIGHTS AND MEASURES.

Micro-photography—the antithesis of Macro-photography—consists of the reproduction of positives in a very minute size, which require the use of a simple microscope or magnifying glass to examine. It must not be confounded with photo-micrography, which is the production of photographs of microscopic objects; yet, curiously enough, in Hardwich's "Photographic Chemistry,"

ninth edition, photo-micrography is described under Micro-photography. Micro-photographs are well known to the majority of amateurs from the minute photographs which are usually sold at seaside places, the photographs being fixed behind a minute magnifying glass in the handle of some little fancy article. Their production is comparatively easy, but the collodion process is the only one possible to use. It is obvious that it is nothing but the process of reduction carried out to a minute degree; but as the focussing of so small a point is impossible, some large object must be photographed and the negative put in its place.

Minim. See WEIGHTS AND MEASURES.

Mirror, Reversing. One of the essentials for carbon and all line work, unless film negatives are used. (See REVERSED NEGATIVES.)

Mirror Silvering. As an amateur may desire to resilver a mirror or a copper reflector, the following recipes may be found useful:—

For glass—

No. 1.	
Nitrate of silver	175 grs.
Distilled water	10 ozs.
No. 2.	
Nitrate of ammonia	262 grs.
Distilled water	10 ozs.
No. 3.	
Pure caustic potash	437·5 grs.
Distilled water	10 ozs.
No. 4.	
Pure sugar-candy	210 grs.
Distilled water	5 ozs.

Dissolve and add

Tartaric acid	50 grs.

Boil in a flask for ten minutes, and when cool add

Alcohol	1 oz.
Distilled water to	10 ozs.

For use, mix Nos. 1 and 2 in equal parts. Mix Nos. 3 and 4 in equal parts. Mix the two solutions, and suspend the glass in it.

To silver copper or any metal it must first of all be cleaned with dilute acid to free from dirt, etc., then well washed, and one of the following applied:—

Dissolve 60 grs. of nitrate of silver in 1 oz. of distilled water, and sufficient liq. ammonia to redissolve the precipitate first formed; add to this solution ½ drm. of caustic potash solution and ½ drm. of glycerine; apply to the metal; add a few drops of ether; rub with a tuft of cotton-wool; dry before the fire, and polish; repeat as often as desired to brighten it. Or—

Nitrate of silver	55 grs.
Liq. ammonia	60 „
Hyposulphite of soda	100 „
Prepared chalk	100 „
Distilled water	1,000 „

Mix, and apply with a flannel. Or—

Nitrate of silver	60 grs.
Cream of tartar	120 „
Salt	120 „
Cyanide of potash	60 „

Make into paste with water and chalk, and apply with a flannel.

Monocular Vision. As the term implies, it is seeing with one eye only. It was formerly supposed by many eminent opticians and physicists that one eye only was employed in vision; but Wheatstone, to whom the great invention of the principle of the stereoscope was due, proved the fallacy of this. In monocular vision objects on the true optical axis line are distinctly seen, but other objects less so, although they are in the circle of vision, and in this particular the similarity of the lens and the human eye is very evident. Monocular vision can judge the direction, but not the distance of an object.

Mountant. The substance used to make the print adhere to its mount. It is absolutely necessary that the mountant should be free from acidity, in order to prevent the destruction of the delicate image. There are several kinds in common use—viz., starch paste, arrowroot, gum, dextrine, india-rubber solution, liquid glue, and gelatine.

Starch Mountant. Starch in powder 1 oz.; mix into a cream with 1 oz. of water, and add to it, constantly stirring, 8½ ozs. of boiling water in which 20 grs. of common alum and 5 drops of

carbolic acid have been dissolved. The mixture should be now a clear translucant jelly free from lumps; if it is not, it should be gently heated in a dish or pan till it clears, constant stirring being an absolute necessity; then it should be squeezed through fine muslin. Ordinary household flour makes a more adhesive paste, but is more liable to acidity. Both will keep fit for use about a week, after which they should be rejected.

Arrowroot Mountant, called Permanent Paste. Dissolve by the aid of gentle heat

Arrowroot	150 grs.
Gelatine	150 „
Distilled water	3 ozs.

When cool, add

Methylated spirit	2½ drms.
Carbolic acid	3 drops.

Gum Solution, or Mucilage. Pale-coloured gum arabic in clean lumps, 4 ozs.; distilled water, 8 ozs. Wash the gum by placing it in a half-pint cup or measure; add half-pint of water; stir briskly round twice or three times, and pour off the water: this carries off any dust or mechanical impurities. Now add the distilled water, and stir frequently at intervals till dissolved. It should be kept in bottles filled as full as possible, and the addition of a little carbolic or salicylic acid will help to preserve it. It will keep only about ten or fourteen days, and when made with hot water about half that time. Powdered gum arabic should never be used.

Dextrine Solution. This is one of the nastiest of all mountants, and decidedly unsatisfactory. It can be made as follows:—

Pure white dextrine	1 oz.
Boiling distilled water	3 ozs.
Methylated spirit	½ oz.

Stir till dissolved, and strain through calico.

India-rubber Solution.

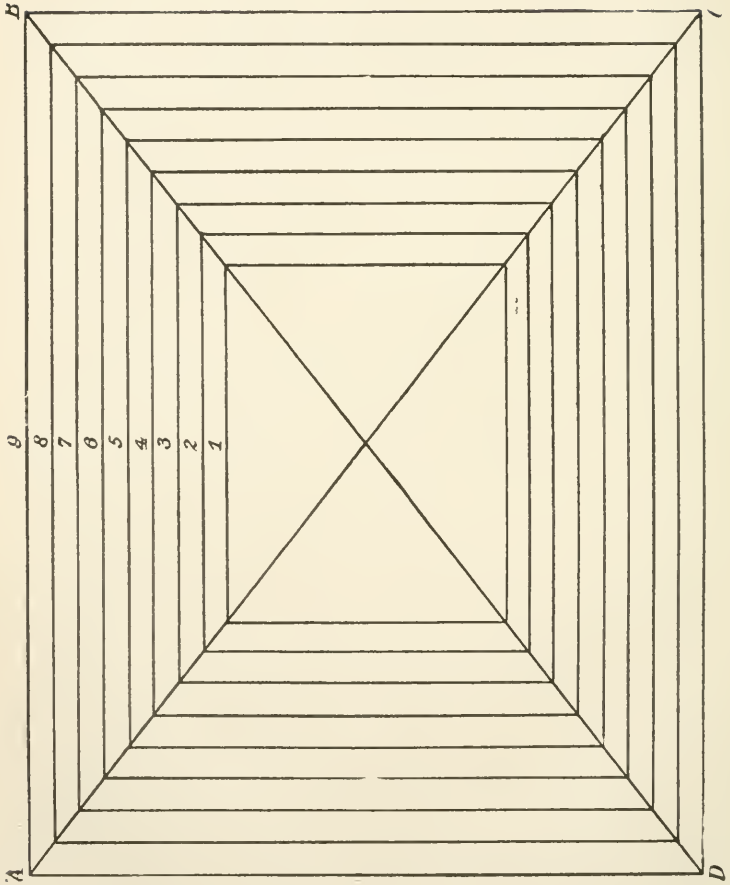
Pure masticated rubber	80 grs.
Chloroform or benzole	8 ozs.

Shake till dissolved. Benzole is cheaper than chloroform, but the smell is rather unpleasant.

Gelatine. This is the author's favourite mountant. It is less liable to change than any other medium, and if properly made is more convenient and easier of application. The print can be mounted whilst still damp, and it can be shifted about on the mount, or any excess of mountant wiped off, without leaving any trace on the mount, even the highly enamelled ones. The following is the most satisfactory method that the author has found:—Soft gelatine, 200 grs.; soak in distilled water (6 ozs.) for an hour. Dissolve by the aid of a water bath, and add, in small quantities at a time, methylated spirit 2½ ozs., stirring constantly; allow it to set. Should any spirit separate out, it should be remelted, and a little more water added. The product should be a pure milk-white firm jelly. A little carbolic acid may be added if desired. When required for use, melt by the aid of hot water or a water bath

Liquid Glue. This is sometimes used, but as many different preparations are sold under this name, each sample should be tested for acidity, as some consist of gelatine dissolved in acetic acid, which would soon cause fading. Another kind which the author has used, but cannot highly recommend, is prepared by dissolving 120 grs. of shellac in 4 drms. of methylated spirit by the aid of heat. Lately some adhesive mounts have been introduced into the market, which are rather convenient, although the author has found them rather liable to stick together at the edges; but if any amateur is desirous of making these, the following directions given by the author in the *Amateur Photographer* will be of service:—Mix in a small glass, mortar, or measure 120 grs. of powdered tragacanth with 6 drms of rectified or methylated spirit, and having put 9 ozs. of water into a pint bottle—or an old pyro bottle will do—pour the mixed tragacanth and spirit quickly into the water; shake for a few minutes, and allow it to stand for twelve hours, shaking it occasionally, and at the end of the time there will be sufficient mucilage of tragacanth to coat 100 to 200 mounts. All that is necessary to do is to give the mounts a good thick coating with a brush, allow it to dry, and giving them a second coat. The mounts will curl up, but they can be easily straightened when dry.

Mounting is the operation of causing prints to adhere to some substance, such as card, cloth, wood, or glass, either for ornament or the better protection of the print itself. As the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mounting of a print is in many cases the making of it, great attention should be paid by amateurs to this subject. The following points should be chiefly regarded:—The mount should be of a suitable colour and size, and sufficient margin should be allowed, no excessive ornamental lines, and the print should be accurately in the centre of its mount.

As the difficulty of placing prints equidistant from the margin is one likely to be met with by every amateur, the following hints may be found useful:—After applying the mountant, lay the print *face* downwards upon a mount exactly similar to that upon which it is desired to mount the print, shift the print about till it is exactly in the centre; now lay on the top of the print another mount exactly the same size, making the edges of the two mounts coincide; rub the hand gently over the top mount, when it may be lifted up with the print *in situ*. Another ingenious method, which is recommended by Mr. T. C. Hepworth, is as follows:—Procure a piece of stout cardboard—a mount will do—22 by 15; draw diagonals from corner to corner, AC, BD, in sketch, cutting each other in centre, and on these lines rectangular figures of the usual dimensions of the trimmed prints. For instance, the smallest may be 4 by 3 or 3 by 3, the next $4\frac{1}{2}$ by $3\frac{1}{2}$, 5 by 4, 6 by 4, 6 by 5, 7 by $5\frac{1}{2}$, and so on. When it is desired to mount a print, place it face downwards upon this gauge, when it will be found that it will coincide with certain of the lines; note the number of figure, remove the print, apply the mountant, and replace upon the lines it covered before, and place upon it the mount which will be found to coincide with some other set of lines; proceed as in the above case, and lift the mount and its adhering print; use further pressure, and roll or burnish. A very convenient little instrument for those who do not possess either a burnishing or rolling machine is an india-rubber roller squeegee, same as used by printers, which will cause absolute contact between the prints and their mounts. For those who possess a copying press, sheets of zinc or tin may be placed between the mounted prints, and great pressure applied in the ordinary way; whereas those whose household appurtenances include a clothes wringing machine with india-rubber rollers, may, if allowed, use these; or the bevelled edge of the cutting glass drawn carefully over the print with some pressure will do all that is required. For mounting prints in optical contact with glass the following method

answers well:—Make a solution of gelatine (Nelson's X opaque), 20 grs. to every ounce of water, and whilst still warm immerse the print face downwards in it; place the glass in it, and after a few seconds bring them into intimate contact and withdraw from solution, and squeegee thoroughly, and allow to dry. To mount prints which have an extremely glossy surface, like Aristotype, etc., when it is desired to retain the high gloss which cannot be done by mounting in the usual way, squeegee the print on to an old negative glass, or cutting shape, or ferrotype plate, and when nearly dry coat the back with the mountant, and apply to the mount; use the squeegee vigorously, and when dry the glass may be stripped off, leaving the print in all its beauty upon the mount.

Muriate of Ammonia. See AMMONIUM CHLORIDE.

Muriatic Acid. See HYDROCHLORIC ACID.

Negative is the term applied to the image in which the lights and shades are reversed. These can be made by direct action of light in the camera, or by printing in a frame from a positive.

Negative Storing. To the amateur whose work is frequent and successful the stock of negatives soon becomes considerable, and the question of storage a bugbear. Many use the grooved negative boxes, but while these are convenient their bulk is a great objection. The best plan is to use paper negative bags, on which can be written the subject, date, and duration of exposure, aperture of diaphragm, mode of development, and any other remarks which may be considered necessary. The negatives in the bags can then be packed close together in boxes not grooved, and they will take up about one fourth of the grooved boxes. An index can be kept of them, and a list can be pasted inside the lid of each box for further reference.

Non-actinic Rays. See SPECTRUM.

Obernetter's Process, or Lichtkupferdruck. A mechanical printing process of very ingenious idea and of extremely pleasing and artistic results. The metallic image of silver of a gelatine positive is converted into chloride of silver, and the film is then stripped and applied to the surface of a copper plate, and, under the influence of a voltaic current, the silver chloride is decomposed, and the chlorine unites with the copper and etches it to a greater or less degree, according to the depth of deposit of silver chloride. The result is a grained intaglio plate of extreme

delicacy and beauty, which is inked and printed from the same as any ordinary etching.

Objective. A term sometimes applied to the lens.

Oil. A term applied to many substances, few of which have any photographic interest. The subject is introduced here, however, for the purpose of giving some hints upon the oiling of paper negatives. Many substances are used for this purpose, as castor oil, vaseline, vaseline oil, white wax, etc., but the author has found the following substitute extremely useful and cleanly in use:—

Gum juniper	60 grs.
„ mastic...	30 „
Canada balsam	1 drm.
Sandarac	60 grs.
Essential oil of camphor	2 ozs.

Mix the gums and balsam, and heat in a water bath; add the oil of camphor; stir frequently till dissolved; apply with a tuft of cotton-wool whilst warm, and when cold polish off superfluous solution with clean wool, and hang up in warm room to dry, or pass a hot iron over it between sheets of blotting paper.

Oil Paintings, to Copy. See COPYING.

Opacity. See DENSITY.

Opalotype. A term applied to pictures on opal glass. They can be made by coating opal glass with a plain gelatino-bromide emulsion, or by using a printing-out emulsion. The exposure and development are the same as for bromide paper. Either polished or ground opal glass may be used, the latter giving very pleasing pictures of a matt surface. Another method of obtaining pictures by the printing-out process is by the use of a collodio-chloride emulsion, which may be made as follows:—

No. 1.

Silver nitrate	31 grs.
Methylated alcohol	28 drms.

Dissolve by the aid of heat immediately before using.

No. 2.

Strontium chloride	31 grs.
Methylated alcohol	28 drms.

No. 3.

Citric acid	31 grs.
Methylated alcohol	28 drms.

No. 4.

Pyroxyline or celloidin	62 grs.
Methylated alcohol	28 drms.
„ ether	28 „

To make the emulsion

Take of No. 2	150 mins.
„ No. 3	150 „
„ No. 4	28 drms.

Mix, and add gradually, with constant agitation,

No. 1	75 mins.

Give the plates an edging of albumen or india-rubber solution a quarter of an inch broad, and, after coating, allow them to dry thoroughly. The prints should be washed, toned, and fixed in the same way as ordinary silver prints, or the sulpho-cyanide toning bath may be used with better effect. (See TONING.) As it is necessary to examine the opal during the operation of printing, it is obvious that some arrangement must be made for replacing it in exactly the same position. Printing frames may be obtained commercially specially adapted for this work, but an ordinary printing frame may be utilised in the following manner:—Replace the hinged back by a solid piece of wood $\frac{1}{16}$ of an inch less in thickness; coat the inside of this back with a composition of gelatine made as follows:—

Gelatine (Nelson's X opaque)	1 oz.
Water	4 ozs.
Glycerine	2 „

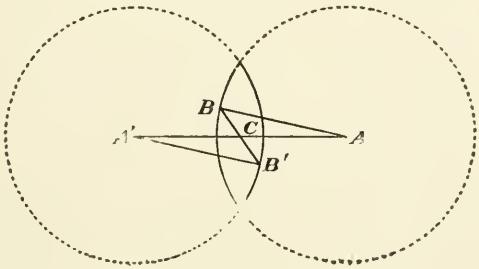
Soak the gelatine in water, and dissolve by the aid of heat; add the glycerine last. The opals will adhere to this on being damped, or a thick india-rubber solution, with a little castor oil added, may be used:—

Pure masticated rubber	40 grs.
Castor oil	10 drops.
Benzole	1 oz.

A small spot of this at each corner will cause the opal to

adhere firmly to the wood. To keep the negative in position, a screw may be driven through one end of the printing frame, and the point of the screw cut off; a groove cut in it in which to fit the negative. To the back affix three or four small tongues or metal pierced with holes, which holes may drop over pins driven into the sides of frame, or the back may be permanently fixed by a hinge to one end of the frame.

Optical Centre. In every lens exists a point situated in its principal axis, any incident ray passing through which point does not suffer deviation; this is termed the optical centre.



None but single lenses have true optical centres, but the optical centre may be approximately found in an achromatic combination by considering it as a single lens. To find the optical centre of a lens draw a line to represent the principal axis, ACA'; then from the centres of curvature draw two radii, AB and A'B', parallel to one another, but oblique to the central axis; then join their extremities, B, B', and the point C at which the principal axis is cut by this line is the optical centre. To find the optical centre of a meniscus lens prolong BB' till it meets the principal axis; the optical centre of plano-concave and plano-convex lenses is found by the intersection of the spherical surfaces by the principal axis.

Optical Lantern. See MAGIC LANTERN.

Optics. That branch of science relating to the nature and laws of vision. The subject is too comprehensive to treat here. For further study the amateur is referred to Glazebrook's "Physical Optics."

Orange Light. Actinic light filtered through any medium

which absorbs all but the orange rays. It is frequently used for the illumination of the dark-room, and is perfectly safe if not too brilliant.

Orthographic and Orthoscopic. Two fanciful titles given to certain classes of lenses.

Osmose. The action that takes place when two liquids of differing densities are separated by a permeable medium. (See DIALYSER.)

Over-exposure is the undue prolongation of the exposure of the sensitive surface, and, as the author has endeavoured to show, the ill effects can be corrected by careful development. The effect of over-exposure on the sensitive surface is that the image starts up quickly, and the plate shows signs of Fogging (*q.v.*) before proper density is obtained, the resulting negative being thin, but full of detail.

Oxalate Developer. See DEVELOPER.

Ox-gall. The fresh gall of the ox, *Fel bovis*, purified, and evaporated to a suitable consistency. It is used photographically to make water-colours take to the surface of albumenised prints. It should be obtained from a chemist's, and in this state is a sticky, rather offensive-smelling mass. It is soluble in water and spirit, and can be dissolved in either, or, preferably, a mixture of both, and applied to surface of print with camel's-hair pencil.

Oxygen. O = 16. A gaseous element at ordinary temperatures, forming $\frac{8}{9}$ by weight of water, and $\frac{23}{77}$ of the air; it is about the most abundant element known, entering into the composition of all animal and vegetable tissues, and about half the weight of the solid earth. It is used in the oxy-hydrogen light, and is usually prepared by heating a mixture of chlorate of potash and black oxide of manganese.

Oxy-Hydrogen, and Oxy-Calcium or Drummond's Light. Both are so much alike that but one description is required. A cylinder or ball of lime is placed in the focus of a parabolic mirror, and a lighted jet of oxygen and hydrogen or coal gas is directed upon it. The lime burns with an exceedingly intense flame, which can be seen at night in hazy weather a distance of sixty miles, and in clear weather over a hundred miles. The

oxy-calcium light differs but slightly, the flame of a spirit-lamp being used instead of hydrogen. (For further particulars see T. C. Hepworth's articles on the "Optical Lantern," in *Amateur Photographer*.)

Packing Plates. Several methods are employed by commercial firms to preserve dry plates from accidental injury and fracture whilst travelling, but the best method is that practised by a well-known London firm, whose method is as follows:—Absolutely pure tissue paper is cut the exact width of the plate, but sufficiently long to enclose five or six plates; stout card cases, just a shade larger than the plate, and a strip of non-actinic paper, are placed lengthwise in the box, with free ends projecting; then a sheet, or the commencement of a sheet, of tissue paper; a plate is laid face downwards, and the tissue paper folded over the back of it; then another plate is laid face downwards on the tissue paper, and this is continued till the case is full, when the free ends of the non-actinic paper are folded over; the whole is then wrapped in black paper, slipped into another case, and that into the outer box. By alternating the plates and paper in this manner, any number of plates may be safely carried by road or rail without any fear of fracture.

As some amateurs may desire to travel abroad—and the Custom-house officer is their bugbear—the following labels may be useful:—

English.—Photographic dry plates. To be opened only in ruby light.

French.—Plaques sèches photographiques. A ouvrir seulement avec éclairage couleur rubis.

Italian.—Lustre da seccare fotografiche. Da aprire solamente con illuminazione colore di rubino.

German.—Photographische Trocken platten. Nur bei dunkelrother Beleuchtung zu öffnen.

Spanish.—Plauchas secas para fotografia abrase el paquete en un cuarto oscuro y á la luz rubi.

Swedish.—Ljuskäushga fotografiska plätar, blivfa förstörda om de uttsättas för ljus. Fas derföre ej öppuas utom i ett absolut mörkt rum.

Or the two following, in French and German, are a little more explicit:—

French.—Plaques photographiques sensibles. Abimées par

exposition à la lumière. Prendre garde de n'ouvrir la boîte que dans une chambre parfaitement obscure.

German.—Photographische Trocken Platten, werden verdorben in dem Lichte ausgesetzt. Müssen also nur in einem absolut dunkeln Zimmer geöffnet werden.

Palladium. Pd = 106. A metallic element sometimes found native in the pure state, and frequently mixed with platinum, which it much resembles. It has been recommended for toning transparencies and enamels in the form of chloride, but its use is limited.

Panel. The style of a commercial photograph, size about 4 by 8½ ins.

Paper, Albumenised. See ALBUMENISED PAPER.

Paper, Sensitised. See SENSITISED PAPER.

Paper, Plain or Matt-surfaced. See SENSITISED PAPER.

Papyrotype, or Papyrography. A modification of photolithography, in which paper is used as the support, instead of a stone or metal plate.

Parabola is the curve described by a moving point, which is always at the same distance from a fixed line, its directrix, that it is from a fixed point, its focus. The chief use in photography of the parabola is in the construction of mirrors or reflectors for Artificial Light (*q.v.*), from the fact that the rays of a light placed in the focus of a parabolic mirror will be reflected in parallel rays.

Paste. See MOUNTANT.

Paste, Encaustic. See ENCAUSTIC PASTE.

Pearlash. A synonym for impure Potassium Carbonate (*q.v.*).

Pellet's Process. See CYANOTYPE.

Pellicle. Literally a thin skin or film, and in this sense applied to the emulsion when the solvents have evaporated. Pellicular films were introduced many years back, and were one of the first adaptations of gelatine to photography.

Pencil of Light. A term applied to the rays of light proceeding from any luminous body. When the object is near, the pencil or rays of light are divergent; when the object is very distant, the pencils may be considered parallel. A pencil the rays of which lessen as it proceeds is said to be convergent.

Perspective is the art of representing solid bodies on a plane surface. It is divided into two branches—linear perspective, which shows the apparent forms of objects by their prospective outlines; and aerial perspective, which distinguishes the distance of objects by the relative brilliancy of their colour. The subject is much too comprehensive to treat here. The amateur who desires to learn the rules of perspective must refer to some of the manuals on this subject.

Phosphorus. P = 31. A non-metallic element widely distributed throughout the animal and vegetable kingdoms, but never occurring in the free state. It is insoluble in water, soluble in ether, chloroform, benzine, turpentine, and other oils, and bisulphide of carbon. It is prepared from bone-ash and other phosphates by treatment with sulphuric acid and sublimation with charcoal and sand. It has but little interest photographically, phosphoric acid, a compound, being but rarely used.

Photo-Engraving. Numerous processes are in every-day use, in the best of which the action of light upon a bituminous film is taken advantage of. As these processes are hardly within the scope of the general run of amateurs, no further mention will be made. The best handbook on the subject is W. T. Wilkinson's "Photo-Mechanical Processes."

Photography is the art of obtaining the representation of objects by the agency of light upon sensitive substances. The following is a short history of the rise and progress of the art:—In the sixteenth century Baptista Porta, a Neapolitan, invented the Camera Obscura (*q.v.*), and this was used to obtain sketches by hand of the objects projected by the lens. In 1777 Scheele, the great chemist, discovered the important fact that chloride of silver blackened in sunlight, the chief action lying in the violet end of the spectrum. In 1802 Thomas Wedgwood, son of the famous potter, published in the "Journal of the Royal Institution" an account of a method of copying paintings on glass, and of making profiles by the agency of light upon nitrate of silver. In the experiments which are thus described he was assisted by Sir Humphrey Davy. They managed to obtain images upon paper and white leather by means of the solar microscope, but were unable to fix them; therefore the image was soon obliterated by the darkening of the whole surface. In 1814 Nicéphore de

Niépce commenced a series of experiments, but although he managed to obtain images upon a bituminous film, the process was impracticable for ordinary purposes, from the inordinate exposure (several hours) which was required. He then, in partnership with Daguerre, carried on his experiments; but it was not until 1839, six years after Niépce's death, that Daguerre communicated to the Académie des Sciences at Paris the process so well known as Daguerreotype. Early in 1839 Fox Talbot, previous to Daguerre's communication, announced to the Royal Society a method of "photogenic drawing," in which pictures were produced upon paper prepared with chloride of silver. Fox Talbot effected the fixation of these pictures by saturated solutions of chloride of sodium and bromide of potassium. The use of hyposulphite of soda, however, soon became general, Sir Humphrey Davy having, in 1821, published the action of this salt upon the salts of silver. In 1841 Fox Talbot patented his process called Talbotype or Calotype (*q.v.*). To the Rev. J. B. Reade is due the credit of first recommending a developer, although Fox Talbot was the first to use a restrainer. Up to this point paper negatives alone were in use; but in 1848 a cousin of the original Niépce, M. Niépce de St. Victor, proposed the use of albumen on glass as a vehicle for the sensitive salts of silver. These plates, however, were very insensitive, and numerous substances, such as starch, gelatine, gum, etc., were proposed; none, however, were successful. In 1851 Le Gray, of Paris, and Scott Archer, of London, proposed the use of collodion, the latter publishing such a complete description of the wet collodion process that but little improvement has ever been effected. A great disadvantage, however, of this process was the necessity of exposing the film whilst wet, necessitating the use of bulky and heavy impedimenta for the landscape photographer in the shape of dark tent, etc. It was then discovered that the application of certain organic substances to the washed film would allow of the plates being used in the dry state. In 1862 Major Russell discovered the use of alkaline pyrogallol as a developer, and his accidental discovery of the restraining power of the soluble bromides gave the first impetus to the manufacture of bromide of silver films, which could be exposed dry. In 1864 Messrs. Sayce and Bolton described the process of collodion emulsion making, which was poured upon

glass plates, and then washed to free from inert salts. In 1874 it was discovered that the emulsion might be washed previous to use, and it 1871 Dr. R. L. Maddox published the first notice of a gelatine emulsion, and from that, in 1878, Mr. Charles Bennett discovered the capabilities of the process and power of increasing the sensitiveness by digestion at high temperatures. Since then the process has been most rapid, the ammonia process becoming known, and rapid films and plates being of every-day occurrence. During the last few years film photography has become quite a standard process, and increased active inventiveness upon the part of commercial firms has improved these till but little improvement seems necessary. Of the application of photography in every-day life it would be almost impossible to treat; the various mechanical printing methods, the use of photography for supplying pictures for illustrated papers, catalogues, price lists, etc., are too well known to need any description. Its use in astronomy for making charts of the celestial bodies, in the interests of justice for the detection of criminals, for the purposes of experimental warfare, and as an assistant in scientific research, for sounding the depths of the sea, and for pathological study in medicine, seems almost unlimited.

Photo-Lithography. One of the most important of all photo-mechanical methods in which a print is obtained from a negative and transferred to a lithographic stone, and printed from in the ordinary way.

Photometer. Literally a measurer of light. It has lately been much recommended for calculating the exposure for the sensitive plates; but as the action of these is solely to measure the visual rays, and as the latent image is imprinted on the plate by the chemical and not the visual rays, it is obviously unfair to judge of the exposure to the one by the intensity of the other.

Phototype. A mechanical printing process in which a gelatine film itself is used to print from.

Pinhole Photography. Of late years the possibility of taking passable negatives without the use of an ordinary camera and lens has become an established fact. For this purpose any rectangular box which is absolutely light-tight will do. In one end make a minute hole with the point of a needle, and at the

other end place the sensitive plate, keeping it in its place by means of a clip or other simple arrangement. A prolonged exposure is required, about twenty or thirty times the ordinary one for any given subject. No focussing is required, as the image is always fairly sharp, no matter what distance the plate is from the hole. The larger the plate the wider the angle, and the greater the distance the larger the image. As an experiment, it should be tried by every amateur, as the materials are always at his command in the shape of an empty plate-box.

Pinholes. Minute transparent spots making their appearance on the plate in the fixing bath. They are chiefly due to air bubbles, or particles of dust adhering to the film whilst in the developer, and thus preventing the action of the developer on the film at these spots. To obviate these the film should be brushed with a soft camel's-hair brush whilst in the developer, but where pinholes are in existence recourse must be had to retouching or painting them out with some non-actinic colour.

Pizzighelli's New Printing-out Process. This is a decided advance upon any other process, and will no doubt in time completely oust the old process. No patents restrict the use of it, and the preparation is comparatively easy. Rives or Saxe paper may be used, either glossy or with matt surface. The following solutions are required:—

No. 1 Solution, Gum Arabic.

Gum arabic (finest white lumps)	770 grs.
Distilled water	27 drms.

No. 2 Solution, Arrowroot.

Arrowroot	30 grs.
Distilled water	27 drms.

Mix the arrowroot into a paste with a little water, add to the remainder of distilled water whilst boiling, and keep the temperature up for five or ten minutes. No. 1 solution gives the best effects.

No. 3 Solution, Ammonia Ferric Oxalate.

Ferric oxalate	308 grs.
Oxalic acid	8 „
Ammonium oxalate	288 or 308 „
Distilled water	27 drms.

No. 4 Solution, Sodium Ferric Oxalate.

Ferric oxalate	308 grs.
Oxalic acid	8 „
Sodium oxalate	230 to 290 „
Distilled water	27 drms

The exact amount of sodium or ammonium oxalate to use is found by the formation of a brilliant emerald green colour turning slightly darker as more of the salt is added. The addition of the salt must be stopped at this stage. After shaking slightly, filter the solutions and preserve from actinic light.

No. 5, Sensitising Liquid.

Solution of chloro-platinite of potash (1 in 6) 408 minims.
„ No. 1 ... ... 391 „
„ „ 3 ... ... 374 „

Or

No. 6.

Solution of chloro-platinite of potash (1 in 6) 408 minims.
„ No. 4 ... ... 374 „
„ „ 1 ... ... 391 „

Or

No. 7.

Chloro-platinite of potash	24 grs.
Sodium oxalate	24 „
Ferric oxalate	31 „
Oxalic acid	3 „
Gum arabic	52 „

Distilled water, to make 480 minims.

The mixtures are well stirred, filtered through muslin, and kept from actinic light. No. 5 gives bluish black, No. 6 brownish black tones. The coating, drying, and storing of the paper are precisely the same as for the original process patented by Willis. Chlorate of potash may be added in the same way, to increase contrast. About 90 minims of sensitising liquid are required for a sheet 10 by 8. The printing may be carried on until the image has appeared in all its parts, and should be no darker when printed than required. When finished, the print is washed in acidified water, as recommended for the old process, and finished in the ordinary way. A second method of printing is to print till the general details are out, but all the half-tones

are wanting. The print is then taken from the frame and put on one side, when the action set up by the light continues, and in from a half to two hours the print is finished, and can be treated as above in acidified water, or the incomplete picture may be developed upon a cold dilute solution of carbonate of soda of the following strength :—

Carbonate of soda	38 grs.
Distilled water	27 drms.

Immerse the print in this till sufficiently developed. A third method of printing is to expose till only the principal details are visible, and develop, as in the old process, upon a hot solution of potassium oxalate. The author has lately seen some specimens of prints on this paper, and has no hesitation in saying that they are the finest productions of photography he has ever seen.

Platinotype. This process was first invented by Mr. W. Willis, and the right for the sale of the paper and materials for making it rests solely in a company formed by him. The basis on which this process is founded is the reduction of ferric oxalate by the action of light into ferrous oxalate, and the reduction of a platinum salt by the ferrous oxalate to the metallic state, when wetted with a suitable agent. The following is stated by Berkely to be the action that takes place :—

$$Fe_2(C_2O_4)_3 = 2FeC_2O_4 + 2CO_2$$

Ferric oxalate = Ferrous oxalate + Carbonic acid gas

$$6Fe(C_2O_4) + 3K_2PtCl_4 = 2Fe(C_2O_4)_3 + Fe_2Cl6 + 6KCl + 3Pt$$

Ferrous oxalate + Chloro-platinite of potassium = Ferric oxalate + Ferric chloride + Potassium chloride + Platinum.

The following are concise directions for the process :—Paper of good strong quality, even in texture and white in colour, should be chosen, and may be sized in one of the following baths :— Soak 150 grs. of Nelson's X opaque gelatine in 30 ozs. of water for half an hour, and heat in a water bath at a temperature of 140° F. to dissolve it. Add 45 grs. of powdered alum and 7 ozs. methylated spirit, filter through muslin, and put in large flat dish. Thoroughly immerse the paper bodily in this solution,

taking care to break all adherent bubbles; the paper should be allowed to soak for three minutes, and then hung up by clips to dry. The drying should be as rapid as possible, and a second bath for the same time should be given, and the paper hung up by the opposite corners. A sizing of gelatine tends to a bluish black tone; arrowroot and starch to a brownish tinge. If arrowroot or starch are used, the following bath may be prepared:— Rub 150 grs. of arrowroot or pure starch powder into a cream with a little water, and then pour gradually and with constant stirring into 30 ozs. of boiling water, and boil for ten minutes, and then add 7 ozs. methylated spirit, and allow to cool. The following are Pizzighelli and Hubl's formulæ for sensitising the paper:—

Solution of Ferric Oxalate.

Ferric oxalate	120 grs.
Distilled water	1 oz.
Oxalic acid	8 grs.

No actinic light must be allowed to gain access to this solution, or the ferric will be reduced to ferrous salt.

Solution for Increasing Contrast.

Solution of ferric oxalate	1 oz.
Chlorate of potash	2 grs.

The same care must be exercised in the keeping of this as of the former solution.

Solution of Chloro-Platinite of Potassium.

Chloro-platinite of potassium	80 grs.
Distilled water	1 oz.

Sensitising Solutions.

No. 1.

Sol. chloro-plat. of potassium	24 drms.
„ ferric oxalate	22 „
Distilled water	4 „

A normal solution, working well and giving deep blacks.

No. 2.

Sol. chloro-plat. potass.	24 drms.
„ ferric oxalate	18 „

Sol. chlorate potash (contrast solution) ...	4 drms.
Distilled water	4 „

This gives brilliant prints.

No. 3.

Sol. chloro-plat. potass.	24 drms.
„ pot. chlor. (contrast solution) ...	4 „
Distilled water	4 „

This is a solution for weak negatives. Chloro-platinite of potash when obtained commercially should be tested as follows:—(1) 1 drm. of the salt should be soluble in 6 drms. of distilled water. (2) The solution should not be acid. This solution will keep unaltered by light for an almost indefinite period. Very feeble light must be used for coating the paper. To keep the paper flat whilst coating, the edges should be turned underneath a plate of glass placed upon a table; for larger pieces the paper can be easily clipped to glass plate by wooden clips, or it can be pinned at the corners by drawing pins. For coating a sheet of paper 8 by 10 ins., 30 minims of sensitiser are required, which should be poured into the middle of paper and spread over the surface with a uniform circular motion by means of a pad composed of a tuft of cotton-wool enclosed in a piece of fine washed muslin. The rubbing should be continued gently for at least three or four minutes. As soon as coated, the sheet should be hung up by two corners to dry, and as soon as the surface moisture has disappeared, the paper should be carefully and quickly dried over a gas burner, or before a stove or fire. The whole success of the process lies in this stage—the drying of the paper; the paper must be absolutely dry This point is known from the change in colour from lemon to an orange colour, and by the crackle of the paper. Care should be taken not to scorch the paper, or fog will be the result. Between the coating and drying about five minutes must be allowed to elapse in summer and eight or nine minutes in winter. The exposure required for the paper is about one-third of that required for a silver print from the same negative. Absolute dryness, both in the keeping before, during, and after exposure is a *sine quâ non*; the slightest trace of moisture immediately renders the paper useless. It should be stored in tubes in which chloride of calcium (anhydrous) is kept to absorb the moisture.

The image on the paper is but faintly visible, and requires a developer to bring it out in all its beauty. This is made as follows:—

Oxalate of potash	130 grs.
Distilled water	1 oz.

This solution may be kept as a stock solution, and when required for use must be heated to a temperature of 170 degs. to 180 degs. F. Development is effected by passing the print face downwards over the surface of the solution and allowing it to remain for two or three seconds, and the developed print should be passed at once into a bath of hydrochloric acid 1 oz., water 60 ozs.; allowed to remain for ten minutes; it should be then passed into another bath for the same period, and lastly into a third; it can be then washed, dried, and mounted in the usual way. The developing solution may be used over and over again. For over-exposed prints solution at 100 degs. F. can be used; for under-exposed over 180 degs. F. may be used with advantage.

Warm Tones with Platinum Prints. The Platinotype Company issue a paper which gives a sepia tinge, which perhaps owes its colour to mercuric and cupric chlorides. The addition of a few drops of solution of these chlorides to the developer materially alters the colour of the image. Warmer tones may be obtained by the following process. The following solutions are required:—

Solution No. 1.

Oxalate of potash	463 grs.
Oxalic acid	15 ,,
Distilled water	27 drms.

Dissolve and add

Solution No. 2	3 drms.

Shake thoroughly, and leave; if crystals form, they are of no consequence.

Solution No. 2.

A.

Chloride of calcium, crystal	147 grs.
Distilled water	2 drms.

Dissolve.

B.

Sulphate of copper, crystal	249 grs.
Distilled water	10 drms.

Dissolve. Mix A and B, filter, and label "Cupric Chloride Solution, No. 2." Put solution No. 1 into an iron enamelled dish, and heat to 180° F., then develop the prints as usual; wash in acidified water (the tint can be altered by raising or lowering the temperature). Prints that are already developed may be treated in the same way. After washing, the prints are soaked for a short time in a 5 per cent. solution of ferrous sulphate, acidulated with a drop or two of sulphuric acid, then rinsed in acidified water and dried.

It has hitherto been supposed that any of the paper which has become old and discoloured through damp or improper keeping was useless, but the following is an interesting and a useful experiment, which may be performed by any worker in platinotype who has some old sensitised paper in his possession. Expose in the ordinary manner about the same time as for a silver print, and prepare the following developer :—

Carbonate of soda	480 grs.
Distilled water	4 ozs.
Alum	12 grs.

Dissolve the soda salt in half the water and the alum in the remainder, mix the two solutions, and shake thoroughly. Do not filter. The exposed prints are placed face downwards upon this cold solution in a dish, and left in contact for ten or fifteen seconds; then withdraw the print, and watch the development. When the image is dense enough, plunge at once into an acidified bath, as in the former process.

Willis's New Process—described by him at the Camera Club Conference, in 1888—is said to be a great improvement upon the old process. By the new process several advantages are obtained, a greater transparency in the shadows, cold development, tentative development, shorter exposure, easy variation in the tone. The following is a short *résumé* of the process. A solution of ferric oxalate is prepared as follows :—

Ferric oxalate	480 grs.
Oxalic acid	32 „
Mercuric chloride	5 „
Distilled water	4 ozs.

This solution must be kept from actinic light. Paper is coated with this solution, about 50 minims being used for each square foot of paper, dried and exposed under a negative in the ordinary way, when a faint image will show; the paper may be kept between exposure and development four or five days without deterioration. The prints are developed upon a cold solution of oxalate of potash, varying in strength from 30 grs. to 120 grs. per oz., and the developer should contain about 9 grs. of chloro-platinite of potash to the ounce. When the greater strengths of oxalate are used, cold tones are obtained with the weaker warmer tones. A good average developer is made as follows:—

Oxalate of potash	50 grs.
Chloro-platinite of potash	9 „
Distilled water	1 oz.

As the mixed developer soon decomposes, a good method is to keep stock solutions of both salts, and mix as required. Many methods may be adopted for developing the prints by floating in the ordinary way, or, as specially recommended, by simply wetting the print thoroughly with the developer and then watching the development, and as soon as the right depth is obtained stopping the same by the usual acid bath, or a camel's-hair brush may be used to brush the developer over, or if one part shows too vigorous it can be locally stopped by applying the acid bath to that part with a brush. The prints are fixed, washed, and dried in the usual way. Further experiments with this process have proved extremely disappointing.

Platinum. Pt=198. This metal occurs usually in the free state, the chief source of supply being Mexico, Brazil, and Siberia. It is a silvery white metal, having specific gravity 21·5. When in an extremely fine state of division, it is absolutely black, and is one of the most permanent and immutable of all metals. It is tolerably hard, very difficult of fusion, not dissolved by

hydrochloric, nitric, or sulphuric acid, and only slightly acted upon by some alkaline substances.

Platinum, Perchloride of. $PtCl_4 = 340$. Synonyms: Bichloride of Platinum, Platinic Chloride. This salt is prepared by dissolving metallic platinum in aqua regia. It occurs in small brownish red masses extremely deliquescent, forming a deep orange or brownish orange solution.

Pneumatic Holder. A convenient little apparatus for holding plates for the purpose of coating them, used chiefly in the old collodion days, the principle relying upon the pressure of the atmosphere to keep the plate in its position on the holder, due to the india-rubber ball being partially exhausted of air.

Poisons. Some of the chemicals used in photographic processes are poisonous when taken internally or when absorbed through the skin. The table on p. 143 will be of some assistance on that point.

Fluoric acid when applied to the skin, even in a dilute state, causes painful ulcers, and 1 in 80 can also cause irritation and tenderness. Bichromate of potash and cyanide of potash, when applied to cuts, wounds, and abrasions and absorbed, cause, the first painful sores, the latter death.

Porcelain Pictures. See ENAMELS and OPALOTYPES.

Portrait Lens. See LENS.

Portraiture. The portrayal of the features of those with whom they are in daily contact may be said to be the summit of ambition of many amateurs, and as a rule it is their weakest point, and naturally the stronghold of the professional. So many happy possessors of a camera consider that all they have to do is to stick their sitter down somewhere near a strong light, tell this much-to-be-pitied individual, after he or she has become thoroughly worn out and tired of the whole thing from frequent changes of position and camera, this being wrong, and then something else requiring readjustment, to look pleasant—fancy looking pleasant when you wish the whole thing elsewhere!—and then, after the usual operations, a first-class pleasing memento is expected to be the result. They expect in a few trials to reach the same standard that it has taken the professional

POISON.	EFFECTS.	ANTIDOTE.
Acid, Acetic	Corrosion of windpipe, violent inflammation ...	For all acids any alkali, but preferably chalk and magnesia, mixed with water, except oxalic, for which chalk alone should be used.
Carbolic	,, ,, ,, ,, ...	
Fluoric	,, ,, ,, ,, ...	
Hydrochloric ...	,, ,, ,, ,, ...	
Nitric	,, ,, ,, ,, ...	
Oxalic	Hot, burning sensation, vomiting, cramp, numbness	
Sulphuric	Corrosion, etc.	
Sulphurous ...	,, ,, ...	
Alcohol	Drunkenness, coma, death	Emetic, stomach-pump.
Ammonia	Swelling of tongue, suffocation	Give diluted acids, vinegar, lemon-juice.
Barium	Irritating, with colic	Give any sulphate, as Epsom salts.
Bromine	Acrid taste, tightness about throat	Use stomach-pump, egg albumen, milk.
Copper Sulphate ...	Caustic and corrosive	White of egg, starch and water.
,, Chloride ...	,, ,, ...	Use stomach-pump.
Gold perchloride ...	,, ,, ...	Emetics.
Iodine	Same as Bromine	See Bromine.
Lead Acetate	Constriction in throat, acute cramp in abdomen ...	Sulphate of soda, magnesia, or zinc.
Mercuric Chloride ...	Acrid taste, burning in throat and stomach, nausea	White of egg, milk, flour paste.
Potash, Bichromate ...	Irritant pains in stomach, vomiting	Emetic, and magnesia and chalk.
,, Cyanide	Insensibility, gasping, spasmodic action of jaws ..	Strong coffee, dash cold water over face, give ammonia, or use smelling salts.
,, Ferrocyanide	,, ,, ,, ,,	
,, Ferridcyanide	,, ,, ,, ,,	
Pyrogallol	Acute burning pain in stomach	Milk, white of egg, emetics.
Silver, all Salts of ...	Powerful irritant, contraction of throat	Give copious draughts of salt and water, followed by emetics of mustard.
Zinc, all Salts of	,, ,, ,, ,, ...	Milk, oil, eggs, emetics.

years of apprenticeship, hard work, and study to learn; and should their results be any but first class and pleasing, the blame is thrown on the lens, camera, light, sitter, the beastly bad plates, anywhere but on the right shoulders. Portraiture needs a keen appreciation of the value of light and shade, a good knowledge of what the lens will do, and considerable artistic skill and ability. It is impossible to give complete directions for the successful working of this branch of photography, but some few hints may perhaps be gleaned from the following article. Most amateurs possess one room better suited for portraiture than others, and the following short *résumé* of the necessary qualifications will soon tell the amateur what room to use:—A room with a good-sized window, preferably facing the N.N.W., or N.E., with an uninterrupted view of sky, will be best; but even those with a good south light may turn out good work by careful manipulation and attention to all details.

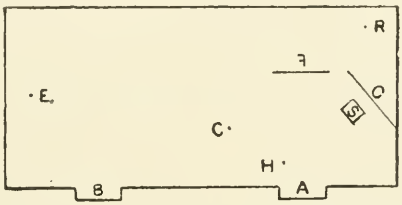
The Lens. The best, of course, is one made expressly for portraiture; but these really require an apprenticeship, as in the author's opinion they are the most difficult to use; and next to that the class known as rapid rectilinear, especially the euryscope, which from their large aperture are equal, if not superior, to a portrait lens for an amateur. The lens should be of long focus, at least double the length of the picture to be produced—viz., for cartes-de-visite, $7\frac{1}{2}$ to $8\frac{1}{2}$ ins., and for cabinets 12 or 14 ins. Otherwise exaggerated effects of large hands and feet, and in the case of large heads noses unduly prominent, are seen. The author has in his possession a photograph of a group in which the front row of figures are sitting down, and their feet are all pointing towards the camera, and are so much exaggerated as to make it a photograph of boot soles, including one with a hole in it, with a background of figures tacked on, the feet being out of all proportion to the bodies to which they belong.

The Camera. Almost any camera will do, but it must have a swing back (*q.v.*).

The Plates. These should be of the most rapid make, so as to shorten the exposure as much as possible.

The Background should be as natural as possible, either the wall of a room, a screen, or a sheet of brown paper; but in no case should the pattern be so pronounced as to become obtrusive, and so detract the eye from the principal object. The accessories

or surroundings should also be subordinate to, and in correct keeping with, the figure. The pose or position of the sitter is the cream of the whole picture. Don't let your sitters throw themselves into what they are pleased to call a natural attitude; as a rule, these are pre-eminently unsuited for good results. To take an ordinary room lighted by two windows as an example, the following sketch will show the proper position to obtain the best lighting:—



A and B are two windows; B should be blocked out entirely, either by curtains, blinds, or shutters, and A should have the lower portion blocked out in the following manner:—Suppose the window be 6 ft. high, about 2 ft. at the bottom should be blocked out entirely by brown paper, the next 2 ft. should have muslin or tissue paper placed over them, and the top left bare and unshaded by anything. The softest and most harmonious lighting can be got by placing the sitter somewhere about S, and the camera placed about C or H, according whether profile or full face is required: for full lengths the camera will most likely have to be placed about E. It may be as well to state here that a very convenient sitter may be found in the clay images sold by itinerant Italians for a few pence, or any statuary maker will make a life-size head for a nominal sum. When obtained, the image should have the head deftly cut off, and filled with cement or plaster, in which a stout piece of copper wire, projecting about 6 ins., should be fixed whilst the cement is still moist; the body should be served in the same way, an oiled stick being inserted in the cement in the place which the wire will enter, which can be easily found by putting the head with its projecting wire in position for a minute. This will enable the head to be moved freely about, and different effects of position and light and shade obtained. This sitter is a most uncomplaining and untiring one, human sitters objecting

to pose as models for more than half an hour at a stretch. It is necessary, no matter how good the light, to use a reflector, F, on the shadowed side of sitter, as in the camera this shadow is abnormally enhanced. For this purpose a white sheet thrown over a clothes-horse, chair, or any other convenient article may be used, or a mirror placed at some distance, and then only so as not to reflect into the eyes, may serve. Never use a cross light from a window on the opposite side of the room, unless the light from the same is much shielded by calico or other substance, as this will throw double shadows, and produce most curious and unlooked-for effects. A head-rest is also a useful article, if properly used, to keep the necessary position. For what are called Rembrandt effects—*i.e.*, the portrayal of the shadowed side of the face—the camera in the above diagram should be placed about R, and the background and reflector removed altogether; but care must be taken to shade the lens from the direct light from the window by a shade or cone projecting in front of it. For outdoor portraiture but little need be said, as it is, as a rule, much easier than indoor, but not always more pleasing. For taking groups, the figures should be arranged as naturally as possible, not all staring at the camera, nor all in straight lines. For large groups the outside members should be a little in front of the plane of the centre ones, a good plan being to arrange them on the arc of a circle of which the lens may be considered the centre. With regard to lighting and posing but little can further be said; experience alone can teach what to do and what to avoid. But there is one other class of portraiture which cannot be passed over in silence, and that is baby portraiture, and such small fry. On this head the author can speak with some authority, as the plate manufacturers have benefited considerably by his experience in these matters, and it is now almost his universal practice to take children's portraits out of doors, or in a conservatory or greenhouse—these restless little beings generally posing themselves for the fractional part of a second, and as quickly altering the pose for some other equally short; but where it is desired to take such portraits indoors the magnesium flash-light will be found extremely valuable. (For further information as to portraiture in general, lighting, posing, etc., the amateur is referred to H. P. Robinson's "The Studio, and what to do in it.")

Positive. A reproduction of any object in which the lights and shades are represented as seen in nature, whether on glass or paper. It is the opposite to Negative (*q.v.*).

Potassium Bichromate. $K_2Cr_2O_7 = 295$. Synonyms: Dichromate of Potash, Acid Chromate of Potash. Is prepared on a large scale from chrome iron ore. It is met with, commercially, as fine orange-red crystals, which give a very deep coloured solution. Solubility: 1 in 10 of water, 1 in 10 of alcohol. It is of great importance commercially, the fact of its being decomposed by light when in contact with organic matter being taken advantage of. It is used for dyeing, and also for tanning hides, the action in this case being analogous to that in the carbon process. It is used, photographically, for nearly every photo-mechanical printing process.

Potassium Bromide. KBr = 119. Prepared in white cubical crystals by acting on bromide of iron with carbonate of potash, or by the action of the metalloid itself with caustic potash, and subsequent purification and crystallisation. Solubility: 1 in 2 of water, 1 in 90 of rectified spirit. It is used as a Restrainer (*q.v.*) and in emulsion making.

Potassium Carbonate. $K_2CO_3 = 136$. Synonyms: Pearlash, Subcarbonate of Potash, Salt of Tartar, Salt of Wormwood, Potash. It contains nearly always about 16 per cent. of water of crystallisation, and is prepared by lixiviation and subsequent purification of the ashes of wood and vegetable matters. Solubility: 100 in 75 of water; insoluble in alcohol and ether. It is extremely deliquescent—that is, absorbing moisture from the air, and becomes a pasty mass. It is used for developing, and for the preparation of the other salts of potash. It should not be confounded with the bicarbonate or acid carbonate of potash ($KHCO_3$), which is a much less active salt.

Potassium Cyanide. KCN = 65. Obtained by fusing ferrocyanide of potassium with carbonate of potash; the resulting fluid mass is poured out on slabs, and then broken up into the irregular masses met with in commerce. Solubility: 1 in 1 of water; insoluble in absolute alcohol. It is used for reducing the density of negatives, and for fixing in the wet process. It is extremely poisonous when taken internally, and also when absorbed through the skin, or by any cut or abrasion. The

addition of an acid immediately causes the evolution of hydrocyanic or prussic acid gas, which is extremely poisonous, and when inhaled, even in small quantities, produces vertigo and headache.

Potassium Ferrocyanide. $K_4FeC_6N_63H_2O = 422$. Synonym: Yellow Prussiate of Potash. Is prepared by heating nitrogenous matter, such as hoofs, horns, hide clippings, etc., with pearlash and iron filings in an iron pot. The resulting mass is dissolved in water and evaporated, and the large yellow plates or crystals of the salt obtained. Solubility: 1 in 3 of water; insoluble in alcohol. The salt is non-poisonous of itself; but as a deadly poison can be easily prepared from it, care should be exercised in its use. It has been recommended by Professor Newton, of New York, as an addition to the carbonate developer; and from researches on the subject, it has almost a unique effect on the negative; it is a preventer of fog, giving a clear blackish image, and sparkle and brilliancy to the negative. There does not seem to be the slightest chemical combination between the sensitive haloid salts and this agent, but it has the same effect as the addition of a little bichromate of potash to the developer; and from continued use and numerous experiments made by the author, it seems to be of real value in the developer.

Potassium Ferridcyanide. $K_4Fe_2(C_6N_6)_2 = 658$. Synonym: Red Prussiate of Potash. Made by passing chlorine gas into solution of ferrocyanide of potash, and crystallising the resulting solution. Solubility: 1 in 3 of water; sparingly soluble in alcohol. It is met with as deep red crystals. It is used for reducing, and in some printing processes.

Potassium Iodide. KI = 166. Prepared by dissolving iodine in hot solution of caustic potash, evaporating and fusing the crystalline mass with charcoal, and subsequent lixiviation. Solubility: 4 in 3 of water, 1 in 16 of alcohol. Used for preparing emulsions.

Potassium Metabisulphite. A salt of indefinite composition, lately introduced as a preservative of pyrogallol in solution. It is most likely prepared by super-saturating carbonate of potash with sulphurous acid gas, SO_2. From a superficial analysis it appears to be chiefly the acid sulphite of potassium, $KHSO_3$, with some K_2SO_3, SO_2. It is also free from hyposulphite, but

contains much sulphate. Solubility: about 1 in 2 of water; insoluble in alcohol.

Potassium Nitrate. $KNO_3 = 101$. Synonyms: Nitre, Saltpetre. Occurs naturally in many parts of India contaminated with nitrate of calcium. It is also made artificially by the process of Nitrification. It can also be made by adding chloride of potash to nitrate of sodium in solution. Solubility: 1 in 4; insoluble in alcohol.

Potassium Nitrite. $KNO_2 = 85$. Can be made by heating nitrate of potassium, when oxygen is given off and the nitrite left. It is an extremely deliquescent salt, and but little use photographically, it being recommended for preparing the paper for Actinometers (*q.v.*).

Potassium Oxalate. $K_2CO_4 = 164$. Synonym: Neutral Oxalate of Potash. Prepared by neutralising oxalic acid with carbonate of potash or caustic potash. Solubility: 1 in 4 of water; slightly soluble in spirit. It is used for the production of ferrous oxalate, and as a developer in the platinotype process. A convenient method of making it is as follows:—Dissolve 13 ozs. of carbonate of potash in 30 ozs. of water, and add gradually about 9 ozs. of oxalic acid, till after boiling the solution is neutral to test paper. Filter and make the resulting solution measure 64 ozs., when a solution of oxalate of potash will be obtained 1 in 4.

Potassium Permanganate. $KMnO_4 = 158$. Prepared by fusing together hydrate and chlorate of potash and black oxide of manganese, boiling the product thus obtained with water, and purifying and crystallising the product. Solubility: 1 in 16 of water; insoluble in alcohol. It is used for intensifying negatives and as a test for hypo.

Potassium Sulphide. $K_2S_2O_3(K_2S_3)_2$. Synonyms: Liver of Sulphur, Sulphurated Potash. Made by heating together sulphur and carbonate of potash, the resulting mass being poured out on slabs and broken up. It usually consists of one molecule of hyposulphite, $K_2S_2O_3$, and two molecules of sulphide, K_2S_3. Solubility: partially soluble in water, and three-quarters of it by weight soluble in alcohol. It is used for the reduction of residues.

Powder Process. A process much used upon the Continent

for the production of prints on paper, and in England for transparencies on glass. The process is not by any means difficult, and as the results are extremely pleasing, and can be obtained in any colour, the process is well worth the attention of amateurs. An organic tacky body, sensitised with bichromate of potash or ammonia, is allowed to dry as much as possible, and exposed to light, when it is found that the tackiness of the organic body disappears in exact proportion to the action of light, and any fine powder dusted on will adhere to the tacky portions unacted upon by light. It is obvious, therefore, that by this means an image can be obtained in any colour, and almost any material, a reversed positive being used to produce a positive. It has been lately recommended in the *Amateur Photographer* for the production of lantern slides, and from experiments made by the author seems very suitable for the purpose.

The following formulæ are recommended for the preparation of the organic tacky body :—

OBERNETTER'S FORMULA.

Dextrine	... 60 grs.
White sugar	... 75 ,,
Ammonium bichromate	... 30 ,,
Glycerine	2 to 8 minims.
Distilled water	... 3 ozs.

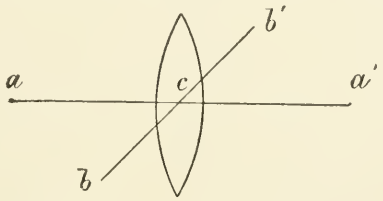
WOODBURY'S FORMULA.

Gum arabic	... 60 grs.
Glucose	... 45 ,,
Glycerine	... 10 minims.
Potassium bichromate	... 30 grs.
Distilled water	... 2 ozs.

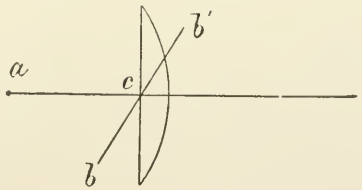
Mix by gently heating, filter, and preserve in a stoppered bottle. A plate is coated with either of the above solutions, and dried at a gentle heat, and then exposed under a positive, reversed as regards left and right, for three or five minutes, to sunlight, or ten or fifteen minutes to diffused light; on removal from the printing-frame a faint image is seen. The plate is then exposed to the air for a few minutes to allow it to absorb moisture, and fine plumbago, as used by electrotypers, is applied with a flat brush, when it adheres to those portions protected from light,

and the lights and shades are represented more or less by a coating of graphite. When the image is fully developed, and there is no further adherence of the graphite, the superfluous powder is dusted off, the film is coated with collodion, and then well washed to remove the unacted-upon gum and bichromate; the film may be detached from the plate, and used for enamels, ivory, opal, or any textile fabric.

Principal Axis is the right line which joins the centres of curvature of the spherical surfaces of a lens, or if one surface is a plane, the principal axis passes through the centre of curvature of the spherical surface, and perpendicular to the plane surface.



aa′, the centres of curvature; *aca′*, the principal axis; *bb′*, the secondary axis. A straight line passing through the optical centre, and making an angle with the principal axis, is termed a



secondary axis. The centres of curvature are the points from which the arcs of the circles forming the spherical surfaces of the lenses are calculated—that is, the centres of curvature are the centres of circles, of which circles the spherical surfaces of the lens are segments.

Printing. This term is applied to any method by means of which a positive is obtained from a negative, or, in fact, a picture is obtained in which to some extent at least the gradations

of light and shade are represented as seen in nature. More usually, however, this term includes the production of pictures upon any flexible support, such as paper; and as the other branches of printing, such as bromide paper, opals, and lantern slides by means of which prints are obtained by development, are treated of elsewhere, it is the author's intention to confine this article entirely to what is termed sensitised or albumenised paper printing. If the operator desires to sensitise his own paper, instructions will be found elsewhere, and it is supposed that he has his paper ready for cutting to the desired size. The author would impress upon his readers the necessity for cutting the paper not to the exact size of the finished print, but rather larger. He recommends the use of an old negative glass for cutting it to shape, as this allows of some margin, and does not require such nice adjustment as when the paper is cut to the exact size. Having the paper ready cut, the next operation is to place it in the printing-frame. This should be done in weak daylight, and the film side of the negative should be placed next to the paper, and one or two thicknesses of blotting paper placed on the back of the paper, the hinged back being put into position, and the springs fastened down. The next question which naturally arises is that of light: what light is the best to print in? On this point there can be no doubt; except during the months of November, December, January, and February, and in the case of very dense negatives, sunshine should never be used. Some authorities recommend printing in the sun with a screen of tissue paper over the negative, but even in this case the author thinks better effects are obtained by printing in the shade. Select, if possible, a window-sill or other open space, which has a free uninterrupted view of the sky, and place the printing-frame out and leave for a short time; then withdraw into a subdued light, and, unfastening one of the springs, turn back the half of the back and examine the paper. Some may think the caution of examining the print in subdued light unnecessary; but it is not. By examining the paper in a strong light the purity of the whites is degraded, and a decided tinge given to them. For printing from weak thin negatives a screen of tissue paper is an advantage, or the back of the negative may be coated with matt varnish or ordinary negative varnish, tinted with gamboge, aurantia, or some other yellow dye. For very dense negatives, as stated above, printing in the

sun is allowable. When a negative is very dense at one end and not at the other, the printing-frame may be placed in a deep lidless box resting up against one side, with the denser end uppermost; by this means the printing may to some extent be equalised. The next question is how dark or to what depth the printing should be carried. On this point considerable difference of opinion exists, it being to some extent dependent upon what toning bath is used, as some baths bleach more than others; but as a rule, for general guidance, printing should be carried on till the whites of the pictures are well coloured and the shadows beginning to block up. Prints should not be kept too long before being toned, as some further chemical change takes place, and discoloration of the paper ensues, and it is then almost impossible to tone satisfactorily, if at all, by any of the ordinary baths. There is one process in photographic printing in which at least considerable artistic skill is required—viz, combination printing, by means of which at least we may to some extent utilise the material ready found, and, employing some of the license of the artist of the brush palette, produce effects which are not strictly true, but are yet more artistic. Thus, in the case a low-lying horizon, the uniform tint of the sky is extremely unnatural and really untruthful, as we never hardly find in nature a sky so barren of clouds or colours as to present one uniform unbroken tint, as given by the agency of the camera and dry plate. In such a case the sky may be graduated in tint from pure white at the horizon to a deeper tint in the zenith, or we may have recourse to a second negative, and print in some fine masses of clouds. The author has in his possession a print of a bit of an Essex marsh, as flat and as uninteresting in itself as it is possible for anything to be, but the whole has been converted by means of a cloud negative into one of the finest pictures it is possible to produce, the clouds giving one the impression of a dull, windy day in autumn, in which the cattle huddle together and turn their backs to the gale, and man instinctively buttons up his coat and bends his head to the wind. It is, I think, as clever and suggestive in its way as any of the grand compositions of J. W. M. Turner, perhaps the only true artist who could depict wind and clouds. Again, by use of a second negative a figure may be introduced into an otherwise uninteresting stretch of country, giving life and beauty to the whole, and raising the composition

at once above the mediocre photograph. To effect such composition requires true artistic skill and considerable clever manipulation in a photographic sense. The usual method of making such an effect is to print the subject, such as a stretch of land, first, and to utilise this print as a mask. For this purpose the outlines must be carefully cut out with a pair of scissors, and after a second print has been taken, to place the first and cut-out mask over the second print, and place on top of it the cloud or second negative, and again expose to light till the second negative has printed in sufficiently deep. Another method is to paint over the first print with gamboge or some other non-actinic paint, and print again under the second negative when dry. This method, however, is not so satisfactory. For tinting the skies a piece of sheet tin or stout cardboard should be used, and one end bent up to about an angle of 45 degs. This can be placed over the print, and the whole exposed to daylight, the metal or cardboard being moved up and down, so as to graduate the tinting. It is only by practice that success in this branch of printing can be obtained, the chief difficulty being to so blend the print from the two negatives as to show not the slightest trace of the use of two negatives. (For further considerations in respect of printing, the reader is referred to Abney and Robinson's "Photographic Printers' Assistant;" and "Silver Printing," by W. M. Ashman.)

Pyroxyline. $C_6H_8(NO_2)_2O_5=252$. Synonyms: Dinitro-cellulose, Gun-cotton. Prepared by acting upon cotton-wool, which is nearly pure cellulose ($C_6H_{10}O_5$), with nitric acid. The following directions for preparing it are taken from Hardwich's "Photographic Chemistry," but the author would advise anybody who requires small quantities to buy it ready made rather than prepare it for their own use, as the operation is not very easy, and the acids are dangerous to handle:—

Sulphuric acid (sp. gr., 1·854 at 60° F.)	18 fluid ozs.
Nitric acid (sp. gr., 1·457 at 60° F.)	6 „ „
Distilled water	$4\frac{3}{4}$ „ „

Pour the water into a dish, add the nitric acid, and lastly the sulphuric acid. The mixture must be well stirred, and the

temperature, which is raised by the addition of the sulphuric acid, should be allowed to sink to 150° F., at which heat the mixture must be kept by means of a water bath. The wool must be first in a strong solution of carbonate of soda or potash to free it from its natural oil, and then washed in plain water till the washings show not the slightest trace of alkalinity or the salt used, and dried. The prepared wool should be then weighed out into balls of about thirty grains each, and immersed one by one into the mixture of acids, and well stirred up, care being taken that each little ball is thoroughly saturated with acid; they should be then left for ten minutes, and then taken out and washed in running water for twenty-four hours, or till they show no acid reaction with litmus; they can be then dried in the sun, or on a water bath. The resulting production should be entirely soluble in a mixture of equal parts of alcohol and ether, and also inflammable. The nitric acid alone acts upon the cotton, the sulphuric causing this action to be much more rapid. This action of the sulphuric acid is said to be catalytic. A special kind of pyroxyline, called celloidin, has been introduced by Dr. Schering, of much greater purity than the other, and which yields a much finer collodion. This is said to be prepared by immersing ordinary pyroxyline in pure nitric acid for ten minutes, washing and drying. Pyroxyline is insoluble in water, alcohol, and ether, but soluble in a mixture of the two latter, and also in glacial acetic acid. It is used for preparing collodion.

Rapidity of Lenses. The rapidity of a lens depends upon the relation the focus bears to the size of working aperture. It is an almost universally misunderstood question. Because a lens-maker calls one lens rapid rectilinear, it is generally supposed that such a lens is the quickest and most suitable for instantaneous or general work, whereas what is termed a wide-angle may be equally as rapid with the same size diaphragm, which gives the same working aperture. The following rule is a standard on this point:—"Depth of focus and definition are opposed to rapidity. Whatever increases the rapidity of a lens reduces the power of definition, and conversely any gain in definition and depth, granting the lens to be well made in other respects, must be made at the expense of rapidity." Definition and depth are thus opposed to rapidity. As rapidity is increased

with larger aperture, definition and depth are lost, till a point is reached at which the extent of such loss prevents the further increase of rapidity. It is universally considered, even by the most eminent authorities, that the apertures of the diaphragms, when expressed as the fractions of the foci, express the relative rapidity of the lens, whether doublet or single—that is, that the rapidity of all lenses when used with the same ratio size diaphragm is equal; so that a portrait, rapid rectilinear, a wide-angle, and a landscape lens, when used with a diaphragm *f*/16—that is, with a diaphragm the aperture of which is $\frac{1}{16}$ of the focal length in diameter—are of the same rapidity. The question is whether this be correct, and I shall endeavour to prove that it is not, although at present we have no better system to take its place. All doublet lenses are composed practically of two condensing lenses placed at either end of the lens mount, with the diaphragms between. Now, a larger bundle of parallel rays will pass through a given sized diaphragm after being condensed by a lens; and the greater the distance of the diaphragm from the lens, or the greater the refractive power of the lens, the larger the bundle of rays admitted. In single lenses there is always the same amount of light admitted through the same size diaphragm, because there is no condensing lens in front of same. Take, for example, a doublet lens of 12-in. focus, with front lens of 15-in. focus and diaphragm *f*/12 3 ins. behind it. Now, it is evident that if a bundle of parallel rays is condensed to a point at 15 ins., at 3 ins. (the place of the diaphragm) it would be condensed to $\frac{1}{5}$ of its diameter, which would be equal to a bundle of parallel rays of $1\frac{1}{4}$ the diameter of the diaphragm. This would give an illumination more than $1\frac{1}{2}$ (1·56) times as strong as the same size diaphragm with a single lens of 12-in. focus. If the diaphragm be moved 1 in. farther back, or the focus of the front lens is reduced to $12\frac{1}{2}$ ins.—*i.e.*, the refractive power of the lens made greater—you would have just double the illumination as with the single lens working with same ratio size diaphragm. From the above the reader will deduce the fact that the present system of numbering diaphragms is correct for single lenses, the ratio being that each diaphragm is about 1·42 times the diameter of the next smaller, and giving therefore just double the illumination upon the plate; but till opticians number the diaphragms of doublet lenses in the ratio of the refractive power

of the front lens, we must be content with the present incorrect method of numbering. Again must be taken into consideration with doublet lenses the loss of illumination by reflection of the light from the surfaces of the lenses. Supposing a lens is being used which works at *f*/8, and it is desired to substitute a lens working at *f*/22, and the exposure for a given subject is known with the former, the increase of exposure is found by squaring and comparing these numbers : *f*/8 × 8 = 64, *f*/22 × 22 = 484. Therefore the exposure will be as 64 to 484, or 1 to 7·5. In this way the necessary increase in exposure for any size aperture may be found.

f	*f*	*f*	*f*	*f*	*f*	*f*	*f*	*f*
4^2	6^2	8^2	$11{\cdot}3^2$	16^2	22^2	32^2	45^2	64^2
16	36	64	127	256	484	1,024	2,025	4,096

Or reducing these, and reckoning the exposure necessary with *f*/4 as unity, the exposures will be—1, 2·25, 4, 7·9, 16, 30·25, 64, 126·5, 256.

Rapid Rectilinear. See LENS.

Reaumur. See THERMOMETER.

Redevelopment. A process usually confined to the wet collodion. It is actually intensification of the image. It has been suggested, however, for dry plates and bromide papers, and is useful in the former case to intensify under-developed negatives, and in the latter to obtain warmer tones. The negative to be intensified is washed thoroughly free from hypo, and bleached in a solution of cupric or mercuric chloride, well washed, and then redeveloped with hydroquinone or ferrous oxalate. To make a solution of cupric chloride :—

Solution I.

Chloride of calcium (crystalline)	147 grs.
Distilled water	2 drms.

Solution II.

Sulphate of copper	249 grs.
Distilled water	10 drms.

Dissolve each separately, mix, and filter. For obtaining warm tones with bromide paper, the finished print is bleached as above, and then redeveloped with hydroquinone or dilute ferrous citrate developer. To obtain a regular tone Mr. Dresser recom-

mends bleaching Alpha paper before fixing with mercuric chloride, and redeveloping with ferrous oxalate

Red Fog. See Fog

Reduction (in Size). An exceedingly useful operation in the preparation of lantern slides or prints from larger sized negatives. One or two methods may be adopted, both of which are satisfactory—one for daylight, the other for artificial light; and the arrangements suggested for enlarging with some modifications will do. The negative to be reduced in size should be placed in the same position (see Enlargement), but in this case the lens is turned towards the negative, and focussed on the ground-glass screen in the usual way. The distance between the negative and the lens may be found by referring to the table given under Enlargement, or the same rules there given may be used for finding the distances, only they must be reversed—that is, whereas in enlargements the greater distance is between lens and sensitive surface, in the case of reduction the greater distance must be between the lens and negative, and the lesser between lens and sensitive plate.

Reduction of Density. When a negative or print has been over-developed or over-printed, the following processes may be adopted for reducing them :—

To Reduce Negatives. Soak the negative in water for five minutes, then immerse in the ordinary hypo bath, to which a few drops of a solution of ferridcyanide of potash (40 grs. to 1 oz. of water) have been added. Reduction will proceed in proportion to the amount of ferridcyanide present. Extreme care must be taken in the case of ferrous-oxalate development, or the whole of the negative will turn a brilliant blue, due to the formation of a pigment with the iron by the ferridcyanide, and even in the case of pyro-developed negatives a good washing should be given, as some pigment may also be formed. The negatives may also be soaked in a bath of cupric or mercuric chloride till partially whitened; then, after washing well, refix in hypo. The former is the preferable, as there is considerably more control over the reduction.

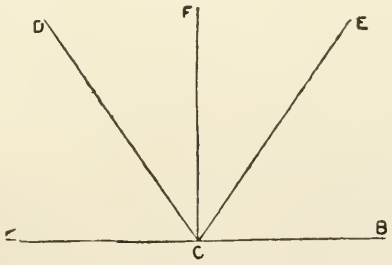
To Reduce Prints. Bromide prints may be reduced in exactly the same way as negatives.

Albumenised Paper Prints may be reduced by dipping into cupric chloride, or by using the chloride of lime or platinum toning baths.

To Reduce Ferro-Prussiate Prints, dip into a weak bath of liq. ammonia, and then into weak hydrochloric acid. Another very good method of reducing negatives for those who use ferrous oxalate developer is to dissolve 4 grs. of ferric oxalate with every ounce of the fixing solution, and immersing the negative in the mixture till sufficiently reduced, then washing thoroughly.

Reflected Light is the light obtained by reflection from any mirror or white surface. It is extremely useful in portraiture for lighting up the shadowed side of a sitter's face; but care should be taken, however, that too much reflected light is not used, or the result will be a hard and lifeless picture. Mirrors should rarely be used, and a rough, not too white surface is the best.

Reflection of Light. When a ray of light falls upon a mirror, the ray is bent from its original direction into another; this is said to be reflection. Reflection of light obeys certain well-known laws, the first of which is that the reflected ray must lie in the same plane as the incident ray; the second law is that the angle formed by the reflected ray with the normal must be equal to the angle formed by the incident ray.



The reflected ray, CE, is in the same plane as the incident ray, DC, and the angle ECF is equal to the angle DCF.

Refraction of Light. When a ray of light passes obliquely from one transparent medium to another it suffers refraction, or is bent out of its course on emerging from that medium.

Refraction obeys well-known laws somewhat similar to reflection. The first law is that the incident, the normal, and the refracted rays are in the same plane, and the second that the angle formed by the incident ray with the normal bears a constant ratio to the angle formed by the refracted ray with the normal. By constant ratio is meant that in a given medium and for different angles of incidence the ratio of the refracted to the incident rays is constant when light passes from a vacuum into the substance; practically it means that the same substance always refracts light to the same extent. It is necessary for practical opticians to find the refractive index of their glass, and this they do usually by making it into a lens of known surfaces, and finding by trial the focus of the lens. It can be done more scientifically by decomposing a ray of white light by means of a prism constructed of the glass, and measuring the refraction of a certain dark line of the spectrum by suitable instruments. The different coloured rays of the spectrum have different refractive indices, that for violet being the greatest, and that for red the least, and this fact is taken into consideration in the achromatising of lenses. (For further information on Reflection and Refraction the reader is referred to any elementary work upon light or optics.)

Rembrandt Portrait. When the shaded side of a sitter is portrayed with the light more or less behind the head, the picture is given the above name, from a fancied resemblance to the works of that great master. (See PORTRAITURE.)

Removal of Film. To clean the films off old and useless negatives nothing is better than soaking the negative in hot water, and then rubbing with a paste composed of pumice-stone powder and glacial acetic acid.

Residues. The saving of the unused silver and gold salts in use in photography may be said to be almost beyond the amateur, unless he is inthe habit of doing a very large amount of work, but the following directions will prove useful:—To reduce the silver from the fixing baths, the old solutions should be placed in a tub or earthenware vessel with some sulphuretted potash (liver of sulphur), and the silver will be precipitated as a black deposit of sulphide, Ag_2S. This should be allowed to collect at the bottom of the vessel till some considerable amount is ready, when it may be reduced to metallic silver, as described

below, or sent to the refiner. All clippings and trimmings from untoned prints should be reserved, and when a fair quantity is obtained should be burnt, commencing at the top of the pile, or the paper may be beaten to pulp with dilute sulphuric acid, and strips of metallic zinc or copper placed in the mixture; metallic silver will be precipitated, and the zinc or copper dissolved. The washings of untoned prints should be placed in a jar, and common salt added till no further precipitate is caused, and the precipitate may be collected and treated as above, or all the residues may be mixed with nitrate of potash and powdered charcoal and fused in a crucible. To reduce old toning-baths, whether of platinum or gold, add solution of ferrous sulphate; a black precipitate of carbonate and oxide of iron mixed with metallic gold results. This may be digested in aqua regia, and the gold in the resulting solution reprecipitated by ferrous sulphate in a pure state, when it can be redissolved in aqua regia to form the auric chloride.

Ordinary albumenised paper absorbs about 30 grs. of nitrate of silver, equal to 19 grs. of pure silver for every sheet. Each sheet weighs about 340 grs.; therefore a quire will weigh about 8,160 grs., and contain about 456 grs. of pure silver.

Of the silver used in sensitising paper will be found—

In the finished print about	...	...	3 per cent.
„ cuttings about	...	...	7 „
„ washing, before toning, about		50 to	55 „
„ fixing bath ...	...	„ 25 „	30 „
„ washing after fixing		„	5 „

Restrainer. Any substance used to prevent the too energetic reducing or developing action of any chemical upon the exposed film. Restrainers may be of two kinds—mechanical and chemical. To the first class belongs water or any tanning agent, as chrome alum, which renders the gelatine less permeable to the developer. To the second class belong any soluble bromide or chloride, and the citrates of potash, soda, and ammonium. A soluble bromide is added to the developer to check the reduction of the unaltered silver bromide, the soluble bromide seemingly forming a double bromide with it, which is less acted upon by the developer. The restraining power of the bromides of

ammonium, potassium, and sodium bear the following proportion to one another:—

Bromide of ammonium—98 parts are equal to 119 parts of bromide of potassium, and equal to 103 parts of bromide of sodium.

Bromide of ammonium is, therefore, the strongest, potassium bromide the weakest, and the sodium salt the medium.

The citrates of potassium, sodium, and ammonium seem to act in entirely a different manner; whereas the bromides prevent the excessive deposit on the high-lights to some extent and allow detail to appear, the citrates prevent detail and allow density to be obtained.

To make these restrainers the bromides can be simply dissolved in water, as follows:—

Ammonium bromide	98 grs.
Distilled water, to make	980 minims

of solution, each drachm of which will contain 6 grs. of bromide.

Potassium bromide	119 grs.
Distilled water, to make	980 minims

of solution, each drachm of which will contain $7\frac{3}{7}$ grs. of bromide of potassium, equal in restraining power to 6 grs. of bromide of ammonium.

Sodium bromide	103 grs.
Distilled water, to make	980 minims

of solution, each drachm of which will contain $6\frac{1}{3}$ grs. of sodium bromide, equal in restraining power to 6 grs. of ammonium bromide, or to $7\frac{3}{7}$ grs. of potassium bromide.

Citrate of Potash Restrainer.

	Citric acid	720 grs.
	Bicarbonate of potash	944 „
or	Carbonate of „	884 „
	Distilled water, to make	$2\frac{1}{2}$ ozs.

of solution.

Citrate of Ammonium Restrainer.

Citric acid	720 grs.
Liq. ammonia, ·880	630 minims.
Distilled water, to make	2½ ozs

of solution.

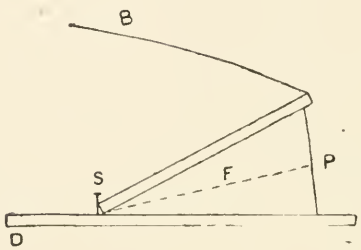
Citrate of Soda Restrainer.

	Citric acid	720 grs.
	Bicarbonate of soda	884 „
or	Carbonate of soda (crystallised)	1,440 „
	Distilled water, to make	2½ ozs.

of solution. These solutions will keep indefinitely, and may be diluted as wanted by adding 1 part of the above to 5 parts of water. The advantage of these last three restrainers is that when a negative shows plenty of detail, but refuses to gain density, the addition of a little of one of the dilute solutions may be made, and the plate left for hours if necessary, till the required density is obtained, without the slightest sign of fog.

Retouching is the operation of doctoring a negative by aid of a pencil or by use of a brush and colour, so as to hide the defects of manipulation or soften down the otherwise too obtrusive freckle or wrinkle in a sitter's face. The subject is too comprehensive to enter upon at any length, as the necessary qualifications for a good retoucher for the face and hands, which are generally those parts which it is desired to retouch, are, first, a general idea of the anatomical position of the muscles and bones of the hands; and, secondly, considerable artistic skill in wielding the pencil or brush. But for the operator who may desire to retouch a landscape negative, so as to be able to block out any pinhole in the sky or other light portion, the following may be of some assistance:—Some sort of retouching desk is needed, and this can be improvised from material within the reach of every one, all that is necessary being a printing-frame of the correct size, a deal board, a piece of black cardboard, and a small mirror or white card. Unscrew the springs of the printing-frame and temporarily remove them altogether, make a small

hole in one end of the face of the frame, have a deal board about 12 ins. long and 6 ins. broad, and arrange as shown in diagram:—



DD, deal board; SS, two nails driven well into board to prevent frame slipping; P, the support for frame; and B, the black card to prevent top light.

A mirror or white card is laid upon DD underneath the frame F, so as to reflect the light up through the negative lying in the rebate of the frame. If the reflection from the mirror be too great, a piece of ground-glass or a focussing-screen may be intervened midway between frame and mirror, in the position of the dotted line. The negative to be retouched should be varnished well with any good negative varnish, and allowed to dry thoroughly; then on those places where retouching is required should be dusted a little very finely powdered cuttle-fish, and, using the finger as a pad, rub the powder up and down or in a circular manner, till on examining the film through a magnifying glass it is seen to be quite rough; now dust the superfluous powder off, and it is ready for work. The amateur retoucher had better begin by using lead pencil, a Faber's or Hardtmuth's HHHH or HHHHHH being perhaps the most suitable, and the point should be sharpened in the following manner:—

The pencil point should always be kept very sharp by rubbing on fine emery paper. Now touch the abraded surface over the pinhole in a circular manner till the hole is no longer

visible. It is as well after several pinholes have been retouched to take a print from the same to see whether they show or not. Instead of the cuttle-fish advised above, any of the following matt varnishes may be used:—

Amber resin	10 grs.
Benzole	1 oz.

Dissolve, and allow to subside for twenty-four hours before use.

Gum dammar	10 grs.
Canada balsam	5 „
Turpentine	1 oz.

Or

Sandarac	6 grs.
Shellac	36 „
Mastic	36 „
Ether	12 drms.

Disolve, and add

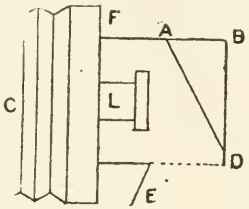
Benzole	2 drms.

Reversal is when those parts of the image which should appear dark in the negative come up light, and *vice versâ*. It is due to the extreme áction of light, and is also known as solarisation. There is no remedy when such has been effected. A very interesting paper on this subject, by Mr. Hugh Brebner, appeared in the *Amateur Photographer* of February 10th, 1888.

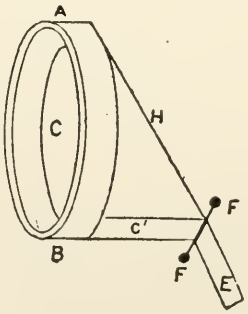
Reversed Negatives. This means that the position of the picture is reversed as regards right and left. Reversed negatives are an absolute necessity for photo-mechanical work. They may be made in the following different ways:—First, in the camera direct; secondly, by reversing the negative film itself; thirdly, by reproduction from other negatives.

First method: Taken in the camera direct. This again may be divided into three heads—viz.: (*a*) those taken by means of a silvered reflector; (*b*) those taken by means of a prism; and (*c*) those taken through the glass plate on the back of the film. By the first of these methods a piece of glass or metal silvered

on the external surface must be used, and mounted in the following manner;—



C, camera; L, lens; F A B D is the section of a hood which can be screwed on to the camera; A D, the reversing mirror, placed at an angle of 45 degs. with the lens, and so adjusted that the axis of the lens is continued to the centre of the mirror; E is a small door, which can be opened or closed at will. The camera is placed sideways towards the object, which is reflected from the exterior surface of A D to the lens. By the second method a right-angled prism is used, as shown in the diagram. The principle involved being precisely the same as with the mirror, the camera is again turned sideways to object.



A B is a hood to fit on lens to take the place of the cap. C C is a right-angled prism, whose breadth is greater than the diameter of the front glass of lens. All the surfaces except C C are enclosed in brass-mounting, but the surface H, opposite to the right angle, must not touch the glass. E is a shutter for exposing; F F, the screws for clamping same. The third method

is by taking negatives through the glass. The most convenient way of doing this is to have a piece of glass of the same thickness as used for the plate ground on one side, and the ground surface placed outside, just the opposite way to the usual focussing-screen. The back of the plate must be carefully cleaned, and should be inserted in the dark slide, with the glass towards the shutter of slide. Care must be taken that the spring used to keep the plate in position does not injure the film.

Second method of procedure: By reversing the negative film itself. This is comparatively easy, and can be done as follows:— The negative is taken and developed in the ordinary way, washed and dried, and is coated with a solution of india-rubber in benzole, and when dry coated with transfer collodion made as follows:—

Pyroxyline	24 grs.
Castor oil	24 minims.
Methylated spirit ·805	2 ozs.
„ ether ·730	1 oz.

And allowed to dry, and placed in a bath of

Hydrofluoric acid	1 drm.
Distilled water	10 ozs.

The film will soon begin to get loose, and should be gently raised up and floated off into a bath of clean water and washed thoroughly, and then floated in a reverse position—that is, with the collodionised side downwards—on to a plate coated with a warm solution of gelatine (about 5 grs. to the ounce). It should be then squeegeed into contact and left to dry.

The third method: By reproduction from the negative. Mr. Bolas proposes the following plan:—A dry plate is soaked for five minutes in a 4 per cent. solution of bichromate of potash, rinsed once or twice in water, and then dipped into a bath of equal parts of methylated spirit and water, the superfluous moisture blotted off, and dried. All these operations must be conducted in the dark-room. It is then exposed under the negative to be reversed to sunlight for three or four minutes, when a faint delicate image will be seen impressed; it is then washed and developed with ferrous oxalate or alkaline pyro, and fixed and washed as usual. The result is a reversed and negative image.

Rising Front. A movable piece of wood fitted to the front of camera, which can be moved up and down so as to exclude or include more or less of the foreground of a picture without shifting camera. It should be sparingly used, however, as of course the shifting of the lens either up or down causes the optical axis of the lens to be altered with regard to the centre of the plate; and as the brightest illumination is obtained with the central rays, it is obvious that unequal illumination may ensue.

Rives Paper. A particular make of paper specially prepared for photographic purposes.

Roller Slide. The introduction of films and paper supports for the sensitive emulsion suggested, of course, the natural idea of using the same in a continuous band for the purpose of exposing on many subjects without changing, and for this purpose the roller slide has been introduced. They are now of such every-day commercial occurrence that no further mention is required.

Rolling Prints. Consists of passing prints between two rollers, or between a roller and a bed of steel. It improves the appearance, and causes the print to lie flat.

Ruby Light. See DARK-ROOM.

Sal-Ammoniac. See AMMONIUM CHLORIDE.

Salted Paper. See SENSITISED PAPER.

Saltpetre. See POTASSIUM NITRATE.

Sandarac. A dry, semi-transparent, friable resin, tasteless, and of yellowish white colour, obtained from the *Callitris quadrivalis* of Northern Africa. It is soluble in turpentine and alcohol, and is used for varnish making.

Satin, Printing on. See SILK.

Sel d'Or. See GOLD, HYPOSULPHITE OF.

Sensitised Paper. This term includes any paper, whether albumenised or plain, which is sensitive to light from being floated upon a solution of nitrate of silver. The operation is not difficult, but home sensitised paper has few advantages over ready sensitised or commercial sensitised paper, and unless

means are specially taken to preserve the same it will not keep. The operator is supposed to have his albumenised paper ready prepared, either at home or that bought commercially; of the latter the author can confidently recommend that prepared on the Continent from *fermented*—not putrid—albumen, which, although it has rather an unpleasant smell, gives exceedingly fine effects. The paper should not be too dry, and it is advisable to place the paper for some time previous to sensitising in a damp atmosphere. The bath may be made up of various strengths; but 50 or 60 grs. to the ounce is the usual strength, the latter giving the best all-round effects.

Nitrate of silver	50 or 60 grs.
Distilled water	1 oz

The amount of solution required for sensitising a sheet of albumenised paper varies considerably with each operator, some using as much as a gallon, others only half that amount; but for ordinary small work sufficient solution should be made up to cover the bottom of dish to the depth of ¼ in. Whilst in use the bath is liable to various ills which militate against good results. The bath may and does become weaker with every sheet of paper sensitised. To obviate this a solution of nitrate of silver, 100 or 120 grs. to the ounce, should be made and kept in reserve. If a 60-gr. bath is used in the first instance after floating each sheet of paper, 2 drms. of the concentrated 120-gr. solution should be added; if a 50-gr. bath, 2 drms. of the 100-gr. solution should be added in the same way. The bath may become acid; to prevent this, after using the bath for one operation of sensitising, a few drops of a solution of carbonate of soda should be added till it produces a permanent but very slight precipitate or deposit of carbonate of silver, occasionally shaking the bottle containing the solution. The bath may become discoloured and loaded with organic matter dissolved from the albumen; in this case a little more solution of soda should be added, the bath placed in a white glass bottle, and placed in the sun or a bright actinic light; it will gradually clear itself, and deposit the organic matter as a black precipitate, from which it should be decanted for use. The operation of floating or sensitising the paper is as follows:—The paper, as stated above, should not be very dry;

this is an absolute necessity for easy work. The author has tried laying the albumenised paper plain side downwards upon a sheet of damp blotting-paper, which should be only just damp, and placing a sheet of dry paper on the albumenised side, leaving under a board for two or three minutes, and then hanging up the albumenised sheet for five minutes, with good effect. The easiest method of "floating" the paper is to use small pieces (say, about double the size required); lay one end on the bath, and gradually lower the paper, pushing it along the surface till it all floats; after it has floated for one minute, the sheet should be raised, and any adherent bubbles broken by means of a feather, quill, or spill of paper. The paper should be allowed to float from two and a half to three minutes, the longer time in winter. When it has floated for this time, it should be gradually drawn off over one edge of the bath, so as to take off as much solution as possible, and hung up to dry by the corners, or pinned up, or hung over laths or rods of wood; or the sheets may, as they come from the bath, be placed face downwards one by one on sheets of chemically pure blotting-paper, and a board and weight placed on the top; or when surface-dry it may be rolled alternately on a roller with blotting-paper. To keep this paper is the great trouble. The best method is to soak sheets of blotting-paper, 1 in. larger all round than the sensitised paper, in solution of carbonate of soda (1 in 20), and when this is dry to lay this and the sensitised paper alternately in a light-, dust-, and air-tight box, with a weight on top. But it will rarely keep more than three weeks in this way, and about a week if no special precautions are taken. By means of this paper, however, purple and even engraving black tones may be obtained without any difficulty.

Ready Sensitised Paper. Commercial sensitised paper has the great advantage of being preserved by some means. These are trade secrets; but the following are recommended by some authorities, and in every case the author has found home sensitised paper prepared in this way quite equal to any obtained commercially. As soon as the paper is surface-dry, float upon a solution of citric acid (30 grs. to the ounce) for one minute, dry as usual, and keep between the soda blotting-paper described above. The addition of 10 drops of perchloric acid to every ounce of sensitising solution is also extremely beneficial and

easy; or float as described above upon the following filtered solutions:—

Ashman's Method.

No. 1.

Picked white gum arabic	¾ oz.
Rochelle salts (tartarated soda)	1¼ ozs.
Distilled water	20 „

No. 2.

Picked white gum arabic	¾ oz.
Tartaric acid	1¼ ozs.
Distilled water	20 „

If the paper be thoroughly dried, wrapped in waste sheets, and stored under pressure, or kept between sodaic blotting-paper, No. 1 will preserve the paper at least a fortnight, and No. 2 some months. All commercial sensitised paper should be cut up as soon as bought, and kept with sodaic blotting-paper as described above.

Preparing and Sensitising Plain or Matt-Surfaced Paper. Plain Saxe paper should be used. 20 grs. of Nelson's No. 1 gelatine are soaked in a pint of distilled water, and after half an hour, dissolved by the aid of a gentle heat, 60 grs. of chloride of ammonium are added, and the paper is soaked in it (not floated) till thoroughly limp. It is then dried, and may be floated on the usual silver bath, and dried and preserved in blotting-paper in the usual way. It may also be sensitised with ammonio-nitrate of silver; but as it will not keep for more than a week, and the ammonio-nitrate solution has to be brushed or daubed on, no directions are considered necessary, as the results are inferior. For toning plain paper a weaker gold bath should be used (about 1 gr. to 16 ozs.), and a fixing bath of not greater strength than 2 ozs. of hypo to the pint should be used. Another formula for preparing plain paper is as follows:—

Ammonium chloride	70 grs.
Sodium citrate	100 „
Sodium chloride	25 „
Gelatine	10 „
Distilled water	10 ozs.

The directions are the same as given above.

Washed Sensitive Paper. Some operators prefer to wash their sensitised paper, and it is said to be more sensitive, tones more rapidly, and gives more uniform results, and can be kept for a fortnight without discoloration. The paper, when sensitised and surface-dry, is passed through, face downwards—*not soaked in*—two or three changes of distilled water, and dried and preserved as usual. Before printing, the paper should be Fumed (*q.v.*). (For further information see Abney's and Robinson's "Silver Printing," and Ashman's "Silver Printing," or Burton's book on Printing.)

Shutters, Instantaneous. The introduction of rapid dry plates has made the means of exposing them for fractional parts of a second for securing moving or so-called instantaneous effects an absolute necessity. These are now so much a part of the necessary outfit of every operator that but little description is needed. (For complete and exhaustive articles on this subject see the *Amateur Photographer* of May 25th and June 1st, 1888.)

Side Swing, or Shifting Front. An arrangement to alter slightly the relative position of objects depicted by the lens upon the focussing-screen, by shifting that portion of the camera front bearing the lens. The same objection applies to the excessive use of this movement, as mentioned under Rising Front (*q.v.*).

Silk, Printing on. As it may be desired occasionally to obtain prints on silk, satin, or other fabric, the following directions may be considered to apply to all:—

Tannin	60 grs.
Distilled water	3½ ozs.

Dissolve

Common salt	60 grs.
Arrowroot	60 „
Acetic acid	½ oz.
Distilled water	3½ ozs.

Dissolve the arrowroot by the aid of a gentle heat, add the remainder of the ingredients, mix the two solutions, filter, immerse the fabric, which should be first washed to free it from

all dressing, in this solution for three minutes, and hang up to dry. When thoroughly dry, sensitise on a bath of

Nitrate of silver	50 grs.
Distilled water	1 oz.
Nitric acid	½ drop.

Dry, print, and wash as usual, and tone in the sulphocyanide bath.

Silver. Ag = 108. The most valuable of all metals in a photographic sense can be obtained from its ores, the chloride or horn silver, the sulphide or silver glance, from some copper ores and lead sulphide, and from iron and copper pyrites. It is also found as iodide, bromide, selenide, telluride, antimonide, arsenide, and mercuride. It is obtained from iron and copper pyrites by Claudet's process, which consists in precipitating it from weak solutions by sodium iodide. Rich ores are melted with litharge or lead, and the silver is then separated by cupellation, the lead being oxidised and run off as litharge, the ingot of silver being left behind. With some lead ores which contain about 8 ozs. of silver to the ton Pattinson's process is used; this consists of extracting crystals of pure lead from the molten mass till rich enough to cupellate. Another process invented by Parkes is also frequently used, zinc is added, which raises the melting point of the ore; the zinc combines, forming an alloy with the silver, which rises to the surface, and is then skimmed off; the alloy is then heated in a retort, the zinc distils off, and the silver is left behind. Another method is by treating the ores with mercury, which also forms an alloy, the mixture being then distilled, and the mercury recovered; this process is used in California and Nevada. Silver may be obtained, chemically pure, by decomposing the chloride AgCl with hydrochloric acid and zinc; the metal separates in a spongy form, and may be fused under carbonate of soda to prevent access of air, and obtain a button of silver. When pure, silver will absorb twenty-two times its volume of oxygen when exposed to the air in a melted state, but on cooling the oxygen is given off. It is the best conductor of heat and electricity of all the metals, and it is extremely malleable and ductile. It can be hammered into sheets $\frac{1}{100000}$ of an inch in thickness. When examined by transmitted light at this stage, it is of a distinct emerald green colour. It can be drawn into wire, 400 ft. of which only weigh 1 gr., and its

tenacity is so great that a silver wire $\frac{1}{25}$ of an inch in diameter will support a weight of 187 lbs. It melts at about 1,832° F. Molten caustic alkalies, or alkaline nitrates, have no effect upon it; it is unaffected by the air, but oxidised by ozone; sulphurous vapours, however, immediately act upon it, forming sulphides. Many silver salts are acted upon by light, with partial reduction to the metallic state. Silver is soluble in nitric acid and boiling sulphuric acid, and only partially so in hydrochloric acid. The standard British coinage contains 92·5 parts of pure silver and 7·5 parts of copper. In the United States and France 10 per cent. of copper is used, and in Germany 25 per cent. To prepare pure silver from any coin, the following process will be found efficient:—Place the coin either entire, or preferably cut up small, in a test tube, with one part of pure nitric acid, and two parts of water; apply a gentle heat, and an action commences at once, orange-red fumes of nitric oxide being evolved; if after the lapse of some time the whole of the coin is not dissolved, add more nitric acid, and again apply heat. When the coin is dissolved, the solution will be seen to be of a bright blue colour, due to the copper; pure silver can be obtained from this solution by evaporating to dryness, and fusing strongly the resulting mass. A little taken out and dissolved in water should give no blue coloration with solution of ammonia; or sheet copper may be placed in the acid solution, when a precipitate of pure silver will take place, which may be collected and again dissolved in nitric acid to form solution of nitrate of silver; or the precipitate may be collected and fused as above to obtain a button of silver.

Silver Albuminate. The white precipitate obtained by adding nitrate of silver in solution to albumen in the dark is thus termed. It is a complex compound of oxide of silver and albumen, and is reduced to a red sub-compound by the action of light. It is this reaction which occurs when printing on sensitised albumenised paper.

Silver, Ammonio-Nitrate of. The pure salt can be obtained by exposing powdered nitrate of silver to ammonia gas, combination taking place very rapidly, and with evolution of sufficient heat to fuse the resulting compound, which contains 22·5 per cent. of ammonia, NH_3, and 77·5 per cent. of silver nitrate, $AgNO_3$. Ammonio-nitrate of silver is used for sensitising plain

salted paper. It cannot be used for the same purpose for albumenised paper, as the albumen would be dissolved.

Silver Bromide. AgBr = 188. Can be prepared by direct union between the elements, as in the Daguerreotype process, or by double decomposition between nitrate of silver and any soluble bromide, as in dry-plate processes:

$AgNo_3$	+	KBr	=	AgBr	+	KNO_3
Silver		Potassium		Silver		Potassium
nitrate	+	bromide	=	bromide	+	nitrate.

Or it may be prepared by dissolving carbonate or oxide of silver in hydrobromic acid. Bromide of silver is darkened to a tawny grey by the prolonged action of light, with evolution of bromine; but by short exposures, as in the camera, it is said to be reduced to a sub-bromide, or, as Carey Lea calls it, a photo-bromide of silver. Sub-bromide of silver in this stage is precisely the same in physical appearance as the bromide; but it is more easily reducible by certain salts, which constitutes the process of Development (*q.v.*). Bromide of silver is insoluble in water, alcohol, and ether, but soluble in solution of alkaline hyposulphites, cyanides, sulphocyanides, ammonia, and saturated solutions of most chlorides, bromides, and iodides.

Silver Chloride. AgCl = 143·5. Can be obtained by direct union between the elements, or by double decomposition with nitrate of silver with a soluble chloride,

$$AgNO_3 + NaCl = AgCl + NaNO_3;$$

or by adding hydrochloric acid to silver nitrate,

$$AgNO_3 + HCl = AgCl + HNO_3.$$

It also occurs as a native ore, called horn silver, from its general appearance. On exposure to light when absolutely pure or dry, no change takes place; but with the smallest trace of organic matter or water it passes from white through varying shades of purple to black, chlorine being disengaged, and a complex body now definitely stated to be a mixture of chloride (AgCl), oxychloride (AgClO), and metallic silver (Ag) resulting. It melts at about 260 degs. F., and is not decomposed when heated with carbon, but is immediately reduced by heating in a current of nascent hydrogen. Zinc, iron, and copper reduce the chloride,

when moistened with an acid, to a metallic state; whilst when heated with the carbonates or hydrates of sodium and potassium or calcium, the chlorine unites with the alkali, pure silver being set free. It is soluble in solutions of the same salts as the bromide, and also in ammonia—a double salt, ammonio-chloride of silver, being formed.

Silver Iodide. AgI = 235. This salt can be formed in an analogous manner to the chloride, either by direct union or double decomposition, using iodine and iodide instead of chlorine and chloride. When prepared by precipitation from a solution of an alkaline iodide with nitrate of silver, the alkaline iodide being in excess, a white precipitate is caused, which is not so sensitive to light as when excess of nitrate of silver is used, when the precipitated iodide is lemon-coloured. Iodide of silver is insoluble in water and dilute nitric acid, almost insoluble in ammonia, but soluble in all the other salts which dissolve bromide. When iodide of silver is dissolved in excess of solution of an alkaline bromide, iodide, or chloride, a double salt is formed, and on addition of water the resulting soluting immediately precipitates the iodide. It is used for making emulsions, giving extremely sensitive emulsions and great latitude of exposure, with great density of image. When making emulsions containing iodide, the bromide of silver should be precipitated after the iodide. By this means greater sensitiveness is obtained. About 5 or 10 per cent. of the sensitive salt should be iodide.

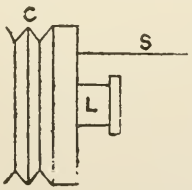
Silver Nitrate. $AgNO_3 = 170$. Is prepared from pure silver by solution in nitric acid, and subsequent purification and crystallisation. Ordinary commercial nitrate is usually very acid, due to its not being absolutely freed from nitric acid; but that prepared for photographic purposes should be almost neutral, or at least show only a faint trace of acid. To the dry-plate operator nitrate of silver is hardly of so much interest as it was to the operator of the wet-plate process; but to those who desire to make their own plates, a pure salt is a *sine quâ non;* and as the testing of this salt is almost beyond the ordinary capabilities of dry-plate workers, the only recommendation which the author can give is to buy the salt from a respectable photographic chemist, and to pay a fair price for it, as the author has in his possession a sample of nitrate bought at a low

price, 25 per cent. of which is nitrate of potassium. Solubility: 100 grs. are soluble in 50 minims of distilled water, and will measure 80 minims; 1 in 15 of rectified spirit. When dissolved in common water, a thick curdy-white precipitate of carbonate and chloride of silver is formed. Boiling alcohol dissolves about one-fourth of its weight of nitrate of silver, but deposits it on cooling. It is soluble in ammonia, with the formation of a double salt. It is used for sensitising paper, and preparing all or nearly all the other salts of silver used in photography. When heated, it melts and forms, when poured into moulds, the lunar caustic of commerce; and when heated higher still gives off some oxygen, and a mixture of nitrite ($AgNO_2$) and nitrate of silver ($AgNO_3$) is left. When exposed to the light, either in solution or in a pure dry state, no action takes place; but on contact with organic matter it darkens through purple to black.

Silver Oxide. $Ag_2O = 232$. May be obtained by adding pure solution of any caustic alkali, except ammonia, to a solution of nitrate of silver, when the oxide is precipitated as a brownish black precipitate. It is but little used now, except to purify silver solutions from copper, but was used in the old wet-plate process to purify the silver bath. It cannot be made by heating silver in a current of oxygen or air, because, although union takes place, the whole of the oxygen is given up on cooling.

Silver Sulphide. $Ag_2S = 242$. This salt is met with in residue recovery, and is the resultant salt of the decomposition of hyposulphite of silver in prints. It is insoluble in water, but soluble in every solvent of the other silver salts, except nitric acid, which converts it into nitrate and sulphate.

Sky Shade. A piece of wood or card used to shade the lens during exposure, to prevent reflections from the sky or sun. The following diagram will illustrate the position:—



C, camera; L, the lens; S, sky shade.

Slide, Dark. This part of the outfit of a photographer hardly needs much description, but it is advisable that the operator should know how to test his slides as to the exclusion of all actinic light, and whether they register exactly the same plane as the focussing-screen. To test whether the dark-slide lets in light, a plate should be inserted in the dark-slide in an absolutely dark room, and then the slide should be placed upon a table in an ordinary room for about fifteen or twenty minutes, and then developed in the usual way. No sign of an image or deposit should make its appearance. The usual places for light to creep in is through the hinges of the shutter and the corners and edges of the slide. To test whether the plate when in the dark-slide is in exactly the same register as the focussing-screen, the camera should be set up in the usual way opposite a printed bill or other lettering, and this should be focussed as accurately and sharply as possible, and the focussing-screen removed; and without shifting the camera in any way whatever, the dark-slide, with a piece of ground-glass in the position usually occupied by the plate, should be inserted and examined, to see whether the image previously focussed is equally as sharp on the ground-glass in the dark-slide.

Slide, Lantern. See TRANSPARENCIES.

Soda, Bicarbonate of. $NaHCO_3 = 84$. Synonyms: Sesqui-carbonate of Soda, Acid Carbonate of Soda. Is prepared by passing carbonic acid gas into carbonate of soda moistened with water. Solubility: 1 in 10 of water; insoluble in alcohol. When heated or dissolved in boiling water, some carbonic acid gas is given off, water and carbonate of soda being formed.

$$2NaHCO_3 = Na_2CO_3 + H_2O + CO_2.$$

It is used for toning. It is invariably met with in commerce as a fine impalpable powder, and should not be confounded with the carbonate which is usually met with in crystals. To test a salt or solution of same, to see whether it be a carbonate or bicarbonate, add to a solution of the salt a few drops of solution of perchloride of mercury. A white precipitate turning red on boiling indicates bicarbonate, and a red precipitate thrown down at once indicates carbonate.

Sodium Acetate. $NaC_2H_3O_2, 3H_2O = 136$. Can be prepared

by neutralising acetic acid with carbonate or hydrate of sodium. Solubility: 1 in 3 of cold water, 1 in 1 of hot water; soluble also in alcohol. It is a slightly alkaline salt, and is used principally in toning.

Sodium Carbonate. Na_2CO_3, $10H_2O$ = 286. Is prepared by the salt-cake process, an outline of which is here given:— Common salt is heated in a reverberatory furnace, with an equal weight of sulphuric acid. Hydrochloric acid is evolved and is collected in water, sulphate of sodium being left behind.

$$2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl.$$

The heat is continued until the sulphate of sodium is perfectly dry. It is then mixed with an equal weight of limestone or chalk, and half its weight of small coal, and again heated, and a mixture of carbonate of lime and sulphide of sodium results.

$$Na_2SO_4 + C_2 = Na_2S + 2CO_2.$$

And on further heating the carbonate of lime and sodium sulphide react, forming sulphide of calcium and carbonate of sodium.

$$Na_2S + CaCO_3 = CaS + Na_2CO_3.$$

The mixture is treated with water, the carbonate of sodium is dissolved, leaving the sulphide of lime, which is known as "soda waste," and which is used to prepare sodium hyposulphite. The solution of carbonate of soda is evaporated and crystallised, the resulting product being "soda-ash," a mixture of carbonate and hydrate of sodium, the latter being due to the action of excess of lime upon the carbonate. The soda-ash is purified by roasting with small coal or sawdust, the hydrate being decomposed into carbonate, the mass being dissolved in water and crystallised. Solubility: 1 in 2 of water; insoluble in alcohol. Heat has no effect upon it, except to drive off the water of crystallisation.

Sodium Chloride. NaCl = 57·5. This, the most abundant source of sodium, occurs native in very large deposits in Cheshire, Galicia, and Eastern Russia, also in sea water, which contains about 3 per cent. Solubility: 1 in 2·77 of cold water, the solubility not being increased by heat. It is sparingly soluble in alcohol. It is used in developing lantern slides and for preparing emulsions, and also sometimes for salting albumenised paper.

Sodium Citrate. $Na_3C_6H_5O_7 = 258$. Made by neutralising citric acid with carbonate, bicarbonate or hydrate of sodium, evaporating, and crystallising the resulting solution. Solubility: 1 in 1 of water; sparingly soluble in alcohol. It is used sometimes as a Restrainer (*q.v.*), and also in preparing some printing-out emulsions.

Sodium Hyposulphite. $Na_2S_2O_35H_2O = 248$. Synonym: Thiosulphate of Soda. This important salt is formed by passing sulphurous acid gas through sulphide of sodium until no further precipitation of sulphur occurs, or it may be made by heating—not boiling,—sulphite of sodium with excess of sulphur. It is met with in commerce as large watery crystals, which should be entirely free from acid or any yellow tinge. It is soluble 1 in 2 of cold water, 1 in 1 of boiling water, and insoluble in alcohol. Its importance in a photographic sense as a solvent for the unacted upon silver salts was discovered by Sir William Herschel. When a salt of silver is added to hyposulphite, two salts are formed, as shown in the following equations:—

$AgCl$	+	$Na_2S_2O_3$	=	$AgNaS_2O_3$	+	$NaCl$.
Silver chloride	+	Sodium hyposulphite	=	Double hyposulphite of silver and sodium	+	Sodium chloride.

And

$2AgCl$	+	$3Na_2S_2O_3$	=	$Ag_2Na_43(S_2O_3)$	+	$2NaCl$.
Silver chloride	+	Sodium hyposulphite	=	Hyposulphite of sodium and silver	+	Sodium chloride.

The first salt, $AgNaS_2O_3$, is almost insoluble in water, and soluble in hyposulphite of soda; therefore excess of hypo should always be used for fixing: the incomplete elimination of this insoluble salt is one of the chief causes of fading in prints. To test whether the whole of the hyposulphites are eliminated either by washing or by the use of an eliminator, the following may be used:—

Potassium permanganate	2 grs.
Potassium carbonate	20 „
Distilled water	40 ozs.

A few drops of this pinkish purple liquid should be added to the last washing water, when, if hypo be present, a greenish

tinge will make its appearance; or a few drops of the last washing water may be added to a solution of mercuric chloride, when a cloudiness will make its appearance if hypo be present. Another test is by making a little starch paste by boiling a pinch of starch in distilled water, and adding a drop or two of solution of iodine in alcohol to it, when a deep blue coloration, due to iodide of starch, will make its appearance. A drop or two of this deep blue liquor may be added to the last washing water, when, if hypo be present, the blue colour will be destroyed. The addition of any acid to a solution of hyposulphite will cause evolution of sulphurous acid and deposition of sulphur; hence will be seen the necessity of making the fixing bath for prints distinctly alkaline, to prevent sulphuration.

Sodium Nitrate. $NaNo_3=85$. Synonym: Chili Saltpetre. This occurs native in Chili, and has been recommended as an addition to developers to give a good chocolate colour to them. Solubility: 1 in 1·2 of water; soluble 1 in 37 parts of alcohol.

Sodium Phosphate. $Na_2HPO_4 12H_2O=358$. Prepared by neutralising phosphoric acid with any alkaline salt of soda. Solubility: 1 in 4 of cold, 1 in 2 of boiling water; insoluble in alcohol. On exposure to the air the crystals effloresce—that is, give up some molecules of water—and it is questionable whether a complex phosphate is not formed. It is used for toning.

Sodium Sulphite. $Na_2SO_3=126$. Is prepared by passing sulphurous acid gas through carbonate of soda in concentrated solution till saturation. Solubility: 1 in 4 of cold water, 1 in 2 of hot water; slightly soluble in alcohol. It is used as a preservative of pyrogallol, as it absorbs oxygen, and is converted into sulphate. This salt is difficult to keep as pure sulphite, but keeps better in concentrated solutions than weak ones. It has also been recommended as a fixing agent; but as its powers are considerably less and its price greater than hyposulphite, it is never likely to come into general use.

Solar Camera. A term applied to a camera specially designed by Woodward for the purposes of enlarging by sunlight. It consists of a camera with a condenser in the place of the focussing-screen and a reflecting mirror behind it, the negative being placed about midway between the condenser and an achromatic lens, which is placed at the focus, or nearly so, of the condenser.

The following sketch (fig. 1) will show the arrangement, but it is now generally superseded by less expensive apparatus:—

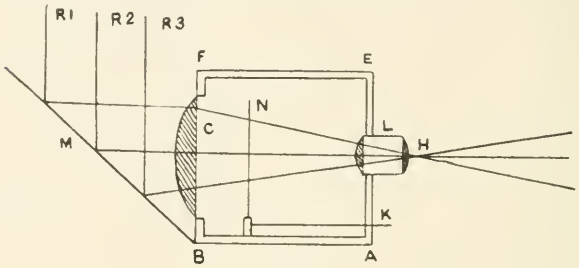


Fig. 1.

EFBA, the camera; M, adjustable mirror; C, condenser; K, screw-rack to focus negative on screen; N, negative; L, the lens; and R^1, R^2, R^3, rays of light impinging on mirror, being reflected through condenser, negative, and lens to H, the focus, and continued to screen, giving an enlarged image.

Specific Gravity is the ratio of weight which a given volume of any substance at a given temperature bears to the weight of a standard substance at a standard temperature. For liquids and solids the standard is 1,000 grs. of distilled water at 60 degs. F. The specific gravity of a liquid is found by filling a specially made bottle quite full. This bottle usually holds exactly 1,000 grs. of distilled water at 60 degs. F. The bottle is counterpoised in a delicate scale by a brass weight. If this bottle is filled with liquid and weighed, the specific gravity is found by dividing the weight by 1,000. Example: The bottle, filled with dilute formic acid, is found to weigh 1,060 grs. 1,060 ÷ 1,000 = 1·060, the specific gravity of dilute formic acid. The bottle, filled with ether, is found to weigh 725 grs. 725 ÷ 1,000 = ·725, the specific gravity of the ether weighed. The specific gravity of a liquid is a standard test of the strength and purity of that liquid. For taking the specific gravities of solids and gases certain very careful precautions have to be taken, but as these have but little interest photographically the operator is referred to any standard work on physics.

Spectroscope. An instrument used to examine the effects of

spectrum analysis. Photography has recently been used as a means of determining the action of certain elements in a gaseous form on the spectrum. For further information reference must be made to Captain Abney's researches on this subject.

Spectrum is the image of the primary colours of heterogeneous white light when decomposed by a prism, and as the photographic action of light depends upon the action of certain portions of the spectrum, some little consideration of this subject is necessary. When a ray of sunlight is allowed to fall upon a prism, it is decomposed into its constituent rays; and as these different coloured rays have different refrangibilities, an image of them can be shown upon a white screen. The prismatic colours are red, orange, yellow, green, blue, indigo, and violet. Beyond the red, the least refrangible rays are certain invisible rays termed the infra red, where most heat lies; whilst beyond the violet lie the ultra violet, the most actinic rays; whilst the brightest visual rays are situated in the yellow. Fig. 2 will show the arrangement of the prism and the spectrum:—

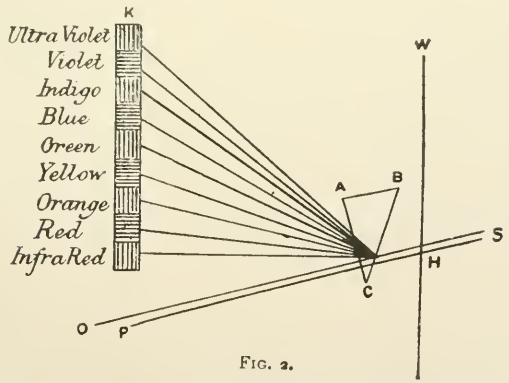


FIG. 2.

W, the window blocked by a shutter; H, a hole, which, whether circular or square, always projects a round image of the sun at P; S, the ray of sunlight; A B C, the prism, which decomposes the light and gives an image of the spectrum at K.

The disposition of the colours is here shown—red the least refrangible, and violet the most refrangible. A Lens (*q.v.*) being

considered as composed of prisms, it is obvious that the light would be refracted and decomposed as above; but by placing another lens or set of prisms in close contact with the first, the decomposed light is reunited, and re-forms white light. It is this principle which guides opticians in making their lenses achromatic. As the most actinic rays reside in the violet portion of the spectrum, it is these rays which, visible or invisible, make the impression upon any sensitive surface; and the yellow and red rays having but little effect on a sensitive film, it is obvious that

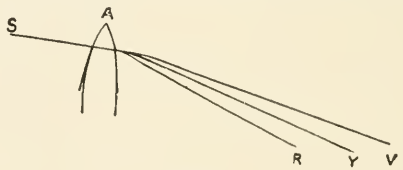


Fig. 3.

these colours in a landscape or picture have but little effect in forming the latent image, and therefore show as black in the finished print; but as these rays are the most visible, and would form the image on the focussing-screen, it is obviously necessary to make the violet and yellow rays coincident. Figs. 3 and 4 will show the effect of a non-achromatic and an achromatic lens.

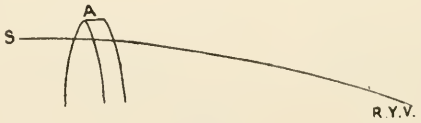


Fig. 4.

A, the lens, in fig. 3 a non-achromatic, in fig. 4 an achromatic or corrected lens; a ray of white light, being in fig. 3 decomposed, the most visual rays or yellow being refracted to Y, the violet or actinic rays being refracted to V in fig. 3; by the use of the second lens, B, fig. 4, these rays are reunited, so as to form one single ray at RYV.

Squeegee. A strip of india-rubber fixed in a piece of wood, leaving about ¼ in. free, used to squeegee any two substances, like

a print and mount, into optical contact. An improved form has lately been introduced, which consists of india-rubber pipe with a wooden roller inserted, with a handle affixed. It is a decided advance on the old form, there being no scraping action with it, and being equally as effective.

Stains are unfortunately met with by nearly every tyro in some form or other, either on plates or paper. On plates they are too often the result of pyro development, especially when soda is used as an accelerator. They can in almost every case be remedied by the use of a Clearing Bath (*q.v.*), or if too bad for this, a little solution of hypochlorite of zinc will generally be found sufficient. Sometimes after printing from a negative before quite dry, dirty brown stains make their appearance where the sensitised paper has stuck to it. These are the most troublesome to remove, no clearing bath having the slightest effect on them. The best plan for their removal is to use a tuft of cotton-wool moistened with a weak solution of cyanide of potassium, or by using the following:—

Sulpho cyanide of potassium	10 grs.
Nitric acid	5 minims.
Distilled water	1 oz.

Great care must be exercised whichever is used, or the negative will be irredeemably damaged.

Stains on Paper. These are numerous, and may be from hypo, dirty or greasy fingers, or from improper keeping There is no remedy for the former. For the latter, see SENSITISED PAPER.

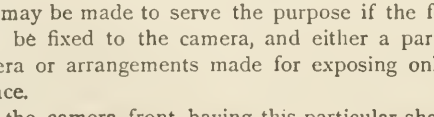
Stand. One of the most important parts of an amateur's outfit. There are numerous good stands in the market, and many bad ones, and whilst it may be invidious to name them, the following points may help the operator in his choice:—The stand should be of sufficient height to allow of the operator standing comfortably upright under the usual cloth, with his eye on a level with the top of the camera. Many commercial stands are much too low; the stand should be light in weight, rigid when set up, and capable of adjustment for uneven ground,

and folding up into a small compass, and, lastly, there should be no loose screws about it. It is always as well to obtain a stand for a larger sized camera than is used, as greater rigidity is obtained. When erecting the stand, which is also called the tripod, one of the legs should always be placed underneath the lens, as by this the front of the camera can easily be lowered or raised, and the operator can comfortably stand between the legs behind.

Stannotype. See Woodburytype.

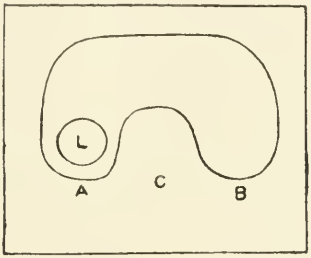
Starch. $C_6H_{10}O_5 = 162$. This substance, most widely diffused throughout the vegetable kingdom, is so well known that little description is required. It is used for making paste for mountants and for sizing paper.

Stereoscope. An optical instrument, devised by Professor Wheatstone in the first instance, for exhibiting two perspective views of an object, so as to give the appearance of one and give an idea of solidity. Professor Wheatstone's idea, which he communicated in 1839, consisted of the use of reflectors; but Sir David Brewster, some years after, introduced the form of stereoscope so common a few years ago, in which half-lenses were used and the pictures placed in a sort of dark box; then large semi-lenses were used; and then whole lenses were used. Leaving the theoretical discussions as to the optical principles involved in using the stereoscope, the following may be considered as the fundamental method of producing stereoscopic pictures. They may be produced by a camera especially constructed for the purpose, which is divided down the centre by an opaque division, and is mounted with two lenses of precisely the same focus and working aperture, and the distance between the optical centres of the two lenses is usually about $2\frac{5}{8}$ ins. apart. Any ordinary half-plate camera, with square bellows, may be adopted by dividing it internally by a partition, and fixing two stereoscopic lenses in the front, and using a carrier in the dark-slide to take plates $6\frac{1}{2}$ by $3\frac{1}{4}$, which is the regulation stereoscopic size, or one lens may be made to serve the purpose if the following shaped front be fixed to the camera, and either a partition put in the camera or arrangements made for exposing only half the plate at once.



C, the camera front, having this particular shaped opening, so

that L, the lens, may be shifted from A to B, and *vice versâ*, if desired. When the prints are taken and finished they should



be cut in two, and the right-hand half mounted on the left-hand side, and the left-hand on the right. Of course exactly the same exposure must be given to each half of the plate, and exposure, printing, and toning must be identical for both halves.

Stop. See DIAPHRAGM.

Stripping Film. A name given to a sensitive emulsion spread upon an insoluble film of gelatine, and affixed to a paper support by a layer of soluble gelatine. The processes of development and fixing are precisely the same as for a dry plate, and, after washing and clearing, the film is squeegeed to a collodionised plate and stripped. For stripping the film from an ordinary plate, so as to make a film for carbon or photo-mechanical work, the following process may be adopted:—The negative should be soaked in a solution of chrome alum for ten or fifteen minutes and allowed to dry thoroughly, and then coated with enamel collodion, and when this has set it should be washed till it no longer repels water, and then immersed in a solution of hydrofluoric acid (1 to 8), till the film begins to blister and become loose. Great care must be exercised in using this acid, as the slightest trace of the strong acid causes extremely painful ulcers, and even in the dilute state the fingers should be placed in it as little as possible. After the film has soaked in this bath for a few minutes and begins to blister, one corner may be brushed or gently lifted up, and the film floated off into a clean dish of water, and then on to a collodionised plate which has previously received an edging of india-rubber solution (4 grs. india-rubber in

benzole, or chloroform 1 oz.). It should be carefully smoothed out on this plate, and can be allowed to dry, and then cut round the edges and stripped off; or it may be simply washed after being floated off the first plate and hung up to dry.

Sublimate, Corrosive. See MERCURY, PERCHLORIDE OF.

Sugar of Lead. See LEAD ACETATE.

Sulphur. S = 32. Synonyms: Flowers of Sulphur, Brimstone. A non-metallic element found native and also in composition with various metals. It has no interest photographically, but its compounds are used.

Sulphur Toning. This was the first of all methods of toning, and whilst the tints are extremely pleasant they are very liable to fade, and cause the production of the well-known yellow print.

Swing-Back. This is an arrangement by means of which the back of the camera, in which the receptacle of the sensitive surface is placed, can be moved in certain directions, so that the parallel lines can be kept upright, or the foreground of a picture placed in focus without the use of an excessively small stop. When focussing a house or an interior, or any subject in which parallel lines occur, if the camera be tilted, unless the swing-back be used the lines in the resulting print will be found to converge at the top. Again, it is useful when using a portrait lens upon a sitting figure. When the eyes have been focussed quite sharp, it will be found that most likely the feet or knees of the sitter would be out of focus, due to the want of depth of focus which these lenses possess; but by use of the swing-back this want can be to a great extent obviated.

Symmetrical Lens. See LENS.

Talbotype. See CALOTYPE.

Test Papers. Small slips of bibulous paper soaked in a solution of litmus or other dye, and used for testing any liquid for its alkalinity or acidity.

Thermometer is an instrument used for determining the temperatures of different substances, liquids, and gases. These instruments are so generally known that but little description is needed; but as several different methods of marking them are

in vogue, the following explanation and rules may make all clear:—There are three principal methods of division: Réaumur, Celsius or Centigrade, and Fahrenheit—Réaumur taking 0 deg. as the temperature of freezing water, and dividing the scale between this point and boiling water into 80 degs. This system is generally dying out. Centigrade or Celsius' system starts from 0 deg. as the freezing point and 100 degs. as the boiling point. This system is gradually gaining ground. Fahrenheit's system takes 32 degs. as the freezing point and 212 degs. as the boiling point. This is the system in common use in England, and, notwithstanding many objections, is one of great value, because of the number of divisions of the scale. To convert degrees of one scale into those of another the following rules must be used:—

To Convert Réaumur into Centigrade.
Multiply by 5 and divide by 4.
Example: 80 degs. R. × 5 ÷ 4 = 100 degs. **C.**

To Convert Réaumur into Fahrenheit.
Multiply by 9 and divide by 4, and add 32.
Example: 80 degs. R. × 9 ÷ 4 + 32 = 212 degs. **F.**

To Convert Centigrade into Réaumur.
Multiply by 4 and divide by 5.
Example: 100 degs. C. × 4 ÷ 5 = 80 degs. **R.**

To Convert Centigrade into Fahrenheit.
Multiply by 9, divide by 5, and add 32 to the result.
Example: 100 degs. C. × 9 ÷ 5 + 32 = 212 degs. **F.**

To Convert Fahrenheit in Réaumur.
Subtract 32, multiply by 4, and divide by 9.
Example: 212 degs. F. − 32 × 4 ÷ 9 = 80 degs. **R.**

To Convert Fahrenheit into Centigrade.
Subtract 32, multiply by 5, and divide by 9.
Example: 212 degs. F. − 32 × 5 ÷ 9 = 100 degs. **C.**

Thinness of Negative. This may be the effect of three causes—first, under-exposure; second, over-exposure; and third, under-development. Thinness from under-exposure is usually caused by the whole plate veiling over before sufficient density

can be obtained, due to the use of excessive alkali (see UNDER-EXPOSURE). In the case of over-exposure it is due to the energetic action of the developer, consequent upon the too great action of light (see OVER-EXPOSURE). In under-development the result is thinness, consequent upon the developer not reducing sufficient silver salt to the metallic state. This is generally distinguished from over- or under-exposure by the absence of fog or veiling.

Toning. If a silver print is placed direct into the fixing bath, an unpleasant brick-red colour is the result. The operation of toning consists in changing this colour by the partial substitution of gold or some other metal for the silver in the print. Several different methods are in common use, but the most general and the best is by means of an alkaline gold bath. The colour obtained by toning varies with each bath, and in many cases with each different brand of paper, and the tone depends to a great extent, too, upon the negative. Some authorities even state that the tone of the print is fixed when the plate is developed, but the author cannot quite bear out this statement. Good bold negatives with plenty of contrast give more easily purple and black tones than weak muddy negatives devoid of any contrast, vigour, or sparkle. The following are the baths most commonly used at the present time, with some notes on the same:—

1. Acetate Bath.

Chloride of gold	...	...	...	...	1 gr.
Acetate of soda	...	...	...	...	30 grs.
Distilled water	...	...	...	...	10 ozs.

Neutralise the gold with a pinch of common chalk mixed with ½ oz. of water, allow to settle, pour off the solution, and add to the acetate dissolved in the water. The bath must be kept at least twenty-four hours before use, and works better even when older. It gives brownish purple tones, which are very pleasing. The bath keeps fairly well if distilled water is used, and if no actinic light is allowed to gain access to it. If the bath be required for immediate use, hot water must be used, and the bath may be used as soon as cold. After toning, the bath should not be thrown away, but filtered and kept for use instead

of water for diluting the next bath. The author prefers keeping a concentrated solution as follows:—

Chloride of gold	15 grs.
Acetate of soda	480 „
Distilled water, to make	7½ ozs.

For use, mix ½ oz., equal to 1 gr. of gold, to ½ pint of water for every sheet of paper to be toned. After use, the bath may be filtered and preserved to dilute the next bath.

2. Bicarbonate and Acetate Bath.

Chloride of gold	15 grs.
Bicarbonate of soda	30 „
Acetate of soda	360 „
Distilled water	15 ozs.

Add the gold and bicarbonate of soda to 2 ozs. of water, shaking occasionally, and keep till colourless; then add the acetate and remainder of water, and keep for six hours, and dilute as for the acetate bath. The same directions apply to this bath as to No. 1. Rich purple-black tones are obtained.

3. Borax Bath.

Chloride of gold	1 gr.
Borax	20 grs.
Distilled water	10 ozs

4. Bicarbonate Bath.

Chloride of gold	1 gr.
Bicarbonate of soda	30 grs.
Distilled water	10 ozs.

These give warm brown tones, the latter inclining to purplish black. They can be used as soon as made, but will not keep.

5. Phosphate Bath.

Chloride of gold	1 gr.
Phosphate of soda	20 grs.
Distilled water	10 ozs.

Gives warm purplish tones. May be used as soon as mixed, Will not keep.

6. Compound Bath.

Stock Solution.

Borax	330 grs.
Acetate of soda	180 „
Bicarbonate of soda	90 „
Distilled water	20 ozs.

Toning Bath.

Stock solution	10 drms
Chloride of gold	1 gr.
Distilled water	10 ozs.

Mix two hours before using. Retain the bath after each toning, and use instead of water for new toning bath. This gives exceedingly rich brown tones, and is a great favourite of the author's.

7. Carbonate Bath.

Chloride of gold	1 gr.
Carbonate of gold	15 grs.
Distilled water	10 ozs.

Mix half an hour before use. Will not keep. Tone to purplish blue, and fix. The resulting colour is a good brown, free from any purplish tinge. But to get a true sepia tone use water at about 170 degs. F., add the gold, and use in ten minutes.

8. Chloride of Lime Bath.

Chloride of gold	15 grs.
Common chalk	150 „
Chloride of lime	24 „
Lime water	15 ozs.

Add the gold to the chalk, and mix into a paste with a little lime water, and leave for one hour; filter, and wash the filter with the remainder of the lime water in which is dissolved the chloride of lime. Add 1 oz. of the above to 10 ozs. of water for every sheet of paper to be toned. When old and the bath refuses to tone, add a little chloride of gold, and leave for fifteen minutes; or if no smell of chlorine, add a grain of chloride of lime. This gives purplish black tones, and keeps well.

9. Acetate and Chloride Bath.

Chloride of gold	15 grs.
Acetate of soda	360 „
Chloride of lime	135 „
Common chalk	360 „
Distilled water	15 ozs.

The directions for mixing this are the same as for the chloride of lime bath, the acetate being added in solution last. This gives warm black tones, and keeps well.

10. Acetate and Borax Bath.

Chloride of gold	15 grs.
Acetate of soda	150 „
Borax	15 „
Distilled water	15 ozs.

Mix the gold and acetate in 3 ozs. of water, and keep for six hours. Add the borax dissolved in remainder, and use at once. This keeps fairly well, and gives brownish black tones.

11. Carbonate of Lime Bath.

Chloride of gold	15 grs.
Carbonate of lime (chalk)	75 „
Distilled water	15 ozs.

Mix the gold and chalk and water, and leave for one hour. Keeps fairly well, and gives brownish purple tones.

12. Tungstate Bath.

Chloride of gold	15 grs.
Tungstate of soda	300 „
Distilled water (at 212° F.)	15 ozs.

Use when cooled. Gives very fine purplish brown tones. Keeps fairly well. Add an ounce of stock bath to the old bath for every sheet of paper used.

13. Platinum Toning Baths.

Platinum perchloride	15 grs.
Bicarbonate of soda	15 „
Distilled water	15 ozs.

Print very deeply, and add to the bath at time of using 1 drop or

nitric acid for every grain of platinum used. Platinum may also be substituted for gold in any of the above baths, or a mixture of equal parts of platinum and gold may be used.

14. Platinum and Hypo Bath.

Platinum perchloride	15 grs.
Hyposulphite of soda	45 „
Hydrochloric acid	15 minims.
Distilled water	15 ozs.

Dissolve the hypo in the water, mix the acid and platinum to the hypo solution. The use of this bath is extremely questionable from the point of permanency, and it is doubtful whether most of the tone is not due to sulphur.

15.

The following was recommended by Dr. Reynolds in the *Amateur Photographer* of August 12th, 1887, and although the author has been enabled to obtain very fine purple tones with it, he has utterly failed to obtain the velvety blacks as stated by Dr. Reynolds:—

Platinum perchloride	2 grs.
Distilled water	20 ozs.

Dissolve, and carefully neutralise the free acid with carbonate of potash. Dissolve 100 grs. of borax in a little hot water, and add to the platinum solution; dissolve 20 grs. of oxalic acid in a little hot water, add 30 minims of formic acid to it, and mix the two solutions. The prints must be over-printed till the image can hardly be discerned; a slight wash previous to toning only is required; fix in hypo 2½ ozs. to a pint, with a drachm of liquid ammonia added. This answers well for plain paper.

16.

The following is also recommended in the *British Journal of Photography* for plain paper:—

Platinum perchloride	1 gr.
Water	16 ozs.
Carbonate of potash ...	sufficient to neutralise.
Formic acid	½ to 1 drm.

By carrying toning to a greater depth blacks are obtained, but shorter time gives warmer tones.

17. Uranium Toning Baths.

Uranium Nitrate Chloride of gold	of each	1 gr.
Bicarbonate of soda		20 grs.
Distilled water		10 ozs.

This bath must be used as soon as mixed, and should be distinctly alkaline to test papers. It gives very fine purplish black tones, and the author has found the best results follow complete elimination of free silver by a salt-and-water bath previous to toning. The prints when toned should also be placed in salt and water.

18

Chloride of gold	4 grs.
Uranium nitrate	4 „
Chloride of sodium (salt)	60 „
Acetate of sodium	60 „
Distilled water	32 ozs.

Neutralise the gold and uranium, previously dissolved in a little water, with bicarbonate of soda. The prints should be rather deeply printed, and washed free from silver, and then toned. This bath gives fine blacks, and with plain or matt-surfaced paper the results can hardly be told from bromide prints. The following is the best fixing bath for this, and the prints should be washed in salt and water after toning:—

Hyposulphite of soda	2 ozs.
Salt	1 oz.
Bicarbonate of soda	½ „
Water	1 pint.

Uranium may also be added to any of the ordinary gold toning baths in use.

Thus far the author has given formulæ for toning baths which he has tried, and can speak from personal experience. The following were baths in use some twenty or thirty years back,

and some were much approved of. The author regrets, however, that he has not had time to experiment with them :—

19. Iron, Gold, and Uranium Bath.

Chloride of gold	1 gr.
Nitrate of uranium	½ ,,
Carbonate of soda	sufficient to neutralise.
Solution of acetate of iron	1 drop.
Distilled water	8 ozs.

This gives a black precipitate at once, which soon dissolves. It is said to give rich black tones. The bath is very unstable.

20. Lead and Gold Bath.

Nitrate of lead	30 grs.
Chloride of sodium (salt)	40 ,,
Hyposulphite of soda	240 ,,
Chloride of gold	1 gr.
Distilled water	10 ozs

Mix in warm water. Use at once. Bath won't keep. Gives rich blacks. Fix in fresh hypo. Permanency of tones not guaranteed.

21. Bromide Bath.

Chloride of gold	1 gr.
Carbonate of soda	15 grs.
Sodium bromide	½ gr.
Distilled water	10 ozs.

Use at once. Won't keep. Gives rich brown or chocolate tones. The more bromide is added the redder the tone.

22. Copper and Gold Bath.

Sulphate of copper	½ gr.
Chloride of gold	½ ,,
Distilled water	5 ozs.

Leave the prints in for five minutes, and then transfer to

Chloride of gold	1 gr.
Acetate of soda	10 grs.
Bicarbonate of soda	10 ,,
Chloride of potassium	2½ ,,
Distilled water	10 ozs.

Fume the paper. Print very deep. Wash two or three times. Gives blackish purple tones.

23. Lime Water and Acetate Bath.

Chloride of gold	15 grs.
Acetate of soda	180 „
Lime water	15 ozs.

Gives purplish tones. Keeps fairly well.

24. Citrate Bath.

Chloride of gold	1 gr.
Carbonate of soda	60 grs.
Citric acid	20 „
Distilled water	10 ozs.

Mix, and warm till it changes colour. Use at once. Won't keep.

25. Restrained Lime Bath.

Chloride of gold	1 gr.
„ „ lime	1 „
„ „ soda	1 „
Distilled water	5 ozs.

This is said to give fine even blacks, the salt acting as a restrainer, and preventing unequal deposition of gold. Bleaches considerably.

26. Mercury Bath.

Mercuric chloride	2 grs.
Tartaric acid	10 „
Hydrochloric acid	5 drops.
Distilled water	10 ozs.

Gives blackish tones.

27. Sel d'Or.

Chloride of gold	1 gr.
Hyposulphite of soda	4 grs.
Hydrochloric acid	4 drops
Distilled water	10 ozs.

Dissolve the gold in half the water, and add to the hypo dissolved in remainder of water, stirring constantly; then add the

acid. Burton strongly recommends this bath. After toning, put prints into a soda bath, and then fix.

So far all the baths given have referred to ordinary albumenised paper. The following are specially recommended for printing-out emulsions, whether on glass or paper, such as Aristotype. In fact, for the latter paper these are the only baths which really give beautiful results :—

28. Sulphocyanide Bath.

Chloride of gold	1 gr.
Sulphocyanide of potash	12 grs.
Hyposulphite of soda	½ gr.
Distilled water	4 ozs.

The prints should be rather deeply printed, and soaked in a solution of alum (1 in 10) first for five minutes, and then given a dip into a bath of carbonate of soda, and then toned faced downwards; afterwards dipped in soda and fixed in fresh hypo.

29. Fixing and Toning Bath.

Hyposulphite of soda	6 ozs.
Sulphocyanide of potash	1 oz.
Acetate of soda	1½ ozs.
Alum	96 grs.
Distilled water	21 ozs.

Fill the bottle containing this solution with clippings of paper or bad prints, or add 100 grs. of chloride of silver, and leave for twenty-four hours, filter, and add

Chloride of gold	15 grs.
„ „ ammonium	30 „
Distilled water	6 ozs.

The same directions for using this bath as for No. 28. The author prefers the use of No. 28, and fixing separately, as with this there is no certainty as to when the gold is exhausted and sulphur toning begins. The prints change to a bright yellow, and run the scale of colours to a brilliant purplish black. Both these, Nos. 28 and 29, may be used for albumenised paper prints.

For toning matt-surfaced paper almost any alkaline gold bath may be used; but Nos. 6, 7, 12, 16, and 18 are especially suitable.

A few Maxims for Toning. Prints should be thoroughly freed

from free silver, except in the case of all baths containing chloride of lime and sulphocyanides; with these free silver is an absolute necessity. After toning, the prints should be invariably placed into a bath of salt, and washed in one or two changes of water; this prevents any further toning action, and a whole batch of prints may be toned before hypo is touched in any shape or form. It is absolutely necessary to keep the toning bath, dish, or fingers uncontaminated by any other chemicals, or spots and stains will be the result. The prints should be handled as little as possible before toning, and they should be kept in constant motion whilst toning, which operation should be conducted in weak daylight, it being more difficult to judge of the true tone by artificial light. When prints are given a preliminary bath of salt and water, a brilliant brown tone, called "Payne Jenning's Brown," results, this artist invariably using this bath—a preliminary bath of carbonate of soda, and fuming the paper before printing, tending to give purple tones.

Loss of Tone in Fixing. This is so often a complaint that no excuse will be made for an attempt to explain this annoying defect. Some baths are particularly liable to it; and some samples of gold, which the author has tested to try and find a reason for this defect, were contaminated with chloride of copper, most likely an accidental adulterant from the use of an alloy of gold and copper in the shape of scrap gold, old jewellery, or coins, for the production of the auric salt. If copper be present, part of the image would be toned by a coloured compound of copper, which would dissolve in the hypo. Many years ago the addition of alkaline gold to the fixing bath was recommended, and the author has proved this to be of great value to prevent loss of tone, sel d'or being actually formed. The following is the formula referred to:—

Chloride of gold	1 gr.
Carbonate of soda	20 grs.
Hypo	4 ozs.
Water	20 „

Add the gold and soda mixed together to the hypo solution, stirring constantly. Mr. Anthony, of New York, recommends making the fixing bath distinctly acid both to test-paper and sight by a slight turbidity, by the addition of acetic acid. and

then neutralising the free acid by the addition of carbonate of soda or liquor ammonia till distinctly alkaline to test-paper. This the author has tried and found useful; but in every case the fixing bath should be distinctly alkaline, either by carbonate of soda or ammonia.

Yellowness of the Whites of Prints. This is at once a sure sign of the acidity of the fixing bath, and consequent sulphur toning. Nothing can be done but to immediately destroy the print, and make the fixing bath alkaline. It more generally makes its appearance in cases of over-toning, when some secondary action seems to take place.

Black Deposit in Toning Baths. On keeping for some time, especially when extreme cleanliness and exclusion of actinic light has not been attended to, all toning baths deposit, more or less, a purplish black precipitate, which is metallic gold in an extremely fine state of division; and when this deposit has occurred the bath is utterly useless. To renovate these old baths the following plan may be adopted:—Collect the precipitate, wash it well, and shake up with distilled water acidulated with nitric acid (1 to 80); add to this a solution of chloride of lime, made by mixing 80 grs. of chloride of lime with 1 oz. of water, and filtering; add the last solution gradually to the deposit of gold mixed with water, and heat to the boiling-point; it will then be found that as more chloride of lime solution is added the gold will dissolve. When entirely dissolved, it may be kept for future use, and sufficient chalk added each time to neutralise any free acid before using. Another method of preserving any alkaline toning bath is, after use, to add sufficient hydrochloric acid to make the bath distinctly acid and of a yellow colour. When required for use, it is only necessary to add sufficient alkali to render the bath colourless, and it will work as well as a fresh-made one. All toning baths should be distinctly alkaline, and if not so, alkali should be added. All amateurs will hail with welcome a bath which will tone albumen prints, no matter how long they have been printed, or how faded and yellow they may be. The following is the process invented by M. Zaudaurek of Vienna, which is of great value:—

Solution A.

Distilled water	17 ozs.
Tungstate of soda	154 grs.

Solution B.

Carbonate of lime (chemical, pure) ...	60 grs.
Chloride of lime	15 „
„ „ gold	60 „
Distilled water	15 ozs.

This solution should be made in a yellow glass bottle, well shaken, and allowed to stand for twenty-four hours; then filtered into another yellow glass bottle, and kept well stoppered. When the prints have been washed they should be placed one by one in the following toning bath :—

Solution A	5 ozs.
„ B	70 to 140 minims.

They should not tone too quickly; about ten minutes in summer should be the shortest time. If they tone quicker than this, reduce the quantity of Solution B. After toning, wash the prints and place in

Fixing Bath.

Solution A	5 ozs.
Hyposulphite of soda	230 grs.

They should be allowed to remain in this till the yellow colour entirely disappears, which may take some hours. After this has disappeared, wash in the usual way.

Tragacanth. A gummy exudation from the stem of *Astragalus verus*, collected in Asia Minor. It should be nearly white, and sparingly soluble in cold water; more so in hot; entirely soluble in alcohol.

Transfers. By this term is meant the pictures produced by transferring an image developed upon a temporary support, and affixed afterwards to its final support. These are usually made by the carbon or collodion process; but lately a special transferotype paper has been introduced, which gives very pleasing effects. This consists of a film of insoluble gelatino-bromide emulsion, affixed to a temporary support of paper by a soluble substratum. The method of exposure and after-treatment is precisely the same as for bromide paper, but they can be toned after transfer by the following process :—

Solution A.

Ferricyanide of potash	100 grs.
Distilled water	24 ozs.

Solution B.

Uranic nitrate	100 grs.
Distilled water	24 ozs.

Keep these separate, and mix only for immediate use. Take equal parts of A and B, mix, and immerse the transferred picture in the bath till the desired tone is obtained. Fix again in

Hyposulphite of soda	3 ozs.
Water	16 „

and wash thoroughly.

The darker the print the deeper the tone. As this process intensifies (it is practically nothing but uranium intensification) medium light prints give the best results. The above formula gives warm red tones; for rich browns, leave the prints in toning solution till they begin to turn; then immerse in weak alum solution, wash, and fix. To transfer these, lay the wet print upon the surface to which it is to be transferred, which may be either polished or ground opal glass, clear or ground glass, porcelain, wood, ivory, canvas, or any other material which will stand hot water. The surface must be perfectly free from grease or dirt; squeegee the wet print carefully on to it, and put under a weight and blotting-paper to dry. When dry pour hot water at about 160 degs. F. upon the paper till it begins to blister; then raise one corner carefully with a knife, and strip the paper off, and gently rub the picture with a wet pad of cotton-wool. The paper may be stripped any time after the picture has been on its support thirty minutes, but it is better to let it dry. Lantern slides, plaques, tiles, and lamp shades may all be ornamented in this manner.

Translucent. See LIGHT.

Transparencies. This is perhaps one of the most pleasing of all photographic productions, whether for the lantern or window decoration. They are usually prepared on special plates, coated generally with a chloride or slow bromide gelatine emulsion, and developed by ferrous oxalate or a modification of the same.

Very fine lantern slides and transparencies can be made by collodion dry plates with the formulæ given under EMULSIONS or by Beechey's collodion emulsion. The exposure varies so much for each brand of plate used that but little help can be given, but this can easily be determined by one or two exposures. For the production of perfect lantern slides or transparencies, perfect negatives with good density and no fog or stain in the shadows are required, as well as extreme care and cleanliness in development and subsequent operations. The tones of the finished pictures depend to a great extent upon the length of exposure and the developer used. With short exposures and a strong developer cold black tones are obtained, but with longer exposures and weaker developers warmer tones are obtained. By means of various developers the author has obtained tones varying from black to bright red.

For black tones, give a short exposure and use the ordinary ferrous-oxalate developer; or absolute and certain black tones may be obtained by adding one part of sulphurous acid to every seven parts of the ordinary developer. Warm black tones:—

No. 1.

Potassium citrate	200 grs.
,, oxalate	60 ,,
Distilled water	1 oz.
Bromide of potassium	½ gr.

No. 2.

Ferrous sulphate	80 grs.
Sulphuric acid	1 drop.
Distilled water	1 oz.

Mix in equal parts.

For warmer tones use—

No. 1.

Citric acid	120 grs.
Ammonium carbonate	88 ,,
Potassium bromide	½ gr.
Distilled water	1 oz.

Mix, and heat gently till effervescence ceases.

For extra warm tones give longer exposure, and use—

No. 1.

Citric acid	180 grs.
Ammonium carbonate	60 ,,
Common salt	½ gr.
Distilled water	1 oz.

For still warmer tones give much longer exposure, and use—

No. 1.

Magnesium carbonate	76 grs.
Citric acid	120 ,,
Common salt	2 ,,
Distilled water	1 oz.

To every three parts of above add one part of—

Ferrous sulphate	140 grs.
Sulphuric acid	1 drop.
Distilled water	1 oz.

For bright red tones give a long exposure, and use—

No. 1.

Citric acid	250 grs.
Liq. ammonia ·880	160 minims.
Distilled water	1½ ozs.

The Developer.

Solution No. 1, as above...	1½ ozs.
,, ferrous sulphate	½ oz.
Common salt	5 grs.
Distilled water	6 ozs.

Mr. B. J. Edwards recommends the following:—

No. 1.

Potash oxalate	960 grs.
Ammonium chloride	40 ,,
Distilled water	16 ozs.

No. 2.

Ferrous sulphate	240 grs.
Citric acid	120 ,,
Alum	120 ,,
Distilled water	16 ozs.

Mix in equal parts.

Lantern plates may also be developed by pyro with the following formula, or, in fact, by any formula, provided the preservative for the pyro is at least doubled. The author has made many experiments in this direction, and finds no preservative to equal the metabisulphite of potash. The following is a formula which he has always found answer well:—

No. 1.

Pyrogallol	40 grs.
Potash metabisulphite	120 ,,
Distilled water	20 ozs.

No. 2.

Ammonium bromide	40 grs.
Liq. ammonia ·880	150 minims.
Distilled water	20 ozs.

Use in equal parts.

Hydroquinone also gives fine black tones, and is very easy of development. After development with ferrous oxalate, the plate should be placed at once into the following clearing bath:—

Hydrochloric or sulphuric acid	60 minims.
Alum	240 grs.
Distilled water	20 ozs.

It should be allowed to remain in this for five minutes, and then placed in another bath of same strength for the same time; then washed thoroughly and fixed in—

Hyposulphite of soda	4 ozs.
Water	20 ,,

Allow it to remain in this for ten minutes, and then place in fresh hypo bath of same strength for a like period; wash for two hours at least in running water, and then place in a chrome alum clearing bath, and wash for five minutes and dry. Pyro-developed plates should be rinsed thoroughly in water, and placed in a bath of methylated spirit for five minutes, a fresh bath being used for every plate; washed thoroughly in water, and then fixed as above, fresh baths being used for every plate. This may seem a little wasteful, but it is absolutely necessary if perfect lantern slides are required without stain or spots of any kind, and after thoroughly washing they should be cleared in the

chrome alum clearing bath. With hydroquinone all that is necessary is to wash thoroughly, fix as above, and clear in a chrome alum bath. This last is not absolutely necessary, but the author prefers it, to clear any slight veil which might appear.

For exposing lantern plates or transparencies, artificial light should be used, as the light is more regular. A good method is to burn one or two inches of magnesium ribbon at a distance of from six to twenty-four inches away, according to the density of the negative.

For colouring lantern slides considerable artistic skill and ability are required, and the subject is rather too comprehensive to treat here; some useful hints may be gleaned on this point from Brodie and Middleton's small book on the subject. Another method of tinting lantern slides in monochrome has lately been introduced, the following being a *précis* of the same. The author has tried it, and has found it eminently successful, very fine effects being obtained at will. After having developed, fixed, and washed the transparency in the ordinary manner, immerse the plate in the following for one minute :—

Sodic sulphite	1 oz.
Sulphuric acid	½ drm.
Water	3 ozs.

Wash and drain, and apply the following :—

Uranic nitrate	15 grs.
Distilled water	2 ozs.
Methylated spirit	½ oz.

To which add, as required, a few drops from time to time of the following, according to the tint required :—

Ferridcyanide of potassium	15 grs.
Distilled water	1 oz.

The action of this is very quick; first brown-black tones are given, then chocolate, reddish brown, tawny yellow or orange. The action can be stopped at any stage by washing; and should the tone not be quite all that is desired, it can be immediately obliterated altogether by dipping in a solution of carbonate of soda or solution of ammonia. When the desired tone is obtained, wash and dry quickly. The directions in the original paper for tinting lantern slides by means of iron salts are extremely loose

and uncertain, but the author has used this method for some time for obtaining colours on Alpha paper. After the transparency is thoroughly fixed and washed free from hypo, it can be soaked for five minutes in a solution of ferrous sulphate (10 grs. to the ounce) then washed, and dipped into a bath of ferridcyanide of potash (15 grs. to the ounce). This gives a brilliant blue tint, which is extremely effective for seascapes or moonlight work. Other effects can be obtained by mixtures of the ferrous and uranic ferridcyanides; various tones and tints can be secured.

When the lantern plates are dried, all that is necessary is to mount them so as to prevent any accidental injury. The usual method of mounting them is to place a mask of black paper over the margins on the film side, and placing over this a covering glass, and binding the whole together by strips of opaque black paper. Transparencies can be either coated with crystal varnish and mounted with ground-glass behind, or a matt varnish may be used and mounted the same as lantern slides.

Transparent. See LIGHT.

Under-Exposure is when the duration of exposure of the sensitive surface is not sufficiently prolonged to impress the details of the object on the sensitive surface. Its effects are thinness of negative, without detail. When under-exposure is suspected, the only thing to do is to reduce the bromide in the developer, and coax the image out with very slow and careful development. Hydroquinone may be used to develop all the detail out, and then density obtained by pyro. To increase density intensification may be resorted to, but nothing can improve the lack of detail.

Uranium. U = 120. A rare metal never found in a pure state, but as an impure oxide, called pitchblende. It is used in the form of nitrates for preparing a printing-out paper, and for intensification. Uranic nitrate is prepared by digesting pitchblende in hydrochloric acid, to dissolve out the other metals, then roasted with charcoal twice, and the residue dissolved in nitric acid, and purified by crystallisation. Formula: $UO_2(NO_3)_2$, $6H_2O = 384$. This is a brilliant yellowish green crystalline salt, very deliquescent, soluble in water 1 in 5, alcohol, and ether. It is decomposed by light when in contact with organic matter into a uranous nitrate.

Uranium Printing. The colours obtained by the use of uranium nitrate are decidedly pleasing, tending to a reddish terra-cotta or copper colour, which may be varied at will. The sensitising solution may be prepared as follows :—

Uranium nitrate	80 grs.
Distilled water	1 oz.

Preserve in the dark. The paper may be floated upon this bath for five minutes, or the solution may be applied rather thickly with a brush or tuft of cotton-wool, or the following may be used :—

Uranium nitrate	80 grs.
Mercuric nitrate	20 ,,
Distilled water	1 oz.

Or—

Uranium nitrate	80 grs.
Cupric nitrate, or sulphate	20 ,,
Distilled water	1 oz.

The paper should be exposed under a negative in *sunlight* till all the principal detail is visible, and then floated on a developer till the tone desired is obtained.

Potassium ferridcyanide	50 grs.
Distilled water	1 oz.

This will give a reddish brown tint.

Silver nitrate	25 grs.
Distilled water	1 oz.

This will give a greyish image, which can be toned after washing in sel d'or.

Chloride of gold	1 gr.
Distilled water	1 oz.

This should be brushed over the image, and gives a purplish black. The prints after development should be washed in a bath of hydrochloric acid 1 in 80, and then washed again thoroughly.

U.S., or Uniform System. See DIAPHRAGMS.

Varnish is a solution of resinous bodies in a volatile solvent, used for covering the film of a negative with a coating of matter impermeable to air and damp.

The following is a table of the principal varnishes of commerce:—

1. Copal, for fine paintings.
2. Japanners' copal.
3. Best body.
4. Carriage.
5. Best white hard.
6. Best white hard, for violins.
7. Best brown hard.
8. Turpentine.
9. Crystal.
10. Amber.
11. Paper.
12. Sealing-wax.
13. Black.

Ingredients.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Shellac ... lbs.	...	...	...	...	...	2	2	...	...	...	...	1½	1	...
Mastic ... „	...	...	...	...	...	1	...	...	...	...	...	...	...	...
Sandarac ... „	...	...	...	...	2	4	...	...	...	...	...	...	...	...
Dammar ... „	...	...	...	..	...	...	...	...	...	...	4	...	...	...
Resin ... „	...	...	...	...	...	...	...	...	4	...	...	...	...	...
Amber ... „	...	...	...	...	...	...	...	...	...	6	...	...	...	...
Benzoin ... „	...	...	...	...	...	1	...	...	...	...	...	...	...	...
Copal ... „	8	7	8	8	...	...	...	...	...	..	...	...	...	...
Sp. of wine gals.	...	...	...	...	1	5	1	...	...	...	...	1	1	...
Turpentine, oil of „	3	3	3½	5½	...	...	...	1	1	4	1	...	...	1
Linseed, oil of „	2	½	2	2½	...	...	...	...	...	2	...	...	...	...
Turpentine lbs.	...	...	...	...	...	2	...	...	...	...	...	...	...	...
do. varnish pts.	...	...	...	...	...	...	1	...	...	...	...	...	...	...
do. Venice ozs.	...	...	...	...	18	...	18	...	...	...	...	...	...	...
Powdered glass ... lbs.	...	...	...	...	...	4	...	...	...	..	...	...	...	...
Black sealing-wax „	...	...	...	...	...	...	...	...	...	...	...	...	3	...
Red do. ... „	...	...	...	...	...	...	...	...	...	...	...	2½	...	3
Asphalt ... „	...	...	...	...	...	...	...	...	...	...	...	...	...	...

For photographic purposes special varnishes are required, and the following will be found very good ones:—

Negative Varnish.

(1)

Orange shellac	1¼ oz.
Mastic	¼ „
Sandarac	1¼ „
Oil of turpentine	¼ „
Venice turpentine	¼ „
Camphor	10 grs.
Methylated spirit, 66 over proof ...	20 ozs.

Or—

(2)

Orange shellac	2 ozs.
Sandarac	2 „
Canada balsam	60 grs.
Oil of lavender	1 oz.
Methylated spirit	16 ozs.

Or—

(3)

White hard varnish	15 ozs.
Methylated spirit	25 „

The above varnishes must be flowed over the negative and then dried before a brisk fire. The following may be applied without warming:—

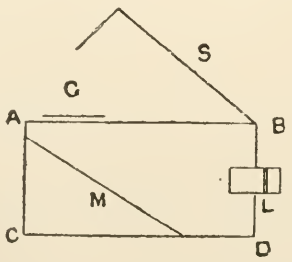
(4)

Negative varnish	5 ozs.
Liq. ammonia ·880—add sufficient to cause the cloudiness first formed to disappear.	

Or—

White hard varnish	10 ozs.
Liq. ammonia ·880	as above.
Water	5 ozs.

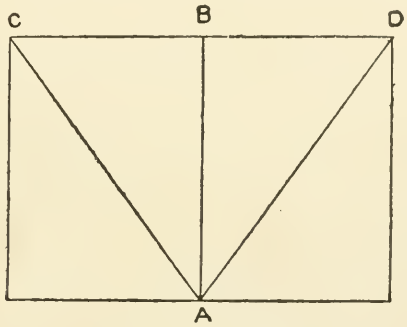
View-Finder. This is a little instrument used for instantaneous photography, to see when the moving object is in the middle



of the field of view and in the middle of the plate. The author has used an ordinary double concave spectacle lens mounted on the front of the camera, and the eye being placed just at the back of the camera. A better method is by utilising the camera

obscura, which may be made at a trifling cost out of a spectacle double lens of about 1½ or 2 ins. focus mounted in a sliding brass tube, a mirror at an angle of 45 degs., and a piece of ground-glass on the top, with a shade. In the preceding diagram, showing the arrangement, ABCD is a rectangular box of card or wood; L, lens in sliding tube; M, mirror; G, ground-glass; S, movable shade, which can be raised or lowered at will.

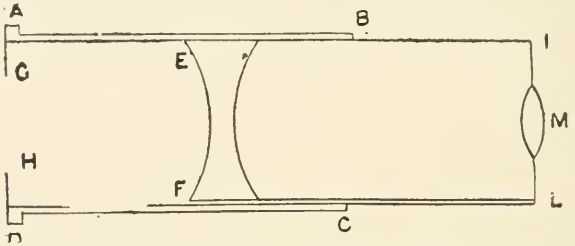
Another method is to use the focussing screen, which, when turned back over the top of camera, should have the lines drawn



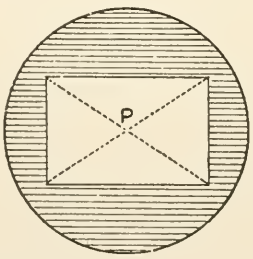
on it as shown in the diagram; then when the eye is placed at A and looking along AB, the object when opposite this will be in the centre of the plate, and CAD is the angle included by the lens. Or a double convex lens of exactly the same focus as the lens may be mounted on the front of the camera, and the focussing screen turned up above the camera, and the focussing cloth thrown over the whole, so as to form a second and temporary camera.

View-Meter. An instrument used to gauge the amount of view included by the lens upon the focussing screen without the trouble of setting up the camera. The following is a very useful, cheap, and ingenious one, which can easily be made by almost any amateur from material at hand:—Obtain two brass tubes 2½ ins. long and 1¾ ins. in diameter, one of which is made just a trifle smaller than the other, so as to slide within it. The following diagram will explain the method of making this useful little instrument.

ABCD, a brass tube bearing at one end a cap in which is an opening (GH), bearing a proportionate size to the plate used: for instance, for quarter-plates, or $4\frac{1}{4}$ by $3\frac{1}{4}$, the opening may be $\frac{17}{16}$ in. by $\frac{13}{16}$; or for half-plate, $\frac{28}{16}$ by $\frac{18}{16}$. This opening frames



the view, and limits its extent according to the distance the inner tube is drawn out. EFIL is the other brass tube sliding inside ABCD, having at one end a double concave lens (EF) of $1\frac{1}{2}$-in. focus, and at the other a double convex lens (M) of 3-in. focus; when the eye is applied to the convex lens the picture is viewed in miniature. P will show front view of cap.



To use this it must be adjusted to the lenses with which it will be worked. To do this it is only necessary to erect the camera, focus carefully, and, marking two prominent objects on the edges of the screen, adjust the small view-meter till the same objects are exactly on the edges of the field of view in that. Now mark on the inner sliding tube with a knife or file the exact point to which it was pulled out or in, and this will always include the amount of view included by that lens. By fastening two fine wires across the cap P, as shown by the dotted lines, it will serve well also as a view-finder, as, when

the moving object is at the point of intersection of the crossed wires, it will be in the centre of the plate. It may also be used as some guide to the probable exposure by placing inside the cap a circle of blue glass, so as to cut off all the rays but those chemically active and which affect the plate.

Vignetting. This consists of shading off the margins of a picture, so as to cause the figure or subject to gradually fade away. There are numerous methods of effecting this: one is by the use of glass with oval or other shaped openings surrounded by a gradually deepening margin of coloured non-actinic glass. These, however, are not satisfactory. Another method is that employed by the French operators of using graduated thicknesses of tissue paper with serrated edges. Another method is to use wooden covers with openings having the underneath edges bevelled off. But the best of all is to use stout sheet lead or pure tinfoil, and to cut the sized opening required, and either to slightly turn up the edges or serrate them, so as to soften the outline; and the farther the vignetting shape is placed from the negative the larger the vignette and the softer the outline.

Washing Negatives and Prints. This is one of the most important of all the operations for the production of permanent negatives, the object being the total elimination of every trace of hyposulphite of soda or silver. There are numerous washing tanks and machines in use, but the author always uses one made out of a biscuit tin, and a wire frame made something after the style of a household toast-rack, in which the negatives can rest face downwards, and has never yet failed to eliminate every trace of hypo from negatives in thirty minutes.

For washing prints, frames of wire covered with coarse canvas may be used, these being placed one over the other, and then placed in the tank for washing. Both negatives and prints should be washed in running water; and the author has found that thirty minutes in a tank, and another two minutes in a bath of hypo eliminator, or five minutes in a chrome alum bath, is quite sufficient. The author also advocates the use of warm water about 80° F., after a plain alum bath; or where very quick washing is desired, the negatives should be placed in a bath of methylated spirit, after removal from fixing bath and rinsing with water: this will extract the water and a considerable portion

of the hypo. For prints, water at 90° F. may be used with no ill effects. Or prints may be placed face upwards on old negative glasses, and a roller squeegee passed twice or three times over them: this is a very easy and quick way of freeing from hypo.

Wastes. See Residues.

Waxing Negatives. See Oiling.

Wide-Angle Lens. See Lens.

Weights and Measures. The confusion which reigns in the photographic world with regard to weights and measures is something appalling. Numerous plans have been proposed to remedy this, but at present with little effect; the confusion arises in great measure from the numerous systems of weights and measures used in different countries. All solid chemicals are sold by avoirdupois weight, whilst many formulæ are written in what is called apothecaries' weight. It has been proposed to use the metric system, but at present there seems no likelihood of its coming into general use. The author has endeavoured throughout the Dictionary to give all formulæ in standard weights about which their can be no dispute. As a standard for dry substances the grain has been employed, and for liquids the minim, or the ounce of 480 minims, except in some cases where the weights are practically immaterial, where a few grains more or less would make no appreciable difference. The author does not intend to enter into any arguments on the question, but simply gives those tables of weights in general use.

Apothecaries' Weight.

20 grains	...	...	=	1 scruple (℈).
3 scruples	...	...	=	1 drachm (ʒ).
8 drachms	...	...	=	1 ounce (℥).

The above weights are used by chemists for the compounding of prescriptions.

1 oz. (℥j) = 8 drms. (ʒviij) = 24 scruples (℈xxiv) = 480 grs. (The pound in this weight is never used; it contains 12 ozs. = 5,760 grs.)

Avoirdupois Weight.

16 drachms	...	...	=	1 ounce.
16 ounces	...	...	=	1 pound.

1 lb. = 16 ozs. = 256 drms. = 7,000 grs. (This weight is used by all dealers for retailing chemicals, etc. 1 oz. = 437·5 grs.)

Liquid Measure.

60	minims	...	...	=	1 drachm (f. ʒ).
8	drachms	...	...	=	1 ounce (f. ℥).
20	ounces	...	...	=	1 pint (O).
8	pints	...	...	=	1 gallon (C).

1 gal. (Cj) = 8 pts. (Oviij) = 160 ozs. (f. ʒ, 160) = 1,280 drms. (f. ℥, 1,280) = 76,800 minims.

The following is the Metric System of weights and measures in use in France and on the Continent generally, and in the United States, and in England amongst scientific chemists. The division in each case is by 10, so that it is extremely easy to calculate the division or multiples of any weight.

Lineal Measure.

1,000	millimetres	...	...	=	1 metre.
100	centimetres	...	...	=	1 „
10	decimetres	...	...	=	1 „
10	metres ...	...	...	=	1 decametre.
100	„ ...	...	...	=	1 hectometre.
1,000	„ ...	...	...	=	1 kilometre.

The metre is the unit, and is equal to 39·37 English inches

Liquid Measure.

1,000	millilitres	...	...	=	1 litre.
100	centilitres	...	...	=	1 „
10	decilitres ...	...	...	=	1 „
10	litres ...	...	...	=	1 decalitre.
100	„ ...	...	...	=	1 hectoiltre
1,000	„ ...	...	...	=	1 kilolitre.

The litre is the unit, and is equal to 35·216 fluid ozs. Liquid measures are usually expressed, however, as cubic centimetres, or c.c., = 16·8 minims.

Dry Measure.

1,000	milligrammes	...	...	=	1 gramme.
100	centigrammes	...	...	=	1 „
10	decigrammes	...	...	=	1 „
10	grammes ...	...	...	=	1 decagramme.
100	„ ...	...	...	=	1 hectogramme.
1,000	„ ...	...	...	=	1 kilogramme.

The gramme is the unit, and is equal to 15·432 grs.

For converting these weights into English, the following tables will be found sufficiently accurate for all purposes :—

Conversion of Grammes into Grains.

1 gramme	...	...	...	=	15·432 grains.
2 grammes	...	...	...	=	30·864 „
3 „	...	...	...	=	46·926 „
4 „	...	...	...	=	61·728 „
5 „	...	...	...	=	77·160 „
6 „	...	...	...	=	92·592 „
7 „	...	...	...	=	108·024 „
8 „	...	...	...	=	123·466 „
9 „	...	...	...	=	138·898 „

Conversion of Grains into Grammes.

1 grain	...	...	...	=	·0648 gramme.
2 grains	...	...	...	=	·1296 „
3 „	...	...	...	=	·1944 „
4 „	...	...	...	=	·2592 „
5 „	...	...	...	=	·3240 „
6 „	...	...	...	=	·3888 „
7 „	...	...	...	=	·4536 „
8 „	...	...	...	=	·5184 „
9 „	...	...	...	=	·5832 „

Supposing it is desired to convert 506·94 grammes into grains, the table is used as follows :—

500	grammes	...	...	=	7716·0 grains.
6	„	...	...	=	92·592 „
·90	gramme	...	...	=	13·889 „
·04	„	...	...	=	·617 „
					7823·098 „

The numbers taken from the tables simply require the altering of the position of the decimal point.

The following may be useful for those short of weights to obtain an approximate weight :—

	Weight.
1 sovereign, new	123·274 grains.
1 shilling	87·273 „
48 pennies	1 lb. avoirdupois.
1 halfpenny and 1 threepenny-piece	¼ ounce.

	Weight
1 florin and 1 sixpence	½ ounce.
3 pennies	1 ,,
4 half-crowns and 1 shilling	2 ounces.
4 florins, 1 half-crown, 2 pennies ...	4 ,,
1 halfpenny	1 inch in diameter.

Wet Collodion Process. This was the first process in which a vehicle for the sensitive silver salt was used. Either negatives or positives can be produced, and the latter, when taken upon thin enamelled-iron plates, are known as ferrotypes or tintypes. The following is a short *résumé* of the process :—A well-cleaned glass plate is coated with Collodion (*q.v.*), and as soon as the collodion has set this coated plate is immersed in a bath made as follows :—

Nitrate of silver	320 grs.
Potassium iodide	1 gr.
Distilled water	8 ozs.

Dissolve the silver salt in 2 ozs. of water, and the potash in ½ oz. Add the latter to the former, and add the remainder of the water. Filter, and test for acidity. If the blue litmus paper is not turned red after an immersion of some short period, a few drops of a dilute nitric acid (1 in 12) should be added till the bath is decidedly acid. The plate is exposed whilst still wet, the exposure being about ten times that for gelatine dry plates of ordinary rapidity under similar circumstances. For development any of the following may be used, but the author prefers Nos. 2, 3, and 4, the last being especially useful, as shorter exposure is required, and more detail is brought out. With No. 5 longer exposure is required, but extreme contrast is obtained :—

No. 1.

Ferrous sulphate	300 grs.
Glacial acetic acid	200 minims.
Methylated spirit	½ oz.
Distilled water	10 ozs.

No. 2.

Ferrous sulphate	200 grs.
Cupric ,, ...	100 ,,
Glacial acetic acid	200 minims.
Methylated spirit	½ oz.
Distilled water	10 ozs.

No. 3.

A.

Ferrous sulphate	240 grs.
Cupric ,, ...	30 ,,
Distilled water	5 ozs.

B.

Nitrate of baryta	30 grs.
Glacial acetic acid	2 drms.
Methylated spirit	½ oz.
Distilled water	5 ozs.

Dissolve A and B separately, then mix and filter.

No. 4.

Ferrous sulphate	300 grs.
Glacial acetic acid	200 ,,
Formic acid (sp. gr. 1·060)	100 minims.
Methylated spirit...	240 ,,
Distilled water	10 ozs.

No. 5.

Ferrous sulphate	200 grs.
Glacial acetic acid	180 minims.
Lump sugar	100 grs.
Methylated spirit...	240 minims.
Distilled water	10 ozs.

No. 6.

Ammonio sulphate of iron	250 grs.
Glacial acetic acid	250 minims.
Methylated spirit	240 ,,
Distilled water	10 ozs.

To develop the exposed plate it should be fixed upon a pneumatic holder and a little of the developer poured evenly on to the surface, and gently rocked backwards and forwards till the image is sufficiently developed, when it may be poured off. The image nearly always requires intensification for negative work, and the following may be used:—

Ferrous sulphate	5 grs.
Citric acid	10 ,,
Distilled water	1 oz.

Add immediately before using a few drops of--

Silver nitrate	10 grs.
Distilled water	1 oz.

Pour on to the unfixed negative, and rock backwards and forwards till dense enough. Then fix in—

Potassium cyanide	120 grs.
Distilled water	10 ozs.

Wash thoroughly, dry, and varnish.

Woodburytype. This is a very beautiful photo-mechanical process, and consists of exposing a thick film of bichromated gelatine to light under a negative, and when fully exposed it is washed to dissolve the unacted-upon soluble portions, and after being soaked in alum is dried. When dry, the gelatine print, which at this period looks like a delicate piece of silk with the image in relief, is placed on to a bed of metal, and a pressure of from four hundred to five hundred tons brought to bear on it. This forces the gelatine into the metal, and makes an impression the same as a seal on hot sealing wax, the film of gelatine itself being unharmed and used over and over again. The metal sheet bearing the impression now becomes a mould, and this is placed in a press and some special liquid gelatine ink is poured on to it, and a sheet of non-absorbent paper placed over. The press is now closed, and pressure being applied, it is obvious that the ink will leave the high-lights and collect in the shadows. When the gelatine ink has set, the paper is removed, bearing the image, and is fixed in alum and dried.

Stannotype. This is also an invention of Mr. Woodbury, and in this process an image in intaglio is produced by exposure of a bichromated gelatine film under a positive, and this is coated with tinfoil, and used for printing from in almost the same manner as in Woodburytype.

Yellow Fog. See Fog.

Yellowness of Prints. See Toning.

Yellow Stain. See Clearing Bath.

Zinc (Zn = 65) exists as calamine or carbonate, as sulphide in zincblende, as oxide, and occasionally in a pure state. It is but little used in photography, and its salts, the bromide, iodide, and chloride, which are formed in somewhat similar manner to the cadmium salts, are not much used. Zinc hypochlorite has lately

been recommended for making hypo eliminator. The formulæ for the salts of zinc are—Bromide, $ZnBr_2 = 225$; Iodide, $ZnI_2 = 319$; Chloride, $ZnCl_2 = 136$; Hypochlorite, $ZnCl_2\,ZnCl_2O_2 = 304$.

Zincography. A photo-mechanical printing process, in which the image is impressed upon a zinc plate by means of a greasy ink, and an etching fluid being applied which eats away the groundwork, leaving the image in relief, so that it can be printed from like ordinary type.

USUAL SIZES OF FRENCH AND ITALIAN DRY PLATES.

FRENCH.						Inches.		
6½	by	9	Centimetres	...	...	2·5	by	3·7
9	„	12	„	...	...	3·7	„	4·7
12	„	15	„	...	...	4·7	„	5·9
13	„	18	„	...	...	5·1	„	7·0
12	„	20	„	...	...	4·7	„	7·8
15	„	21	„	...	...	5·9	„	8·2
15	„	22	„	...	...	5·9	„	8·6
18	„	24	„	...	...	7·0	„	9·4
21	„	27	„	...	...	8·2	„	10·6
24	„	30	„	...	...	9·4	„	11·8
27	„	33	„	...	...	10·6	„	12·9
27	„	35	„	...	...	10·6	„	13·7
30	„	40	„	...	...	11·8	„	15·7
40	„	50	„	...	...	15·7	„	19·6
50	„	60	„	...	...	19·6	„	23·6

ITALIAN.						Inches.		
9	by	12	Centimetres	...	...	3·7	by	4·7
12	„	16	„	...	...	4·7	„	6·3
12	„	18	„	...	...	4·7	„	5·9
13	„	18	„	...	...	5·1	„	7·0
12	„	20	„	...	...	4·7	„	7·8
18	„	24	„	...	...	7·0	„	9·4
21	„	27	„	...	...	8·2	„	10·6
24	„	30	„	...	...	9·4	„	11·8
27	„	33	„	...	...	10·6	„	12·9
30	„	36	„	...	...	11·8	„	14·1
40	„	50	„	...	...	15·7	„	19·6
50	„	60	„	...	...	19·6	„	23·6

Sizes of Glass, Mounts, Paper, Etc.

Petite cards	$1\frac{5}{8}$ by $3\frac{1}{4}$
One-ninth plate	2 „ $2\frac{1}{2}$
One-sixth plate	$3\frac{3}{4}$ „ $3\frac{1}{4}$
One-fourth plate	$3\frac{1}{4}$ „ $4\frac{1}{4}$
Half plate ... ... $4\frac{1}{2}$ by $6\frac{1}{2}$ and	$4\frac{1}{4}$ „ $5\frac{1}{2}$
Half plate (English)	$4\frac{3}{4}$ „ $6\frac{1}{2}$
Whole plate (4-4)	$6\frac{1}{2}$ „ $8\frac{1}{2}$
Extra 4-4	8 „ 10

Other sizes are expressed by inches.

Sizes of Mounts.

Stereoscopic	$3\frac{1}{2}$ by 7, 4 by 7, $4\frac{1}{4}$ by 7, $4\frac{1}{2}$ by 7, 5 by 8
Victoria	$3\frac{1}{4}$ by 5
Imperial	$7\frac{7}{8}$ „ $9\frac{7}{8}$
Boudoir	$5\frac{1}{4}$ „ $8\frac{1}{2}$
Panel	4 „ $8\frac{1}{4}$
Minette	$1\frac{1}{2}$ „ $2\frac{3}{8}$
Card	$2\frac{1}{2}$ „ $4\frac{3}{8}$
Cabinet	$4\frac{1}{4}$ „ $6\frac{1}{2}$
Promenade	$4\frac{1}{8}$ „ $7\frac{1}{8}$

Sizes of Albumen Paper.

18 by $22\frac{3}{4}$, $20\frac{1}{2}$ by $24\frac{1}{2}$, 22 by 36, 26 by 40, 27 by 42

Sizes of blotting paper ... ... 19 by 24

Freezing Mixtures.

Reducing the Temperature PARTS.	From Degrees of the Celsius	To Thermometer.
3 Nitrate of sodium + 4 water ...	+ 13·2 deg.	— 5·3 deg.
9 Phosphate of sodium 4 dilute nitric acid	+ 10 „	— 9 „
3 Sulphate of sodium + 2 dilute nitric acid	+ 10 „	— 10 „
1 Nitrate of sodium + 4 water ...	... ...	— 10·6 „
1 Chloride of potassium + 4 water ...	... ...	— 11·8 „
5 Sal-ammoniac + 5 saltpetre ...	... ...	...
8 Sulphate of sodium + 5 conc. sulphuric acid	+ 10 deg.	— 17 „

Reducing the Temperature PARTS.	From Degrees of the Celsius	To Thermometer.
1 Sulphocyanate of potass. + 1 water	+ 18 deg.	— 21 deg.
1 Chloride of sodium + 3 snow		— 21 „
1 Sal-ammoniac + 1 saltpetre + 1 water	+ 8 deg.	— 24 „
3 Crystal. chloride of calcium + 1 snow		— 36 „
1 Snow + 1 dilute sulphuric acid ...	— 5 deg.	— 41 „

Table of the Elements.

	Symbol and Atomic Value.	Atomic Weight.
Aluminium (Al_2^{vi})	Al^{iv}	27·5
Antimony (Sb''')	Sb^{v}	122
Arsenicum (As''')	As^{v}	75
Barium	Ba''	137
Beryllium, or Glucinum	Be''	9·5
Bismuth (Bi''')	Bi^{v}	208
Boron	B'''	11
Bromine	Br'	80
Cadmium	Cd''	112
Cæsium	Cs'	133
Calcium	Ca''	40
Carbon (C'')	C^{iv}	12
Cerium (Ce'')	Ce^{vi}	92
Chlorine	Cl'	35·5
Chromium (Cr_2^{vi})	Cr^{vi}	52·5
Cobalt (Co'')	Co^{vi}	58·8
Copper	Cu''	63·5
Davyum	—	—
Decipium	—	—
Didymium	D''	96
Erbium (?)	Eb''	112·6
Fluorine	F'	19
Gallium	—	—
Gold	Au'''	196·7
Hydrogen	H'	1
Indium	In^{vi}	75·6
Iodine	I'	127
Iridium	Ir^{iv}	197
Iron (Fe'' & Fe_2^{vi})	Fe^{vi}	56
Lanthanium	La'	92
Lavœsium	—	—

	Symbol and Atomic Value.	Atomic Weight.
Lead (Pb″)	Pb^{iv}	207
Lithium	L′	7
Magnesium	Mg″	24
Manganese (Mn″ & Mn^{iv}) ...	Mn^{vi}	55
Mercury	Hg″	200
Molybdenum	Mo^{vi}	96
Mosandeum	—	—
Nephmium	—	—
Nickel (Ni″)	Ni^{vi}	58·8
Niobium	Nb^{v}	97·6
Nitrogen (N′ & N‴)	N^{v}	14
Norwegium	—	—
Osmium	Os^{iv}	199
Oxygen	O″	16
Palladium...	Pd^{iv}	106·5
Phillipium	—	—
Phosphorus (P‴)...	P^{v}	31
Platinum	Pt^{iv}	198
Potassium	K′	39
Rhodium	Rh^{iv}	104·3
Rubidium...	Rb′	85·3
Ruthenium	Ru^{iv}	104·2
Scandium...	—	—
Selenium	Se^{vi}	79·5
Silicon	Si^{iv}	28
Silver	Ag′	108
Sodium	Na′	23
Strontium...	Sr″	87·5
Sulphur (S″ & S^{iv})	S^{vi}	32
Tantalum...	Ta^{v}	182
Tellurium...	Te^{vi}	129
Terbium (?)	—	—
Thallium	Tl″	204
Thorinum...	Th″	232
Tin (Sn″)	Sn^{iv}	118
Titanium	Ti^{iv}	50
Tungsten	W^{vi}	184
Uralium	—	—
Uranium	U^{vi}	120
Vanadiun	V^{v}	51·3
Yttirbium	—	—
Yttrium	Y″	61·7
Zinc	Zn″	65
Zirconium	Zr^{iv}	89·5

TABLE OF THE FORMULÆ OF CHEMICALS USED IN PHOTOGRAPHY.

	Formula.	Molecular Weight.
Acid, Acetic	$HC_2H_3O_2$	60
,, Boracic or Boric ...	H_3BO_3	62
,, Carbolic	HC_6H_6O	94
,, Citric	$H_3C_6H_5O_7$, H_2O	210
,, Formic	$HCHO_2$	46
,, Gallic	$HC_7H_5O_5$	170
,, Hydrobromic	HBr	81
,, Hydrochloric	HCl	36·5
,, Nitric	HNO_3	63
,, Oxalic	$H_2C_2O_4$, $2H_2O$	126
,, Pyrogallic	$H_3C_6H_3O_3$	126
,, Salicylic	$HC_7H_5O_3$	138
,, Sulphuric	H_2SO_4	98
,, Sulphurous	H_2SO_3	82
,, Tannic	$H_4C_{27}H_{18}O_{17}$	618
,, Tartaric	$H_4C_4H_2O_6$	150
Alcohol	C_2H_5HO	46
,, Methyl	CH_3HO	32
Alum	$Al_2(SO_4)_3$, $K_2SO_4 24H_2O$	948
,, Chrome	$Cr_2(SO_4)_3K_2SO_4$, $24H_2O$	999
Ammonium Bichromate ...	$(NH_4)_2Cr_2O_7$	253
,, Bromide ...	NH_4Br	98
,, Carbonate ...	NH_4HCO_3, $NH_4CO_2NH_2$	175
,, Chloride ...	NH_4Ce	53·5
,, Iodide	NH_4I	145
,, Nitrate ...	NH_4NO_3	80
,, Oxalate ...	$(NH_4)_2C_2O_4$	124
,, Sulphide ...	NH_4HS	51
,, Sulphocyanide	NH_4CNS	76
Barium Bromide	$BaBr_2$	297
,, Chloride	$BaCl_2$, $2H_2O$	244
,, Iodide	BaI_2	391
,, Nitrate	$Ba(NO_3)_2$	261
Cadmium Bromide	$CdBr_2 4H_2O$	344
,, Chloride ...	$CdCl_2$	183
,, Iodide	CdI_2	366
Calcium Bromide	$CaBr_2 4H_2O$	272
,, Carbonate ...	$CaCO_3$	100
,, Chloride	$CaCl_2$	111
,, Iodide	CaI_2	294

	Formula.	Molecular Weight.
Calcium Hypochlorite, or Chloride of Lime	$CaCl_2O_2CaCl_2$	254
Copper Acetate	$Cu(C_2H_3O_2)\,HO$	200
,, Bromide	$CuBr_2$	223·4
,, Chloride	$CuCl_2H_2O$	171
,, Sulphate	$CuSO_45H_2O$	249
,, and Ammonium Sulphate	$CuSO_4NH_3$	245·5
Glycerine	$C_3H_5(HO)_3$	92
Gold Perchloride	$AuCl_3$	302·5
Hydroquinone	$C_6H_4{}_2HO$	110
Hydroxylamine Chloride ...	NH_3OHCl	—
Iron Chloride (ferrous) ...	$FeCl_2$	127
,, ,, (ferric) ...	Fe_2Cl_6	325
,, Citrate	$Fe_2(C_6H_5O_7)_2$	598
,, Iodide	FeI_2	310
,, Nitrate	$Fe(NO_3)_26H_2O$	288
,, Oxalate (ferrous) ...	FeC_2O_4	144
,, ,, (ferric) ...	$Fe_2(C_2O_4)_3$	376
,, Sulphate (ferrous) ...	$FeSO_4,7H_2O$	278
,, ,, (ferric) ...	$Fe_2(SO_4)_3$	400
,, Ammonia Sulphate ...	$FeSO_4,(NH_4)_2SO_46H_2O$	392
Lead Acetate	$Pb(C_2H_3O_23)_2H_2O$	379
,, Carbonate	$PbCO_3,Pb(HO)_2$	774
,, Iodide	PbI_2	460
,, Nitrate	$Pb(NO_3)_2$	331
,, Oxide	PbO	223
Lithium Bromide	$LiBr$	87
,, Chloride	$LiCl$	42·5
,, Iodide	LiI	134
Magnesium Bromide ...	$MgBr$	184
,, Chloride ...	$MgCl_2$	95
,, Iodide	MgI_2	278
,, Sulphate ...	$MgSO_47H_2O$	246
Mercury Chloride (mercuric)	$HgCl_2$	271
,, ,, (mercurous)	$HgCl$	235·5
,, Cyanide	$HgCy_2$	252
,, Iodide (mercuric)	HgI_2	454
,, ,, (mercurous)	HgI	327
Platinum Chloride	$PtCl_4$	339
Potassium Bicarbonate ...	$KHCO_3$	100
,, Bichromate ...	$K_2Cr_2O_7$	294·6
,, Bromide ...	KBr	119·1
,, Carbonate ...	K_2CO_3	138·2

	Formula.	Molecular Weight.
Potassium Chlorate ...	$KClO_3$	122·4
,, Chloride ...	KCl	74·5
,, Chloro-platinite	—	488·4
,, Citrate	$K_3C_6H_5O_7H_2O$	324·3
,, Cyanide ...	KCN	65
,, Ferricyanide ...	$K_6Fe_2C_{12}N_{12}$	658
,, Ferrocyanide ...	$K_4FeC_6N_6 3H_2O$	422
,, Hydrate ...	KHO	56·1
,, Iodide	KI	166·1
,, Nitrate	KNO_3	101·1
,, Permanganate...	$K_2M_2O_3$	316·2
,, Sulphocyanide	KCNS	97
Silver Acetate	$AgC_2H_3O_2$	167
,, Bromide	AgBr	188
,, Carbonate	Ag_2CO_3	276
,, Chloride	AgCl	143·5
,, Citrate	$Ag_3C_6H_5O_7$	513
,, Fluoride	AgFl	127
,, Iodide	AgI	235
,, Nitrate	$AgNO_3$	170
,, Nitrite	$AgNO_2$	154
,, Oxalate	$Ag_2C_2O_4$	304
,, Oxide	Ag_2O	232
,, Sulphide	Ag_2S	248
Sodium Acetate	$NaC_2H_3O_2, 6H_2O$	190
,, Biborate (Borax) ...	$Na_2B_4O_7 10H_2O$	382
,, Bromide	NaBr	103
,, Bicarbonate ...	$NaHCO_3$	84
,, Carbonate... ...	$Na_2CO_3 10H_2O$	286
,, Chloride	NaCl	58·5
,, Citrate	$Na_3C_6H_5O_7$	258
,, Hydrate	NaHO	40
,, Hyposulphite ...	$Na_2S_2O_3 5H_2O$	248
,, Iodide	NaI	150
,, Nitrate	$NaNO_3$	85
,, Sulphantimonite ...	$NaSbS_3$	241
,, Sulphate	$Na_2SO_4 10H_2O$	322
,, Sulphide	$Na_2S 9H_2O$	240
,, Sulphite	$Na_2SO_3 7H_2O$	252
Strontium Bromide ...	$SrBr_2 6H_2O$	355·5
,, Chloride... ...	$SrCl_2 6H_2O$	266·5
,, Nitrate	$Sr(NO_3)_2$	211·5
Tin Chloride (Stannic) ...	$SnCl_4$	260
,, ,, (Stannous) ...	$SnCl_2 2H_2O$	225

	Formula.	Molecular Weight.
Uranium Bromide	$UBr_4 4H_2O$	352
,, Nitrate	$UO_2(NO_3)_2 6H_2O$	384
,, Sulphate	$UO_2(SO_4) 3H_2O$	302
Zinc Bromide	$ZnBr_2$	225·2
,, Chloride	$ZnCl_2$	136·2
,, Iodide	ZnI_2	319·2
,, Nitrate...	$Zn(NO_3)_2 6H_2O$	189
,, Sulphate	$ZnSO_4, 7H_2O$	287

TABLE OF SOLUBILITIES.

	One part is soluble in cold water.	One part is soluble in hot water.	Sol. in Alcohol.
Acid, Boracic	30	3	1 in 30
,, Citric	·75	·5	10 in 15
,, Gallic	100	3	1 in 8
,, Oxalic	15	1	insol.
,, Pyrogallic	2	1	9 in 10
,, Salicylic	760	9	1 in 3½
,, Tannic	·8	·5	10 in 8
,, Tartaric	·8	·5	1 in 5
Alum	10	·8	insol.
,, Chrome	10	dec.	insol.
Ammonium Bromide ...	1·5	1	1 in 13
,, Carbonate ...	4	dec.	sparingly
,, Chloride ...	3	1	1 in 55
,, Citrate ...	·5	·25	sol.
,, Iodide ...	·75	dec.	1 in 4
,, Nitrate ...	2	1	sol.
,, Sulphocyanide	1	·5	sol.
Barium Bromide	·96	·75	sol.
,, Chloride	2·18	1·5	sparingly
,, Iodide	·48	·35	sol.
,, Nitrate	12	3	sparingly
Cadmium Bromide ...	1·5	1	sparingly
,, Chloride ...	·71	·67	sol.
,, Iodide	1·5	1	1 in 2
Calcium Bromide	1	·75	sol.
,, Chloride	·75	·5	1 in 10
,, Iodide	·75	·5	1 in 10

	One part is soluble in cold water.	One part is soluble in hot water.	Sol. in Alcohol.
Cobalt Chloride	1	·75	sol.
Copper Bromide	1	·75	sol.
„ Chloride	1	·5	sol.
„ Nitrate	3	1	sol.
„ Sulphate	3	1	insol.
Gold Perchloride	1	·75	sol.
Hydroquinone	sol.	sol.	sol.
Hydroxylamine	sol.	sol.	insol.
Iron Chloride (Ferrous) ...	2	1	1 in 1
„ „ (Ferric) ...	·75	·5	1 in 1
„ Oxalate, insoluble except	in excess of	alkaline	oxalate
„ Sulphate (Ferrous) ...	1·5	1	insol.
Lead Acetate	2·5	2	1 in 12·5
„ Nitrate	7·7	7	
Lithium Bromide	·66	·5	sol.
„ Chloride	1·3	1	sol.
„ Iodide	·61	·5	sol
Magnesium Bromide ...	1	·75	sol.
„ Chloride ...	2	1·5	sol.
„ Iodide ...	1	·75	sol.
„ Sulphate ...	1·3	1	sparingly
Mercury Chloride (Mercuric)	19	3	5
Platinum Bichloride ...	1	·5	sol.
Potassium Bicarbonate ...	3	2	insol.
„ Bichromate ...	10	7	insol.
„ Bromide ...	2	1	1 in 90.
„ Carbonate ...	·75	·5	insol.
„ Chlorate ...	16	2	insol.
„ Chloride ...	3	2	sparingly
„ Citrate ...	·6	·3	insol.
„ Cyanide ...	1	·5	insol.
„ Ferricyanide ...	2·5	1·2	insol.
„ Ferrocyanide ...	3	1	insol.
„ Hydrate ...	·5	·25	sparingly
„ Iodide ...	·75	·5	1 in 16
„ Nitrate ...	4	2·5	insol.
„ Nitrite ...	1	·5	
„ Oxalate ...	3	2	sparingly
„ Permanganate	16	10	insol.
„ Sulphocyanide	2	1	sparingly
Silver Acetate	sparingly		
„ Citrate		sparingly	
„ Nitrate	1	·5	1 in 4 boiling

	One part is soluble in cold water.	One part is soluble in hot water.	Sol. in Alcohol.
Silver Nitrite	300	dec.	insol.
„ Oxalate	sparingly	sol.	insol.
„ Oxide	insol.	insol.	insol.
„ Sulphate	200	88	insol.
Sodium Acetate	3	·66	insol.
„ Biborate (Borax)	12·5	2	insol.
„ Bisulphite ...	2	1	insol.
„ Bromide	1·25	1	1 in 16
„ Carbonate ...	2	1	insol.
„ Chloride	2·75	2·75	sparingly
„ Citrate	1	·5	sparingly
„ Hydrate	1·65	1	sol.
„ Hyposulphite ...	1·5	1	insol.
„ Iodide	·5	·3	sparingly
„ Nitrate	1·136	1	1 in 37
„ Phosphate ...	4	2	insol.
„ Sulphate	2	·4	sol.
„ Sulphite	4	2	sparingly
„ Tartrate	1·75	1	insol.
„ Tungstate ...	4	2	insol.
Strontium Bromide ...	1	·75	sparingly
„ Chloride ...	1·8	1	sparingly
„ Iodide	·5	·27	sparingly
Uranium Bromide ...	1	·5	sol.
„ Nitrate	·5	·25	sol.
„ Oxalate	nearly insol.	30	insol.
Zinc Bromide	1	·5	v. sol.
„ Chloride	·33		v. sol.
„ Iodide	·33		v. sol.
„ Sulphate	·7	·5	insol.

List of Dry Plates, and Sensitometer Numbers.

Abney (Bromo-Iodide)	60	times	23-25
Academy	121	„	about 19
„ (Extra Rapid)	26	„	„ 22
Advance	12	„	„ 22
Albert	—		—
Alliance (30 times)	30	„	18
„ (60 „)	60	„	23
Apollo (Ordinary)	12	„	about 19

Apollo (Extra Rapid) ...	...	...	26	times	about	22
Appleton ...	...	...	12	„	„	19
Azaline ...	...	...	60	„	„	25
Beernaert ...	...	...	60	„		25
Brightonian (Ordinary)	...	...	20-25	„		19
„ (Extra Rapid)	...	...	60	„		24
Brilliant... ...	...	...	—			—
Britannia (Ordinary) ...	...	...	12	„	about	19
„ (Extra Rapid)	...	...	26	„	„	22
British	...	...	—			—
Cadett (Rapid) ...	...	...	—			20
„ (Rapid Lightning)	...	...	—			25
Chapman's ...	...	...	—		about	18
Charterhouse (A.)	...	...	30	„		—
„ (B.)	...	...	60	„		—
„ (C.)	...	...	—			—
Clapham ...	...	...	—		about	19
Clarke	...	...	—		„	19
Cranbourne ...	...	...	—			—
Derby (Ordinary)	...	...	20	„		20
„ (Extra Rapid) ...	...	...	40	„		22-24
Derwent ...	...	...	—			—
Don	...	...	—			—
Eclipse	...	...	60	„		25
Edwards' Xl. (Extra Sensitive)		...	30	„		15-19
„ Xl. (Special Instantaneous)			50	„		20-22
„ Xl. (Isochromatic)...		...	50-100	„		—
Elliott & Fry ...	...	...	—			—
England (Ordinary) ...	...	...	4	„		15
„ (Extra Rapid)	...	...	15	„		20
Facilis	...	...	—			—
Favourite (Slow)	...	...	—			—
„ (Rapid)	...	...	—			—
„ (Extra)	...	...	—			—
Flexible Films ...	...	...	—			15-17
Freeman ...	...	...	—			—
Fry's Slow Landscape	...	...	6	„		12-15
„ (30 times)	...	...	30	„		20-22
„ (60 „)	...	...	60	„		25
German (Ordinary) ...	...	...	30	„		20

German (Extra Rapid)	60	times		25
Globe	—			—
Gresham	—			—
Ilford (Ordinary)	30	„		18, 19
„ (Extra Rapid)	40	„		19, 20
„ (Special)	60	„		23-25
Imperial	60	„		23
Jerome	—			—
Jubilee	—			—
London (Ordinary)	5	„		15
„ (Instantaneous)	15	„		19
„ (Drop-Shutter Special) ...	60	„		24
Ludgate	—			—
Manchester	—			—
Matchless (Extra Rapid)	60	„		20-22
„ (30 times)	30	„		15-17
Mawson (Ordinary)	60	„		—
„ (Cheap)	—			—
„ (Photo-Mechanical)	—			—
Miall (Ordinary)	—			—
„ (Extra Rapid)	—			—
Mirror	—			—
Monckhoven	—		about	20
North British	—			—
Paget (30 times)	30	„		—
„ (50 „)	50	„		—
Perfection (Rapid)	—			—
„ (Extra Rapid)	—			—
Premier	—			—
„ (Extra Rapid)	—			—
Regent (Slow)	—			—
„ (Extra Rapid)	—			—
Richmond (Ultra Rapid)	60	„		24, 25
„ (Special Instantaneous) ...	15	„		18-20
Rouch	—			—
Soho	30	„		—
„ (Extra Rapid)	60	„		—
Stanley	—			—
Sun	—			—
Tailfer	50-100	„		—

Thomas (Thickly Coated)	15	times		15-18
„ (Extra Rapid)	60	„		25
Trafalgar (Slow)	3	„		15
„ (Extra Rapid)	12½	„		20
Unique	—			—
United Kingdom	20	„		21
Uranium	—			—
Vectis	—			—
Vérel (30 times)	30	„		—
„ (60 „)	60	„		—
Vogel	—			—
Woolwich (Ordinary)	—			—
„ (Extra Rapid)	—			—

These results have been to some extent collected from other sources, and from the statements of the makers of the plates, or from information from amateurs who may have used them, or from the author's own trials.

CADETT'S TABLE, SHOWING THE RELATIVE RAPIDITIES OF PLATES OF VARYING SENSITOMETER NUMBERS.

Number of times more sensitive than—

	25	24	23	22	21	20	19	18	17	16	15	*B*
25	1	1⅓	1¾	2⅓	3	4	5	7	9	12	16	
24	—	1	1⅓	1¾	2⅓	3	4	5	7	9	12	
23	—	—	1	1⅓	1¾	2⅓	3	4	5	7	9	
22	—	—	—	1	1⅓	1¾	2⅓	3	4	5	7	
21	—	—	—	—	1	1⅓	1¾	2⅓	3	4	5	
20	—	—	—	—	—	1	1⅓	1¾	2⅓	3	4	
19	—	—	—	—	—	—	1	1⅓	1¾	2⅓	3	
18	—	—	—	—	—	—	—	1	1⅓	1¾	2⅓	
17	—	—	—	—	—	—	—	—	1	1⅓	1¾	
16	—	—	—	—	—	—	—	—	—	1	1⅓	
15	—	—	—	—	—	—	—	—	—	—	1	
A												

To use this table to compare the rapidity of two plates, the sensitometer numbers of which are known, run the eye up the column *A* till the sensitometer number is reached, and then along the line of figures till it reaches the column of figures under the sensitometer number of the second plate, when the figure there shown will tell at once the difference in rapidity. Example—A plate has

been used of ordinary rapidity showing 18 on sensitometer, and it is desired to use a plate of sensitometer No. 22: what will be the reduction in exposure? Find 22 in column *A*, and carry the eye along the line of figures opposite to it till it meets the column under 18 in *B* line—the number 3 will be found; therefore the 22 plate is three times as sensitive as the No. 18, and will therefore require one-third of the exposure.

SUNDRY FORMULÆ.

Wilde's Iodine Restrainer.

Iodine	19 grs.
Alcohol (methylated)	200 minims.
Distilled water	200 „

Dissolve in above order; from 8 to 15 drops to 4 ozs. of iron developer gives great strength to the negatives.

Belitzki's Hypo Eliminator.

Chloride of lime	308 grs.
Distilled water	35 ozs.

Stir well, and add to the milky liquid

Sulphate of zinc	616 grs.
Distilled water	5 ozs.

Filter; the clear supernatant liquid is hypochlorite of zinc solution. One part to sixty of water will remove the last traces of hypo in five minutes. The solution is active as long as it smells of hypochlorous acid.

Wet Collodion:—

Liesegang's.

Alcohol	10 ozs.
Ether	10 „
Pyroxyline...	154 grs.

Iodiser.

Alcohol	7 ozs.
Iodide ammonium	90 grs.
„ potassium	45
Bromide „	30

Mix in equal parts.

Silver Bath.

Nitrate of silver	154 grs.
Distilled water	5 „

If the bath fogs, add a few drops of iodine solution (1 part of iodine in 10 of alcohol).

Bromine Hypo Eliminator.

A solution of bromine in water of a light sherry colour will remove the last traces of hypo in negatives.

Dr. Eder's Intensifier.

Whiten the negative by soaking in a saturated solution of mercuric chloride; wash well, and immerse in

Potassium cyanide	10 grs.
„ iodide	5 „
Mercuric chloride	5 „
Distilled water	4 ozs.

Wash and dry.

Eau de Javelle.

Chloride of lime	2 ozs.
Carbonate of potash	4 „
Water	40 „

Mix the chloride of lime with 30 ozs. of water; dissolve the potash in 10 ozs. of water. Mix, boil, and filter. Used as an hypo eliminator.

Labarraque's Solution.

Chloride of lime	2 ozs.
Carbonate of soda	4 „
Water	40 „

Directions to make the same as for Eau de Javelle.

Aqueous Shellac Varnish.

Shellac	16 ozs.
Borax	3 „
Distilled water	3 pints.

The whole must be kept boiling some time. When solution is effected, it may be diluted as desired without fear of precipitation.

Crystal Varnish for Ferrotypes.

Dammar	25 grs.
Benzole	1 oz.

Rivot's Self-Toned Paper.

Chloride of gold	60 grs.
„ „ ammonium	120 „
Distilled water	20 ozs.

Float albumenised paper on this bath to salt, allow to dry, and then on

Ammonio-nitrate of silver	60 grs.
Distilled water	1 oz.

Dry quickly.

Red Prints.

Citric acid	100 grs.
Chloride of ammonium	100 „
Gelatine	10 „
Distilled water	10 ozs.

Dissolve the citric acid in a small portion of water, and exactly neutralise with carbonate of soda (228 grs. of common washing soda will be about enough). Mix with the other ingredients. Float the paper on this solution for two minutes, and sensitise upon a 50-grain nitrate of silver bath. Do not tone; simply fix and wash.

A New Developer.

The following formula is recommended by a Russian amateur, who states that it has been used for some two years with very good effects, the colour being somewhat similar to a wet plate.

No. 1.

Sodium sulphite	300 grs.
Ferrocyanide of potassium	700 „
Carbonate of soda	700 „
Distilled water	7½ ozs.

No. 2.

Pyrogallic acid	150 grs.
Chloride of ammonium	150 „
Distilled water	3 ozs.

No. 3.

Trimethylamine	5 minims.
Distilled water	95 ,,

Developer.

No. 1 solution	5 drms.
,, 2 ,, ...	40 minims.
,, 3 ,, ...	15 ,,

Nos. 1 and 2 are perfectly stable, and will keep some little time; but No. 3 should be added only when required for use. Development proceeds rapidly; and if sufficient density is not obtained, three or five drops more of No. 3 can be added.

Trimethylamine, $(CH_3)_3N = 59$, is an oily liquid, very alkaline, of strong fetid odour, intensely disagreeable, and persistent. It is a common product of decomposition, and is also a bye-product in the distillation of beet spirit.

Furnell's New Developer.

This has been recommended by Mr. Furnell, who states he has kept pyro in solution by means of this for four years, and no sign of deterioration or darkening of colour showing. It is especially useful for plates inclined to frill; it gives extreme latitude of exposure with any plates, and gives clear glass in the shadows, and is especially useful for positives. It is obviously unsuited for stripping films, the action of the alum being a sure preventer of stripping.

Stock Sodic Solution.

Sodium sulphite	300 grs.
Powdered alum	60 ,,
Distilled water, to make	18 ozs.

Dissolve, allow to stand until clear, and filter. This will keep indefinitely.

Stock Pyrogallol Solution.

Stock sodic solution	1 oz.
Pyrogallol	8 grs
Nitrate of soda	12 ,,

This will keep indefinitely.

Stock Ammonia Solution.

Liquor ammonia (·880)	90 minims.
Bromide of ammonium	30 „
Distilled water, to make	15 drms.

Developer.

Sol. pyro	4 drms.
Water, to make	2 ozs.

Flood the plate without previously wetting, add to the developer 10 minims of ammonia solution, and repeat the dose if the required density is not obtained. When fully developed do not wash the plate, but flood with a saturated solution of alum, rinse, and fix in the following bath :—

Hyposulphite of soda	4 ozs.
Carbonate „ „	1 „
Saturated solution of alum	1 „
Water	20 „

Allow it to clear ; then filter. It can be used almost indefinitely. Mr. Furnell states he has used some for three years, and no sign of staining. If it gets turbid it should be allowed to settle. The author has tried this, and it certainly seems an improvement upon many developers in the market, the negatives being full of detail, and of a good chocolate quick-printing colour, due to the nitrate of soda. The alum should be omitted from the fixing bath, as it decomposes part of the hypo and weakens the fixing power, besides rendering sulphur deposition liable.

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