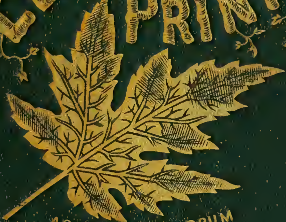
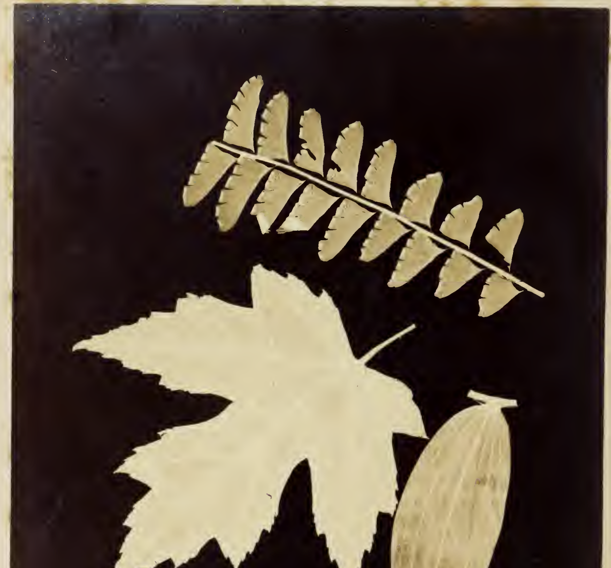
LEAF PRINTS



ACER DASY CARPUM

Wilmot Leighton Marden.



LEAF PRINTS:

OR

Glimpses at Photography.

BY

CHARLES F. HIMES, PH.D.,

PROFESSOR OF NATURAL SCIENCE, DICKINSON COLLEGE, CARLISLE, PA.

PHILADELPHIA:
BENERMAN & WILSON.
1868.

CAXTON PRESS OF

SHERMAN & CO., PHILADELPHIA.

Contents.

Preface.

No one of the methods suggested for taking impressions of leaves for botanical purposes surpasses the photographic in beauty or accuracy, whilst it has an additional recommendation in the easy, interesting, and practical lesson in science that it may be made to teach, and the delightful recreation it affords.

The practical study of science is beginning to displace the old method of simply burdening the memory with the dry, unfruitful, and consequently, uninteresting facts of a text-book. A certain amount of practical work *by the pupil* has been added to the usual course of experimental lectures, even in some of our best female seminaries. Facts and principles thus practically learned are retained by the memory, and suggest themselves readily when occasion demands, whilst the discipline involved in their acquirement is not accomplished by other branches of study, and enables the pupil to read more intelligently ordinary scientific treatises.

No special application of science is better adapted to amateur pursuit than Photography, as the number of all classes engaged in it in our own country and England shows. It requires little and inexpensive apparatus, and rewards ordinary skill and perseverance, whilst it presents attractive fields wide enough for the most acute investigation. By reason of the nice conditions and almost infinitesimally small quantities involved in its practice, it trains the mind to habits of close observation, of method, and of cleanliness, and familiarizes it with the most common chemical manipulations.

These few pages are simply intended to direct the attention to the most salient points in the history, theory, and practice of photography,—as a glimpse at, rather than an introduction to practical photography. They will serve to enable any one to read intelligently the more exhaustive works and the journals devoted to the art.

The details of the manipulations are adapted to the most limited facilities, and are so minutely described, that by the aid of the accompanying explanations of the principles involved, the amateur may be able to work his way without difficulty.

The process by development was only intended to illustrate the main feature of Daguerre's discovery, and is therefore scarcely complete enough for practical purposes.

Lesson of the Illustration.

"Leaves take all kinds of strange shapes, as if to invite us to examine them. Star-shaped, heart-shaped, spear-shaped, arrow-shaped, fretted, fringed, cleft, furrowed, serrated, sinuated; in whorls, in tufts, in spires, in wreaths endlessly expressive, deceptive, fantastic, never the same from footstalk to blossom; they seem perpetually to tempt our watchfulness, and take delight in outstripping our wonder." "Jags and rents are their laws of being. . . . . . The outline of a buttercup leaf, how delicately rent into beauty! As in the aiguilles of the great Alps, so in this lowest field herb, where rending is the law of being, it is the law of loveliness." This quotation, with Ruskin's impress sharp upon it, gives a fragment of an artist's view of leaves. The illustration accompanying this little tract, is intended to point toward an equally interesting and important, though, perhaps, more prosy view of leaves,—to act as a finger-board toward a botanical text-book.

One great object of the study of botany, is to enable the student to recognize readily the individuals of the surrounding flora, to call them by their names, and to arrange them according to their degrees of kinship.

The number and distinctness of the characteristics of a plant often concentrated in its leaf, and the comparative ease with which the story written on the leaf can be deciphered, make the study of its morphology peculiarly important and interesting to the beginner in botany.

The leaves for the illustration were selected from the limited range of a *hortus siccus*, and were not quite as well adapted therefore, to photographic printing as freshly gathered ones; they will serve, however, to direct attention to the account of the history of plants, that a collection of their leaves can give.

In one of the specimens, a leaf of the *Acer dasycarpum*, one of our commonest maples, five large veins or ribs radiate from the base and smaller veins, and veinlets are given off in all directions, which by their interosculations with each other, impart a netted appearance to the leaf. In another specimen, a leaf of the *Polygonatum multiflorum*, or Solomon's Seal, the veins run unbroken from base to apex, parallel to each other, connected by little veinlets. The third specimen is a piece of a branch of the *Adiantum pedatum*, or Maidenhair, which scarcely does justice to the most delicate and graceful of our North American ferns. The veins in it are given off in pairs, and are therefore called forked veins.

The character of the venation of a leaf is so readily distinguished, that it is very easy to classify a plant with those having reticulated or net-veined, nerved or parallel-veined, or forked-veined leaves. But the venation of the leaf of a plant, with very few exceptions, tells of other very marked traits of plant life, much less easily distinguished by the tyro in botanical observation. Thus it says in the leaf first described, that the plant on which it grew belonged to the grand series of PHÆNOGAMOUS OR FLOWERING PLANTS; that it belonged to the first grand division of this series, called from the nature of the embryo in the seed *Dicotyledonous*, or, also on account of the manner in which the material of which the plant is composed, has been deposited in the formation of its stem, *Exogenous*,—

outside-growers; also that the numerical plan of the plant is based on the number five.

It would not be easy for the beginner in botanical analysis, to detect all the traits of character common to the Maple and the Buttercup. For whilst the dicotyledonous character of the embryo would be very apparent in the seed of the Maple, in the seed of the Buttercup it would require some skill to find it. The examination of the stems would scarcely reveal with certainty to the undisciplined observer, similarity in the mode of growth. The numerical plan of a plant is, in many cases, still more difficult to discover. But the *reticulated* venation of the leaf points unmistakably to all these facts of kinship, between the stately "builder plants" and one of the humbler "tented plants," as Ruskin calls them, that cover the ground.

Thus the *nerved* or *parallel-veined* leaf of the Solomon's Seal tells just as full and clear a story about its plant, and as unmistakably publishes its relationship to the Grasses, the Indian corn, the Palms, and all the other plants of the second grand division of the flowering plants, called from the nature of the embryo *Monocotyledonous*, or from their mode of growth, *Endogenous,—inside-growers*, and having as the base of their numerical plan the number three.

The *forked* veins of the Maidenhair, indicate as truly its place in the second great series of plants called CRYPTOGAMOUS or FLOWERLESS PLANTS, and also that it belongs to the class of *Acrogens* of this series, and to the order *Filices* or *Ferns*, plants that seem to concentrate in their leaves, or fronds as they are called, with the leaf, and flower, and seed, the beauty of all three.

Besides this general classification, that the *structure* of the leaf, especially of the most important series, the flowering plants, enables us readily to make, the general outline of their forms, intimately connected with their venation, affords us the readiest marks for characterizing species and varieties, thus rendering familiarity with leaf forms one of the greatest aids in making the acquaintance of the flora of a neighborhood. Thus the leaves of the different species of forest trees, when placed side by side, declare to a great extent very minute specific differences, and the description of them draws largely upon the technical terms of botany. The leaf of the *Acer saccharinum*, or Sugar Maple, placed aside of the leaf in the illustration, shows at once a very marked difference, and yet one hard to be realized by one not thoroughly familiar with the technical terms, upon reading the description in the *Species Plantarum*.

But the fronds of the Ferns reward in the highest degree the study of leaf morphology. Almost all specific and generic characteristics are found in them, when the nature of the fructification,—the shape of the sori, their position, &c., is considered,—all of which can be perfectly represented by the photographic method used for the illustration, in which the marginal fructification is beautifully rendered. Thus the place of this, one of the lower orders of vegetation in our earth's flora in pre-Adamic times, is written in the impressions of its leaves upon the rocks. They tell that during the carboniferous era, when the vast beds of coal were stowed away for the subsequent use of man, the ferns which at present seem only to serve to relieve by their freshness and beauty, the waste and gloomy places, preponderated in number of species and genera, and in some of their representatives, even in our zone, aspired to the dignity of treehood, as they now only do in the tropics.

For the methods of selection and preparation of leaves for photographic purposes, the reader is referred to the section on negatives.

Historical Introduction.

The art of Photography rests upon the *sensitiveness* of certain substances, especially compounds of silver, to the action of light, by which their chemical or physical nature is changed. The term, therefore, includes all processes for "drawing by light," even the use of indelible ink. The influence of light on animal life and vegetation was early noticed, and the darkening effect of light upon the chloride of silver was known to the Alchemists. In the early part of this century, Wedgewood and Davy made the first experiments with a view to the adaptation of this peculiar sun-force to the performance of artistic drudgery. They moistened a sheet of paper with a solution of nitrate of silver, and projected the shadow of the object they wished to copy upon it. The portion upon which the light fell was darkened; that on which the shadow fell remained white. This process was only valuable for the promise it held out, as it required hours to produce, at best, very poor silhouettes. It was abandoned for want of a means of *fixing* the pictures, that is, of preserving the white portion unchanged by the subsequent action of light to which it might be exposed. More subtle investigations by Herschell, Niepce, Daguerre, Talbot, and others, led to the discovery of many substances available for photographic purposes. These investigations culminated in the invention of Daguerre. Whilst employing a camera to assist him in his profession as a scene painter, in 1824, it occurred to him to search for some method for rendering permanent the beautiful pictures formed in the camera. The Alchemists never had originated a more unpromising pursuit. So intense, though uniformly unsuccessful, were Daguerre's efforts, that his wife asked medical advice in regard to the symptoms of insanity in her husband. After years of toil in the most jealous secrecy, and attended only by continual disappointment, the following accident came to his assistance. It should not, however, detract from his merit, for he had been obliged to work his way across the path of such an accident, and to learn how to make it fruitful. In the course of his numerous experiments, he submitted polished silver tablets to the action of vapor of iodine until the bright surface was converted into a creamy yellow one of iodide of silver. He then caused the image formed in the camera to fall upon the plates thus prepared, under varying conditions, with a faint hope that it might remain, but he was obliged to stow them away, one after another, in his rubbish-box, apparently unaffected, to be re-polished and re-used in pursuit of the same phantom. Upon taking one of these cast-away plates from the box to re-polish it, to his great astonishment he found upon it a perfect realization of his dream; as if some magician in mockery of him, in the darkness of the closet, had drawn upon it the image to which it had been exposed in the camera.

He placed several iodized plates that had been exposed in the camera, in the box as before, each time, however, having first removed something from the box. Each time the *latent* invisible image formed by a short exposure in the camera was *developed* into a beautiful visible one in the box. At last everything was removed but some mercury. The magician was detected. The mercury, which had volatilized at ordinary temperature had, by reason of some change effected in the iodide of silver, only condensed upon the portions traced by light. By further experiments, he succeeded in *fixing* the images, and in January, 1839, exhibited his first specimens. The French government, under lead of Arago and Gay-Lussac, gave the process as "a gift to the world," by pensioning Daguerre and Niepce, his equally enthusiastic but less fortunate co-laborer.

Like many other great discoveries, this had ripened in several countries at the same time. In England, Talbot, on the 31st of January, read a paper on "A Method of Photogenic Drawing." His experiments had been directed chiefly to the production of images of natural objects, especially botanical specimens. His method was founded upon the darkening of chloride of silver, and was substantially that given in the accompanying manual. The production of "pictures of lace, leaves, and ferns, which," to quote his own language, "it would take the most skillful artist days or weeks of labor to trace or copy, is effected by the boundless powers of natural chemistry in a few seconds." He formed chloride of silver on a piece of paper, as described in this manual, placed a leaf or engraving upon it, and exposed to the sunlight. The light darkened the chloride beneath the transparent and white parts of the leaf or engraving, whilst the more opaque parts protected the chloride beneath them, and preserved it white. So also the bright sky in the picture of a landscape formed in the camera would produce the darkest impression, and a dark object a very faint one. Such pictures with reversed light and shade are called *negatives*. It occurred to Talbot to place a *negative* upon chlorided paper, and thus to produce a negative of the negative, or a perfect copy of the original, called a *positive*. From a single negative, in this way, any number of positives can be made, and it thus becomes the photographic equivalent of an engraved plate. The Calotype process was perfected by Talbot in 1841, and embodied Daguerre's discovery of a latent impression upon iodide of silver, which lessened the time required so much as to allow of the use of the camera, and the method of multiplication, suggested by himself, by the employment of paper, made transparent by waxing, to receive the image instead of a silver plate.

Thus the *change of color* produced in Chloride of Silver by light, suggested the earliest form of Photography. The formation in a much *shorter time* of an invisible or *latent* but *developable* effect upon Iodide of Silver, gave rise to processes sufficiently sensitive for the camera, whilst the production of *negatives* upon transparent substances, such as waxed-paper and glass, rendered possible a more extended application of photography, and the property which certain substances, as the Hyposulphite of Soda, first suggested by Herschell, have, of dissolving unchanged portions of the silver compound, whilst they do not affect the portions acted on by light, afforded a simple means for *fixing* photographic pictures.

The process of Wedgewood and Davy required hours to catch the shadow of a stationary object. Now ships scudding before the breeze, the breaking waves, the cannon-ball at any instant of its flight, or even half protruding from the muzzle, all leave their image on a film of matter more sensitive than the retina of the eye. Old methods of multiplication of photographic copies have been supplanted by more rapid and cheaper ones, and photolithography already begins to fulfil the promises it has long held out, by furnishing our atlases with the most accurate maps, and our books with first class illustrations. All arts and sciences have become more or less indebted to photography, and the numerous journals devoted solely to its interests, are continually filled with new processes and new applications. It is perfectly faithful in the minutest details, it commits no errors of observation; the smallest objects, the choicest revelations of the microscope, that demand much skill in the use of the instrument to be enjoyed by means of it, are placed before every one, enlarged several thousand diameters "by the wonderful insight of heaven's broad and simple sunshine." In medical science, photographs of malformations and morbid structures are made to replace defective, though tediously executed hand drawings. The magnetic needle, as it obeys during the day the changes in the earth's magnetism, makes a continuous record of its variations on photographic paper; the mercury of the barometer records its fluctuations by the same means. The hourly phases of the sun and its eclipses, the bottom of the sea, the interior of the eye and of the Pyramids, all are photographically mapped.

The stereoscope multiplies wonderfully the applications of photography. It affords an endless variety of objects from art and nature, from the statuary of the old world to the choicest fragments of the interior of the Mammoth Cave in almost tangible form, for the fireside entertainment. It exhibits a new view of the moon, and reproduces perfectly geological, zoological, botanical, and mineralogical specimens, even to the lustre of the latter, and by a still further application of the stereoscopic principle in photosculpture, photography furnishes all the details necessary for a perfect statue.

Thus far, however, Photography, though many-eyed, has been color-blind; but there are promises that in its future, these monochromatic representations will be displaced by perfect reproductions of the pictures of the camera, in all their richness of color, just as they fascinated the visionary painter. The difficulties in the way, seem to those most wise in these things, to be almost insurmountable, but all are hopeful.

The earnest and unremitting experiments of Niepce de St. Victor, nephew of Niepce, Becquerel, and Poitevin, have advanced Heliochromy to a point analogous to that at which Wedgewood and Davy left Photography. Photographs in colors have been produced by Poitevin, but his process is *slow*, and the pictures for *want of a perfect method of fixing*, are as evanescent as the shadows caught more than half a century ago.

Manual.

Preliminary Remarks.

Any ordinary room, moderately darkened by good thick blinds, best yellow or red, without interfering with its other uses, may be employed for all the processes given, except the one by re-development, which requires more absolute exclusion of light by means of shutters. Pieces of carpet or matting should be placed beneath and around a small operating table, as far as the photographic use of the room extends, to receive the inevitable stains. An ordinary packing-box, about two feet long and sixteen inches square at each end, will serve to hold all the apparatus, and may be adapted to drying paper after salting, albumenizing, and sensitizing, by having strips of wood nailed along the back and front, in the inside about an inch from the top, upon which narrow strips of soft wood can rest across the box. On these strips the papers may be hung, by means of spring clothes-clips, having pins driven in one end and bent in the form of a hook, or the paper may be fastened by one corner to the strip of soft wood by a pin. If clothes-clips are used, different sets should be kept for salted or albumenized paper, sensitized paper, and washed prints, but all may be used for holding the negative in printing. A string drawn across the dark-room will also answer to hang them on. Ordinary oblong queensware dishes will suffice for all purposes, but at least one porcelain tray with a spout, such as can be obtained at any photographic depot, is advisable for nitrate of silver solutions. With some practice, however, a liquid may be transferred without loss, from any dish to the bottle, by placing a moistened glass rod against the edge of the dish, and pouring the liquid slowly along it.

A moist pellet of cotton placed loosely in the neck of a glass funnel will answer for filtering. If paper filters are used, and they are preferable, a sheet of filter paper should be cut into circular pieces of such a size, that when they are folded into a quadrant, and placed in the glass funnel, they will not project above the edge of the funnel.

Glass rods are indispensable in operating with solutions of nitrate of silver.

A small apothecaries' scales and weights, which can be obtained for a dollar, will answer for weighing solids. Water, and other liquids, the proportions of which in the different formulæ are given in terms of weights, need not be weighed. The proper quantity is obtained by *measuring* in an ordinary apothecaries' measuring glass. One of four ounces graduated in drachms and ounces, will meet all requirements.

Rain water, or clear spring water, will answer in all cases where pure water is mentioned.

All bottles should be conspicuously labelled, and if they contain solutions, it is well to put their formulæ on the labels.

A full list of Apparatus and Chemicals is appended, from which the amateur can make a selection.

Leaf Negatives.

Although any ramble will furnish leaf-negatives ready for use without subsequent treatment, there are a few practical hints in regard to them that may at times be of service. Leaves in full vigor, gathered at any season, will print well. Spring leaves are, however, the least intense. Late specimens, therefore, from plants having very delicate leaves, will give the most vigorous prints.

In gathering leaves for photographic purposes, some care should be taken to procure perfect and characteristic specimens. The margins should be kept as free from overlapping as possible, when the leaves are placed in the printing-frame or pressed. Some are more easily managed if very slightly wilted, but generally the sooner they are subjected to a slight pressure, the better. A portfolio or ordinary atlas, supplied with sheets of printing-paper, should be taken to the woods, in which the most delicate ones, as the maidenhair, fine-haired mountain fern, &c., can be placed as soon as plucked. Many leaves can be printed from without pressing or drying, as forest leaves, many ferns, columbine, anemone, black currant, &c., but when the juices of the leaf may be expressed by the pressure used in printing, and stain the sensitive paper, it will be necessary to subject them to some pressure between the folds of bibulous paper. They should not, however, be dried as for an herbarium.

The ribs and veins in prints made from undried leaves appear as sharply defined dark lines, and the whole appearance of the prints is superior to those made from dried leaves, in which the ribs and veins are represented by comparatively ill-defined white lines. The maple leaf of the accompanying illustration, can therefore easily be surpassed by any reader, by printing from a freshly plucked leaf.

The reason of the difference alluded to lies in the fact, that the ribs and veins, whilst filled with the fluids which they convey, are transparent, and allow the light to pass through, and make a record of them in dark lines. When dry and empty, they are opaque, and by preventing the action of the light, produce white lines.

Dried leaves may be made to give prints in all respects equal to, and sometimes, even superior to those obtained from freshly-gathered ones, by soaking them for several hours in water, until the veins become expanded and filled. They must then be pressed between folds of bibulous paper, until dry enough superficially to be printed from. After this treatment, they will only remain in good photographic condition several days, but the operation can be repeated as often as desired. A little glycerine added to the water, will cause the veins to remain transparent longer, and a little hydrochloric acid will facilitate the filling of the veins in some cases.

When it is desired to print from several leaves, upon the same piece of paper at the same time, it will be found convenient to fasten them to the glass by means of dilute gum-water. Immediately after being fastened to the glass in this way, they should be subjected to the pressure of the clothes-clips as in printing from them. In some cases it is best to place the leaves, especially dried ones, between folds of writing-paper, and subject them to as great a degree of pressure as can be obtained by means of an ordinary letter-press, before fastening them on the glass. If the leaves are not of the same intensity, the most *intense*, those that require the longest time to print, may be bleached as much as necessary by means of Labarraque's solution, or those least intense may be stained light yellow, by means of turmeric. Small plants, with flowers that preserve their shape somewhat in pressing, as violets, can be photographed entire. It would be advisable for the amateur to begin with the processes with Ferricyanide of Potassium and Bichromate of Potash, as they are very easy, and require but one chemical, a few clothes-clips, and pieces of glass, and writing-paper. The bichromate process is most sensitive, whilst the ferricyanide process is well adapted to very delicate leaves.

The size of the leaves to be photographed by means of these two processes, is only limited by the size of the paper and glass.

WAXED PRINTS AS NEGATIVES.

All prints taken directly from the leaves have a dark background; the general effect is in many respects rendered more pleasing by reversing this, by printing again from one of these prints, in the same manner as from the leaf. The print will be more perfect, if the print to be used as a negative is rendered more transparent by *waxing;* for this purpose the following method will answer. Melt some pure white wax by placing it in a shallow vessel, placed in a pan of boiling water on the stove. Draw pieces of bibulous paper (filter-paper or blotting-paper) through the melted wax, so that they become completely saturated. Place a sheet so waxed upon several sheets of bibulous paper, and upon it alternate layers of bibulous and waxed paper, until about half a dozen waxed papers are in the pile. Place on top several sheets of bibulous paper, and press the whole with a flat-iron that has been heated by being placed in boiling water. All the sheets will become uniformly waxed in this way. In order to wax a print to be used as a negative, place it upon bibulous paper, and upon it one of the uniformly waxed sheets, with several folds of paper above it, and press with a flat-iron warmed as before. If there seems to be an excess of wax in the negative, it can be removed by pressing it as before, but simply between folds of bibulous paper. It will print better than its appearance will indicate. Prints on albumen paper make better negatives than those on plain paper.

In addition to the class of negatives without the camera, a few collodion negatives of portraits and views are excellent for practice. They can be readily obtained from any photographer, as it is to their interest to encourage amateur pursuit of the art.

Silver Process.

GENERAL OUTLINE.

FROM the preceding historical sketch, the general character of all photographic processes may be seen. A single experiment will serve to illustrate more clearly the action of light on Chloride of Silver, and explain the chemistry of the ordinary printing process. Fill a test-tube, or champagne-glass, with rain-water, drop into it a small crystal of Nitrate of Silver, and stir with a glass rod until entirely dissolved; then add a few drops of a solution of common salt; a dense, white, curdy precipitate of chloride of silver will be formed. The reaction is due to an interchange of elements, called *double decomposition.*

Nitrate of Silver + Chloride of Sodium
form Nitrate of Soda + Chloride of Silver.

The nitric acid and oxygen that were united with the silver to form nitrate of silver are now united with the sodium to form nitrate of soda, and the chlorine that was united with the sodium, is now united with the silver to form chloride of silver. The element chlorine, by reason of its superior *affinity* for silver, will leave any substance with which it may be combined, as sodium (as in the experiment), potassium, ammonium, and take silver out of any of its compounds that may be present to form chloride of silver, provided both compounds are in solution, so that the little atoms can have freedom of motion enough to arrange themselves according to their affinities. Chlorine gas passed over a silver plate will also form chloride of silver. If instead of chloride of sodium, iodide of sodium be used in the experiment, or if a silver plate be exposed to vapor of iodine, Iodide of Silver will be formed, as Daguerre formed it. If two glasses, one with chloride, and the other with iodide of silver, be placed in the light, the chloride will darken rapidly, because the slender beams of light insinuating themselves between the atoms of chlorine and silver, in spite of their powerful affinity for each other, dissect off a portion of the chlorine, which, being a gas at ordinary temperatures, escapes, leaving behind silver with less chlorine attached, called subchloride, which is violet-colored.

The iodide will not be visibly changed, but the printing of a picture by the development process will fully illustrate the *latent* effect of light upon it.

If much nitrate of silver is used in the first experiment, the mass of chloride formed will only be darkened externally by exposure to the light, as may be seen by stirring after the exposure. A thin film of chloride, therefore, only can be used. Such a film it would be difficult to get by spreading the chloride upon any substance, but it is beautifully obtained in the various photographic processes by *forming* it in thin layers of paper, albumen, collodion, &c., as the details of the manipulation will show.

PAPER.

The ordinary writing-paper is not sufficiently uniform in texture, to be as well adapted to the more delicate photographic uses as that expressly prepared for the purpose, which can be obtained of any dealer in photographic materials. The Saxony paper (papier Saxe) is as good as any, and less variable in its quality. It can be procured in sheets about eighteen by twenty-two inches. In cutting it into pieces of the desired size, as well as in all subsequent operations, care should be taken not to soil it, or to allow it to come in contact with the fingers more than necessary. It is well to mark the smoother side in the corner of each piece with a pencil. It may be used plain, or a glaze may be imparted to it by means of albumen. Plain paper is preferred by many by reason of its soft and more artistic effect, and success with it is quite certain; but the finer surface imparted by albumen gives greater sharpness of details, and makes the use of it in copying leaves advisable. Thin paper, whether plain or albumenized, gives sharper prints of leaves than thick of the same quality. Silk, linen, and other fabrics may be used instead of paper.

SALTING AND ALBUMENIZING.

The first treatment of the paper is to impregnate it uniformly with some chloride, which in the subsequent operation of sensitizing, may be converted into chloride of silver. Many chlorides are well adapted to this purpose. Chloride of sodium (common salt) is always at hand, but chloride of ammonium can be obtained pure more readily. The proportions of chloride in the formulæ given may be varied with advantage for different subjects. When a weak negative, a delicate leaf, such as the Maidenhair, is to be copied, especially in dull weather, by using a few more grains of chloride to the ounce of water, more vigorous prints can be obtained.

Plain Paper.—Fill a shallow dish or tray of porcelain or queensware to the depth of half an inch or more, with a solution made according to annexed formula.

Pure Water, ...	16 ounces.
Chloride of Sodium, or of Ammonium,	128 grains.

Immerse half a dozen papers one by one. Turn the whole of them over, and take them out in the order in which they were immersed, and hang them up separately to dry, as directed in the preliminary remarks.

One grain of refined gelatine added to each ounce of the salting solution given above, imparts more firmness to the paper and improves the tone. It will dissolve readily by gently warming the liquid, which should then be filtered before immersing the papers.

Albumenized Paper.—Paper of this kind, of the most superior quality, is found ready prepared in the trade. Where good results are desired with the greatest economy of time and expense, the amateur will find it advisable to purchase rather than to prepare it himself. By means of the following formula, such as desire may with proper care obtain excellent results:

Pure Water, ...	4 ounces.
Albumen, ...	8 "
Chloride of Ammonium, . . .	120 grains.

An egg will be found to furnish about an ounce of albumen. Each egg should be broken separately by a smart blow against the edge of a glass, and the white dropped into the glass. Should the membranous cords that attach the yolk to the inner membrane of the shell, pass along into the glass, they must be removed by means of a small wire or tooth-pick. The whole must be beaten to a perfect froth, and then allowed to pass into the liquid state again. The clear liquid may then be measured out, and the water in which the chloride has been dissolved added. The mixture is then to be beaten for five minutes, and placed aside, best in a tall jar, to subside. The clear liquid may then be strained through a piece of cambric into a tray. Take the paper by two opposite corners, bend it, place the convex middle part on the liquid first, and lower it gradually toward the corners, so as to drive all air-bubbles forward. Allow it to remain two minutes, raise it up gently, and if any spots appear free from albumen, it must be replaced upon the liquid in the same way for the same length of time. After removal, it is to be pinned up by two corners to dry, in a place free from dust. By using a larger proportion of albumen, a higher gloss may be obtained, and less chloride should be used. Thin paper is more easily albumenized than thick.

SENSITIZING.

This operation consists in converting the chloride with which the paper is now impregnated into the Chloride of Silver, by bringing it in contact with Nitrate of Silver in solution. It requires the darkened room. Make enough solution according to the formula,

Pure Water, ...	1 ounce.
Nitrate of Silver, ...	60 grains.

to fill a shallow queensware dish to the depth of half an inch. The dish should be well washed before use with pure water, and for the sake of economy of solution, should not be much larger than the paper to be sensitized. Well water is preferable to rain water, collected from wooden roofs or preserved in wooden cisterns, for making silver solutions, as salts are present in small quantity, and do not precipitate much silver, or otherwise injure the solution. If there is a precipitate, the solution should be filtered into the tray, or be allowed to stand for a day or two, and the clear liquid then be carefully poured off into the tray. If a scum appears upon the solution in the tray, it may be removed by drawing slips of blotting-paper over it. Lower the plain chlorided, or albumenized, paper upon it as directed in albumenizing. If it curls up at first, breathing upon it will in most cases flatten it at once. As soon as the sheet has become perfectly flat, lift it up by one corner, pass a smooth glass rod over it, to wipe off any air-bubbles that may be on it, and prevent uniform contact with the solution, replace it on the bath, and allow it to remain about three minutes if plain, or from three to six minutes if albumenized. Then lift out one corner by means of the glass rod, attach a spring clip, or put a pin through it, allow it to drain for a moment over the tray, and hang it up to dry in the dark, as directed in the Preliminary Remarks. It will dry more quickly if the drop at the lower corner is removed, after it has been hanging a few minutes, by touching it with a piece of blotting-paper. It should also be kept in the dark when dry. It is best to use it soon after it is dry, as it generally becomes discolored in a day or two, even in the dark.

The discoloration of the sensitizing solution that takes place after a short use, will not affect the paper permanently. It is well, however, not to expose the bath to light more than necessary. It may be decolorized if desired, by adding about a tablespoonful of kaolin to half a pint, shaking it, allowing it to stand for a few hours, and filtering before use.

Each sheet of paper sensitized, takes with it a portion of silver from the bath as chloride of silver. When the bath has become much impoverished by use, the pictures will present a *mealy* appearance. The addition of a few crystals of Nitrate of Silver to the bath will remedy this defect.

Fuming with Ammonia.—By subjecting *thoroughly dried* sensitive paper to the action of ammonia gas, a sensitizing bath of only thirty grains of nitrate of silver to the ounce of water will produce the finest results, and success under varying circumstances is rendered more certain. The *fuming* may be accomplished by bending the sheet with the albumenized side out, so that opposite corners may be caught by a clothes-clip, and hanging it up in a box with a lid, constructed like the one described, but smaller, having on the bottom a saucer partially filled with *strong* aqua ammonia. From three to ten minutes will suffice for the fuming. The paper should then be used immediately, as it deteriorates *after* fuming; but if sensitized on a weak bath, as recommended, it may be kept longer *before* fuming than if sensitized on a sixty-grain bath. The ammonia in the saucer should not be poured back into the bottle, as it will generally be too weak to be used again. The fuming may also be accomplished by pinning the paper by the four corners on a board, sensitized side out, and covering an ordinary pasteboard box, in the bottom of which a small saucer of ammonia has been placed, with it.

Ammonio-Nitrate Process.—Plain chlorided paper gives superior prints of a beautiful black tone, when sensitized by Ammonio-Nitrate of Silver. In salting paper for this process, it is best to use about five grains of chloride to the ounce of water. To make the sensitizing solution, take

Pure Water, ...	$\frac{1}{2}$ ounce.
Nitrate of Silver, ...	60 grains.

Add to this solution, drop by drop, strong Aqua Ammonia. A heavy brown precipitate of oxide of silver will be formed. Continue to add ammonia cautiously, drop by drop, and stir the solution after each addition with a glass rod until it clears up. No more ammonia should be added than is absolutely necessary to clear it, and in order to be certain of the absence of free ammonia, add to the clear solution, drop by drop, solution of Nitrate of Silver until it becomes *slightly* turbid again. Filter and preserve for use in a bottle covered with black paper or asphaltum varnish. To apply this solution, pour a small quantity into a saucer, dip into it a tuft of clean raw cotton, and moisten the chlorided paper as evenly and thoroughly as possible, by drawing the cotton brush lengthwise and crosswise over the sheet, pinned by its four corners to a board. Dry it as other paper. If the paper is not sufficiently moistened, or if free ammonia be present, white lines will appear upon the print.

EXPOSURE TO LIGHT.

The leaf, or object to be copied, is now to be pressed into close contact with the sensitive paper, and exposed to light. To accomplish this, cut a piece of window glass of the size of the sensitive paper in half, allow the halves to remain in contact at the ends, and place upon them a dozen layers of soft paper, and on top of these a piece of black cloth or velvet, with the nap uppermost. Lay the sensitive paper on the cloth, and upon it the leaf or object to be copied, and cover it with a flat well-cleaned piece of glass about the size of the paper. Compress the whole by means of the spring clips, embracing the upper and lower glasses, one at each corner of the lower halves. The clips will answer the purpose better if the round projecting ends are cut off, so as not to shade the sensitive paper more than necessary.

Expose to the sunlight, so that the rays strike the sensitive paper as perpendicularly as possible. It will begin to darken immediately. The exposure must be continued until the print becomes very much darker than it is to appear when finished, as the subsequent operations of *toning* and *fixing* reduce its intensity greatly. The exact degree of over-printing required can only be ascertained by experience. The print may be examined from time to time during the exposure with ordinary care, without disturbing the leaf, by removing the clip from one of the lower halves, and bending back the sensitive paper, cloth, &c. If not sufficiently exposed, replace as at first in the sunlight. By pasting a strip of paper over the adjoining edges of the lower halves, a convenient hinge is formed. In using a *glass* negative, the covering glass is not used, the negative itself, placed with the collodion side next to the sensitive paper, taking its place.

The time required to print in any case depends upon the intensity of the subject, the strength of the light, and the sensitiveness of the paper. A Common Polypody will require more time than the delicate Maidenhair, a winter day longer than a summer day, Ferricyanide of Potassium longer than Chloride of Silver.

The prints may be kept in a dark drawer for several hours, at times even several days, without deteriorating, before toning and fixing.

Very convenient printing-frames are sold by all dealers in photographic materials.

TONING AND FIXING.

If a solution of Hyposulphite of Soda be added to the glass containing Chloride of Silver, in the experiment previously suggested, the chloride will dissolve and disappear, just as a lump of sugar on the addition of water. If a print on removal from the frame is exposed to light, it will soon darken uniformly, and the picture be lost. If it is first placed in a solution of Hyposulphite of Soda, the white chloride, which was protected from the action of the light by the dark portions of the leaf, will be dissolved, whilst the portions changed by light will only be turned a foxy red. The print in this condition can be exposed to the light for any length of time without change, since the Chloride of Silver changeable by light has been dissolved away.

The principle of *fixing* in all photographic processes is illustrated by the above experiment. But the print, though not destroyed, is robbed of half its beauty by the hypo, by reason of the change of color. In order to prevent this, it is in most cases subjected to the previous operation of *Toning*, which consists in substituting gold for the silver compound in the unfixed print. Toning is both tedious and expensive, and requires considerable care and experience, so that in many cases, where the reddish color is not very objectionable, as in forest leaves, the prints may be placed in the *Fixing Bath*, subsequently given, immediately after printing. In most cases, however, the trouble and expense of toning will be more than repaid by the increased beauty of the prints. The details of toning vary very much. The following method is adapted to the wants of amateurs. The prints should be washed in running water ten minutes, or in half a dozen changes in a dish, pouring off dry before each change, and finally be placed in a solution of common salt, containing about two grains to the ounce of water, about three minutes. *Unless the nitrate of silver in the print be thoroughly removed in this way, it will render the Toning Bath worthless.*

Chloride of Gold is sold in bottles containing fifteen grains. Dissolve the contents of one in thirty drachms of water, add a drop of Hydrochloric acid, and preserve as a stock solution in a bottle. Make several ounces of a saturated solution of washing soda also as a stock solution. When prints are to be toned, prepare the following

Toning Bath.

Water, ...	4 ounces.
Chloride of Gold (solution), . . .	1 drachm.

Pour into a tray, and drop in a small piece of blue litmus paper. It will become bright red by reason of the free acid. Render it alkaline by adding drop by drop from the soda solution, stirring all the while with a glass rod, until the color of the paper appears to be changing to blue. Drop in another blue piece, and if after standing for five minutes, it still retains its blue color, the bath is in condition to use, and will remain so for several hours. Immerse three or four of the washed prints in it one by one. Wave the dish gently backward and forward to prevent their sticking together, or projecting partially above the surface, or some parts will be imperfectly toned. The prints change first to dingy red, thence to a chocolate brown, and finally to a rich purple, when they must be removed to a basin of clean water. They must be somewhat over-toned, as *fixing* partially destroys their color. A little experience will teach the degree of over-toning required. If too much toned, they will retain a cold inky appearance after fixing; if too little, a foxy red appearance. Pictures much over-printed take the blackest tones. Plain paper tones more rapidly than albumenized.

The first prints pass to the proper tone in about three minutes, but after the bath becomes weakened by use, the later ones may require ten minutes, or even more. It is poor economy to use a bath in such a condition. It is advisable, therefore, when it works very slowly, to transfer the prints to clean water, add a drachm of gold solution to the bath, and neutralize as at first, and retransfer the untoned prints to the bath.

If allowed to remain alkaline for several days, it will become utterly worthless, but if hydrochloric acid be added to it drop by drop, until a piece of blue litmus paper dipped in it becomes red, it will keep as well as the stock solution, and need only be neutralized with the soda solution before using, as in the first place. By adopting this plan, no gold will be wasted by keeping the bath in its best working condition up to the last print.

The prints as fast as toned may be placed in a dish of clean water until all are toned. Make a

Fixing Bath

of Water, ...	6 ounces.
Hyposulphite of Soda, ...	1 ounce.

Pour the solution into a dish, and transfer the prints to it one by one, by taking them by the corners and immersing them quickly, *taking care not to touch the faces of them with fingers soiled with the hyposulphite*, or black spots will be produced. A slight change of color will take place, but the purple color will return if they have been sufficiently toned. The prints should be allowed to remain in the *Fixing Bath* from ten to twenty minutes.

By using one hand for the Toning Bath, and the other for the Fixing Bath, the prints may be transferred as fast as they are toned, immediately to the Fixing Bath. In doing so, however, there is danger of conveying through forgetfulness, a little of the hyposulphite to the Toning Bath, and thus injuring it.

WASHING AND MOUNTING.

After fixing, the prints must be freed from the last traces of hyposulphite. The yellowing of many photographs can be attributed to imperfect washing. It is best accomplished in running water, by placing the prints *loosely* in porcelain or wooden vessels in a bath tub, and allowing the water to flow on to the bottom of the dish for about four hours, or they may be placed in a basket in a running stream of clear water. If running water is not to be had, they should be passed through several changes of water, to remove the larger part of the hyposulphite, and then be allowed to soak in clear water, which should be renewed half a dozen times at intervals of twenty minutes. They are then to be hung up in the air to dry. The curling in drying, especially of albumenized prints, may be prevented by hanging up two back to back.

Prints may be mounted on printers' cardboard, with freshly prepared solution of gum arabic, or warm solution of gelatine, or thick starch paste. Mucilage which has become acid will cause the prints to deteriorate after mounting.

Their appearance is much improved after mounting by passing them under a photographic roller, or pressing under an ordinary letter press. If the paste is allowed to dry under pressure, they will not bend.

Printing by Development.

This process is simply given as an illustration of the latent effect of light upon Iodide and Bromide of Silver. It is substantially that of Talbot. The beginner cannot expect as good results with this as with the ordinary process.

Float Saxe paper on a bath of

Water, ...	20 ounces.
Iodide of Potassium, ...	120 grains.
Bromide of Potassium, ...	30 grains.

until it ceases to curl up; sensitize when dry on a bath of

Water, ...	1 ounce.
Nitrate of Silver, ...	30 grains.
Acetic Acid, No. 8, ...	1 drachm.

Dry in a *perfectly dark* room. Expose under a negative about half a minute to diffused light. No trace of a picture will be seen. Develop by lamplight, by placing it in a clean dish containing a saturated solution of Gallic Acid, made by filling a bottle with water, and placing in it more crystals of gallic acid than will dissolve upon shaking. The solution will keep best if a lump of camphor be added. The development of the picture, if it has received the proper exposure, will be complete in about fifteen minutes; it is then to be well washed in cold, and best subsequently in warm water, and then fixed in a solution of hyposulphite of soda, containing one ounce of the hyposulphite to two ounces of water.

Processes without Silver.

To such as do not desire to enter as deeply into photography as the preceding process seems to require, the two following processes recommend themselves by their simplicity, certainty, and inexpensiveness, whilst they are well adapted to botanical purposes, and serve as a good introduction to photographic manipulation before entering upon the more complex and sensitive silver process.

Blue Photographs.

Moisten a piece of ordinary writing-paper, or papier Saxe, pinned by the four corners to a board, uniformly by means of a tuft of raw cotton, in a solution of

Ferricyanide of Potassium (Red Prussiate of Potash),	100 grains.
Water, ...	1 ounce.

When dry it will be of a bright yellow color, and ready to be printed on. Proceed as in Section, Exposure to Light. It will require from half an hour to several hours to print. On removal from the printing-frame, the yellow picture on a blue ground is fixed by simply washing it in water until the yellow portion becomes perfectly white, by the solution of the unchanged ferricyanide of which it is composed.

Brown Photographs.

If a saturated Solution of Bichromate of Potash is used instead of the ferricyanide, brown prints may be obtained in the same way.

Paper prepared with the bichromate is more sensitive than the preceding, and will render the venation of leaves almost as well as chloride of silver paper, whilst the ferricyanide paper will only render the venation of the more delicate leaves.

The strength of the solution may be varied in the two processes, but if the solution is too weak, or the paper too porous, the print will be too much within the texture of the paper, and appear best as a transparency.

In a very hot sun with the ferricyanide paper, the venation will in some cases appear blue on a yellow ground.

Removal of Stains.

Stains upon the hands or clothing caused by Nitrate of Silver are as permanent as indelible ink, of which it is the base, the ammonio-nitrate answering well for marking purposes. They may be readily removed by rubbing with a lump of cyanide of potassium, the edge of which has been dipped in water.

If of long standing, and very black, they are more easily removed by the cyanide, if they are first moistened with a few drops of a tincture of iodine. *Cyanide of potassium is a most violent poison*, and should not be allowed to penetrate fresh cuts, nor should the vapor arising from it be inhaled. A very strong solution of hyposulphite of soda will answer almost as well, if the tincture of iodine be used, and is comparatively harmless.

Red stains made by acids may be removed by treating them with ammonia or dilute solution of washing soda.

Apparatus and Chemicals.

In the following complete schedule of apparatus and chemicals employed in *all* the preceding processes, the apparatus required, in addition to such as every household furnishes, is marked with an asterisk. The chemicals are classified according to the processes in which they are used. The whole set, or such selection as any one may make, can readily be obtained from any Photographic Stock dealer.

Some one of the numerous journals devoted to Photography, would be found very useful to the amateur at all stages of his progress, besides furnishing a record of the progress of Photography and its newest applications. *The Philadelphia Photographer*, a monthly journal, holds the very highest rank at home and abroad in this class of publications, in its literary and typographical, as well as scientific character. Each number is embellished with a specimen photograph, generally of great excellence; and its Editor will always be found ready to assist the amateur, by answering through its columns all inquiries on Photographic subjects.

Apparatus.

*A set of Apothecaries' scales and weights.
*A measuring glass, capacity, 4 ounces.
*A glass funnel, " 6 ounces.
*A glass stirring-rod, about 8 inches.
*Spring clothes-clips, 3 dozen.

*Glass plates,—flat window glass.

Two porcelain trays, 8 by 10 inches, with lip.

A printing-frame, 8 by 10 inches.

A filtering-stand.

A quire of filter-paper, or package of filters to fit the glass funnel.

A quire of Saxe paper, for process with Silver.

CHEMICALS.

Silver Process,—		
Salting, .	. Chloride of Ammonium, . .	1 ounce.
	Gelatine, ...	1 ounce.
Sensitizing,	. Nitrate of Silver, ...	1 ounce.
Ammonio-Nitrate and Fuming,	Aqua Ammonia, FFF, . . .	1 pound.
Toning, .	. Chloride of Gold, ...	15 grains.
Fixing, .	. Hyposulphite of Soda, . . .	1 pound.
Without Silver,—		
Blue, .	. Ferricyanide of Potassium, . .	1 ounce.
Brown, .	. Bichromate of Potash, . . .	2 ounces.
By Development,	Iodide of Potassium, . . .	¼ ounce.
	Bromide of Ammonium, . .	¼ ounce.
	Gallic Acid, ...	¼ ounce.
	Acetic Acid, No. 8, . . .	4 ounces.
Removing Stains, .	Tincture of Iodine, ...	1 ounce.
	Cyanide of Potassium (very poisonous),	1 ounce.