WILSON'S

QUARTER CENTURY

IN

PHOTOGRAPHY.

A COLLECTION OF HINTS ON PRACTICAL PHOTOGRAPHY

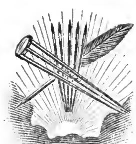
WHICH FORM

A COMPLETE TEXT-BOOK OF THE ART.

BY

EDWARD L. WILSON,

EDITOR OF "THE PHILADELPHIA PHOTOGRAPHER," AUTHOR OF "WILSON'S PHOTOGRAPHICS," "PHOTOGRAPHIC MOSAICS," ETC.



The camera is mightier than the pen or the pencil.

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TO

THE VETERAN PHOTOGRAPHERS

WHO FOR A

QUARTER OF A CENTURY HAVE FOCUSSED THE CAMERA,

FIVE HUNDRED OF WHOM I WOULD LIKE TO MENTION BY NAME,

AND TO THE

YOUNGER ONES WHO, WITH THEM, ARE HONESTLY LABORING TO UPHOLD THE MOST BEAUTIFUL ART-SCIENCE EVER DISCOVERED,

This Book is Inscribed,

BY THE AUTHOR.

PREFACE.

A QUARTER of a century ago I abandoned the vocation of merchant, to which I had been trained against my will, and entered the establishment of Mr. F. Gutekunst, photographer, Philadelphia, as an employé.

With a sort of a there-must-be-hypo-in-the-wash-water look in their faces, many friends advised against such a course, averring that Photography was "a circus kind of a business, destined to a short life, and unfit for a gentleman to engage in."

But frequent visits to the studios of some photographic friends had caused me to be fascinated with the art. I believed in it, became an optimist concerning it, engaged in it, and in about a year announced myself as editor in chief of a magazine whose purpose it should be to elevate Photography and to do what it could to help those who became devoted to it with me.

This work has gone on ever since. *The Philadelphia Photographer*, like a great journalistic funnel, has received and let through without interruption the generous offerings of our co-workers from all parts of the world.

Much of what they gave has become covered up and forgotten. For the past two years I have been engaged in a process of recovery, selection, filtration, and condensation, the result of which goes out now in the book accompanying this.

It is issued just now as an anniversary offering. If I live to do the same work again, I shall be an old man, and Photography will doubtless be able to present us with portraits of the people of other worlds provided it keeps sailing on at its present speed.

I have tried to make *Quarter Century in Photography* useful alike to learner and earner—a book fully up to the times, and helpful for all time.

Where our art has been the weakest, I have endeavored to be the strongest. Where I have been weak, I have called in the words of wiser workers. This plan proved so acceptable in *Wilson's Photographics*, that I have ventured to follow it in this work. I send it forth with the hope that it may help maintain the high position our beloved art has attained, and hold up the hands of the noble men and women who are devoted to it, for at least another *Quarter Century*.

EDWARD L. WILSON.

NEW YORK, June 1, 1887.

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WILSON'S QUARTER CENTURY IN PHOTOGRAPHY.

CHAPTER I.

THE HISTORY OF PHOTOGRAPHY.

1. PHOTOGRAPHY, wise men tell us, is the art of drawing by light.

If this is true, then Adam, when he came to the "knowledge of good and evil," became also the first discoverer of photography. He saw his full length shadow pursuing him, and tried to hide from it. He was glad enough, doubtless, that it diminished as the day went on, and that it was not fixed. Since his time, however, men have arisen who, prompted more by the love of the beautiful than by the dread of shadows, have endeavored to render permanent the wonderful traceries of the sun.

Their achievements, which enable us every one to make home more beautiful, and which have made all of our lives happier, entitle them to a word of

1. What a pity that stern and splendid old realist, Oliver Cromwell, did not live to have his portrait taken—"wart and all!" The note of photography rings thoroughly in accord with present art tendencies. They would have clean naturalness, faithful realism, clear detail; these she gives. There is greater fondness for landscape than ever before; this is, above all, the province and most favorable field of photography. The life of the time, studies and stories of the people; she can render these. Late-born, she is in sympathy with the age. She is in the very forefront of the march of modern feeling.

The future holds great things for her. She has battles to win, wars against foes within and without—against the fever of facility, against cheapness and carelessness and ignorance, that have brought down on her artistic dislike and popular light esteem. But beyond a doubt she will surmount these troubles as she grows, and gain the place she deserves; and it will be by the aid and effort of the men who gallantly and rightly seek to exalt their calling, to make it pure and of good report, and to hold as high and as honorable as any the name of Artist-Photographer.—F. H. WILSON.

The discovery of photography ranks amongst the most wonderful applications of modern science; we owe it almost solely to the genius of Niepce and Daguerre. If we mention, even in a work which can only briefly make record of about twenty-five years of the growth of their art.

2. Permit me to begin.

First came the philosopher, lasso in hand, who captured the shadow, and held it long enough to give his friends a sight.

This was Jean Baptiste Porta, the inventor of the Camera Obscura. He lived in the latter half of the sixteenth century.

Through a tiny hole in a shutter the rays of light entered into a dark-room and drew upon a white screen the image of objects outside, reversed.

Although the same process had been going on all over the world since Adam, Porta seems to have been the first one who discovered it. Enraptured, he placed a convex lens in the aperture in his shutter and then, catching the image upon a mirror, reversed it.

But his lasso was not powerful enough to hold what he had caught. Many a mind was set to work to help.

An alchemist came next with mysterious subtlety, and took hold. In his search for the Philosopher's Stone he discovered chloride of silver. Spreading some of it upon a flat surface, he noticed that any image projected upon it by

could know the obstacles which these great minds had to overcome before solving a problem which had long been looked upon as Utopian, we could see with what perseverance the inventor must arm himself to attain his ends. Nothing is more instructive than the impartial history of great discoveries; it shows us how slow is the march of progress, and how many beacons must shine along the course of centuries to guide the inventor into regions of the unknown. First appears a man who sows the germ, others follow and cultivate it, up to the time when some genius fertilizes and renders it fruitful. —G. Tissandier.

2. The germ of photography is the dark-room (or camera obscura), discovered in the second half of the sixteenth century, by J. B. Porta, a clever Italian philosopher.

The process which the illustrious Neapolitan employed was most simple. He made an aperture, hardly large enough to admit the little finger, in the shutter of a window so perfectly closed as entirely to exclude light. The rays of light penetrating the circular hole into the dark-room were projected upon a white screen, on which they depicted the reversed image of exterior objects. The simple observation of Nature might have led at once to this discovery. The foliage of trees does not entirely intercept the sun's light; it often allows rays of light to pass through the spaces which exist between the leaves, and the images of the ruler of the day appear as luminous disks in the midst of the well-defined shadows on the ground. It is easy to reproduce this phenomenon by passing the light of a candle across a small orifice, and projecting it on to a screen, on which a reversed image of the flame will be seen.—G. Tissandier.

means of his lens was imprinted with all the gradations of Nature translated into blacks and grays.

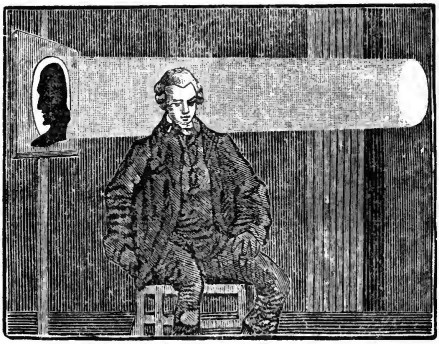
But Fabricus, for he it was, let the rope slip through his fingers, because he was looking for something more substantial than shadows.

In 1760 Triphaine de la Roche, a native of Normandy, was told by the genii that a certain subtle ingredient spread upon canvas would secure images from Nature cast thereon and fix them. He was either too frivolous, or too secretive to reveal more, and again the lasso failed.

In 1777, Scheele, the famous chemist of Sweden, discovered that chloride of silver was much more sensitive to the rays of blue and violet in light than it was to those of red and green.

3. In 1780, Prof. Charles, in a course of lectures, by means of a strong solar ray projected a shadow of the head of one of his pupils upon a sheet of white paper which had been soaked in a solution of chloride of silver, and secured a silhouette in white on a black ground—but it fled on exposure to the light.

Fig. 1.



Wedgewood and Sir Humphrey Davy made similar experiments, and in 1802 published a remarkable treatise on the reproduction of objects by light.

James Watt, the inventor of the steam-engine, also interested himself in this research; but for none of the distinguished scientists would the captured imagery remain when facing the sun, its creator.

3. Porta lost no time in recommending the use of the dark-room to all painters desirous of obtaining exact and minute delineation; and, shortly afterward, Canaletto profited by his advice, and employed the invention for taking his admirable views of Venice.

What would the Neapolitan philosopher and the Venetian painter have said had they been told that this image of the dark-room would one day draw itself, not merely fugitively, but that it would print itself on a glass moistened with chemical agents? that it would transform itself into a durable picture, only to be compared for exactness to the reflection of a mirror? This wonder was, indeed, to be accomplished unknown to Porta; but his work was not in itself sufficient to conduct science to such a result; numerous laborers had also to add their stone to the edifice.—G. TISSANDIER.

It was reserved for two Frenchmen to so deftly throw and strain the snare, that the fugitive was at last captured. Their names are familiar—Daguerre and Niepce. Examples of their individual work are not uncommon, and everybody has seen daguerrotypes made by their followers.

Mr. Fox Talbot, an Englishman, came almost simultaneously with Daguerre and Niepce, with his paper negatives.

4. Not much progress was made, however, until, in 1851, Mr. Scott Archer made public the collodion process upon glass. That became the master of them all, and has been most largely in use. Its modifications have been almost endless. Many of them will be detailed in the pages which follow, together with a record of some of the successes which have rewarded industrious experiment to overcome the drawbacks of the collodion process upon glass.

As a result of such experiment, collodion, the silver bath, and even glass, are falling more and more into disuse.

The names of the good people who have brought about these marvellous changes are, as nearly as I can collate them, enrolled herein, and much of what they have said is recorded in this work.

Photography is! It has no real rival. And when I come to tell of some five-and-twenty years of its life, at the very beginning I see I am going to be crowded for space, and therefore must not devote much to history, or to theory, or even to praise.

To the work then!

4. "Photography is still in its infancy." This is a phrase which has been so often reiterated within the last thirty years that it seems about time to drop it. If photography were still in its swaddling clothes after so long a period, we might well despair of its ever attaining to manhood. That this is not the case, however, will become apparent at once if we consider for a moment the consequences which would attend its sudden demise, if that were possible. It would be felt as a shock throughout the whole civilized world; it would create a void which thousands of minds would at once endeavor to fill. This is not the result which follows the death of an infant. Its fond parents may shed tears of anguish, and the friends of the parents may mourn *their* sorrow; but the world remains unmoved, and continues its occupations as if nothing had happened.

Nevertheless, it goes without saying that photography has not yet reached the end of its development, and that a long period of advance is still before it. How would it do then if we called it a youth instead of an infant? And a promising youth, too, who has already given proof of his great powers, has scored not a few victories in the race of life, and is still hard at work with all his faculties unimpaired upon the problems, the solution of which he has set himself as his special task.—S. R. KOEHLER.

CHAPTER II.

THE THEORY OF PHOTOGRAPHY.

5. ALL photographic images may be divided into two classes, the apparent and the latent.

Chloride of silver is usually employed in producing apparent images, as in sun-printing, and was the material used by the early experimenters.

Iodide of silver is mostly employed for latent images.

With chloride of silver the changes caused by the action of light are visible to the eye.

When iodide of silver is used as the base of operations, the changes, though just as real, are invisible until certain other chemical agents are brought into contact with it, and develop them.

For our purpose light is divided into chemical or actinic rays—such as affect the silver salts—and non-actinic rays, which create no change in the silver salts.

Recent experiments, however, have resulted in securing active service from nearly every color of the prism, under proper conditions.

Red and yellow being non-actinic, by admitting into the developing-room only such light as comes through glass, or other media of these colors, all harm from light in the wrong place is avoided.

So much for light on the theory before us.

5. Photography, like many other things, may be viewed from many standpoints. It may be viewed artistically, theoretically, practically, or historically. Each and all of these ways would, doubtless, be of interest; but let us look at the theory of photography. Chemistry has taken unto itself optics, and from these two has sprung another science—photography—combining the characteristics of its progenitors. We have two ways to treat of the theory of photography, then—chemical and physical. Let us take the former. But while chemistry may boast, while physics may boast, of having endowed photography with many things, it cannot be denied that she has taken to herself many things that neither chemistry nor physics can boast. Springing thus from an earth of exact mathematical science, photography has grown upward until she spreads her branches in the heavens of art.—HENRY M. M'INTIRE, M. E.

6. Now as to the formation of the photographic image by means of the action of light upon silver salts. Whether bromide, chloride, or iodide is used, the action is similar. Iodide will be used for the present illustration.

To a solution of nitrate of silver we add a small quantity of the soluble iodide of some metal, say ammonium. Iodide of silver is thus formed.

We use plain collodion as the vehicle for the operation. It has no influence upon the chemical reaction.

Certain salts which contain bromine and iodine are dissolved in plain collodion, and such iodized collodion is flowed over a glass plate, and allowed to set. The film is then immersed in a solution of nitrate of silver. Whilst still moist, the film is taken out of the bath and exposed to the action of light. The rays of light are directed by a lens and form an image.

The formation of a subiodide of silver is caused by the change.

If no body which will absorb iodine be present this change will not take place, for if we thoroughly wash a plate on taking it out of the bath, and attempt to develop it, after exposure to light no alteration in its aspect will be manifest. It is therefore evident that in wet photography the nitrate of silver plays an important part.

In dry-plate photography the action of light is precisely the same, but the free nitrate of silver solution is replaced in this case by some body *which will combine with iodine.*

6. It is a firm fact of chemistry that if two solutions are poured together, and by any change a salt can be formed that will be insoluble in the resulting liquid, that salt is bound to be formed, and, being formed, to be precipitated.

Thus, the bromine by leaving its ammonium, and the silver by leaving its nitric acid, find that they can unite together, and form an insoluble salt. And now the ammonium being left, the nitric acid being left with nothing else to do, unite with each other, and form nitrate of ammonium, which, being soluble, must remain in solution.

If, in place of the bromide of ammonium, we should substitute iodide of ammonium, we should obtain similar results, a precipitate of iodide of silver. ($AgNO_3 + NH_4I = AgI + NH_4NO_3$, nitrate of silver and iodide of ammonium make iodide of silver and nitrate of ammonium.) And also, if in place of the iodide or bromide of ammonium, we should put some other iodide or bromide, we should obtain like results, precipitates of iodide or bromide of silver, as the case might be.

Now let us take some salted collodion, and flow a glass plate with it; we have then the glass covered with a thin film of collodion, which acts as a ground or vehicle, and contains a bromide and an iodide. This plate is now placed in the silver bath. What takes place there is easily said. The bromide in the collodion causes bromide of silver to be precipitated upon the plate, and the iodide in like manner iodide of silver, and we have,

7. The change to the state of subiodide being invisible or latent, we must find some agent which will make the chemical action apparent. Pyrogallic acid is a chemical well known for its affinity for oxygen, as are the ferrous or proto-salts of iron, the latter tending to form the ferric or per-salts that are combined with more oxygen. I will take the example of the latter when applied to the latent image. Its use is based on the assumption that the subiodide of silver has an affinity for metallic silver, and, consequently, causes the silver from the free nitrate solution to be deposited by the developer upon those parts acted upon by light. For greater regularity and less rapidity of action acetic acid is added to the developer.

If sufficiently slow, the subiodide will attract all the particles of metallic silver as they are formed, and thus build up a metallic image. In practice the acid added is just sufficient to cause this gradual reduction of the silver. Heat increasing the rapidity of the chemical action, it follows that in decidedly hot weather a larger quantity of acetic acid should be used than in cold.

The stronger the iron solution the greater chemical power it will have, and the more rapidly it will decompose the silver solution. As a consequence, with

when the plate is taken from the bath, a thin but uniform film of bromide and iodide of silver, and adhering to this some of the bath—a solution of nitrate of silver.

The plate is now placed in the dark-slide, and exposed. What effect does the exposure have on the plate? Here we meet face to face the question, What is the chemical action of light? Let us look at a few experiments. If we take some chloride of silver, some bromide of silver, and some iodide of silver, and expose these to the action of the sunlight, we will see that they all darken, that the chloride becomes a violet color, the bromide yellowish-gray, and the iodide greenish. It may also be noticed that from the chloride free chlorine escapes, and from the bromide and the iodide bromine and iodine, as the case may be.—Henry M. M'Intire, M. E.

7. On account of the reducing power of light, a picture could be made upon the prepared plate in the camera; this would require hours of exposure. But in place of this, another property is made use of; that is, the attraction existing between the silver film acted upon by the light, and metallic silver in a finely divided state.

It has been found that the parts of the exposed plate that have been acted upon by the light have a great attraction for small particles of metallic silver. It is only required then that the plate be covered with silver in a finely divided state. How can this be done?

This can be, and is done, by the developer. There is upon the surface of the negative a solution of nitrate of silver, which it brought from the bath. This serves as the source of the metallic silver. But this is not the only good office that this solution performs. If, when the plate is submitted to the action of the light, and the chlorine, bromine, or iodine is given off, there be something to catch and retain the chlorine, bromine, or a strong solution, all parts of the picture acted upon by light will immediately become nuclei for the deposition of silver, and the deposit will be of more even density than if a weaker solution had been employed; for with the latter those parts most acted upon by the light—*i. e.*, which had been most thoroughly converted into subiodide—having the most attractive force, would draw the deposit of silver to them, and the image would be much more intense at those parts than where the light had less strongly acted.

Either pyrogallic acid or protosulphate of iron may be employed with nitrate of silver, to cause an increase of density by thickening the deposit of the metallic silver. This is called intensifying. The reactions are analogous to those of development, excepting that the metallic silver is the attractive matter instead of the subiodide. Both these have the property of assisting the decomposition of the solution of the silver salt, as before stated. The silver must be reduced gradually to the metallic state, when it will be deposited on those parts on which silver has already been reduced by the action of the developer, in the ratio of their densities.

iodine, the sensitiveness will be found to be increased, and this the bath solution does. Being a solution of nitrate of silver, as soon as the chlorine, bromine, or iodine strikes it, it seizes at once upon that chlorine, bromine, or iodine, and makes them its own in the shape of chloride, bromide, or iodide of silver.

We have then upon the exposed plate a solution of nitrate of silver; from this the metallic silver must be obtained. How can this be done?

By a "reducing agent;" something that will take away the nitric acid from the silver, and leave the silver in its free state. Hence the developer contains a reducing agent, either pyrogallic acid or protosulphate of iron. The action of either of these is the same. —HENRY M. M'INTIRE, M. E.

The theory which I propose may be summed up in the following propositions:

a. Pure iodide of silver is always sensitive to light.

b. When isolated, it is never decomposed by light, but undergoes a merely physical or molecular change.

c. But when exposed in the presence of free nitrate of silver, it undergoes with time a distinct and abundant reduction.

d. This reduction is to a sub-iodide, and not, as supposed by some, to metallic silver.

From these propositions there result the following important corollaries:

a. The image on pure iodide of silver, isolated, is *single.*

b. That on iodide of silver moistened with solution of nitrate of silver, may be, and probably generally is, *double.* That is, it consists of a physical image impressed upon particles of iodide, and they may also be a reduced image due to the nitrate of silver.

c. Where an organic film is present, containing the iodide, and the whole is moistened with nitrate of silver, the image may be *triple*—it may consist of the two former with the addition of a third, due to the organic matter, as exemplified in my experiments of

8. After the development of the latent image the iodide and bromide of silver are left unaltered, and probably the subiodides and bromides.

Looking at the reverse side of the plate (that which does not bear the film), the green color of the iodide and bromide of silver will be apparent.

Were this unaltered iodide and bromide of silver left in the film, a print taken from it on paper in the ordinary manner would be found to be nearly a blank, the iodide and bromide possessing almost as much power of preventing the passage of light as the reduced silver itself. Certain chemical solutions, however, are found to be capable of dissolving the iodide and bromide, leaving the metallic silver unchanged.

These chemical solutions are termed "*fixing solutions*," and the operation of dissolving out the iodide and bromide of silver is termed "*fixing the image*." These terms apply equally to those agents and operations in printing which render the image permanent. Here, however, chloride of silver is acted upon.

removal of the iodide by solvents, and production of a picture, independently of the iodide.

It also results from the foregoing that the physical theory is preëminently the true one, because those holding that opinion have never denied that the silver haloids were, under favorable circumstances, reducible by light, and our view that a developable image may be produced, independently of any reduction or decomposition, is one that has been placed beyond controversy.—M. Carey Lea.

8. And now the plate is to be fixed. For this purpose, we have choice of two solutions —hyposulphite of soda and cyanide of potassium. As the theory of both is ultimately the same, let us look only at the action of the cyanide of potassium.

Nitrate of silver and cyanide of potassium form cyanide of silver and nitrate of potassium. If we take this precipitate, and treat it with some more cyanide of potassium, we will find that it will dissolve, the double cyanide of silver and potassium being formed— $AgCy + KCy = (Ag + K)Cy_2$. Cyanide of silver and cyanide of potassium form the double cyanide of silver and potassium. If we should now experiment upon the action of potassium cyanide upon metallic silver, we should find that it will have no effect upon it, except in the presence of the oxygen of the air.

We can now see at a glance what an efficient agent this will be for fixing; how when it is poured upon the plate it will attack the silver unacted upon by light, changing the bromine and iodide into cyanide; going still further, how it will dissolve this cyanide when it is formed. But all this time it will have no effect on that substance produced by the combined action of light and the developer, metallic silver. But the fact that in presence of air it will attack the metal, shows the necessity of having the fixing solution to cover the entire plate, and also of pouring it off quickly and washing with water immediately. The action of hyposulphite of soda is similar to the cyanide.—Henry M. M'Intire, M. E.

Dismissing the chlorides of the alkalies and iodide of potassium (owing to their imperfections as fixing agents), the first solvent of iodide, bromide, or chloride of silver that is to be noticed is hyposulphite of soda.

The chemical reaction of this salt upon the bromide is similar to that upon the iodide. The double salt is soluble in a solution of hyposulphite of soda; consequently the darkest shadows of the image will be rendered transparent through the removal of the iodide, by the application of the latter in excess.

The only other fixing agent that is in general use is cyanide of potassium. It is very poisonous.

CHAPTER III.

LIGHT.

9. We have already learned that light is the chief producing agent in photography. If light could be called an inventor, the photographic image might well be regarded as the acme of its genius. The astounding changes on which our art depends exceed in interest everything else under the sun. Every element of light seems to be required in their production.

These elements or qualities of light are numerous. They are intensity; "regular" reflexion; "irregular" reflexion; refraction; dispersion, and absorption.

The sources of light employed in photography are both natural and artificial. Of course, the sun is the chief.

9. In the constant trials that are made of new sources of light for photographic uses, enough attention seems scarcely to have been paid to the nature of the light, as well as to its brilliancy. No fact is more familiar than that all highly actinic artificial light is either blue or bluish, and it seems certain that if any given light were to be tinged with blue its actinic power would be thereby materially increased.

The light of burning magnesium acts more powerfully than the lime light, which is far more intense. Evidently this is owing to its blue tinge. It would, therefore, be a very interesting experiment to tinge the lime light blue, and observe whether its actinic power would not be greatly heightened thereby. This effect should not be produced by interposing blue glass, which cannot increase the blue rays, but would probably be produced by soaking the lime cylinder in a strong solution of copper salt—probably a saturated solution of chloride of copper would be the most effectual. The experiment could be easily tried by those who are in the habit of using the lime light, and might give exceedingly interesting results.—M. Carey Lea.

Dr. Monckhoven's night light consists of the oxyhydrogen light, with pillars of pure carbonate of magnesia instead of lime cylinders. The result is a light with the chemical intensity of the ordinary magnesium light, without its unsteadiness and irregularity, and at a less cost; or, in other words, it is a Drummond light with a much higher actinic power than that of incandescent lime. The light is intense, concentrated, actinic, steady, and continuous, supplying all the conditions requisite for photographic enlarging operations.—Dr. H. Vogel.

The electric light will be given attention further on.

10. Intensity, in degree, is governed by the source and by the medium through which the light must pass in order to reach any given point.

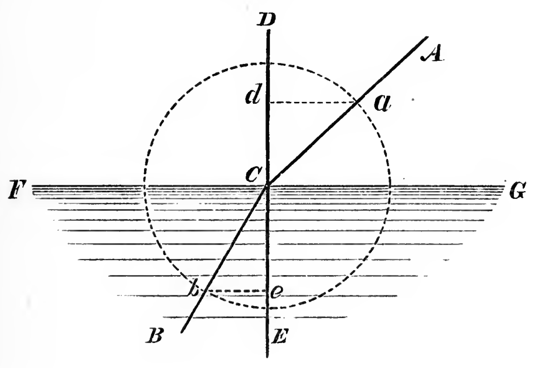
Reflexion is "regular" when the beam of white light falls upon a surface and is transmitted from it as white light.

Reflexion is "irregular" when it falls upon bodies which take up certain portions only of the colored rays composing white light, and reflecting those tints alone, absorb the rest, and the objects appear to us colored.

Refraction is the change of direction which a beam of light acquires in passing from a medium of one density, as air, to another of different density, as water or glass.

10. The first thing, then, to be noted of light is that it travels, when left to itself, in straight lines; *but* as soon as it enters a substance of a different density, then its path is changed at the point where it leaves the one and enters the other. Having once entered the new medium, it continues in a straight line in its new course until it meets another medium, and one of different density. This bending of the ray of light is called *refraction*, and the following facts have been noticed in regard to this refraction. The ray that is passing through the first medium is called the incident ray, and this one, after it is bent, the refracted ray; the line drawn at the point where the ray leaves one medium and enters the other, perpendicular to the surface of the media, the normal; the angle which the incident ray makes with the normal, the angle of incidence; and the angle which the refracted ray makes with the normal, the angle of refraction. That is, referring to Fig. 2, *A C* is the incident ray; *C B*, the refracted ray: *D E*, drawn perpendicular to the surface of the media, *F G*, the normal; *A C D*, the angle which *A C* makes with this normal, the angle of incidence; and *B C E*, the angle which *B C* makes with the normal, the angle of refraction.—Henry M. M'Intire, M. E.

Fig. 2.



A strong, high light affects the chemical substances used in photography much more rapidly and powerfully, comparatively speaking, than a mellow, diffused, or half-light. Perhaps the point will be better understood by considering the following mathematical formula: Let the high-light be equal to one hundred; then black, as the absence of all light, theoretically at least, will be equal to 0; half-light will be equal to fifty; quarter, equal to twenty-five; and so on. Now let ten seconds be the time required for the high-

In the construction of lenses advantage is taken of this quality of light by the use of optical glass varying in density, thus securing the whitest possible light, or achromatism.

Dispersion is the separation of a beam of white light into its component rays which vary from each other in color and in refrangibility.

The prism disperses the rays of light and creates the solar spectrum. The clouds scatter the rays of the sun and produce the glories of sunset and sunrise.

When a narrow beam of light is admitted into a darkened room it will illumine an object close to the point of entry. Remove the object further and further away, soon it ceases to be visible. This is because of the absorption of the light. Some surfaces, like velvet, coarse papers, and fabrics absorb light.

11. Understanding fairly these varied qualities of light, we shall see, as we go on, how mysteriously they enter into the practice of photography, either in

light to produce its full effect, that is to say, so to change the chemical substance used as to render it completely insoluble. If the process went on with equal rapidity all over the plate, the chemical substance would be one-half destroyed in the half-lights at the end of the same ten seconds; one-quarter in the quarter-lights; and so on. This, however, is not the case in practice. While the full light exerts its full effect in ten seconds, the half-light, being more feeble, may require fifteen seconds to exert its full effect, the quarter-light twenty seconds, and so on. If, therefore, the quarter-light is to be shown at its full force, necessitating an exposure of twenty seconds, the half-light, which ought to stop at fifteen seconds, will have to be over-exposed for five seconds; *during which five seconds it continues to work on the chemical substance still undecomposed,* and the result is a falsification of the gradations, a heightening of the contrasts between light and dark, and a tendency to destroy those middle tones which give unity and artistic beauty to a picture. To recur once more to our formula: at the end of twenty seconds, the proportion instead of being $1=100$; $\frac{1}{2}=50$; $\frac{1}{4}=25$; will probably be something like this: $1=100$; $\frac{1}{2}=60$; $\frac{1}{4}=25$. It is evident from this that the harmony must be destroyed. On the other hand, if the exposure had been limited to ten seconds, the result would have resembled this formula: $1=100$; $\frac{1}{2}=40$; $\frac{1}{4}=15$; that is to say, we would have seen glaring high-lights in a surrounding mass of dimness and darkness. And this is actually the case in so-called under-exposed pictures.—S. R. KOEHLER.

11. Remember these points:

a. The high-lights act more rapidly, they take hold of the plate more suddenly than lower lights.

b. They, therefore, accomplish their full results in comparatively much less time than lower lights.

c. Photographic action decreases in the inverse ratio to the length of exposure.

From all this, the difficulty of the following problem, with the ordinary methods of photography, will be readily understood: Given, a bride in a white dress to be photo-the management of the lens and diaphragm or in the selection and arrangement of the subject. They govern the whole process, and are sometimes very exacting. But if we carefully consider them and conform to their rules they will usually be good to us.

What follows relative to lenses will give further light on this subject.

graphed against a white background. In this case the tints of the flesh will be the darkest part of the picture (even if we ignore entirely the additional difficulty resulting from the red and yellow rays reflected by the flesh). By the time, therefore, when the higher lights in the white drapery have produced their full effect, the face and arms are still so underdeveloped, that, if the exposure were then stopped, these parts would appear altogether too dark. But if, on the contrary, the exposure were continued until the face, etc., are properly developed, the delicate shadows in the white drapery and background would all be burned away by overexposure, and the result, although different, would be equally disagreeable.—S. R. KOEHLER.

The effect produced by a given light in, say, ten seconds, is not duplicated by another exposure of ten seconds; and the feebler the light the greater the difference in the effect produced during each subsequent period of equal duration. For example: A strong light acting on a plate probably produces fifty per cent. of its maximum effect in the first two seconds, twenty-five per cent. more in the three seconds following, and the remaining twenty-five per cent. in the five seconds left. The full effect having then been reached, that is to say, the decomposition or change of the chemical substance having been completed, the process stops. With the half-light the case is different: Fifteen seconds being needed for the production of its legitimate effect, twenty-five of its fifty per cent. are perhaps effected within the first three seconds, twelve and one-half per cent. more in the following five seconds, and the other twelve and one-half per cent. in the remaining seven seconds. But here the process does *not* stop, and while the quarter-lights and still lower lights are being developed, the half-light goes on increasing in brightness, as previously explained, although in an inverse ratio to the length of time, that is to say, with constantly decreasing rapidity.—S. R. KOEHLER.

Some new values have been given to light recently as applied to photographing colors and colored objects, whereby true color-value is obtained. The interesting and useful results are detailed further on.—EDWARD L. WILSON.

CHAPTER IV.

THE CAMERA.

12. THE accomplishments of photography have taught the public to be very exacting. It is expected to produce results, except as to color, about as the eye sees them ; and some *exigeants* are unhappy because no poor, starved genius has yet given us "photographs in colors."

A word as to the eye. It is the natural camera obscura, lens, diaphragm, and all, and a much more perfect one, too, than man can ever hope to produce. The eye consists of four coats or membranes, viz., the sclerotic or white of the eye, A A A A ; the cornea, B B, a transparent medium in front of the eye, through which we see; the choroid, a velvety membrane which absorbs the rays which pass the retina, preventing internal reflection, and which lines the sclerotic coat on the inside. The retina, R R R R, is the innermost coat of all, and is simply an expansion of the optic nerve, O O, which, communicating directly with the brain, is the immediate seat of vision; P P is the iris of the eye. In its centre is a circular opening called the pupil, X. Behind the pupil

FIG. 3.

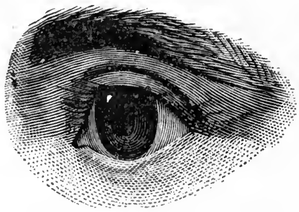
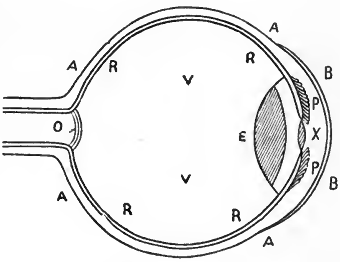


FIG. 4.



and iris is the crystalline lens, E, a firm and perfectly transparent body through which the rays of light pass on their way from the pupil to the retina. The posterior chamber, V V, is filled with the vitreous humor which shapes the whole construction.

12. The act of vision is accomplished by means of a special organ or pair of organs, the eyes, which are partly physical, or, as we may say, instrumental in their action, officiating exactly as certain lifeless and inorganic structures, such as we artificially construct, would officiate, in collecting and distributing the light rays; and partly physio-

13. Now put your camera together, and you will see how much it resembles the eye. The lenses take the place of the aqueous humor and the crystalline lenses; the diaphragm performs the functions of the pupil and the iris; the ground glass is the retina of the camera.

The camera must receive its image upon a flat surface, which fact constrains it much, especially in the production of large pictures. Again, as the object to be photographed is neared, the aperture through which the light enters must be decreased in order to obtain sharpness.

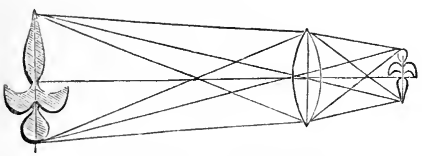
logical in their structure, calling into play those conditions of life about which we know but little, and which we can in no wise artificially reproduce, or by any amount of skill ourselves construct.

In the eye we have, in the first place, a lens, capable, like our ordinary lenses, of forming an image upon the inner wall of the eye-cavity, or retina.

We will then inquire, in the first place, how a simple lens brings about such a result as the formation of an image.

The diagram shows this almost without need of further explanation. The rays from the summit of the object, which, without the lens, would be scattered, are each differently bent by the different parts of the lens which they encounter, but so as to be united in a single point. The same thing happens for each other point of the object and its emitted rays, and the result is the production of an image, as is shown. This image, moreover, is inverted; you see how this comes by a mere glance at the diagram.—Prof. Henry Morton.

Fig. 5.



13. Here comes in the second part of the eye's constitution. The retina is not simply a dead screen, receiving and reflecting the various impressions of light which fall upon it. It is a forest of *living* nerves, which not only can distinguish between the intensities and colors of the rays which touch them, but also recognize *the direction in which they come.* Thus, the inversion of the image, as far as the sensation of the retina is concerned, *does not exist.* If the retina perceives the rays from the summits of objects as coming *down to it*, and those from the bases as *coming up*, and thus regarding *the object* and not the (to it) invisible image formed on its own substance, this nerve-screen *sees* everything in its proper position. It is a natural error to think of the eye as looking at the image formed on its own retina, but a little thought will show us that such an idea is parallel to the absurdity of hoping to see one's own face without a glass or equivalent reflection.

It is then upon the sensitive screen of the retina that the light rays, collected and grouped by the eye-lens, make their impression. The nerves of this organ, like those of others, have certain limits to the range of their coexistent perceptions. Thus, just as we cannot hear a whisper in the presence of the rattle of a train, or taste a delicate flavor if mingled with a bitter draught, so we cannot perceive a faint impression of light in presence of another of far greater intensity.—Prof. Henry Morton.

CHAPTER V.

ABOUT LENSES.

14. When *Wilson's Photographics* was prepared I was of the opinion that photographers were so well informed on the subject of lenses that it would be unnecessary to devote more than a very few pages to their consideration. I have since changed that opinion on account of the general ignorance I find concerning photographic optics, and so, will now endeavor to spread some light on the subject.

The major notes are elaborate and exhaustive. They appeared serially in the *Philadelphia Photographer*, and are by America's most distinguished optician. With such help I hope to make the matter quite intelligible.

Let us first visit a manufactory of lenses together and learn the mechanics of optics.

It is a matter of primary importance that the glass of which achromatic

14. I am often asked, "In what respects do the lenses of large and small angle differ?"

If you have a tube of one inch diameter and one inch long, it would be a square, or have an angle of 90°, and if a lens were placed in it, it would show a picture of all objects in front of it that were included in a line drawn diagonally from the back to the front of the tube and continued to the horizon. The same lines drawn toward the ground-glass will show the size of the illuminated circle at the focus of the lens. To illustrate, suppose there were ninety posts or trees placed at equal distances apart: if you place a lens with an angle of 90° at such a distance from them that they will exactly cover the circle, and then place another lens of 45°, but of the same focus, only forty-five trees will be seen, but each tree will be exactly alike in size. In this case each tree would occupy the space of one degree, and if the lens was placed at half the distance it would then take the space of two degrees, and only half the number would be shown, but each tree would be twice the size.

From this it will be seen that it is the angle of the lens that determines the size of the circle of illumination; the size of each object, if taken at the same distance, depending on the focus. The principal reason why lenses of small angles are used is, because opticians are enabled to make the work with comparatively large diaphragms, and consequently quicker. The diameter of the lens is governed by the judgment of the maker, and does not affect the focus or angle, for a lens of any diameter if placed in a tube of the proper length will give any angle required.—R. Morrison.

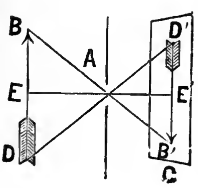
lenses are made be of the utmost purity. Up to within a recent period, the production of large disks of optical glass so free from defect as to render them adapted for achromatic lenses, was looked upon as impossible; for even with the greatest skill, and by using the most perfect appliances of the period, defects of a nature fatal to excellence were inherent in optical flint glass. These defects, to which the best flint was especially subject, consisted in a want of homogeneity and in the presence of striæ, knots, threads, and other defects of a similar nature. This difficulty in the way of obtaining optical glass continued until about seventy years ago, when M. Guinand, a Swiss clockmaker and amateur optician, succeeded in solving the problem that till that time had engaged the attention of numerous men of science and practical glassmakers. Although Guinand's discovery has thus opened the way to the successful production of large disks of optical glass, yet the price of such, even in its rough form, is very high. This partly accounts for the high price of large lenses.

Before a disk of glass is sent into the grinding-shop it is subject to critical

Let me try to explain just what a lens is, using diagrams to assist me.

Light is propagated in a straight line. We cannot see around a corner. If a ray of direct sunlight passes through a small hole of any given shape into a darkened chamber, and we hold a screen near behind the aperture, we observe a bright image of the shape of the hole. If we increase the distance of the screen and the aperture, the image of the hole disappears in the penumbra, and the round image of the sun takes its place; and, if the hole is small enough, you will see not only the image of the sun, but the image of all the external objects will appear likewise. This is one of the most interesting experiments, and its explanation is easy. Each point of the object *B D* (Fig. 6) radiates light in every direction, light of the same color as it appears to our eye. From the point *B*, no light can reach the screen *C*, except through the small aperture *A* at *B′*; but if the aperture is infinitely small, no other point of the object can send its rays to *B′*. The same is true for every other point, for *E* or *D*, for instance; these can only send rays to their respective points *D′* and *E′*, and so on with the rest, and an inverted image, with all the natural colors of the object, is produced on the screen. If we now enlarge the hole, different points of the object would reach the same place upon the screen; the images of these points would overlap each other, and the image of the object would be indistinct. If the aperture is sufficiently enlarged, the image disappears, and the screen is illuminated homogeneously, taking only a tint of the most prominent colors of the objects. Therefore, the smaller the hole is, the sharper but fainter is the image. The size of the image depends upon the distance of the object from the hole, and also upon the distance of the screen from the hole. This primitive camera obscura is known by the name of pinhole camera.

Fig. 6.



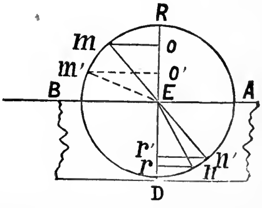
examination, to permit of which, two small portions of the edge, opposite to each other, are ground flat and polished. A beam of polarized light is now transmitted through the disk, which is then examined by an analyzing prism. Now we are where the rough and hard work is done, and as each stage progresses, there is less hard work for the muscles and more for the brain. After the optical glass passes muster, it is cut into pieces of proper size by the "splitting" machine, diamond dust being used for the *persuasive* power.

FIG. 7.

In the grinding of a lens, the first operation consists in "roughing" it, or bringing it approximately to the curvature it is ultimately to assume. Fig. 7 shows in which way this is effected. Cast-iron blocks turned to an appropriate degree of curvature, either concave or convex, according to the nature of the surface, together with coarse emery and water, form the tools required at this stage. When the glass is handed to the rougher it is round in shape,

Light, we said, is propagated in a straight line; but this is only true, when it continues in a medium of the same density, or if it enters a medium perpendicular or normal. But if a ray passes from one medium into another of different density obliquely, its direction is changed; it is refracted. This property of light was known to the ancients about eighteen hundred years ago, but the discovery of the law of refraction was left to Willebrod Snell, professor in the University of Leyden, 1621. I will briefly state this very important discovery, which elevated optics to a positive science. If a ray of light, *R* (Fig. 8), falls perpendicularly upon a plane surface of a piece of glass, *A B*, it enters the glass without changing its course, in a straight line, *R D*, it only changes its velocity. But if a ray, *m*, strikes the surface at *E*, obliquely, it is refracted to *n*. A ray, *m,′* is refracted to *n′*. Now if we erect perpendiculars from the points *m* and *n*, and also from the points *m′* and *n′*, to the normal *R D*, and divide the length *o m* by *n p* and also divide *o′ m′* by *n′ p′*, we will have in both cases the same quotient, or, as it is generally expressed: the sine of the angle of incidence divided by the sine of the angle of refraction is a constant, whatever the angle of incidence may be. This constant quotient is called the index of refraction. Different media have different

FIG. 8.



although the edges are rough, having previously passed through the hands of another staff of workmen, who chip the glass into something near the size required.

After the first rough grinding has been effected, the embryo lens then passes into the hands of the "lens-grinder," whose function it is to follow up the work of the rougher, until the surface is brought up to that exquisite degree of polish seen in the best lenses, to effect which a great degree of care and skill is required.

indices of refraction; thus a diamond has a higher index of refraction than flint glass, and flint glass a higher one than crown glass.

Another important law of refraction may be mentioned, it is this: The incident and refracted ray and the normal are situated in the same plane.

If a ray of light falls on a parallel piece of glass, *A* (Fig. 9), perpendicularly, it will pass through it in a right line, because it is coincident with the normal. But if a ray,

FIG. 9.

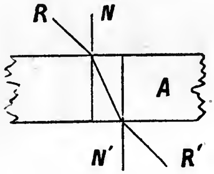
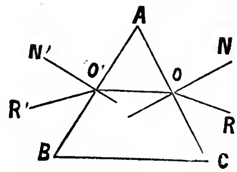


FIG. 10.



R, strikes the glass obliquely, it will be refracted toward the normal, *N*, and away from it when leaving it. As the normals *N* and *N'* are parallel, so must the incident and refracted ray be after leaving the glass.

Now let us see another case, where the two surfaces are not parallel, but form an angle with each other. Such a medium is called a prism.

R o (Fig. 10) is an incident ray; the ray is refracted toward the normal *N*, along *o o'*, and by leaving the prism it is again refracted, but this time from its normal *N*, as it passes from a denser to a rarer medium. Therefore, incident rays on a face of a prism are always refracted toward the base. We are now tolerabiy well prepared to see what a lens is.

A lens is a transparent medium, of which the two surfaces are either both curved, or the one is plane and the other curved. If the curves are spherical, the lens is called a spherical lens; if the curve is parabolic, it is a parabolic lens, etc. Lenses are divided into two classes, converging and diverging lenses. The converging lenses, which are thicker in the centre than at the margin, are: The double convex with both surfaces conxex; the plano-convex with one surface plane and the other convex; and the convex-concave (meniscus) with one convex and one concave surface, but the convex of the shortest radius. This class of lenses, which may all be used as magnifying or burning glasses, are called convex or positive glasses, and these only are, strictly speaking, lenses. The diverging lenses, which are thinner in the centre than at their margin, are: The

In this work the curved tool is attached to the top of a post (Fig. 11), around which the workman slowly walks, grinding the lens by the pressure of both hands. Not only must he by walking round the posts change his own position with respect to the grinding-tool, but he must also constantly change the position of the lens in relation to his hand, as he sweeps it over the surface of the tool. In this way are avoided such errors of figure as would invariably occur if these precautions were not taken.

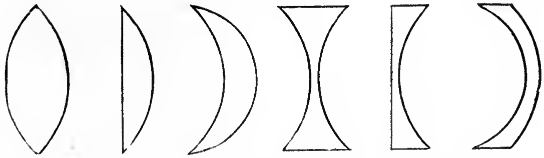
Fig. 11.

The piece of glass which is to serve as one of the lenses of a combination, is cemented to the centre of the "tool," and around it are cemented six other pieces of glass called "pads." These are subjected to the same amount of grinding, but are of no use except that they serve as *bearings* to insure the exact grinding of the centre piece. Thus it will be seen that a photographic lens is actually the centre part of a large lens. Very often a number of small lenses are ground together at once on one tool. In no other way could they be made more cheaply than larger lenses, for the amount of work

double concave, with both surfaces concave; the plano-concave, with one surface plane, the other concave; and the concavo-convex, with a concave and a convex surface, the concave having the shorter radius. These diverging lenses are called negative glasses.

The general properties of lenses which are of importance, are: 1. The principal axis. 2. The optical centre. 3. The principal and conjugated foci, and, 4. The nodal points

Fig. 12.



or conjugated centres. A straight line, drawn through the centres of curvature of the spherical surfaces of a lens, is the principal axis of the lens; if the one surface is plane, the axis passes through the centre of curvature of the spherical side, and is perpendicular to the plane surface. In all lenses the principal axis must go through the middle of the upon them is just the same. Having been ground to a true curve the next and final operation, so far as the surface of the lens is concerned, is to bring it to a high degree of polish or gloss.

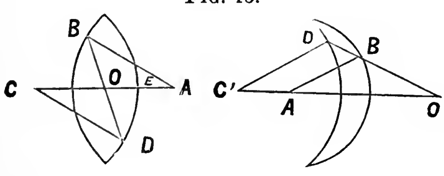
The lens is now finished in all but the "edging," which is almost of equal importance with the proper grinding of the surface, because on the edging of a lens depends the correct centring of the combination. To effect this the lens is cemented to a chuck in a turning lathe, and while revolving it is centred accurately by watching the reflection of a lighted candle thrown from the surface. Advantage is taken of the soft state of the cement to bring it to such a state as to show, while revolving, the image of the flame quite stationary and free from the "wobble" it would have if it were not properly centred. When the cement is hard, a workman slowly brings in contact with the revolving edge a piece of metal charged with emery and water, by which the asperities are removed and the edge made square and accurate. Fig. 14 represents the "edger" holding a small metallic cup in his hand, wherewith he is finishing the edge of a lens that has been ground true.

The number of tools or curves in a lens establishment is very great, consisting of upwards of two thousand, all of them being ground with such accuracy that the curvature of each is known to the fourth place of decimals, their

lens, that it, in the concave through the thinnest, and in the convex through the thickest part; otherwise, we have a prism with spherical surfaces, and not a lens.

Every lens possesses a point, situated in its principal axis, which is of great importance. A ray of light passing through that point will undergo equal opposite refraction, so that it will leave the lens parallel with the direction in which it entered. If we consider the lens without thickness, we simply say, rays passing through the optical centre of a lens undergo no refraction. The optical centre can readily be found by drawing two radii, *A B* and *C D* (Fig. 13), from the centre of curvature *A* and *C′* of its surface, parallel to each other, but oblique to the axis *A C*, then connect the two extremes *B* and *D*, and the line *B D* or its prolongation will cut the principal axis in *O*, the optical centre. If the lens is a double convex one of equal radii, the optical centre is the centre of the lens, or its centre of gravity. Fig. 13 is such a lens. Now suppose we change one curve into a shallower one, of longer radius, it is evident that the optical centre is shifted towards the predominant, more curved side, and if we continue to make that side shallower, it will gradually move towards *E*, until the surface is converted into a plane, in which case the optical centre is coincident with the point where the axis cuts the curved surface *E*. This, we will see

Fig. 13.



respective radii extending from thirty feet down to a hundredth of an inch. The curvature to which any particular lens is to be ground is calculated mathematically to suit the refractive and dispersive ratios of the glass of which it is to be formed; and after the lens is finished, if, on examination, it fails to come up to the standard of sharpness, the particular surface which exercises control over the shortcoming is reground in a tool one degree deeper or shallower in curvature.

FIG. 14.

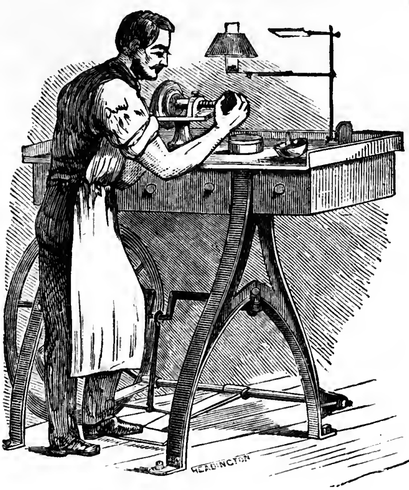
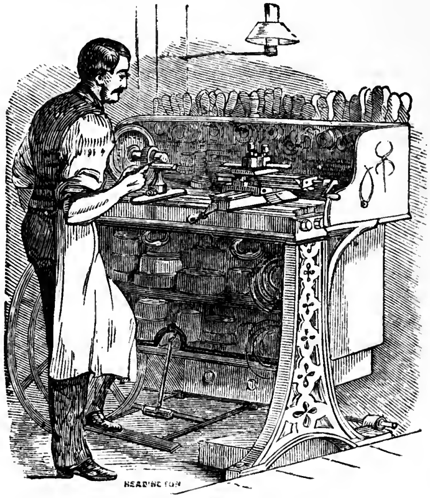


FIG. 15.



A large shop in every factory is devoted to brass-turning and fitting. In the engraving, Fig. 15, is seen one of the numerous workmen engaged in

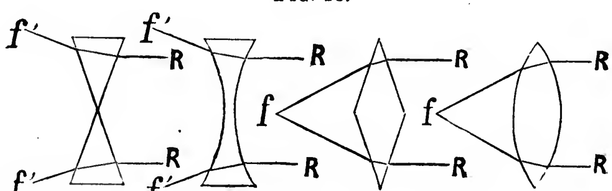
afterwards, is an important point. But let us go on in the same way, still reducing that surface by making it a concave or negative one; it is clear that the optical centre still marches on, moving out of the lens, and if we go on so far as to make the negative curve equal to the positive one, then the optical centre would be in infinity, and if we disregard the thickness, we have no lens, but a non-optical glass like a watch-glass. All straight lines passing through the optical centre of a lens are called secondary axes. The next and most important of the general properties of a lens are its principal focus and the conjugated foci. If we hold a convex lens towards the sun, and a sheet of paper at a certain distance behind it, we observe a bright little circle, in which the sunlight, falling upon the lens, is collected; the point where the circle is smallest, and, therefore, most intensely illuminated, is called the principal focus; that is, the focus for parallel rays.

If we have to calculate the area of a circle, we are bound to look at the circle as a making the mount of one of the new small symmetrical lenses. In this kind of lens the Messrs. Ross have effected a reformation that has for a long time been much desired by photographers, viz., the reduction of the diameter of the lenses to the smallest possible size, and the causing of the whole series of twelve to screw into one flange, one cap also fitting all of them. It would be well if this system of having one standard flange for all lenses up to a certain size were more prevalent, for it would prove a boon of inestimable value to photographers. A system of universality of screw has for many years been in use in connection with the manufacture of object-glasses for microscopes; in whatever country microscopes or objectives are made, they are fitted to one gauge. The varying diameters of photographic objectives will ever, of course, prevent the adoption of a universal flange for all purposes; but what can and ought to be done is the adoption throughout the world of a series of flanges, as few as possible, of recognized and *standard* sizes.

When two achromatic lenses are to be mounted, they are first of all placed in a trial mount so adapted as to permit of an approximation or separation of the

polygon of an infinite number of sides, and we will do well to take the lens as an infinite number of prisms, more so, as the infinitely small portion of the lens struck by the ray may be taken for a tangent plane. Thus a converging lens may be considered as prisms united at their bases, and a diverging lens of prisms united at their apices. As we already know that prisms refract parallel rays toward the base, it is easily seen why converging lenses refract the rays *R R* (Fig. 16) to *f*, and that diverging lenses diverge the rays *R R* to *f′*.

FIG. 16.



The distance of the focus from the lens depends, 1st, upon the curvature; 2d, upon the refracting power of the material; and 3d, upon the thickness of the lens.

Not to make the matter unnecessarily complicated, we will take the supposition that our lenses have an extremely small, or no thickness at all. For common glass of an index of refraction of 1.5, calculation shows that a plano-convex lens has a focal length of the diameter of the sphere of which the lens is a part. A double-convex lens of equal radii has its focus half that distance, or equal to the radius of the surfaces. If the double-convex lens of equal radii, say of 10 inches, is made of the following substances, the thickness neglected, the foci would be:

lenses. The test object is a watch dial placed at the extreme end of the testing-room, and the image of this dial is examined through a powerful eyepiece. Unless it can divide the closest lines upon this dial the lens is rejected. In this trial, both the central and oblique pencils are examined, and the exact amount of separation of the lenses from each other is now determined by experiment and marked upon each pair, as the instructions for the workman to whom is intrusted the duty of the final adjustment of the length of tube. This is an operation which influences materially the performance of the lens, when it is considered that so nicely poised are the qualities in some of the combinations of more recent production, that a deviation of a fortieth part of an inch from the exact distance required, and determined in the way described, will affect its performance and be detected by the manager in course of the final trial, which is made after the lenses have been finished.

Thus we see how much care and skill are required to produce even the tiniest tool used in our art, and how costly it must be.

In selecting a lens, the purchaser is helped by knowing its equivalent focus and its included angle of view.

It is important to be able to determine the equivalent focal length of a combination, for, until that is done, the other cannot be determined with exactness. I propose briefly to describe the best methods of doing both.

Two simple methods of determining the equivalent focus of a combination have been pointed out by Mr. Grubb, the optician.

For common glass, index of refraction 1.5 = focus 10 inches.
For flint glass, index of refraction 1.6 = focus 8.33 inches.
For diamond, index of refraction 2.439 = focus 3.48 inches.

We see that the diamond lens of the same radius has a focal length of little over one-third of the crown-glass lens.

We have now seen that luminous rays from a point infinitely distant are collected to a single point in the axis, the principal focus. But let us suppose we move the luminous point towards the lens, to make the rays perceptibly converging; then the lens, which was strong enough to bring parallel rays to the point where the principal focus is situated, is not strong enough to bring these diverging rays to the same point, but they will cross the axis at a point farther removed from the lens; and as the radiating luminous point is moved nearer to the lens, the farther off from the lens they will cross the axis; by moving still on, we come to a point where the radiating point and the point where the rays cross the axis on the opposite side are equally distant from the lens. In this case the radiating point and the rays where they cross the axis are nearly four times the distance of the principal focus apart. For ordinary purposes, this affords a ready means to determine the principal focus of a lens. But let us move on still nearer to the lens, *a.* Determine the central point of your focussing-screen, by drawing diagonals from the corners. Select two distant objects, and bring them into focus on your ground-glass, so that the intersection of the diagonals shall be midway between them. The camera is supposed to be placed upon a smooth table with a sheet of white paper under it. Measure with a compass the distance between the two distant objects, as they appear on the ground-glass. Now turn the camera so that one of the distant objects shall correspond with the central point, and run a pencil along the side of the camera so as to mark its position on the paper. Next, rotate the camera until the central point corresponds with the other distant object, and draw a line along the side of the camera again. These two lines (produced if necessary) will form an angle. You have measured with compasses the distance between the images of the two objects on the ground-glass. Set this off so that it may connect the two lines drawn on the paper, forming therewith an isosceles triangle, of which it is the base, and the two lines drawn are the legs. The length of either of these two lines is the equivalent focal length of the combination.

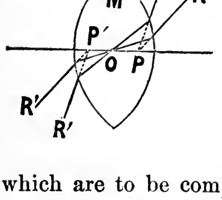
This method is of universal application to all sorts of lenses. The second method is intended for portrait lenses only.

Draw on the ground-glass two vertical lines several inches apart, say about half the focal length of the lens or anywhere thereabouts. Focus a distant

and the focus on the other side will continue to move farther away until we reach the principal focus this side; then the rays will emerge parallel on the other side. By overstepping that point, the rays will emerge diverging. These variable distances of the luminous point and the focus on the other side, are called the conjugated foci. There remains to be mentioned another important general property of lenses, the nodal points, or, as they are sometimes called, the centres of admission and emission.

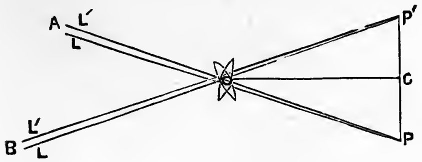
M is a double-convex lens of equal radii, *o* is its optical centre. Any ray passing through the optical centre, as *R R*, emerges on the other side parallel to its first direction, *R′ R′*, as explained before. If we now prolong *R* and *R* in their first direction, they will meet at a point *P*, the one nodal point, or the centre of admission, and if the emerging rays are also prolonged, they will converge to a point *P′*, the other nodal point, or the centre of emission. We recollect that in the pinhole camera the size of the image compared with that of the object is exactly in the same proportion as the distance from the screen to the hole is to the distance of the object from the hole. These distances represent the two conjugated foci, as there is no deviation of the rays from a straight line, and the two triangles, which are to be compared, meet with their apices. But if we have a bi-convex lens (Fig. 19) and *A B* an object, *C D* its image, it is clear that the conjugated foci are to be

Fig. 17.



object on the ground-glass, and turn the camera until one of the lines passes through its centre. Draw a line along the side of the camera upon the paper as before. Rotate the camera until the other line passes through the centre of the object, and draw another line along the side of the camera. Produce these lines till they meet, forming an isosceles triangle with the distance between the two parallels on the ground-glass for a base. As before, the length of one of the legs will give the equivalent focal length sought..

FIG. 18.

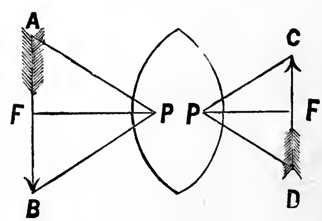


The annexed (Fig. 18) is suggested by Mr. M. Carey Lea.

A and *B* are the distant objects, from which the rays *L* and *L′* are brought to a focus at *P P′* on the ground-glass, equidistant from the centre *C*, and the distance *P P′*, is measured with compasses. (These rays are what are termed "parallel rays," the distance of the object being so great, in comparison with the focal length, that they may be considered parallel.) The camera is now turned until the image of *A* moves from *P* to *C*, and the line *O P* is drawn along the edge of the camera on the paper underneath. Then the image *P′* of the object *B* is similarly brought to *C*, and the line *O P′* is drawn. Next, the triangle *O P P′* is completed by setting off the base *P P′*, and the legs, *O P*, *O P′*, are evidently the focal distance. (For simplicity of

measured from the nodal points *P* and *P*, and the two conjugated foci are *F P* and *F P*, showing how erroneous it is to measure the foci either from the surface of the lens, or from the optical centre. In a meniscus, the one nodal point is situated outside of the lens, and the other one inside of the lens. But in a plano-convex lens the optical centre as well as the nodal point are situated where the principal axis crosses the curved side. The plano-convex lens is therefore the only lens of which the focal length can be measured directly. If the plane side is placed towards a very distant object, the distance of the curved side to the image is the principal focus.

FIG. 19.



It is often necessary to know the focal length of a lens or a combination of lenses, especially in photography; but if no plano-convex lens of known focal length is at hand, for the purpose of comparing the size of the image, the following way may be adopted: first, focus the lens for a very distant object, on a screen, and mark the position of the screen. Do not move the lens, but place a bright object figure, a single lens is taken; the principle is evidently exactly the same for a combination.)

b. The same figure will serve to illustrate the second method. In this, the two points P and P' are, first, arbitrarily marked on the ground-glass so that the image of a single distant object, A, shall fall on P, and the line $O\,P$ is drawn on the paper by the side of the camera. The camera is then rotated till the image of *the same* distant object falls on the mark P', and the line $O\,P'$ is obtained. The construction in this case is evidently the same as before.

Having found the equivalent focus, by either of these methods, it is easy to determine the included angle of view. Fig. 20.

Fig. 20.

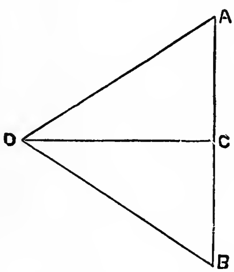
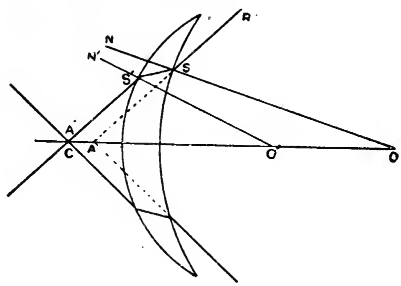


Fig. 21.



Let $A\,B$ be the diameter of the circle of light given by the lens, which, of course, is easily determined by measurement, and $C\,D$ the equivalent focus as found; we want the angle $A\,D\,B$.

We have $A\,C = D\,C$ Tan. $A\,D\,C$, Tan $A\,D\,O = \frac{A\,C}{CD}$, from whence the angle, $A\,D\,B = 2\,A\,D\,C$, is easily computed by logarithms.

about twice the focus of the lens in front of it, as near as you can suppose; now move the screen about the same distance from the lens as the object was placed, and focus thereupon. If you find the object and image not of exactly the same size, move object and screen accordingly, and focus sharp, until the object and image are precisely of the same size; mark the position of the screen again, and the distance of the first and second mark is the focal length of the lens, or the equivalent lens of a combination of lenses.

We are now acquainted with the most important properties of a lens, and it remains only to be said, that all combinations of lenses have precisely the same general properties as single lenses.

We come now to a somewhat more complicated and difficult part of the subject, the aberrations of lenses and the modes of their correction. So far we have supposed the

The law which fixes the focal length of a meniscus objective is different from that in the case of the combination. In the meniscus *the apex of the emitted cone is coincident with the optical centre,* and from that optical centre, not the actual centre, the focal length must be measured.

In Fig. 21, let *O O′* be the centre of curvature of the faces of the meniscus lens, exposed, of course, with its concave surface toward the light. Let a ray of light, *R*, be incident upon the first surface at *S* at such an angle that it will, after refraction, pass through the optical centre *C*, which, in the case of a meniscus presented with its concave surface to the object, as usual, is always outside of the lens on the convex side. It will at *S* be deflected toward the normal, *O N*, and reach the second surface at *S′*, where it will be deflected away from the normal, *O′ N′*, of the exterior curve, and will pass through the centre *C*. As there is no second lens, it will suffer no further deflection, and therefore the optical centre is in this case, also, the apex of the cone of emitted rays. If the ray *R S* be produced, it will cut the axis at a point, *A*, which is the apex of the cone of entering rays. The distance from the point *C* (and

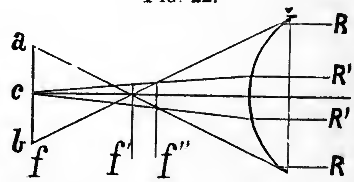
lens as very small, in relation to its focal length, and that with such a lens all rays coming from one point are refracted by the lens in one point again; but in practical optics such is not the case, as lenses of very large aperture are often required in modern optical instruments, and the rays coming from one point are no longer collected in one point, and this optical defect occasions the different aberrations. For over a century the correction of these aberrations employed our most eminent mathematicians, as Euler, Fraunhofer, Herschel, Fresnel, Littrow, Gauss, Airy, Petzval, and others.

The most important of these aberrations are spherical aberration, chromatic aberration, curvature of field, distortion, and astigmation.

The marginal parallel rays *R R* (Fig. 22), passing through a convex lens *L*, cross the axis at *f′* nearer to the lens than the more central ones *R′ R′*, which cross at *f*. This is a result of the spherical surface of the lens, and is called spherical aberration.

If we present a convex, short-focus lens to solar rays. and produce a sharp image of the the sun on a piece of white paper, we will find that the image at *f*, which is the one made by the central rays (and therefore is the sharpest), is surrounded by a halo, *a b*, which is what we call the lateral spherical aberration. This halo is, as you see, produced by the shorter marginal rays *R R*, after crossing the axis, diverging, and is also called the circle of aberration.

Fig. 22.



f′ f, the distance of the difference of the central and marginal rays, constitutes the longitudinal aberration. The least spherical aberration is where the two cones intersect each other between *f′* and *f*. This aberration is called positive.

not from the actual centre of the lens) to the focussing-screen will be the equivalent focal length.

In order to show how incorrect is the common mode of measuring the focal length of a meniscus from the back surface of the lens, it is simply necessary to observe, in Fig. 12, how far the position of the optical centre *C* is removed from the actual centre of the lens. It will be seen how far behind the back surface it is situated.

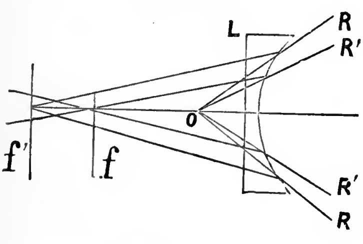
The "back focus" which is so much used in describing lenses, and which is the distance from the posterior surface of the back lens to the focussing surface, is liable to this very serious objection, that it is not merely a very rough approximation, but that its incorrectnesses are in opposite directions in different lenses. The "back focus" of a meniscus is always materially longer than the true focus, whilst it is shorter than the true one in the case of a combination objective.

15. The photographer should not expect too much from a lens. I am often asked to point out a universal lens which would answer for all purposes—equally serviceable for portraiture, landscapes, architectural objects, etc.; if possible, such a lens is to be wide-angled and quick-acting.

That such a lens does not exist I hardly need to mention here. A good

If converging rays *R R* and *R′ R′* (Fig. 23), which we suppose would be collected in the point *o*, fall on a concave lens, the marginal rays *R R* are refracted stronger than the more central ones *R′ R′*, consequently *R R* will cross the axis farther from the lens, at *f′*, than the more central ones, *R′ R′*, which cross the axis at *f*. In this case the spherical aberration is of the opposite character, and is called negative aberration. It is evident, from the foregoing, that spherical aberration varies with the aperture of the lens and the material of which the lens is made. Therefore, the larger a lens is in proportion to its focal length, the greater its spherical aberration. A lens of an aperture of, say $\frac{1}{50}$th of its focal length, has no perceptible spherical aberration. The longitudinal spherical aberration increases as the square of the diameter of its aperture, and inversely, as its focal length, while the lateral aberration increases as the cube of its aperture, and inversely, as the square of its focal length.

FIG. 23.



Thus, if we have two lenses of the same curvature, made of the same material, but the one of twice the aperture of the other, the longitudinal aberration of the larger one is four times as great, and the lateral or circle of aberration is eight times as great as that of the smaller one.

photographer will always need several lenses when he wants to do more than to make portraits; all that he can do is to accomplish with a few lenses as much as possible. I knew a photographer who was often called upon to take architectural views—a work in which the demand for actinic power, form, angle of view, and flatness of the picture is very manifold. In order to satisfy all these, he unscrewed the lenses from the different objectives and recombined them in pasteboard tubes in various manners. For instance, the front lens of a Steinheil with the back lens of a Voigtlander portrait, or the frant lens of an Orthoscope with the back lens of a Hermagis portrait, etc. He then constructed on the spot, the combination which gave on the ground-glass the most suitable picture. It is evident that in spite of stops, many optical errors cannot be avoided, but it shows what can be done with a little common sense and a little optical knowledge, for his architectural views rank amongst the best that I have seen.

In regard to optics, there remains in fact much to be desired, although often shortcomings are attributed to the lens which really belong to the operator. Here is an original case: A man took the picture of a building, and obtained two images instead of one; one picture was sharp and clearly defined, while the outlines of the other were indistinct. He repeated the experiment several times, always with the same result. Supposing the fault to be with the lens, he removed it and substituted another; the result remained the same. Finally he discovered that a small hole in the front board of the camera was the cause

If two lenses have the same aperture, but the focal length of the one is twice as long as that of the other, the longer one has only one-half the longitudinal and one-fourth the lateral aberration. As a lens made of a denser medium, say of heavy flint glass or diamond, requires, for the same focal length a longer radius of curvature than one made of crown glass, it follows that its spherical aberration is less.

The single lens of ordinary glass, having an index of refraction of 1.5, has the form of lost spherical aberration when it is a crossed convex lens with the surfaces of different radii, the proportions of the radii depending on the index of refraction of the material of which the lens is made. For ordinary glass, index 1.5, the radii are as 1 to 6, the shortest curve towards parallel rays. The best form for a lens made of flint glass, index 1.6, is the plano-convex, and for diamond, is a meniscus, of which the convex radius is to the concave as 2 to 5, for radii of curvature.

We see that in lenses of wide apertures the spherical aberration may be considerable enough to interfere with the sharpness of the image, especially if, as in a telescope and microscope, the image with all its errors is magnified by an eyepiece. Let us now see what means we have to reduce, correct, or destroy the spherical aberration. The most simple way is by the use of a diaphragm. A diaphragm is a non-transparent plate, comof all the trouble. A small hole will produce by itself an image on the ground-glass (pinhole camera), and in this instance it acted like a second lens.

Lenses vary, even when of the same advertised angle and focal length. Especially is this so with wide-angle lenses.

"Do wide-angle lenses give true perspective?" therefore remains a query but partly answered.

It is obvious that a drawing on a surface, of objects situated in different planes, can be made a correct representation for only *one* position of the eye with reference to it. For when we vary the position of the eye, previously

monly made of metal, perforated in the centre (Fig. 24). *A B* is such a diaphagm; *c d*, the aperture of it. If this diaphragm is placed in contact with the lens, it is nearly equal to reducing the lens to the size of the aperture of the diaphragm, and as we have seen before, the spherical aberration is considerably reduced, but the light also. If the loss of light is of little consequence, this mode of reducing spherical aberration may be adopted with advantage. Another way of reducing the spherical aberration is by adopting, for a given aperture and focal length, two or more lenses of the same aperture, and the same equivalent focus of the single lens. We have seen before, that two lenses of the same aperture, but their focal length as 1 to 2 to each other, the longer one has only one-fourth of the spherical aberration of the shorter one. Lens *M* (Fig. 25) has its focus at *f*. The lenses *L* and *N* are of the same aperture as *M*, but each has twice the focal length of the lens *M;* therefore each has only one-fourth the spherical aberration of *M;* but *L* and *N* together have the same focal length as *M*, and as their apertures are alike, the combination *L N* has only one-half the lateral spherical aberration of the lens *M*. But by this mode of correcting, it is not possible to destroy the spherical aberration completely, although it is stated in some works on optics, that a combination of two convergent lenses was calculated by Sir John Herschel, and said to be free from spherical aberration. This, however, is a mistake, which Herschel himself has rectified in his memoirs.

Fig. 24.

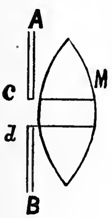
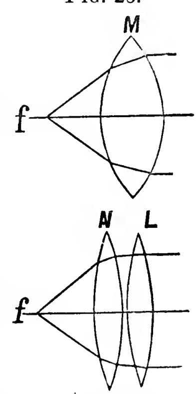


Fig. 25.



We now come to the most important method of correcting spherical aberration, that is, by a second lens of opposite character. Suppose we want to correct the spherical aberration of the positive lens *L* (Fig. 26) along its axis. *f f′* is the longitudinal spherical aberration of the rays *A B*, parallel to the axis *A*, at the margin of the lens, and *B* near the centre of the lens *L*. If we combine this lens with a convergent negative lens *M*, it is not difficult to see, by what we learned before, that the lens *M* has very little power to change the direction of the ray *b f′*, and bring it, say, to *F;* but it will greatly change the course of *A f*, so as to bring it also to *F*. since the prismatic form is greater at the margin than at the centre. Of course, the form of the lens must be fixed upon, before the objects themselves, their relative positions change, and the picture would have to be altered correspondingly to be right for the new position. So when we vary the eye from its proper place, before a correct picture, we have distortion as a natural consequence.

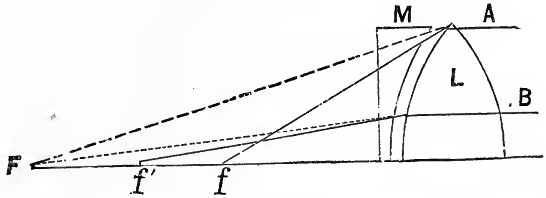
It is found, in practice, that when a drawing is made to include from 20° to 30°, much latitude may be allowed in the position of the eye without the distortion being apparent. For this reason such pictures are most *readily* viewed. As we increase the angle of view the necessity for placing the eye in its proper position becomes more obvious, and when we reach an angle of 90°, the eye must be placed, with considerable accuracy, at a distance from the picture equal to one-half its width, else the amount of distortion may be considerable.

We will now consider the case of photographing a row of houses, of equal size, with a wide-angle lens. The camera is supposed to be opposite the central house, with the plate parallel to the row. It is objected that the resulting picture will give the houses all of the same size, when we measure them on the plate.

After what has been said about the necessity for placing the eye in the right position, a little consideration will show this is as it should be, for the proper perspective effect is produced by the picture itself, the extreme houses in the picture being more distant from the eye than the central one, in the same pro-

suited to the material of which it is made; for our present purpose, both of the lenses may be made of the same glass, but it is much better if the lens *M* is made of a denser

FIG 26.



glass, as we shall soon see, that the same lens may be used to correct the chromatic aberration also. By this method the spherical aberration can not only be corrected, but the marginal rays can be made to cross the axis farther from the lens than the central ones; in this case the lens is called over-corrected, while if not enough corrected, it is called under-corrected. So far we have considered the aberration of rays parallel with the axis. But magic lanterns, photographic and microscopic lenses include angles from 40° to 175°, and the foregoing is only applicable to a narrow angle near the centre of the lens. If a lens, corrected, parallel to its axis, for spherical aberration, is struck obliquely by parallel portion as when viewing the houses themselves from the point where the view was taken.

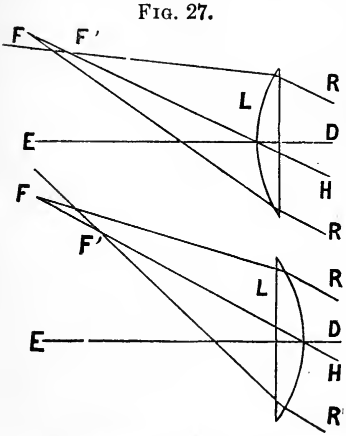
It is for the reason just mentioned, that perpendicular and, consequently, parallel lines in nature are represented by parallel lines in a perspective drawing; though, in looking up, as, for instance, at the sides of a high building, the sides apparently converge.

If, with the camera before the window, the lens be kept constantly at the same point, while the camera is turned so as to receive the image of the window on different parts of the ground-glass in succession, it will be seen that this image expands as it moves from the centre, and at the borders of the plate becomes considerably larger. Let us carry this experiment further, and catch the image, projected under the above conditions, on different parts of a sensitive plate, and develop it. Now return the plate having the images to the camera, and, taking off the lens, place the optical centre of the eye at the point previously occupied by the diaphragm. Now all these images will appear of the same size. This should be the case, for they were taken from the same point, and each representation, if truthful, should subtend the same angle, provided the eye is in *correct* position.

To secure lenses as perfectly correct as possible is the aim of the buyer.

rays, but the longitudinal aberration is different for two diameters, and is greatest in the plane laid through the axis of the lens and the radiating point, then, the circle of aberration becomes the more elongated, as the more obliquely and marginally the light strikes the lens, until it terminates in a point at their extreme margin, which is known as the coma.

Fig. 27.



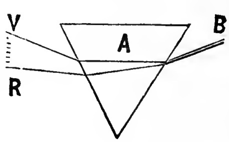
L is a plano-convex lens; *H F*, an axis through the optical centre, making a considerable angle with the axis *D E*. *R* and *R'* are parallel margin rays. The ray *R* will cut the axis at *F'*, and *R'* farther off at *F*, and therefore the image of a luminous point is no more a point, but appears elongated, and in the extreme has the shape of a coma, which in this case is directed downwards. If we reverse the lens, as in the next figure, so that the incident rays fall on the convex side, the coma is directed outwards. We see we have here, by reversing the lens, opposite comas; and by such lenses of opposite character properly combined at the right distance, and furthermore, by the use of a diaphragm at the proper place, the spherical aberration for oblique rays can be reduced to a small amount.

The first condition of non-distortion I believe to be this: That the pencils before and after transmission through the lens, are in the same right lines; pencils in a strict sense, not rays, but such small sheafs of rays as, emanating from single points of the object, are focalized by minute elements of the lens so as to produce corresponding parts of the image.

If the lines of direction in these various pencils before and after transmission are parallel or coincident, it is clear that one important condition of non-distortion will be fulfilled, and that the relative dimensions or angular distances of objects and parts of objects will be maintained; and that wherever the tangent plane, which represents the plane of foci, is situated, it will receive a

So far we have considered a ray of light, refracted by a transparent medium, to be still a single ray. Such would be the case were the white ray of light of a single homogeneous color; but what we call a white light is composed of different colored rays, which, by passing through a refracting medium, are refracted in different degrees. This is the source of another aberration of even more importance than the spherical aberration—the chromatic aberration. By passing a beam of white light, *B* (Fig. 28), through a prism, it is not only refracted, but decomposed into seven colors, red, orange, yellow, green, blue, indigo, and violet. These different colored rays are differently refracted by the prism. The violet ray, as the most refrangible one, is refracted towards *V*, and the red one, as the least refrangible, is refracted towards *R*, and other colored rays fill out the space between *V* and *R* in the order of their refrangibility. This is known as dispersion. The dispersion of refracting media is measured by the length of the spectrum which they produce. Flint glass has more dispersive power than crown glass, because the spectrum which it produces is longer than that of crown glass. The dispersion of a medium is indicated by the difference of refraction between the index of refraction of the red and the violet. Let us now see what effect the dispersion has on images produced by single lenses.

Fig. 28.



White light *a* and *b* is falling on a double-convex lens (Fig. 29). The ray *a* is decomposed into the different colored rays as soon as it enters the lens, and the red ray, as the least refracted, will cross the axis *p q* in *r*, while the violet ray crosses the axis in *v*.

Fig. 29.

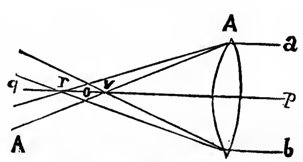
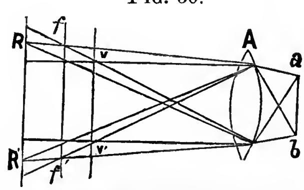


Fig. 30.



Between the red and violet the other colored rays cross the axis. The same is with the ray *b*, and if we do not consider the spherical aberration of the rays between *a* and *b*, all true image. To give a rough illustration, suppose the object to be a circle. The pencils from it to the lens will represent the surface of a cone. If now the transmitted pencils are parallel with these, they will form another cone, whose section wherever cut by a plane tangentital to the axis of the lens, must be a true circle like the first or object.

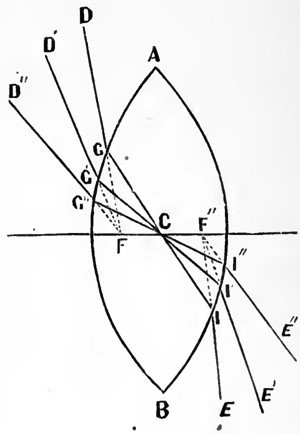
the red rays will have their focus at *r*, and all the violet ones at *v*. Between *r* and *v*, the foci of all the other colored rays are situated. The space between *r* and *v* is called the longitudinal chromatic aberration. The length of the aberration changes with the dispersive power of the media out of which the lens is made; it is, for instance, twice as great if the lens is made of flint glass, as if the lens were made of crown glass. The influence of the chromatic aberration on the image of a lens is shown in Fig. 30. The white light from the object *a b*, refracted and dispersed by the lens *A*, does not form a colorless image, *f f′*, but the red rays form one at *R* and *R′*, and the violet at *V V′*. But between these, an endless number of colored images of rays of different refrangibility are produced. The red image is the largest. If we place a screen at *R R′* we do not get simply a red image, as all the other dispersed images are formed on the screen; and as the mixing of all the different colors of the solar light makes white light again, so the mixed images, that is, the central part, is colorless, and only the margin is blue, because it is surrounded by the diffusion image of the blue diverging rays.

If the screen is moved to *V V′*, then the image is surrounded by a red margin; if it is moved to *f f′*, the colored margin disappears, but the image, composed of the different dispersed images, appears undefined and not clear. This effect is more increased, because each colored image has its spherical aberration also. Chromatic aberration alone would place the different colored images in regular succession behind each other; but spherical aberration mixes these images of different colors, and only the two outer ones, red and violet, remain. From the foregoing, it is clear that chromatic aberration must necessarily interfere with the definition of a lens, and that it is desirable to find a way to correct this evil. From the moment when Newton unravelled the nature of solar light, proving that light is composed of rays of different refrangibility, our greatest philosophers and opticians have spent their time and skill in the attempt to produce lenses without chromatic aberration, or at least to reduce it to a minimum. Sir Isaac Newton was of the opinion that refraction and dispersion of different refracting substances are always in the same ratio to each other, and concluded that it was hopeless to produce refraction without color, by combining convex and concave glasses. Leonhard Euler, the great mathematician, on the other hand, reasoned in another way, and this is a curious instance of how a correct conclusion was drawn from false premises. He assumed that the human eye is achromatic, and consequently a lens could be made achromatic too, and Newton must be in error; he constructed theoretical rules for making achromatic lenses, and Dollond, the optician, succeeded in carrying them out. But Dollond, by comparing the eye with his lenses, observed that the eye cannot be achromatic; and Fraunhofer afterward measured the chromatic aberration of the human eye, and found that an eye that is able to bring parallel rays of red light to focus on the retina, can only bring violet rays to a focus coming from a distance of two feet.

Now it will be remembered that the especial property of the *optical centre* in lenses is this, that any ray passing through it experiences no angular displacement, but has its emergent portion parallel with its incident part.

The accompanying cut illustrates this fully—*I E*, *I′ E′*, and *I″ E″* being respectively parallel to *D G*, *D′ G′*, and *D″ G″*.

FIG 31.



It would thus appear that a common lens with a diaphragm, excluding all pencils but those passing through its optical centre, would fulfil this condition of non-distortion.

Want of flatness, etc., however, practically exclude such an arrangement, and oblige us to resort to compound lenses.

The condition of *coincidence* in the direction of rays before and after transmission is found in the pin-hole camera, of which more anon.

So far for the first condition of non-distortion; but there is yet another.

The pencils transmitted must be such as would have met, if not refracted, at a common point. The reason of this is obvious after a little reflection. If an image were formed by the action of pencils which were emitted toward different termini, it would suffer distortion, like that of a perspective drawing made not from one but from many points of

Now, let us see how we get rid of these beautiful colors, which we admire so much in the rainbow and the glittering dewdrop, but which hurt the eye of an optician in an optical instrument. If a ray of white light, *R* (Fig. 32), falls obliquely on a parallel plane glass, it is decomposed as soon as it enters the glass; but on the other side all the colored rays which made white light are, on leaving the glass, parallel to their former direction.

FIG. 32.

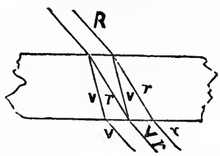
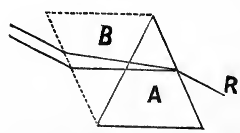


FIG. 33.



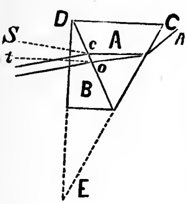
But if a prism, *A* (Fig. 33), is struck by an oblique ray, *R*, the ray is dispersed in the glass, and the colored rays leave the prism diverging, and they cannot be properly mixed again to white light, except we can give to the leaving rays their parallelism again.

view. As an illustration we may compare this action with the effect of combining, to form an image, part of the picture of an object seen with one eye, with another part as seen by the other. Now a glance at the cut will show us that the pencils which pass the optical centre are not such as would have met at a single point, for while the angles of the different rays *in* the lens, with a common centre, *C*, are in proportion to each other as their arcs, those formed by prolongation of *D G*, *D'' G*, *D'' G''* toward *F*, as refracted rays, are in proportion to each other as their sines.

Now, if we combine a prism, *B*, of the same angle and material, in a reversed position to *A*, it is evident that we restore the diverging rays again to parallel rays; but, unfortunately, we destroy not only the dispersion, but the refraction—we make a thick, parallel glass out of the prism.

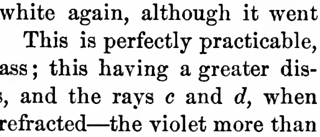
Let us try it in another way. The ray *R* (Fig. 34), passes into a prism of crown glass, *A*, and a colored image would be formed at *S t*, if the prism *B* would not interfere. If we now could combine with the prism *A*, one of a less angle, but made from material like flint glass, of greater dispersive power, so as to have the same dispersive power as the larger-angle prism *A*, we can restore the diverging into parallel rays, and the light will come out white again, although it went through the compound prism *C D E*. This is perfectly practicable, if we make the prism *B* of flint glass; this having a greater dispersive power than the crown glass, and the rays *c* and *d*, when entering the prism *B*, are somewhat refracted—the violet more than the red—and their divergency is smaller; and if the prisms have the right proportions, the red and violet rays come out into the air parallel, and at the same time, the rays passing from the prism *B* will have a different angular direction than that with which they entered the prism *A*. Thus we have refraction without dispersion.

FIG. 34.



Let us adapt this principle to a lens, *A* (Fig. 35), made of crown glass. The rays *a* and *c* enter the lens at *b* and *d*, and are dispersed; the red would cross the axis at *r*, and the violet at *v*. We associate the plano-concave *c*, of flint glass, with the lens *A*. As the negative flint lens is of a denser medium, the violet, as well as the red rays, will be refracted, but the violet more so than the red; and, if form and dispersive power of the two lenses are in the right proportions, the red, as well as the violet, will meet at the point *f*; the image formed there is colorless, or achromatic, or, in other words, it will appear in its natural colors. But even in the best achromatic lenses there is still a small amount of color left, which cannot be destroyed. If we compare the spectrum of a prism of crown glass with one of flint glass of the same angle, we find that the more refrangible blue, indigo, and violet, take not only absolutely, but also relatively, more space than one in the spectrum of the crown-glass prism. So, if we succeed in uniting the outer

FIG. 35.



It is only for rays near the axis, or, in other words, for a small angle, that this second condition is approximately fulfilled in the case of a single lens.

In the case of the pin-hole camera, however (diffraction being neglected), this condition is absolutely secured.

If, now, we take a combination of two meniscus lenses, in reversed order to each other, and put the stop in the optical centre of the combination, we are enabled to enlarge the angle very considerably, and, with a right choice of radii, can get the focus of each pencil (central or marginal) sufficiently in a tangent plane.

rays, red and violet, the intermediate colors cannot unite completely, and this remainder of uncorrected colored rays we call the secondary spectrum. Complete achromatism, therefore, cannot be attained, but we must be content to come as near as possible to the requirements. A selection of crown and flint glass, in which the proportions of length of the spectra of the different rays are nearly related, will bring us very near to our purpose. Fortunately, the colors of the secondary spectrum are feeble, and do not interfere much with the sharpness of the image, and we are well pleased if a lens exhibits only the secondary colors—light purple and greenish, as it is a proof that the most objectionable effects from achromatism are removed. The association of flint and crown glass serves not only to correct chromatic aberration, but, as we have seen before, if the right form for each of a pair of lenses be selected, it corrects spherical aberration also. Such a lens, corrected for spherical and chromatic aberration, we call an *aplanatic* lens.

We now come to another aberration of lenses, the curvature of field. The image of a flat object, formed by a lens, cannot be received on a plane screen; the screen ought to be concave. *A*, *B*, and *C* (Fig. 36), are very distant points, and, therefore, nearly equally distant from the lens *D*, of which the point *B* is situated in the line of the axis of the lens, while the points *A* and *C* are above and below the axis. It is evident that the images of these points are formed at nearly equal distances from the optical centre, not far from the principal focus. The field *F E G* is therefore curved, and cannot be received on the screen *H I* equally sharp. The curvature of field is generally attributed

Fig. 36.

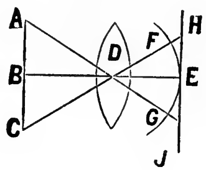
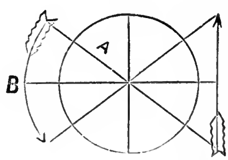


Fig. 37.



to spherical aberration; sometimes it is even thought to be spherical aberration itself, but it has nothing to do with it. If lenses could be made with parabolic curves, free from spherical aberration, the curvature of field would be about the same.

Suppose we have a globular lens, *A* (Fig. 37), with a diaphragm in the middle, so

As regards distortion, however, we cannot *overcome* the error shown in the case of the single lens, but may simply *reduce it.* *Perfect correction* of distortion is just as unattainable as perfect correction of spherical or chromatic aberration, which last are practically *reduced,* not *eliminated,* in the best combinations. All correction is, in fact, a question not of essence, but of degree.

In fact, this distortion, as can be readily proved, is but a special case of spherical aberration, *i. e.,* for converging pencils or rays.

What can be done, however, by proper arrangement, the following figures will show. In one of Zentmayer's lenses, of about twenty-two inches focus, the first radius is 1.84, the second 1.99. As Zentmayer employs rays radial to the first surface, the thickness of his lens does not here come in question.

small as to reduce spherical aberration to almost nothing. Now we know that the focus of a sphere of crown glass is situated one-quarter of the diameter behind the globe, at *B*, and as all the pencils are normal, they all will form their image one-quarter of the diameter of the globe behind it; that is, the image lies in a curve, concentric with the lens, although the spherical aberration is not perceptible. To understand the correction of the curvature of field, we must make clear what is meant by depth of focus, and what the effect of a diaphragm is. Depth of focus is the property of a lens to give a tolerably clear image of objects, not in one plane. Fig. 38a and Fig. 38b will make it plain. In Fig. 38a we make use of the whole aperture of a lens, *D*; *R R* are parallel rays, striking the margin of the lens. The image is formed at a screen, *A*; if the screen is moved to *B* or *C*, the image of the point *a* spreads out, because the angle of the crossing rays is large. When the same lens, *D* (Fig. 38b), is provided with a diaphragm, so as to reduce the aperture considerably, the focus of the rays *R R* is still at *a*. If we now move the screen the same distance as before, to *C* or *D*, we find that the image of the point *a* is considerably reduced. If we now look at Fig. 36 we see that only *E* can be sharp on the screen, and if the screen be moved toward the lens until the points *F* and *G* are sharply defined upon it, then the point *E* will lie beyond the screen and become indistinct; but if we provide the lens with a small central diaphragm, we can find a place for the screen where all three points can be brought to it, without the images being sensibly diminished in sharpness.

FIG. 38a.

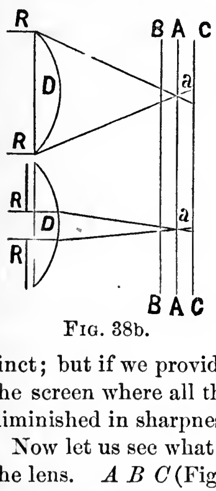


FIG. 38b.

Now let us see what takes place, if we move the diaphragm to a proper distance from the lens. *A B C* (Fig. 39) are distant points, *L* a converging lens. Let us trace the course of the rays, commencing from the points *A*, *B*, *C*. The rays from the points *B*, situated in the axis, and the image of the point *B* will be formed at *F*, the principal focus. But it is different with the rays coming from *A* and *C*. The rays proceeding from the point *A*—A^{i}, A^{ii}, A^{iii}, A^{iv}, A^{v}, are refracted to *a, b, c, d, e*; similarly the rays

A radial ray 5° from the centre will cross the axis at a distance of 1.719 inches from the first surface; a radial ray of 20° at 1.72 inches; and a ray 36° at 1.724; giving a difference between rays of 5° and 36° of but 0.005 ($\frac{5}{1000}$) of an inch, with a focal length of twenty-two inches.

To produce a lens of least distortion it is not only necessary therefore that *some* ratio should exist between the components of the system, but a *certain* and *exact* relation must be established, which, once fixed, will apply to all cases, and by reason of which each transmitted pencil from any part of the front lens will find just an equivalent part of the second lens to correct its distortion. In the Globe lens (a special instance of this principle) such a result is obtained in one case; that is, when it is used to copy full size, so that object and image have equal dimensions.

from the point *C* are refracted to *a′*, *b′*, *c′*, *d′*, *e′*; occasioning, as we have seen before, spherical aberration. If we place a screen at the principal focus *F*, it will not receive a distinct image, even if we have a concave screen; as will be observed, all the rays outside of the axis arrive at different distances behind the lens. You notice that none but the

Fig. 39.

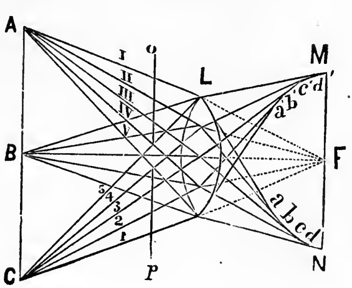
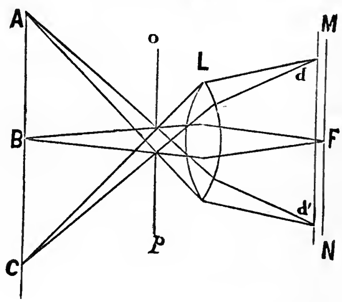


Fig. 40.



rays A^{iv} and A^{v}, C_4 and C_5, have their foci near the plane of the screen *M N*. Now if we find a place for a diaphragm, so that only these rays pass the lens, and the depth of the lens is as great as *d M*, we may expect a pretty sharp image on a plane screen. By looking over the figure, we see that such a plane is in *O P* (Figs. 39 and 40). A diaphragm in this place, and of the proper size, will allow only the most favorable rays to pass, and a tolerably flat and sharp image is obtained. The smaller the diaphragm the sharper and flatter the image. But as we mentioned before, small diaphragms have the disadvantage that the light is cut off to such an extent; and for most purposes the lens becomes useless. But suppose we would employ a negative lens, under the same conditions, we would have no real image, but a virtual one, the curvature of the field would be reversed, and the marginal rays have a longer focus than the central ones.

So, again, Mr. Zentmayer has developed a certain ratio, which, once established, remains the same throughout all his combinations; and the same will be shown by an intelligent study of all other effective arrangements which have in view the same object of securing minimum distortion.

Lack of *depth,* and its attendant inconveniences, have hitherto been a great drawback to artistic freedom of effect in photographic portraiture.

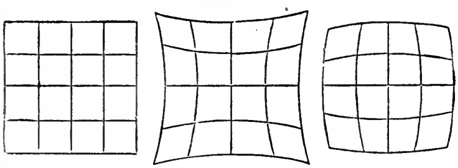
In arranging a model for the simplest form of picture, a bust, how disagreeable the effect of the blurred outline of the further shoulder.

The impossibility of obtaining equal distinctness at unequal distances from the instrument, more than all other causes put together, make photographs stiff, formal, heartless, and produces those conventional peculiarities in sun-pictures,

Therefore, it is possible to associate a negative with a positive lens and to render the field flat.

The next aberration which we have to deal with is the distortion. If we describe a network of straight lines (Fig. 41), and hold a convex lens over it, placing the eye at a distance from it in the axis of the lens, only the two right-angle lines of the centre appear straight; the others appear curved. When the upper is in the reverse position to the lower one, they appear pincushion-shaped. Distortion of the negative lens is reversed; the lines appear as the curved sides of a barrel.

FIG. 41.



The cause of distortion is somewhat difficult to explain, but the following figures make it clear. Let us describe upon a plate or plane surface a number of circles, *A*, *B*, *C*, equidistant from each other (Fig. 42 in front view, and Fig. 43 in profile), and place in front of them (Fig. 43) the lens *L*. Now the rays which proceed from *A*, *B*, *C*, parallel to the axis of the lens, strike it at *d*, *e*, *g*, from whence they will be refracted, and meet

FIG. 42.

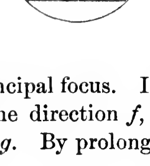
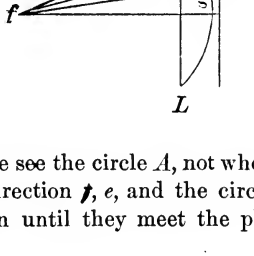


FIG. 43.



at *f*, the principal focus. If we place the eye at *f*, we see the circle *A*, not where it really is, but in the direction *f*, *d*, the circle *B* in the direction *f*, *e*, and the circle *C* in the direction *f*, *g*. By prolonging the lines of direction until they meet the plane of the which rendered a photograph of any kind, from life, or its engraved reproduction, recognizable as far as it is visible.

How it was to be removed, or at least so far removed as to give us practically the necessary freedom, was a puzzle.

A theoretical answer would be, "by constructing a lens which shall have equal foci for objects at different distances from itself." But theory again says,

circles *A, B, C*, we observe that the circles do not appear equally apart, but their distance is increasing from *C* to *A*; they will appear as in Fig. 44.

We will suppose for a moment that the circles *A* and *B* (Fig. 42) are of such relative diameters that a square inclosing *B*, with its sides tangenital, shall have its corners in the circle *A*. Now if we draw the circle *A* and *B* (Fig. 44), (as they will *appear* from *f*), the distance between *A* and *B* will be greater, or equal to *a b* (Fig. 43), and as the contact of the side of the square with *B* (tangentially) and with *A* at the ends must be kept, the line of the side will now *appear* curved or bent (Fig. 44).

FIG. 44.

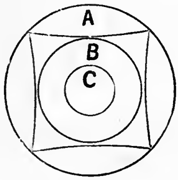


FIG. 45.

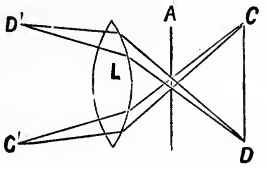
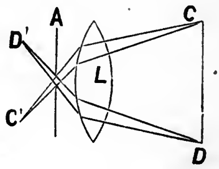


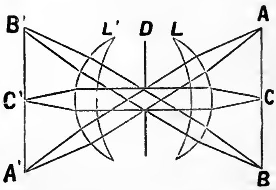
FIG. 46.



A single lens without distortion cannot be made, but by combining two or more lenses in connection with diaphragms in a certain position the distortion can be corrected completely. If a diaphragm is placed in front of a lens *L* (Fig. 45), different parts of the lens are employed to form different parts of the object *CD*. In this case the distortion is barrel-shaped; but by placing the diaphragm behind the lens (as in Fig. 46) the distortion is of the opposite nature—that is, pincushion-shaped. Rays coming from *D* (Fig. 45) pass through the upper part of the lens, while in the latter, through the lower part.

Now you will readily see that, by uniting two lenses equal to each other, *L, L'*, (Fig. 47), and placing a diaphragm, *D*, between them, it follows that the distortion accompanying the lens *L*, with its diaphragm behind it, is corrected by the action of the same diaphragm, upon the rays entering the lens *L'*, where the diaphragm is now in front of the lens *L'*. The modern photographic objectives to be used for architectural work and copying are constructed on this principle.

FIG. 47.



Unfortunately this advantage is obtained at the sacrifice of aperture, that is, of light. I mentioned before that the negative lens has the opposite distortion of the positive lens, so that by proper combination of lenses of suitable curves any material distortion can nearly be overcome upon a limited field.

"this is impossible." Just here, however, is noticed a divergence between theory and practice, or, to speak more correctly, we see that some theories cannot be perfectly carried into practice (and that there might not accrue much advantage if they could be).

It was left for M. Claudet to give an ingenious plan by which the two combinations of the ordinary portrait tube being gradually made to approach each other during exposure, the plane of greatest sharpness moves through the whole subject, resting alternately on each part from front to rear, thus *diffusing the focus* evenly over the sitter.

This method requires very heavy, firm stands, steady nerves, and nice judgment in the operator. It was asserted that M. Claudet produced some exquisite results.

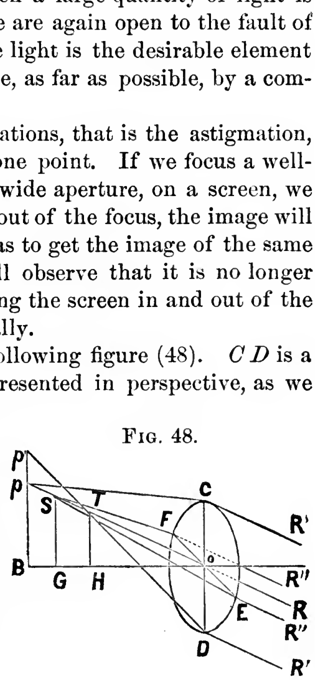
Mr. J. H. Dallmeyer invented a lens capable of giving any amount of diffusion, with its concomitant depth, that may be required.

Photographic objectives used for portrait purposes, when a large quantity of light is desirable for brief exposure, are thus corrected; but these are again open to the fault of a restricted angle of vision. In all other lenses, when the light is the desirable element to be preserved, the correction of distortion must be made, as far as possible, by a combination of lenses.

We now come to the last of the more important aberrations, that is the astigmation, a word coming from the Greek, meaning, not coming to one point. If we focus a well-defined round object, situated in the axis of a lens of a wide aperture, on a screen, we find the image round; even if we move the screen in and out of the focus, the image will get only less sharp; but if we turn the lens sideways, so as to get the image of the same object formed by pencils oblique to the axis, then we will observe that it is no longer possible to form a sharp image of the object, and by moving the screen in and out of the focus the image appears elongated, horizontally or vertically.

Now let us see whether it can be made clear in the following figure (48). *C D* is a convex lens, of which *A B* is the axis. The lens is represented in perspective, as we have to show two planes, in different directions. The radiating point *R* is situated at infinity, and outside of the principal axis. We will lay a plane through the axis *A B* and the point *R*, which will cut the lens in its diameter *C D*. Let us lay another plane through the point *R*, at a right angle to the former, and which will cut the lens in its diameter *E F*. If we draw the line *R p* through the optical centre of the lens, a ray following it would not be refracted, as we have seen before, and constitutes a secondary axis. *R p* is the line where the two planes cut each other, and consequently belongs to both planes. Let us draw the two extreme rays, *R′ C* and *R′ D* of the diameter *C D*, which, after refraction are *T* and *p′*, as we learned by analyzing spherical aberration. If

Fig. 48.



The back combination varies from the old style in its curves, and the two lenses that compose it are mounted so that they can be brought near together or set apart, by turning a screw. When close together, they produce pictures on the old plan of one plane of sharpness; by separating them, the sharpness is lessened, and the focus diffused so that a series of objects situated between fifteen and eighteen feet from the camera can all be rendered equally well, with the full aperture and field of the lens.

Some of these instruments are in use, but the "diffusion" principle is not much practised. Great improvements have been made in lenses for large figures, and the modern dry plate enables the photographer to employ lenses of longer focus which were considered "absolutely too slow" a few years ago.

Large direct portraits, therefore, are now more the rule than the exception.

we now look to the other plane, the rays $R'' F$ and $R'' E$ are symmetrical to the axis, and are exactly equally refracted, meeting at the point S. If the lens is now diaphragmed down, so as to improve the aberration of the plane $C D$, we find that we have for one lens two distinct foci. If we focus, for instance, a brick wall, we will have the horizontal white mortar lines in focus, while the vertical ones are out of focus, and *vice versa.* By looking to the figure you can easily see that that universal doctor in optics, the diaphragm, will also cure astigmation, at least will bring it to a minimum. Fig. 47 will suggest a way by which astigmation may be destroyed almost completely. The diaphragm D divides the lens L into an infinite number of lenses, of which each acts on a different radiating point, and the pencils in or out of the axis strike the lenses almost normal, hence such a combination is not only nearly free of distortion, but of astigmation also.

In nearly all human eyes there exists an aberration, also called astigmation. Although in its effect similar to the astigmation of lenses, just mentioned, it is of a different character. Nature intends that the curves of the cornea and crystalline lens of the human eye should be spherical; but the exceptions seem to be the rule. The curves of the cornea and crystalline lens of the eye are in nearly all cases more or less elliptical, egg-shaped, and consequently have in one meridian a longer focus than in the other. If such an eye brings the image of a line parallel to one meridian to a focus at the retina, the images of lines parallel to all the other meridians do not collect at the retina, especially the one at right angles to the former, and a distorted, blurred image is the result. The advancement of science has lately enabled our oculists to correct this evil by spectacles, of which the glasses are parts of cylinders instead of spheres.

Now, knowing all the defects of lenses, and the different modes of correcting the same, let us look back to that primitive instrument—the pinhole camera. The pinhole camera is free from all the errors, as spherical and chromatic aberrations, distortion, curvature of field, astigmation, and the only objection against it is the extremely small aperture. What an amount of speculation and hard labor of the most eminent men were necessary to furnish a substitute, equally free from errors, having a larger aperture, giving a brighter image. And, even now, none of the aberrations can be completely corrected, and the

Enough has been said to aid the buyer in his selection, though the following points are essential:

Avoid any brownness of color, detected by placing the lens on a sheet of white paper.

Bubbles of any size often impair the brilliancy of the image.

Scratches and hairlines should cause a lens to be rejected.

Centring.—To every lens there belongs an optical axis, a line perpendicular to the surface of the lens, and passing through its centre of curvature. Every achromatized lens consists of at least two portions, and it is necessary that these should be so arranged when attached together by the balsam used for that purpose, that the optical axis of each should exactly correspond. When two lenses or more are united to form an objective, not only must the parts of each be properly disposed, but the front lens must have its axis coincident with that of the back lens. This will depend upon correct mounting.

To make the test, the observer places himself in a dark room with a single candle. Standing five or six feet from it, he looks at it through the objective, inclining the latter a little until he sees a series of bright points, which are the images of the candle, produced by successive reflections from the different sur-

best that can be done, and that for a limited aperture only, is to reduce the errors so far as to diminish their extension, so as to make them appear to our eye at a smaller angle than the eye is able to distinguish. In lenses used as objectives, where the image is magnified by high eye-pieces, even that is extremely difficult, as the errors are also magnified. Our most celebrated opticians, such as Fraunhofer, never attempted to give a telescopic objective a larger aperture than the focus divided by ten, except in very small pocket telescopes. And his larger telescope, the one he made for the Dorpat Observatory, and which he considered his best objective, has a focus of 160 inches, while the aperture is only 108 lines, that is $\frac{1}{17}$th of the focal length, and its highest magnification is 720 times. The larger telescopes of Dollond are nearly twice as long. The same artist, Fraunhofer, took precaution to warn young opticians and amateurs not to listen to the very natural desire to try their skill on larger apertures, and giving higher magnification, if they do not wish to be disappointed, and lose time and money. But the school of experience seems to be the only one to cure this desire.

But here I feel bound to mention that, a few years ago, Mr. Steinheil, of Munich, read a paper before the Academy of Sciences of that city, on an improved telescope objective. It is composed of four lenses—one positive crown-glass lens, combined with a compound negative lens, which itself is a triplet of two flint and one crown-glass lenses. By this formula a four-inch telescope is only two feet long, while in the ordinary way it is twice as long.

While I am speaking about wide apertures, I cannot pass without mentioning a very serious obstacle connected with large apertures; it might be called the parallactic error.

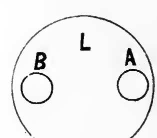
faces of the lens. When a lens has four pieces of glass in its construction, as in the case of the portrait, globe, orthoscopic, and some other lenses, the number of possible images is very considerable. These cannot generally be all found at once, but eight, ten, or more can be counted; a little practice, and altering the inclination of the lens, materially aids in increasing the number.

If now the centring is perfect, it will be found that, by carefully adjusting the position of the lens, all of these reflections can be made to range themselves in a straight line. But if any one or more of the component parts is out of centre, this will be found impracticable. One or more of the bright points will remain obstinately out of line; and, when a little movement is made which brings them in, it will be found that some other image, previously in line, has slid out of it. When the observer, after very careful trial, finds that it is positively impossible to make all the images range, he will be justified in concluding that there is a fault in the centring.

Chemical Focus.—The correction for chromatic aberration is now greatly better made than formerly. To test whether a lens is properly corrected, select a newspaper printed with sharp-cut type, and paste a piece a foot or fifteen inches square upon a smooth piece of board. Set this up before the camera, with the columns vertical, but inclined in a slanting direction, so that one side, the right, for example, shall be a couple of inches nearer the camera

I am frequently asked why a large photographic object does not give the same sharp image that a small one does. It is somewhat more difficult to correct a large objective than a small one, even if the aperture stands in the same relation to the focal length. But it is not only this. Suppose we have a large photographic objective, say of six inches aperture, *L* (Fig. 49). Each part of the lens receives radiating rays from each point of the object, and brings them to a focus, the respective place. Now if we cover the lens by pasting paper over it, leaving only the aperture *A* free, we still get an image, only more feeble in light. Again, cover the aperture *A*, and open the aperture *B*, you get an image of the same object; but the apertures *A* and *B* are, say, four inches apart. Both cannot give precisely the same image, as they are taken from another base. The images will be similar to the two images of a stereograph, which are taken in a similar way by two lenses. Now open both apertures, *A* and *B*, and, as the images are not equal, they cannot cover each other, but will overlap, especially the images of the nearer objects. If we now use the whole aperture of six inches diameter, it is clear that we will have an infinite number of images none equal to the other, every one overlapping the other, and the image necessarily must be a blurred one. For this there is no remedy but cutting down the aperture.

FIG. 49.



We now have a reasonable knowledge of what a lens is.—JOSEPH ZENTMAYER.

than the left, keeping the board, however, exactly upright. Focus carefully along the central upright line, and copy it full size, or thereabouts.

Next examine the hair-strokes of the letters on the negative with a microscope. If the lens is properly corrected, the central line should be in the sharpest focus. If, however, it be found that a portion to the right or left of the central line is in better focus than the centre, then the correction has evidently been faulty. If the sharpest image is of a part *nearer* to the lens than the centre, the lens is *under-corrected;* if of a part further from the centre, the lens is *over-corrected.* In either case, it is said to have a *chemical focus*—that is, its chemical and visual focus do not correspond, a fault of the first magnitude, and sufficient cause for rejecting the lens entirely.

And yet, after all these tests, our nearly perfect instrument needs a great deal of intelligent "managing" under the skylight before it can be made to produce its best results.

This part of the subject is so important, that the next chapter will be devoted to the managing machinery, namely, to the "stop" or "diaphragm."

15. A word as to the care of lenses. Only the softest fabrics or chamois skin should be used to wipe them; they should not be fingered. Keep your head clear when you separate their parts, that you may replace them exactly. Then be careful not to expect one lens to do everything. For varied work there must be a variety of lenses.—George W. Wallace.

CHAPTER VI.

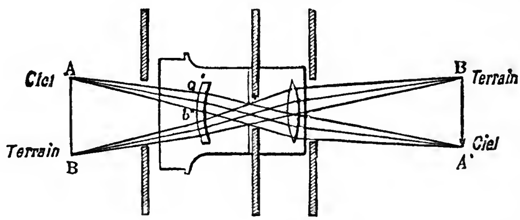
THE DIAPHRAGM OR STOP.

16. THE original purpose of the diaphragm was to "stop" the passage of certain useless rays through the lens, thus preventing the distortion which would follow their admission, and by so doing secure a more correct and sharp image.

16. The first thing to do is to understand thoroughly the march of the luminous rays. The pure and simple analysis of the phenomena produced will always furnish us some useful information.

Let us take as a type a rectilinear objective, the use of which is very frequent in instantaneous photography. The reasoning may also be applied to the simple objective.

FIG. 50.

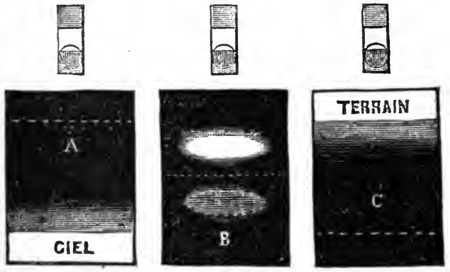


Suppose *A B* to be the object that we wish to reproduce. The point *A* sends a pencil of light on the first lens; slightly deviating, these rays strike in a parallel manner the second lens, on which they are again refracted and form at *A′* the image of *A*. The point *B* acts in the same manner and gives an image at *B′*. All the points of the line *A B* give a similar image between *A′ B′*. It is seen at once that the image is reversed. In our cut, *A* represents the sky and *B* the earth. On the ground-glass the earth, *B′*, is above and the sky, *A′* below. From this first remark we shall already be able to draw some interesting conclusions. If, placing a plate pierced with an opening before the objective, we cause it to descend slowly, we see that it will allow rays emanating from *A* to pass first, then successively the intermediate ones from *A* to *B*, and, finally, those coming from *B*. In continuing the movement, it is the rays emanating from *A* which disappear first and those at *B* last. On our ground-glass the sky commences to appear, then the landscape, and finally the foreground; at this time the image is complete, then the reverse is produced, the last planes being the last visible. If the plate has a uniform motion the lighting of the different portions, although not having been made strictly at the same time, will be equal as regards the duration. If, on the contrary, the movement is accelerated, either by a free fall or by the action of a spring, the image will be unequally lighted. In the present case, it is the ground which will receive the shortest exposure. This result is contrary to the facts shown by photography, which require a longer exposure for the

Diaphragms are of various shapes. Some are mere disks, or strips of metal perforated in the centre and made to enter through a slit in the lens tube. Others are disks of metal supplied with holes of various sizes, and so contrived

first planes than for the sky. We therefore think, in a theoretical point of view, that the use of the shutter in front of the objective is defective. And if in going backward we make the same reasoning, we will find that the results are reversed. The sky will have the shortest exposure and the ground the longest. This solution seems to us preferable in every way. The drop used for this demonstration is the one styled the *guillotine.* We may, therefore, admit in principle that there is every advantage in placing the *guillotine* behind the objective, in preference to before it. Some had proposed to place the *guillotine* in the objective at the optical centre, or rather at a very near plane, so as not to prevent the use of the stops. This position seems at first to be very advantageous, since as soon as the *guillotine* acts it should unmask equal quantities of rays coming from *A* and from *B*. From the start, the image, therefore, would be entirely visible on the ground-glass. As the guillotine continues its movement the sum of the rays admitted would increase in the same proportions for the points *A* and *B*. The image would become more and more bright, to disappear in the same way by general extinction. The image would, therefore, be complete during the whole time of exposure. A thorough investigation of the question has proved to us that the image is not produced in this manner. In order to analyze the formation of images M. Darlot has constructed for us an objective which allows the working of metallic plates pierced with openings in five different positions: before and behind the lenses, at the optical centre, before and behind this last. Placing the plate back of the optical centre, he saw that the image was not complete from the start. It appears little by little, near the centre of the glass plate, like a spindle, analogous in shape to that of the segment uncovered by the diaphragm. Fig. 51 shows the appearance of the image on the ground-glass according to the position of the stop. *A*, stop placed before the objective; *B*, stop placed near the centre of the objective; *C*, stop placed back of the objective. When this continues its motion, the image becomes enlarged on both sides like a double folding-door. The action of the stop is the same, one portion of the plate shaped like a spindle being the last to remain lighted, but in a position like that of the first spindle as regards the centre of the plate. If a diaphragm, however small it may be, placed in the axis of the objective, always gives a complete image, a diaphragm not in the centre as regards this axis does not give the same result. In this case, some rays only can pass, those coming from the centre of the image; the others are intercepted by the sun-screen, or are lost in the interior of the mounting. The rather abstruse explanation of this phenomenon would carry us too far.

FIG. 51.



as to revolve and bring one of these holes over the focal centre of the lens at each movement. The importance of the diaphragm is very great. Too much attention cannot be given to its application in practice.

To resume, if we wish to represent the manner in which the image would appear, according to the divers positions of the diaphragm in the objective, we will have the following representation (Fig. 51): In front, the sky appears first; back, it is the ground. At the optical centre, or near it, we find the almost central portion of the image. It seems, therefore, that the passage of a stop, uncovering the objective laterally, should be absolutely condemned in a theoretical point of view, since in the first cases the image is successive and in the others it is always unequal. Struck with the objections which are presented by the theory of stops which uncover the objective laterally, and on the other hand remarking that the prints obtained with these appliances contain none of the defects that theory seemed to indicate, we have endeavored to discover from what arose this difference between the theoretical and practical results. We ascertained that the action of these stops is not the same when the velocity is moderated experimentally, to control the manner in which the image is produced, or when the appliance works at its normal degree of velocity. An image that appears unequally lighted or having aberrations when the appliance works slowly, does not appear when it works rapidly. Our eye perceives it when the appliance is retarded in its movement; but as soon as the rapidity becomes great, the intensity is not sufficient to act on the sensitive surface. The light that penetrates into the appliance when the shutter works, presents an increasing intensity from obscurity until complete illumination, intensity depending upon the number of rays progressively admitted. It is only when the intensity is sufficient that the impression commences. This is a fact easy to verify by all the optical methods of photographic registry.—ALBERT LONDE.

There is no step in photography that could be accomplished with so much facility in proportion to its importance as the one connected with stops.

If all makers, instead of stamping numbers or other marks upon their diaphragms, would stamp opposite to each opening the relation of its diameter to the focal length of the lens, the advantage would be exceedingly great. The openings would then be marked *f* 20, *f* 25, etc., or, omitting the *f* as being understood, simply 20, 25, 30, etc., indicating that the opening in question was one-twentieth, one-twenty-fifth, etc., the focal length of the lens or combination. The following benefits would result from this change:

The photographer who uses a number of lenses, in place of being obliged to remember the relations of each diaphragm of each lens to light, so as, after estimating the general strength of the illumination, to guess at the proper exposures by reflecting over his experience for the particular lens and diaphragm which he is about to employ, would simply need to learn the exposure necessary for a stop of *f* 20, *f* 25, for any lens whatever. It is true that the relation of the diameter of the stop to the absolute focal length, does not fix the proportion of light admitted with entire accuracy, but it does so sufficiently to answer all practical purposes. When the stop is between the lenses, the proportion of light that passes through it, will, to some extent, depend upon the construction given to

17. Not content with the service for which it was originally devised by the optician, the thoughtful photographer has suggested other uses for it, and other forms of construction by means of which these new uses can be made practical and easy to all.

One of the greatest trials of the landscape photographer is, that his distance becomes very much overexposed, and when clouds are desired they are lost before sufficient time can be secured for his foreground. The one must be sacrificed in some degree to save the other.

One suggestion to help this comes from Mr. Joseph C. Burritt. It consists simply of a thin brass disk, slit in the centre and flared out at top and bottom,

the front lens. But variations that can arise in this way, are scarcely sufficient to diminish the practical utility of the principle here involved. If an *f*25 diaphragm requires with a given light an exposure of a given number of seconds with one lens, it will demand the same approximately with any other, though the focal length be longer or shorter. So that, if this improvement were adopted, the photographer could manage any number of lenses with the same convenience as to fixing the exposure, as if he always worked with one.

A feature in this which is extremely favorable to opticians, is that it would immensely diminish the trouble of trying new lenses. In place of trying various stops, experimental exposures, and so forth, the photographer would be able to give the right exposure at once, even with a lens he had never seen before. For, knowing that with a given light he would expose ten seconds, let us say, with an *f*20 stop, he would do the same with the lens under trial with the corresponding stop, and be spared a great part of the labor which often deters photographers from experimenting. Photographers now, moreover, feel that the times of exposure have to be learned for each new lens, and the employment of new lenses tends to confuse the experience painfully acquired for those actually in use. This is by no means all. For, if stops are marked by figures in this way, we can easily estimate *comparative exposures*. Then, if we wish to pass from an *f*20 stop to an *f*25, we know at once that the exposure for the latter must be a little over one-half more than the former. For, 20 multiplied by itself is 400; and 25, 625. The ratio between 400 and 625 indicates the increased exposure necessary in the former case.—M. Carey Lea.

17. There is a common idea prevalent that stops to lenses are arranged upon some regular system, and that they are suited for exposures, each one-half longer than the next larger in sequence; that if 20 seconds be the right exposure for any stop, the next smaller must have 30, and so on. This, I think, is not the case; it certainly was not in any determination that I have made. For example, a triplet lens showed the following relations between its stops: *f*13½, *f*18⅘, *f*21, *f*27, *f*35¼, *f*54.

The ratios of the squares of these relations to which the exposures must be directly proportioned, are: 182.25; 353.44; 441; 729; 1242.56; 2916.

It will be seen that there is only sufficient regularity to mislead, and not for any real utility.

the former being flared in a reverse direction from the latter. It will be made plain by the engraving (Fig. 52).

Fig. 52.

Fig. 53.

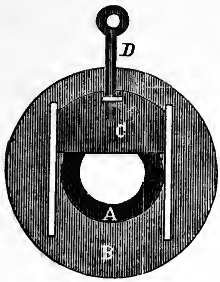
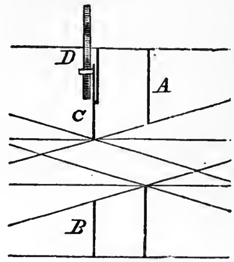


Fig. 54.



A simple slide in front of the ordinary diaphragm, answers a very good purpose.

The distance between this slide and the diaphragm depends much on the size of the diaphragm, and also on the width of the angle of the lens.

Fig. 53 gives a front, and Fig. 54 a side view. In the former, *A* is the ordinary diaphragm; *B*, a plate for holding the slide; *C*, is the slide, worked up and down by means of the screw, *D*, outside of the lens-tube.

In the case of another lens, the diameters of the stops were found to be $\frac{15}{64}$, $\frac{18}{64}$, $\frac{3}{64}$, $\frac{26}{64}$, $\frac{36}{64}$, of an inch.

The squares of the numerators of these fractions are respectively 225, 325, 529, 676, 1296.

To be in the ratio of one-half longer exposures, these numbers, starting with the first, should be 225, 337, 505, 757, 1135.

It will be observed, that after the first three, the differences are material, and that throughout they are sometimes on the side of longer, sometimes of shorter exposure.

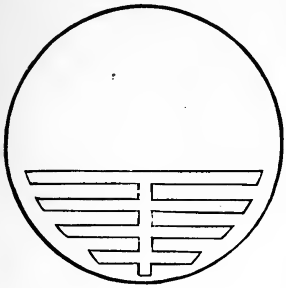
If these relations of stops to focal lengths were stamped on the diaphragms, photographers would soon get into the way of taking them habitually into account, and of expecting a certain defining power with an *f* 20 stop, and so on.

If any one will be at the pains of looking at the information given as to exposures, with the processes of the last few years, he will perhaps be surprised to find how wholly useless and indefinite it is in the great majority of cases. And when it is considered that this is further complicated by the uncertainty of the light, it will be felt that the information given is just nothing at all.

But if a writer tells us that his process receives a proper exposure by 25 seconds of good light and an *f* 20 stop, we at once get a good conception of what is the comparative sensitiveness of his method.—M. Carey Lea.

18. Mr. M. Carey Lea and Mr. Thomas Sutton have both suggested other forms for the same object. Mr. Lea's plan is this, Fig. 55. The figure drawn inside of the circle, which indicates the size of the lens, represents a set of narrow parallel bars connected by a transverse bar. This is cut out of soft, dark blotting-paper, not sized paper, and is attached to the lens itself, with the aid of a little paste. It is used upon a view lens, the lower half of which it thus partly covers. The bars must not be too wide nor too near together.

Fig 55.



Their proper size will always depend upon that of the diaphragm with which they are used; each bar and each space between two bars must be less than half the diameter of the stop used, otherwise a shadow will be produced, and will show itself on the ground-glass and in the negative. When this cross-barred diaphragm is properly made and properly applied, it does not appear at all upon the ground-glass, and its effect is only to diminish largely the illumination of the sky.

Mr. Sutton's invention has several advantages.

The idea is simply that the plate in which the stop is pierced, shall be

18. Many are disappointed in the small amount of information obtainable regarding exposures.

This can be easily remedied by representing the size of our stops in terms of the focal length of the lens.

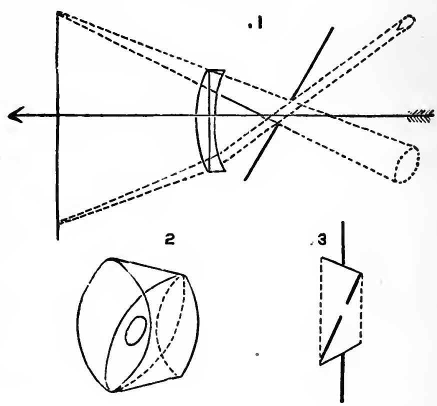
Expressing the size of the stops by their diameters, as is frequently done, is only misleading; and unless the focal length is given is of no practical use.

A half-inch stop, used on a lens with an equivalent focus of twelve inches, would require four times the exposure that the same stop would require on a lens of six-inch equivalent focus. As the rapidity of lenses is controlled by their equivalent focal lengths, and also by their apertures, no "scientific" or "universal" system of stops can be made, except one based on these two elements; the ratios between the areas of apertures and duration of exposures having been determined by careful experiments. In order to correct a very general misunderstanding regarding what is called equivalent focus and how it is obtained, it may be advisable to state that the expression is used in connection with compound lenses, and means a focus of some distant object equal to that produced by a single plano-convex lens, with the plane side toward the object, producing an image of the same distant object of the same size. In the case of the plano-convex lens, we can easily measure its focal length by measuring the distance from the image on the ground-glass to the convex surface of the lens. In compound lenses, however, this will not give us the true focal length, but what is usually called the "back focus." The *inclined*, instead of being, as usual, at right angles with the axis of the lens. Thus, the beam of light admitted from the foreground corresponds with the full size of the diaphragm, whilst that from the upper part of the picture is greatly reduced in size. The inventor calculates, that by inclining the stop at an angle of 35 degrees, the proportion of light admittted from the foreground will be four times that from the sky.

Thus, the sky portion of the picture is kept back, and time allowed for the foreground to impress itself.

The mechanical contrivance to effect this object, consists of a tube of metal slightly conical, and of a size to pass by its smaller end into the largest of the stops, and by reason of its conical form, to catch fast when passed half way up. Inside of this conical tube is a piece of metal which occupies an inclined position, and in it an opening is made of such size as is judged proper; it should have the same diameter as that of the stop with which the lens is most commonly used, or may exceed this by a little.

Fig. 56.



In Fig. 56, 1, the inclined stop is seen, and the much larger beam that it admits from below than that from above. (By a mistake of the engraver, the larger beam has been made conical, to the right of the lens. Its sides should, of course, be parallel, like those of the smaller beam.) In Fig. 56, 2, the conical tube is seen with the inclined plate and the opening of the stop cut in it. Fig. 56, 3, is a section of the same when set in place.

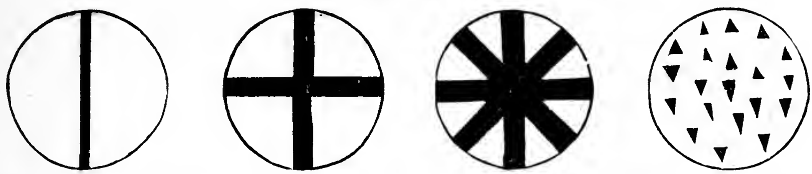
equivalent focus of a compound lens is the distance from the image on the ground-glass of some very distant object, to a point within the lens called the centre of emission.

This point is obtained by a formula based upon the radii of the curves of the different lenses, and the refractive power of the materials used in the lenses. Fortunately it is not necessary for us to use the formula, for the equivalent focus of any form of lens can be easily obtained in the following manner:

Mark two perpendicular lines on the ground-glass equidistant from the centre. Set the camera on a sheet of paper and focus on some point in a very distant object. Move the camera so that this point will fall upon one of the lines on the ground-glass. Draw

The inventor suggests a second advantage, that even when it is not desired to attempt clouds, or when there are none to attempt, it may frequently happen that if we suppose the view to be divided by a diagonal line, one of the parts will be much less illuminated than the other, and tend to produce too great a contrast in the negative. In such a case, he would propose to turn the stop round to an angle of 45 degrees. Thus, of the light coming from the less illuminated part, a much larger proportion is admitted, and a useful approximation to equalization is obtained.

FIG. 57.



Disks of tin foil or ferrotype plate may be cut similar to the designs represented in Fig. 57, and placed at the back of the lens; and though largely increasing the exposure, the use of such has been found in portraiture to secure a much rounder figure. This is easy to understand.

19. Mr. M. M. Griswold, some time ago, suggested an "illuminated" stop,

a pencil along the side of the camera, ruling a line on the paper underneath. Now partially rotate the camera on a centre passing through the centre of the lens, until the point falls upon the other line on the ground-glass, and draw another line on the paper. Extend these two lines until they meet. Bisect this angle with a line upon which you erect a perpendicular equal in length to one-half the distance between the two lines on the ground-glass. Connect the top of this perpendicular and the bisecting line with a line parallel with the side of the angle. The distance from the point where this line touches the bisecting line to the foot of the perpendicular is the absolute focal length of the lens used.—C. W. DEAN.

19. The object in focussing upon a very distant object is that we may obtain the focus from parallel rays. This focus is represented by f, and of course is entirely different from the focus of converging rays from an object near the lens. A practical fact regarding the equivalent focus of the lens is that it controls the size of the image; that is, two lenses of the same equivalent focus, when focussed upon any distant object, will produce images of the same size. A lens having twice the focal length of another, when placed in the same spot and focussed upon the same distant object, will produce an image having twice the linear dimensions of the image given by the first. Having obtained the equivalent focus of the lens, we can designate our stops in terms of $\frac{f}{1}$ by means of a fraction, the numerator of which is equal to the diameter of the stop, and the denominator is equal to the equivalent focus of the lens. Reducing this fraction to an equivalent, one

by the use of which he accelerated the exposure of the negative. He made it of photographic paper, rendered translucent by castor oil, and substituted it for the ordinary diaphragm. By experiment he found that red was the best color for the paper stop, and by using such a stop he diminished the exposure very materially, without increasing the size of the stop, and without any detriment to the sharpness of the image.

Photographs made with the illuminated stop have no harsh contrasts, but fine detail, and a tendency to great softness.

The necessity of quickly changing the diaphragms has excited the inventive genius of some of our opticians, too. Mr. Schnitzer devised one composed of six wings which opened and shut toward a common centre. Some of the recently invented "drop shutters" are upon the same principle, and serve both as a shutter and as a stop. As a rule, the holes are not round. Mr. Joseph Zentmayer's adjustable diaphragm gives a round aperture. It consists of two rollers of the same diameter, geared together by delicate cog-work, so that they revolve upon each other. On each roller, in a plane perpendicular to the axis, a tapering semicircular groove is cut, the corresponding parts of each groove

whose numerator is unity, we have a fraction which means that the diameter of the stop is one-eighth, one-twentieth, or one-fortieth, as the case may be, of the focal length of the lens.

To show that this focal length is the one from parallel rays, the fraction is usually written $\frac{f}{8}$, $\frac{f}{20}$, $\frac{f}{40}$.

Having marked our stops in terms of their focal length, we can approximately determine the relative duration of exposure required by each by remembering that these fractions represent the diameter of aperture whose areas are to each other as the squares of these diameters; and that approximately the duration of exposure is inversely as the areas of the stops; for example, to ascertain the relative time required by two stops, $\frac{f}{10}$ and $\frac{f}{30}$, the area of the first can be represented by $(\frac{1}{10})^2 = \frac{1}{100}$, and the second by $(\frac{1}{30})^2 = \frac{1}{900}$. This shows that the first stop is nine times as large as the second, and requires approximately one-ninth the time for exposure.

The same result is obtained by dividing one fraction by the other and squaring the result.

While the above rules will assist us in obtaining correct exposures with the different size stops, an equally important question is, "Which stop shall I use?" Up to certain limits, the smaller the stop the greater the sharpness, depth of focus, and size of good picture obtained. The small stop, however, produces a map-like effect, and tends to harshness of contrast and to diminish aërial perspective.

Some opticians say that the diameter of the smallest stop should never be less than one-twenty-fifth or one-thirtieth the focal length of the lens. On the other hand, the larger the stop (if correctly exposed) the greater the amount of detail in the shadows, and the bolder the picture, and the greater the amount of "atmosphere."

being opposite. Then, by revolving the rollers, the circular opening formed by the contact of the two tapering grooves enlarges or contracts, depending upon the direction in which the rollers are turned, the rollers being so accurately set together that no light can pass, except through the diaphragm. The motion is so gradual, that unless some form of index is used, it would be next to impossible to twice obtain exactly the same size of opening.

Fig. 65.

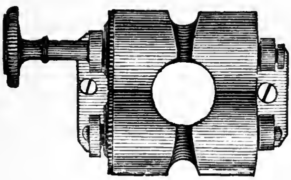
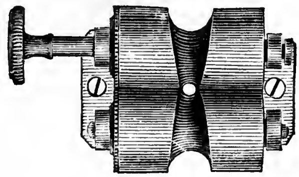


Fig. 66.



Applied to the microscope, this plan answers perfectly. Used as a diaphragm in double combination photographic lenses, it would, in some cases, be objectionable, although of advantage in single-view lenses. The cause of difficulty is, that the diaphragm will not remain permanent in the same plane.

In the chapter on "Exposure," further help may be had in this matter.

Probably the best rule to adopt is to use a stop small enough to give sharp definition at the edges of the picture, and no smaller. To secure uniformity in our work, and enable us to aid each other in answering that vexing question, "How long shall I expose?" I would suggest that the stops be marked in terms of $\frac{f}{}$, and also with a figure representing the approximate relative value of the stop as compared with the full opening of the lens with which it is used. For example, a stop marked $7\frac{f}{22}$ would mean that the stop requires seven times the exposure of the full opening of the lens, and the diameter of the stop is equal to one-twenty-second of the focal length of the lens.

As most of us use lenses working no faster than $\frac{f}{7}$, the adoption of the "universal" system, based on $\frac{f}{4}$, would necessitate an amount of mental arithmetic which some of us might consider tiresome. In this system, the first figure would show the relative exposure as compared with the other stops; while the fraction would show the rapidity of the lens as compared with other lenses.

By adopting this system, we are able to obtain correct exposures with any lens, regardless of the maker or its form.—C. W. Dean.

Always use the largest possible stop in order to secure vigor, roundness, and atmospheric effect in the picture. A small stop produces sharpness, but at the expense of the foregoing essential qualities. As a rule, focus for some prominent object in the foreground, or upon that which is to constitute the point of interest in the picture. Do this with a medium stop, then insert the next, or the next but one smaller, sufficient to prevent objects not focussed upon appearing too much blurred.—J. H. Dallmeyer.

CHAPTER VII.

GLASS-HOUSE CONSTRUCTION.

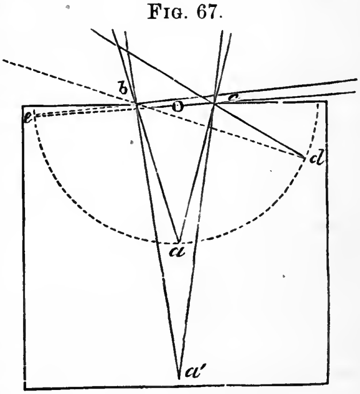
20. As our art progresses, more and more interest seems to be taken in the construction of the glass-house. How to secure the best mode of lighting the model, and how to construct the atelier, have become quite as important questions as what lenses or developers are best. The idea that "*any* room with a top or side light in any convenient locality and direction is good enough for making pictures," is exploded, and there is a growing desire among artists to find out the best way to construct their lights in order to secure the best results.

The thing of first importance is to select the locality for the glass-house. This should be done with much care. One should not disregard the fact that

20. If we wish to find out how much light there is at any given point in the glass-house, we only need to determine how large a piece of the sky illuminates this point.

If we take, for instance, a room like the annexed figure, inclosed on all sides by a wall and on the one side a window *b c;* if we take further different points in the room, as *a, d, e, a′*, then the amount of light which any one of these points receives, will be proportionate to the distance and position in regard to the window. The point *a′*, which is more distant from the window, will appear darker than *a*, and *a* will again appear lighter than the points *d* or *e*, which are the same distance from the window, but not opposite to it.

Fig. 67.



If we wish now to find out positively the amount of light which a certain point receives, it will be necessary to draw lines from this point to the corners of the window *b* and *c;* the angle which is thus formed, or the angle of light, gives a criterion of the size of the piece of the sky which illuminates this point. Following this construction, a glance at the figure will show that the angle of light which we obtain for *a′* is smaller than for *a*, and again, the angle at *a* is larger than at *d*, and *d* again larger than *e*. If we take a point on the wall containing the window, the angle will be reduced to a line. Such a point would, therefore, be absolutely dark, if it was not illuminated by reflection from the wall.

the *quality*, and not the *quantity* or *intensity* of the light, is the great requirement to be sought for. A strong light produces unpleasant and inartistic shadows, and contracts the features of the model. Consequently, the direct action of the sun's rays and all reflections from adjacent buildings should be avoided

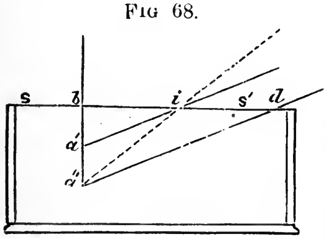
21. Having then secured a proper place, how shall we build the glass-room? One part should be open to the north, another to the east, a third to the west, and the south side should be closed. In many cases it will be found impossible to have a side light; but if this be so, care should be taken that the inclination of the top light is toward the north. It would be better to elevate the room, even a story higher, to get one side light at least. In fact, it is almost a necessity that the model should face the north, in order that there need be no contraction of the features by a too powerful light. Even should a dark wall be at the north of the room, the sitter should face it or nearly so, and the south should be obscured.

Fig. 69 is a diagram of a typical American glass-room. It has proved to be one of the very best arrangements and a safe model to go by. The view given

For small windows, we have the law that *the illumination of a point is at the inverse rate of the square of its distance from the window.*

When the window is larger, the light does *not* decrease with the same rapidity. At first sight these principles will appear as mere theoretical trash; I shall, however, endeavor to draw some practical conclusions from them. I take a glass-house, the glass-side of which, *S′ S*, admits of being closed by curtains; I take, further, a point *a′*, which receives, through an opening in the curtain *b i*. just sufficient light for taking a portrait, then *b a′ i* would be the angle of light for this point.

FIG 68.



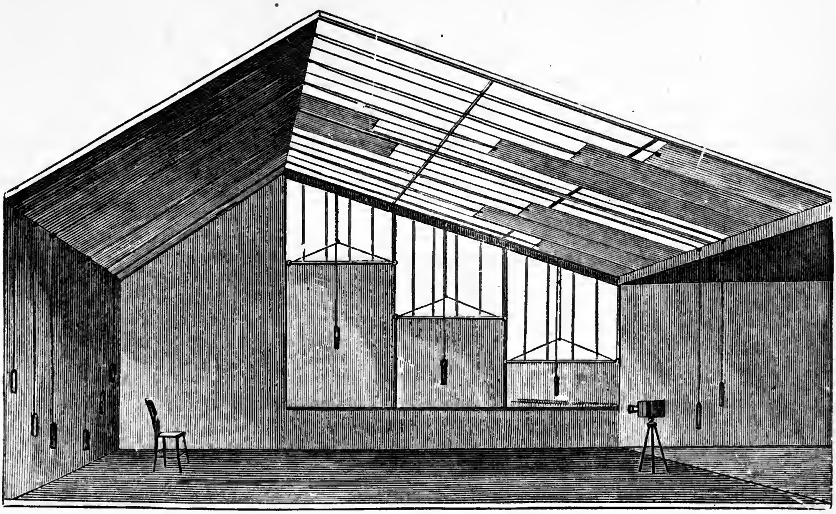
If I take now a second point *a″*, to which I desire to give the same amount of light, *without being able to move the spot from its place;* in this case the angles of light *b a″ i* would be much smaller, and, in order to obtain the same amount of light for *a″* as for *a′*, the opening in the curtain would have to be enlarged until the two angles coincide.

I have met with many photographers who do not even understand these simple and easy rules, and who vainly attempt to take pictures at *a″* in the same time and with the same effect as at *a′*.—DR. H. W. VOGEL.

21. There is more *art* in *lighting* the model than most are willing to concede. A mild, soft light is what is required. A strong illumination produces shadows of great intensity, and often contracts the features of the model. This is why some people complain that their pictures make them look older than they really are.—GEORGE H. FENNEMORE.

of it is from the east side, thus showing the arrangement of the top and one side. Of course, then, the side we see is the west side; by the chair we observe

Fig. 69.



where the model is placed, and the camera and stand point out the space near which they are used. The dimensions of the room are as follows:

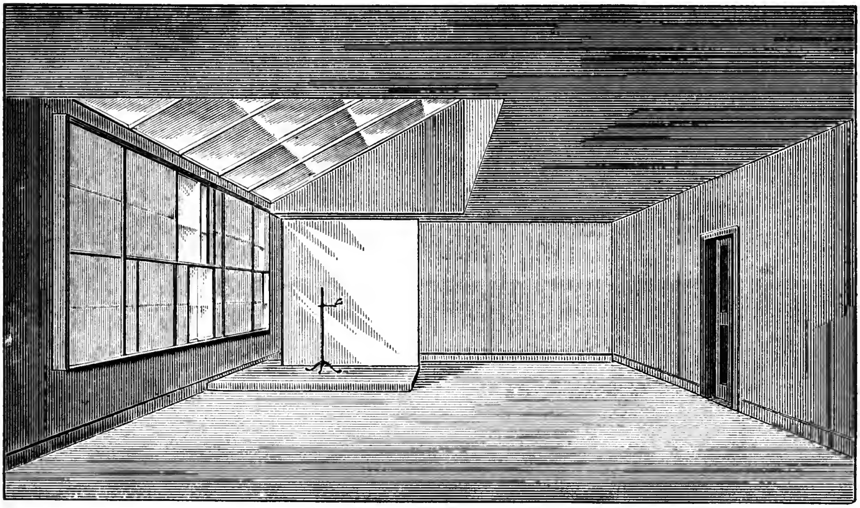
Width of side light	13 feet.
Height of side light at the lowest point	6 feet 10 inches.
Height of side light at the highest point	11 feet 9 inches.
Distance from the floor to the bottom of the side light	14 inches.
Width of the top light	17 feet 6 inches.
Length of the top light	15 feet.
Depth of the room as shown in the diagram	32 feet.

It will be seen that instead of blinds, curtains or shades are used to modify the light at the top and on both sides. By a proper arrangement of weights, pulleys, etc., they are made to change the light as the operator may desire. If the light be too strong from the direction of the top or side, the curtains are drawn so as to soften the shadows, and secure such relief as is found requisite. These curtains can be raised or lowered to any extent; so it will be seen that by their use almost any modification of light can be secured. They may be made of blue or white muslin, and therefore admit only the kind of light needed. Experience must teach the proper use of them. On days when the sun shines directly upon or in the room, the whole of the curtains should be drawn over, and at other times they may be arranged variously, somewhat as they appear in the diagram.

22. Where an extensive business is done, and the floor is large enough, a studio like this could be divided by a heavy curtain, and thus two complete skylights secured, one with an east side light and the other with a western exposure. The advantages of such a plan are obvious.

Where the construction cannot be as above, much the same advantages may be had by adopting a modification of it. In Fig. 70, the top and side light

Fig. 70.

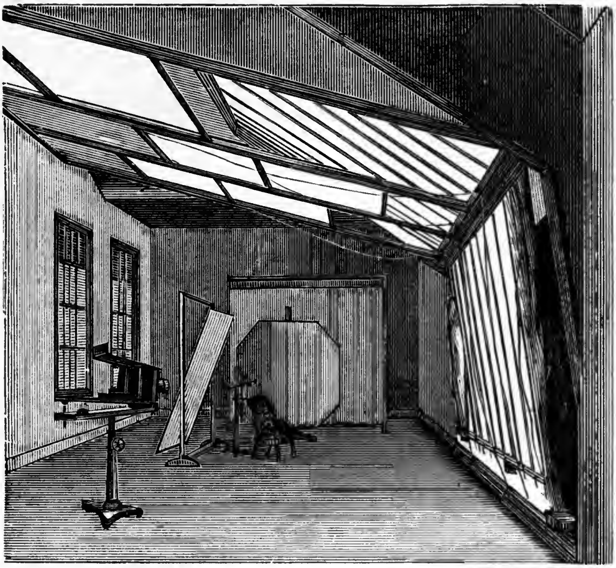


are both from the north, and the room is so planned that the background may be used in the east or in the west, at will. The models shown are quite low, and formerly, when wet plates were most used, this was an object, because it accelerated the exposure.

22. Every portraitist of experience knows very well that the best results are got in diffused light, not direct, and that is obtained from the front, top, and side lights, or the farthest *corner* through which the light is admitted, no matter whether the gallery has a flat, or span, or side sloping roof. Direct top light is wrong, likewise direct side light. In studios built with side light only, the best, or, rather, the most pleasing pictures are made by placing the model on one side of the background, the farthest from the source

23. A more diffused light may be obtained by a higher construction, but its use also requires a higher degree of skill. The plan represented in Fig. 71 is engraved from the studio of Mr. J. H. Kent, Rochester, New York. It will

Fig. 71.



be seen that the side light leans or is inclined somewhat, a plan by which Mr. Kent believes he secures advantages in grading the light upon the lower draperies and accessories. Mr. Kent uses the handscreen to modify the light during exposure. This is explained in the next chapter.

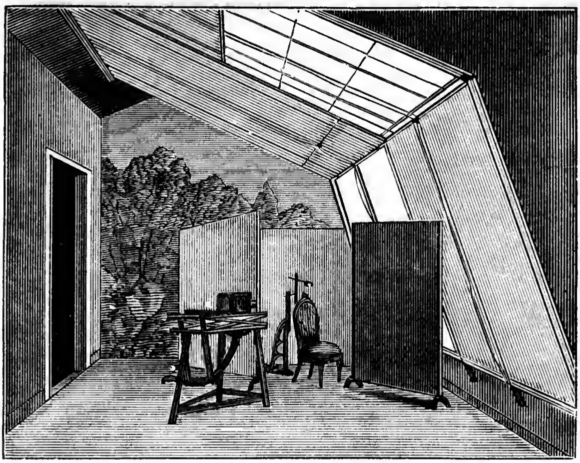
of light; those with top light only, by shading the sitter over the head. An operator once said: "We take sitters from the front, *therefore the front should be the* PREDOMINANT LIGHT." Another operator said: "I should put it thus: *therefore* we want the predominant light from the side. People do not take a landscape or a building with the sun plump behind the camera."

I say that depends upon circumstances; it is convenient (and I speak from much experience) at times to get the sun "plump behind the camera."—David Duncan.

23. A top side light is the best combination. The most common error in skylights is the height. In many cases this is from choice, as high lights have their advocates, who sustain them from theory rather than from practice; in many others it is from necessity arising from the construction of the building, which cannot be altered. But a photog-

24. Mr. James Landy, Cincinnati, Ohio, inclines his side light still more, and uses it variously as a top, side, and even front light, according to the subject in hand. It is peculiarly adapted for "shadow" and "Rembrandt" effects, ana for "statuary" pictures as well. With a well-constructed skylight in the top of the operator's cranium, such a studio construction will help to almost any sort of lighting the heart could desire. (Fig. 72.)

FIG. 72.



The dimensions of this studio are as follows: Length 40 feet, width 25 feet, top and side light, each 12 feet wide. The side light reaches to within 2

rapher had better reject a location altogether than accept it with an unfavorable light, for success depends upon that more than upon any other part of the gallery.

The loss of light, which is the principal objection to a high skylight, may be compensated for by making the light proportionately larger. As, for instance, suppose a light sixteen feet square and eight feet high above the head of the sitter; the latter would receive the same amount of light above an angle of forty-five degrees as under a light twenty-four feet square and twelve feet high; but place the sixteen feet light at the height of twelve feet, and there will be a loss of fifty per cent. in the amount of light admitted to the sitter.

Thus it is clearly to be seen, as all practice proves, that a high light will work slow compared with a low light of the same size.—R. J. CHUTE.

24. Fig. 73 is a longitudinal section of an ordinary ridge-roof studio, 30 feet long, 9 feet high to the eaves, and 5 feet from level of eaves to ridge, making in all 14 feet. Six feet from the background, over the head of the model, is opaque. The skylight is 10 feet long, and the remainder of the roof is opaque. *A* is the model, 6 feet high, and the

feet 6 inches of the floor, stands at an angle of about 25 degrees, and is 10 feet high. The top light is 20 feet long, and inclined at an angle of 40 degrees. In a skylight of this construction one may obtain almost any effect desired, especially when helped by the appliances which are suggested further on.

dotted lines *B B* drawn from his head and feet, and cutting the roof at the extreme ends of the skylight, show the quantity of "direct" light he is capable of receiving from that

Fig. 73.

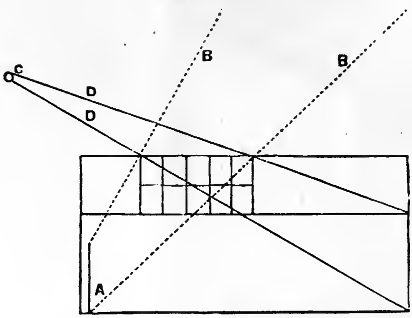
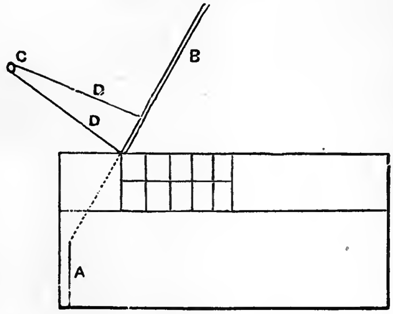


Fig. 74.



source; *C* is the sun, who very unceremoniously floods the camera end of the studio with his rays (*D D*), tormenting the unfortunate operator almost beyond endurance. A quantity of light also descends vertically into the room.

Fig. 75.

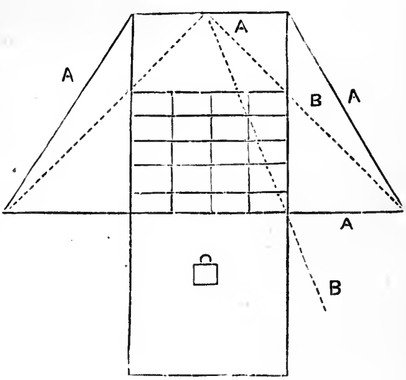


Fig. 74 is similar to Fig. 73, with this exception, the dotted line *B*, from the head of the model, through the skylight, which was only imaginary in Fig. 73, has become an opaque sunshade, or shield, which effectually prevents the sun from entering the studio. As it is carried up to a point exactly above the extreme end of the skylight, it also cuts off the whole of the vertical rays which fell upon the floor, and being reflected in various directions, do their best to destroy the brilliancy of the picture; in fact, a number of the obnoxious "jets" are extinguished without in any way interfering with the direct north light which still falls upon the model at the same angle as at first.

If this method of lighting is good for the skylight, it is also good for the side lights (I mean windows in the sides of the studios). Shade these in the same manner, being careful not to interfere with the direct north light, and the lens, no longer having to

25. In some of the colder sections of our country, where snow is plentiful, a cone light is used. Such a plan is described and illustrated in *Wilson's Photographics*. Another method, adopted somewhat in Canada, is to use a flat top light inside.

Fig. 76.

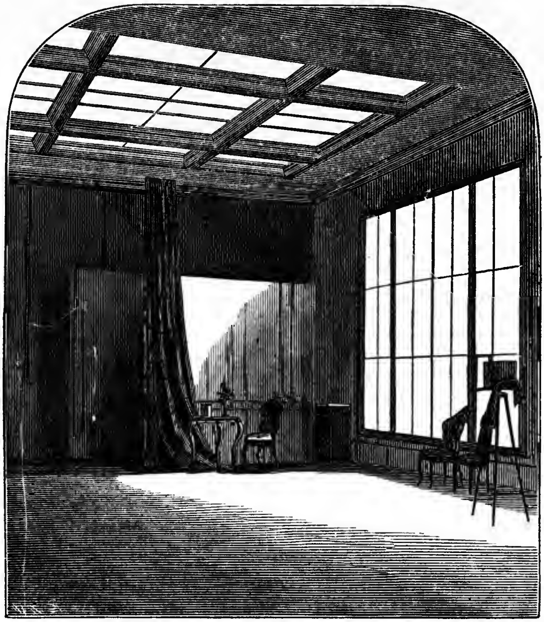


Fig. 76 represents a skylight which is 50 feet long, 20½ feet wide, and 14 feet high from the floor to the flat light above. The side light is 10½ feet

fight its way through a fog to get at the model, will gratefully express its sense of relief by the increased brilliancy of the image projected upon the plate.

Fig. 75 shows the shape of the roof shield (*A A A A*), and also the angles of the side shields and their distance from the house. These may commence at the south end of the studio, or at the junction of the dotted lines with the skylight. *B B* show the angle of direct side light falling upon the sitter to be exactly the same as if the shields were not there.

To carry this plan out in its integrity, a plot of ground 37 feet by 30 feet would be required. Where this is not available, the top shield alone may be used.—R. A.

25. Having had some recent experience in working a high side light, I was much pleased with the results secured by it. It was about twelve feet square, and situated due north. I ran a blue, opaque curtain across the bottom, so that the top of it was about

high, by 15 feet wide. The flat top light is 15 feet square. Over this flat light there is a sloping top or roof light, 15 feet wide, and about 13 feet deep. As the slope is rather steep, and there is snow upon it much of the time, the flat light is introduced to prevent leakage during the melting season. The studio stands due north, and both ends of the room are used.

26. In Europe one finds much less attention paid to skylight construction

four and a half feet from the floor. Above this were two breadths of white muslin curtains, running on wires so as to be readily adjusted to the requirements of the light or sitter. On the shadow side I placed a screen of a light neutral tint, which being moved near or far from the subject produced the desired effect. In addition I ran a white curtain on a wire across this side screen, at about the height of the sitter's head, for the purpose of lighting up dark or tanned faces. This light for single heads I found to work remarkably well, producing negatives as well lighted and of as fine modelling as could be produced under most of the combination lights.—R. J. CHUTE.

26. Beware of too much light. The reflections from a variety of objects, and the light from a mass of illuminated atmosphere reaching the lens, instead of the light only from the objects forming the picture, must necessarily tend materially to destroy brilliancy.

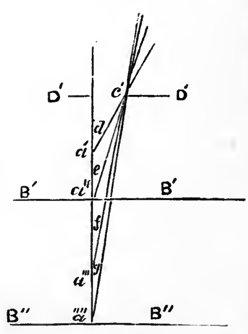
There are many ways in which the lens can be protected from false lights. Many persons inclose the camera in a travelling dark-room. Others use a cone in front of the lens, projecting about a foot. Mr. Robinson, in his admirable article on the "Glass-room," provides for the light chiefly reaching the sitter, but he also employs such a cone as I have described. Some photographers darken permanently one end of the dark-room, and some even resort to the use of an unsightly tunnel.

Every studio should possess ample facility for removing all unnecessary light, without in any way interfering with comfort and elegance.—G. WHARTON SIMPSON.

Another query: Which is most practical for portraiture—a high or a low glass-house?

Suppose *D* (Fig. 77) is the glass roof, with an opening *c*, at a distance of about twelve feet from the floor *B B′*; *a′ a″* is a standing figure; then the angle *d* and *e* would determine the quantity of light which head and feet would receive through the opening *c*; if we now take a glass-house of twice the height, *i. e.*, the floor at *B″ B″* and the figure at *a‴ a⁗*, then *f* and *g* are the corresponding angles of light; a glance at the figure will show (still better a simple mathematical consideration) that the angles *f* and *g*, and *d* and *e*, differ very slightly, and hence, it follows, that in a very high glass-house, head and feet receive nearly the same amount of light, and a person is evenly illuminated from head to feet.

FIG. 77.



The difference in a low glass-house is much greater; then the difference between the angles is more noticeable, and the angle *d* at the head is larger than the angle *e* at the feet. The question is, Which is the most profitable?

In a portrait the head is undoubtedly of first importance; it ought to receive the principal light, and all the other parts can be kept in a half light; for portraiture, than in America. One of the reasons for this is because of the crowded quarters with which the photographer must be content in many localities. Many studios are in the form of *an annex* to some great structure—a hotel, for example, and on the roof.

One of the best models is that of Mr. Charles Reutlinger, the veteran Parisian photographer. It will be gathered from the description that it has many disadvantages. (Fig. 79.) The studio is exposed to the north, is quite

therefore, a low glass-house is preferable, and celebrated photographers, like Reutlinger, Salomon, etc., have glass-houses of from 10 to 12 feet high.

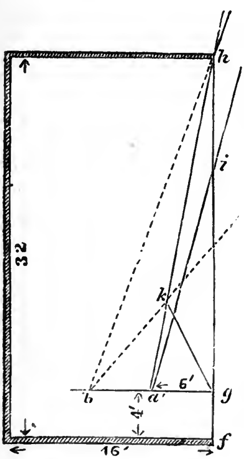
Pictures taken in high glass-houses appear, very often, from head to feet, flat and monotonous, unless particular precaution has been exercised.

The practical conclusions which can be drawn from the above, go still further: I can prove that an excessively long glass-house is of as little use as an excessively high one.

I start with an example. The glass-house of my friends, Loescher & Petsch, is 32 feet long by 16 feet wide, with north front. (Fig. 78.)

Suppose 5 feet from the glass side and 4 from the back, we place a person *a*; the whole side is open, except immediately alongside and behind the person *f g*; we will have a criterion of the amount of light, by drawing the lines *a g* and *a h*, that is, we construct the angle of light *g a h*.

Fig. 78.



If the glass-house, instead of being 32 feet long, were only 24 feet long, *i. e.*, if it stopped at *i*, then the amount of light would be determined by the angle *i a g*, all other circumstances being equal. The figure shows that the difference between the angles *i a g* and *h a g* is small, or, what amounts to the same, that in this particular instance the lengthening of the room by 8 feet (the piece *i h*) is of no advantage.

If we imagine now, instead of the long glass side *g h*, another inclined one, *k g*, of only 8 feet length, the angle of light *k a g* will then be exactly as large as the angle *h a g*, or, which is the same, *the small side of only* 8 *feet will give as much light to the person at a, as the long side of* 28 *feet.*

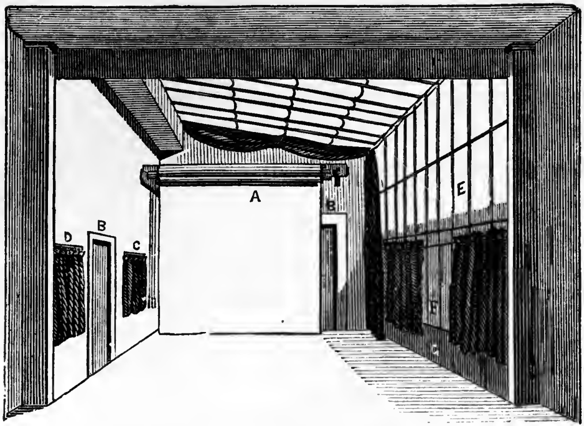
According to the above, the long side of 28 feet can be replaced by one of 8 feet, when we propose to take the portrait of a person at *a*. In the same manner I can replace the long glass roof of 28 feet by an inclined one of 8 feet length.

When I construct a glass-house now with inclined sides and an analogously inclined roof, I will obtain a room which, to the taking of single portraits, is as well adapted as one of 28 feet in length. Such a glass-house would have the form represented in Fig. 80.

I do not mean to say, however, that it follows from the above that the construction with inclined sides is perfect. On the contrary, such a construction has some serious drawbacks.

plain, and is 30 feet long by 15 feet wide; but of the length only 16 feet are of glass; the balance is a small room, which was added to give it more

FIG. 79.



length. The glass side is 9 feet high, and is divided into three parts. 1st. The lower part, *G*, is a wall $1\frac{1}{2}$ feet high. 2d. The middle part, *F*, 4 feet high, is of stained glass. 3d. The top, *E*, $4\frac{1}{2}$ feet, is of common white glass.

A glass-house like the one described in Fig. 80, with sides inclined, would do very well for taking single portraits. The side wall should face north. But the case is entirely different when we wish to use the whole space for taking groups.

FIG. 80.

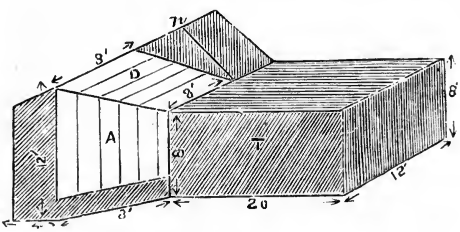
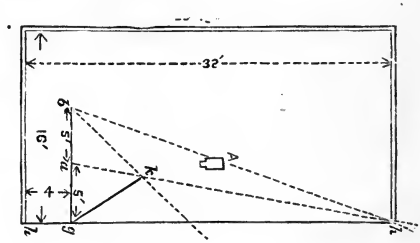


FIG. 81.



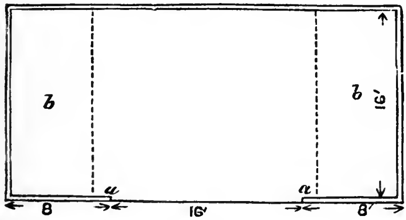
Suppose we wish to take the portrait of a person at *b*, Fig. 81, in an ordinary glass-house, twice as far distant from the glass side, as *a*; by measuring now the angle of light, and drawing the lines *b h* and *b k*, we will find the quantity of light which the sides *g h* and *g k* will give at the angles *h b g* and *k b g*; it is evident that the angle *h b g* is much larger than *k b g*, and consequently the illumination of a point distant from the

The whole roof of this is made of stained glass. To guard against the strong rays of the sun in summer, a blind over the whole length of the roof is used which has a height of about 5 feet, and is managed by a crank inside of the studio. Besides, there are inside six different screens or curtains of blue calico, to shade the light from the top, and also to guard against the reflection of the sun from the houses opposite. There is only one side where one can sit the model; and it is only when they sit for small vignettes that one can place them on the other side, on account of the shortness of the studio. This accounts for all Mr. Reutlinger's productions being lighted from the same side, which is very troublesome with a great many subjects. Another inconvenience is the small width. For this reason, he is unable to have his backgrounds on frames, as is usually the practice. He uses rollers, which are let up and down, with balustrades, chimneys, columns, etc., as auxiliaries. We see by this, that the greatest caution and order in the small remaining space is necessary for the posing of persons, and many outsiders are astonished that so many pictures are made in such a small, insignificant room.

In Amsterdam, Mr. P. A. Mottu has erected an elaborate studio, supplied with all manner of inside screens, shutters, and blinds. (Fig. 83.) This is a double studio, again divided, when in use, by heavy drapery. The plan of

inclined side, *k g*, in a glass-house facing north, is much more favorable than in the smaller one, which gave for *a*, for a single portrait, the same amount of light as the larger one. In the small glass-house we are confined to the small space in the neighborhood of the glass side, while, with a glass-house the front of which faces north, we can spread in depth, and have the advantage which it offers for taking groups and making artistic arrangements.

FIG. 82.



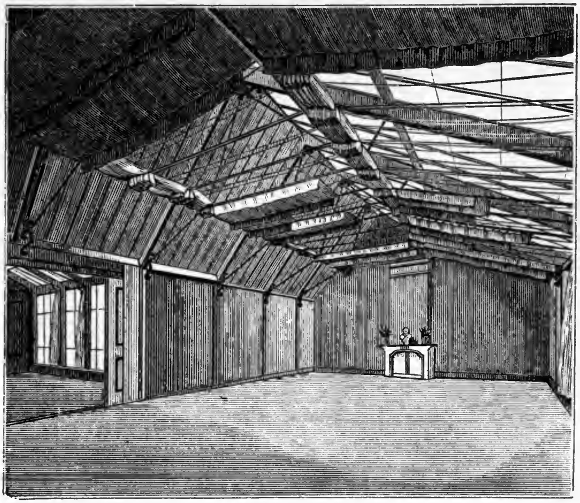
Artists will always give the preference to a north-front glass-house.

I might carry out the above still further, but I think the explanation of the principles of illumination will be sufficient.

To anyone who wishes to construct a north-front glass-house for small work, I would recommend the annexed plan (Fig. 82). It represents a space of 32 feet long; the middle, *a a*, is glazed for a space of 16 feet; depth, 16 feet; height, front, 10, and back, 15 feet. The space *b b* is dark, and serves for moving back the apparatus. If only one person is to be illuminated from one side, as Reutlinger does, a space can be partitioned off and used for other purposes.—DR. H. W. VOGEL.

curtaining and arranging the inside blinds may be useful, though perhaps unnecessarily elaborate.

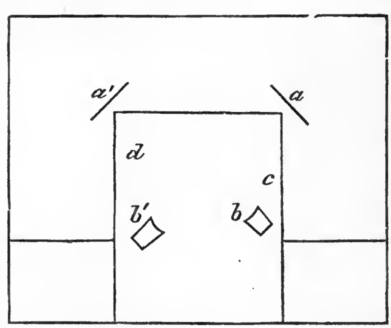
FIG. 83.



27. The most exasperating light of any is the one with only a *south* exposure. The sun reaches it nearly all day during the summer, and in the winter

27. I have worked a light, not quite south, but so situated that it received the sun all the forepart of the day. From my experience with that light I would suggest opaque curtains under white muslin, so as to *exclude* the light from such portion as may be desired, by arranging the opaque curtains so as to open or close different parts of the light.

FIG. 84.



Any drab or slate-colored material may be used, and can be put up conveniently and at little expense, by running them on wires, laterally across the light. The sitter *must* be placed *in* the light, not away to one side of it.

The following amendments to the diagram (Fig. 84) will illustrate the best method of working. Place the sitter on the lines *a* or *a′*, as may be desirable for the sitter, with the camera at *b* or *b′*, and arrange the curtains by the directions given in *Bigelow's Album*, for such effect as you wish to produce.

Placing the sitter fronting the light, or the sitter and camera on a line with the light, cannot, in the nature of things, produce good work under any light. Notice a view made with the sun directly behind the camera and it is available for fewer hours than any other. Avoid it, if possible. The drawings and notes will be useful. In a south light the sitters are usually placed at *a* or *a*, and the camera at *d* or *d*. A standing figure or group gener-

Fig. 85.

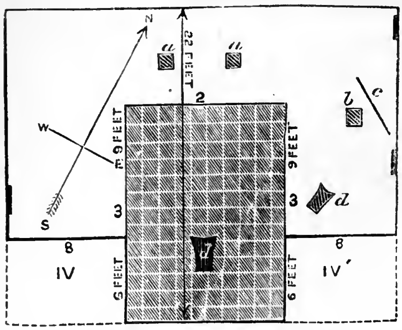
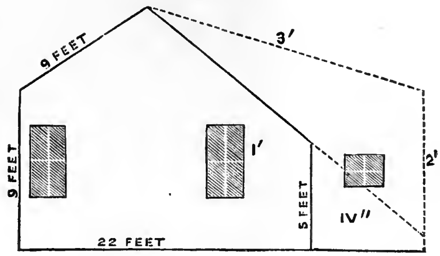


Fig. 86.



ally to the right. At *b* place the sitter for a shadow or Rembrandt effect, *c* being a Bigelow background.

I also add a horizontal view. (Fig. 86.) The difficulties are apparent.

see how flat and insipid it is. Notice another of the same subject, with the sun at right angles, or nearly so, with the view, and see the boldness and relief. This is just as applicable to portraiture as to landscape photography. If we would have form and modelling, the light must fall *around* the sitter, and come mainly from one side.—John L. Gihon.

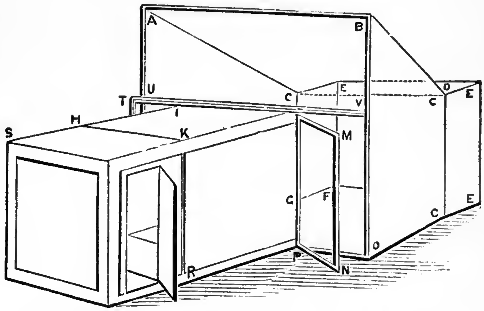
I have concluded to give my experience of running a south light. My top-light is about 10 x 15, side-light about 8 x 15, with a pitch of about two feet from the highest part of the top-light to the top of the side-light. I have six curtains on my top-light, divided in the centre, so that I can slide them either way, as they run on wires, without being held fast at either end. My side-light has ten shutters, which can be opened separately or all together, if the light is weak; and, lastly, my glass is pretty heavily blue-frosted.

I place the model under the centre of the skylight and draw down all the curtains and shut off the side-light. Now there is no light at all on the subject or at least a very subdued one. I then open my last side-shutter, which is about four feet from and in the rear of the sitter, and light up the side of the head and top of the forehead, and this manner of lighting also throws a very soft effect back of the head, giving detail to the hair and rounding the figure up. Now we find that the shadows are a little too strong on the other side of the face, and to remedy this I draw back the left half of my first or second curtain (I am now supposed to be facing the sitter), according to the time of day, enough to give the desired effect, and use no side screen (which I consider spoils the effect of every picture in which it is used).

This way of lighting, which was new to me, I found out by accident, by being compelled to make a sitting late in the evening. I opened the back side-light in order to

28. Allusion has been made to studios in Europe which are built upon the roofs of larger buildings. Fig. 87 is a plan made from such a studio. One great advantage it has, namely, an occasional overflow cannot damage the property below. Moreover, it is warm in winter, cool in summer; neither morning nor evening sun shall annoy; there is equality of light, and that light most easily managed; it is easily ventilated, and on the glass dust does not accumulate more than on common windows, and is removable with no greater difficulty.

Fig 87.



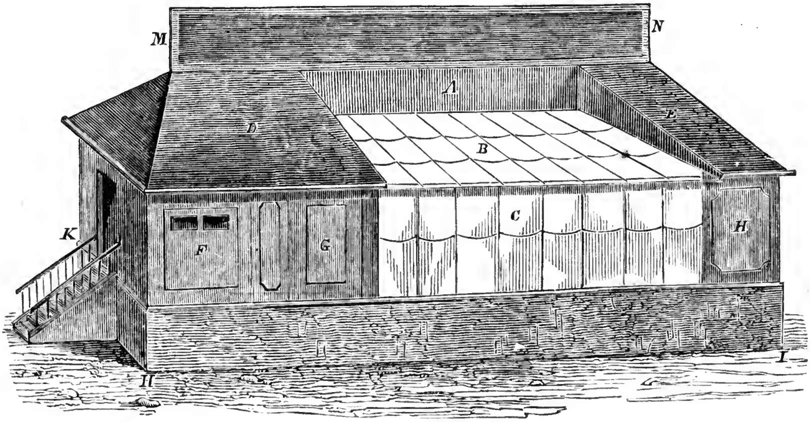
A F, glass-house; *A B U V*, swing window; *L M P N* and *T*, French windows; *H I L K*, tunnel; *S R* dark-room.

The *source* of light is entirely from the front, and the top-front light and the side lights are amply supplied by reflection from the roof and sides sloping respectively upward and outward. The angle here adopted may be 40° or 50°.

shorten the exposure, and got a very good result, since which time I have practised it.—C. S. McCormick.

28. Mr. Luckhardt's establishment is a model one. It is situated on the roof or ter-

Fig. 88.



race of the Grand Hotel, Vienna. His reception, dressing, exhibition, finishing, and delivery rooms are all on one floor, and over these the skylight, dark-room, printing, and

With a window eight feet by ten, facing the north, and a model opposite it at the distance of thirteen or fourteen feet, the lighting is good. Add the sloping walls and ceiling, with their reflecting surfaces, and you have a soft light.

solar-camera departments are conveniently arranged, and supplied with every necessary thing to make the best of results. The assortment of furniture and backgrounds is lavish and elegant. The drawings (Figs. 88 and 89) will bring it more plainly to mind.

The first one is an exterior view. It represents it as standing on the ground, while in reality it is built upon the solid marble roof of a hotel, the other rooms mentioned being underneath in the hotel building.

K is the entrance from the roof to the dark-room; *B* is the top-light, which is sunk below the angle of the roof *D E*; and *C* is the side-light, both of which face the north. It reminded me more of Messrs. Trask & Bacon's Philadelphia light than any I have seen. *M N* is a "sunshade," erected to protect the skylight from the southern sun. Separate from this on the roof are the printing and solar-camera rooms.

Fig. 89.

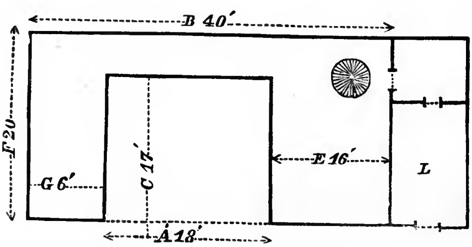
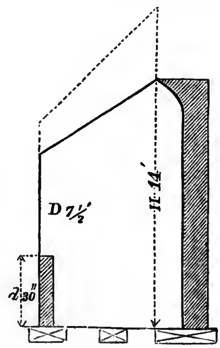


Fig. 90.



The next figure (Fig. 89) gives us the exact ground-plan of the whole, and the third figure (Fig. 90) a sectional view of the skylight proper.

The dimensions are given by the figures in Austrian feet and inches, and the Austrian foot is about three-eights of an inch longer than ours. Where two commas are over the figure it means inches, and where one only is used, feet are meant.

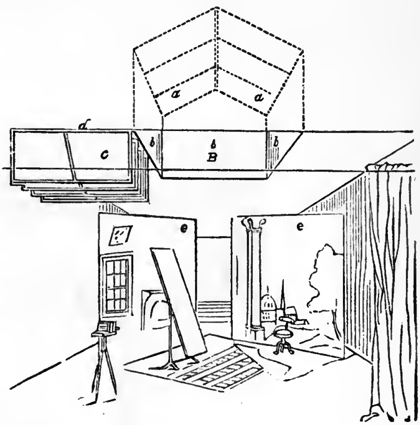
Mr. Luckhardt usually works an open light, and from both ends of the room, east and west.

He truly said, "The skylight construction is not the thing. It is the good quality of the light from heaven itself. Give me that and I will do all the rest, even without any studio. If the light is not good, I dismiss my sitters, and wait until it is good; or, if they cannot wait, I ask them to come again. If they cannot do either, then I request them to go to another photographer, as I will not willingly make a bad picture. With me it is all a matter of feeling, and I cannot work without it. One cannot impart this to another, or hardly describe it."

29. I once saw a man make very good work in what he called his "Curiosity Skylight." And it was a "curiosity." The diagram (Fig. 91) will prove it.

The top-light was originally made to light the store below. *a a* are the lights, six in number (half-inch thick glass), 3 x 4 feet, arranged as indicated by the dotted lines. *B* the end, and *b b* the sides of the opening in the roof, 4 feet 9 inches by 12 feet; and *c*, screens of blue paper which slide under the ceiling, *d*, when not in use; *e e* are the backgrounds in position. The side-walls are white-coated, and act as side lights.

FIG 91.



By placing the sitters near the middle of the room, strong top-light is obtained; and by placing them near the white wall strong side-light. The backgrounds usually stand about six feet from under the light; and to darken them run them back from the sitter. He arranged sittings on all sides of the light occasionally, but usually on the southeast or southwest side. By becoming familiar with the light he became master of it. The glass was half an inch thick, ribbed.

Those who think their skylights are not good should study the nature of them, and in nine cases out of ten they will find they have too much light, or are making sittings on the wrong side of the room. If you cannot direct the light the way you wish, watch which way it *will* go, and by a little judicious management of your screens, your worst enemy, light, becomes your servant and friend.

I have seen many worse glass houses than this. I have tried to show a variety of forms for study, for I am well aware how much dodging is often required to get even a tolerable studio.

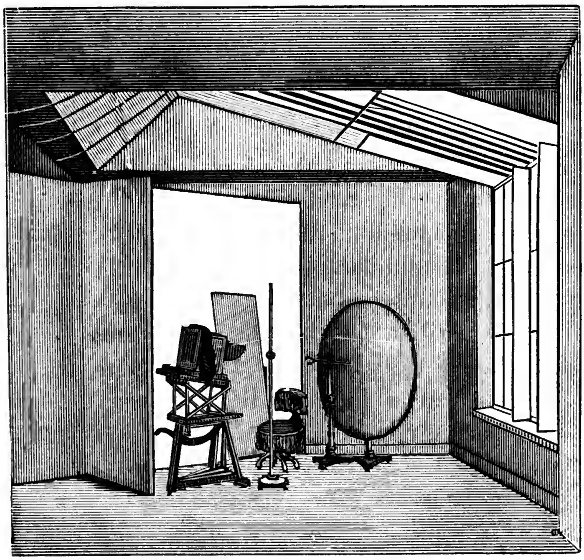
29. My method of taking children's photographs is very simple; the first and most essential requisite being *patience* coupled with good humor, or at least a *seeming* good humor. Add to these prerequisites, good assistants, good lights, good chemicals, and good artists, and you have my secret, if such you choose to term it, of taking pictures of children. One of the studios which I use has a south light, and is peculiarly adapted to

30. So much now for the elevation. As further help I add two ground-plans, thus providing suggestions for even the humblest of our fraternity.

The first (Fig. 93) is of a studio in Texas, 40 feet long by 20 feet wide. The side-light comes within 3 feet of the floor. The lower side of the skylight rests upon the side-light, and the upper side is raised 5 feet higher, and the sides boxed up and tinned the same as the roof.

the taking of children's pictures, it being covered with fluted glass, and well supplied with screens, which enable me to throw on or shut off the light almost instantaneously in any quantity to suit the subject. I have, with the assistance of these essentials, taken more

FIG 92.



than twenty children in one day, beside other work as it chanced to come in. I make it a rule to have two plates always ready when taking children, which enable me to make four impressions of the child, one of which is almost sure to be a goood one. This is my simple way of *taking* pictures of the little ones, and good artists complete the work so simply begun.—JOHN A. SCHOLTEN.

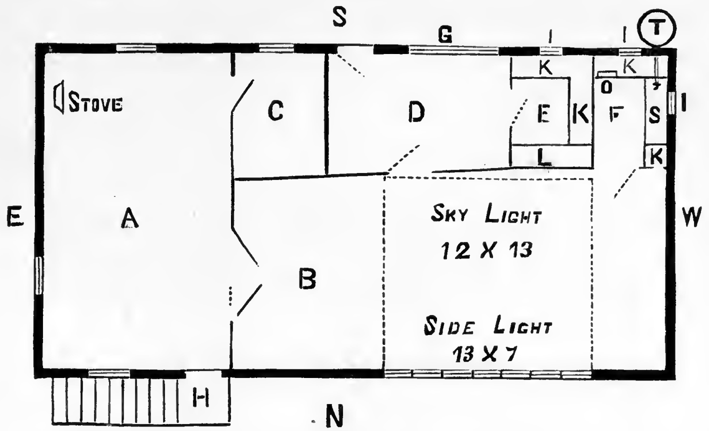
30. The construction of the roof of a glass-house is a matter that will bear, and should get, very serious consideration.

The form of sash-bar I give below is rather different from that in common use, and consists of two pieces. Here are sections of them. Fig. 94.

The object of the grooves in *B* is to catch and convey outside any leakage at the edges of the panes; and is copied from the *Photographic News Year-Book.*

A is the reception-room, 12 by 20 feet. *B* is the studio, 13 by 28 feet. A double door leading into it can be thrown open, and the camera run back into the reception-room a distance of 40 feet, which is a great advantage when

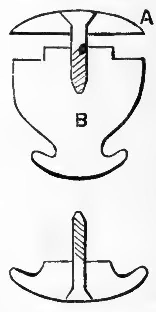
Fig. 93.



making groups. *C* is the dressing-room, 6 by 8½ feet. *D* the printing-room, 11 by 6 feet. *G* is a long window for printing in. The frames are placed on a shelf just outside. *E* the dark-room for paper, negatives, etc. *F* is the

Where the ordinary form of sash is in use, a strip of wood shaped thus, and screwed to the underside of the bar, will be found a very useful addition. The plan, however, I have to suggest, is the employment of a strip of soft India-rubber cord in place of putty on the outside of the glass, which is brought closely down upon it by means of the slip of wood (or, preferably, iron) shown in the cut, marked *A*. The glass having been bedded as usual in putty, *A* is screwed down, and with the India-rubber forms an impermeable joint, which, unlike the putty, will yield to the shaking of the roof in windy weather, but it will not allow the passage of any water. Another advantage consists in the fact that if the glass be also bedded on rubber, they can, by merely unscrewing *A*, be lifted out, without the very serious risk of breakage that attends the removal of glass fastened in with putty; and photographers would then be able to arrange with glass merchants for the yearly renewal of the glass in their studios at a low figure; no unimportant point, when the rapid yellowing of common glass is considered. When large panes are used, leakage will also take place at the lap-joints, partly by capillary attraction, but mostly from the bending of glass in heavy

Fig. 94.



negative dark-room; *k k k* are shelves 18 inches wide, 3 feet from the floor; above these are several other shelves for storage, etc. *S* is the sink, with a pipe to carry off the water. Over this develop, fix, and put the developing-bottles on the little shelf to the right. *T* is a cistern outside, with lead pipe to lead the water into the room. *O* is a 14 by 17 inch bath. The shelf back of this is 24 inches wide, giving plenty of room for plate-holders back of it. *I I I* are little yellow windows, of two thicknesses of orange glass. *L* shelves, to the ceiling, for different sized negatives.

The outside blinds recommended by Mr. Trask, further on, are used here.

For those whose means are greater the ground-plan of Mr. Henry Rocher's Chicago studio will be found useful. It has about all the useful conveniences.

31. *Plan of basement floor:* Rooms 8 feet high. *N*, north; *S*, south; *E*, east; *W*, west. *A*, entrance and hall. *B*, Mr. Rocher's private parlor. *C*, artist's room. *c*, artist's seat and easel. *D D*, retoucher's stands. *E*, mounting

winds. To prevent this, a thin piece of elastic might be inserted between the panes, and supplemented by the use of a strip of wood placed on the top of the iron rods that run along under the laps inside the house. As these joints soon get filled with dirt, the employment of the wood would not occasion any loss of light, and would strengthen the glass very materially, thus allowing the use of large panes. There are many modifications of the above plan that might be adopted, but I will venture to assert that the principle is the right one.

To those who print outside with glass-fronted frames, the adoption of this plan will save a good many prints in wet weather, and possibly *some* negatives, as I have seen such a thing as the paper sticking to negatives, and fetching away the film with it when pulled off.—LONDON STONE.

31. I have always been bothered with leaky skylights, until a short time ago, when I determined to put a stop to it. I tore out my old light and made a frame out of pine pieces $1\frac{1}{2}$ x 3 inches for the centre strips, and the edges are considerably heavier. And, in place of making the sash as is usual, I cut a groove on each side of the centre strip, about $\frac{1}{2}$ inch from the top, as seen in Fig. 95, and put pieces of tin in, shaped as in Fig. 96, to prevent the glass from slipping down; then I mixed my putty, about one-half white lead, and puttied the glass in carefully, then gave the outside two heavy coats of white-lead paint, and I have been well rewarded for the trouble, as it is as light as can be.

FIG. 95.

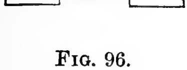


FIG. 96.

One great mistake in putting in lights is, that the sash is not heavy enough, so that the wind shakes the putty loose. With this, if the putty all comes out the glass cannot.
—A. E. TURNBULL.

tables. *F*, furnace. *G G*, shelves. *H*, framing table. *I*, dumb-waiter. *K*, toning and fixing table. *L*, sink. *M N*, washing tanks. *O*, vault for tubes, etc.

FIG. 97.

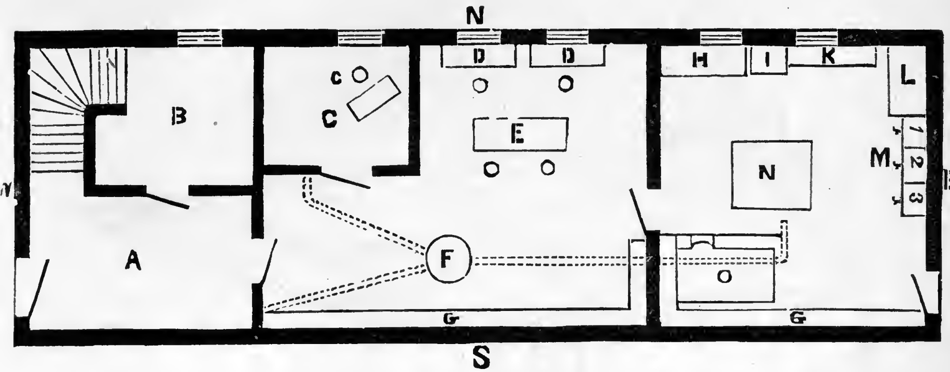
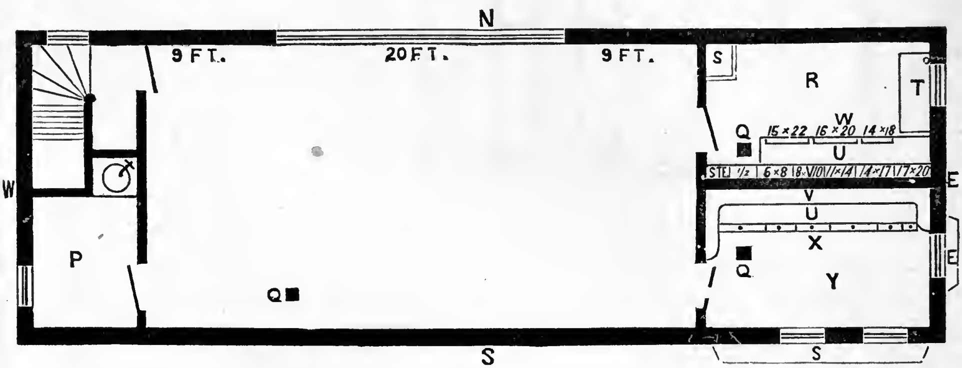


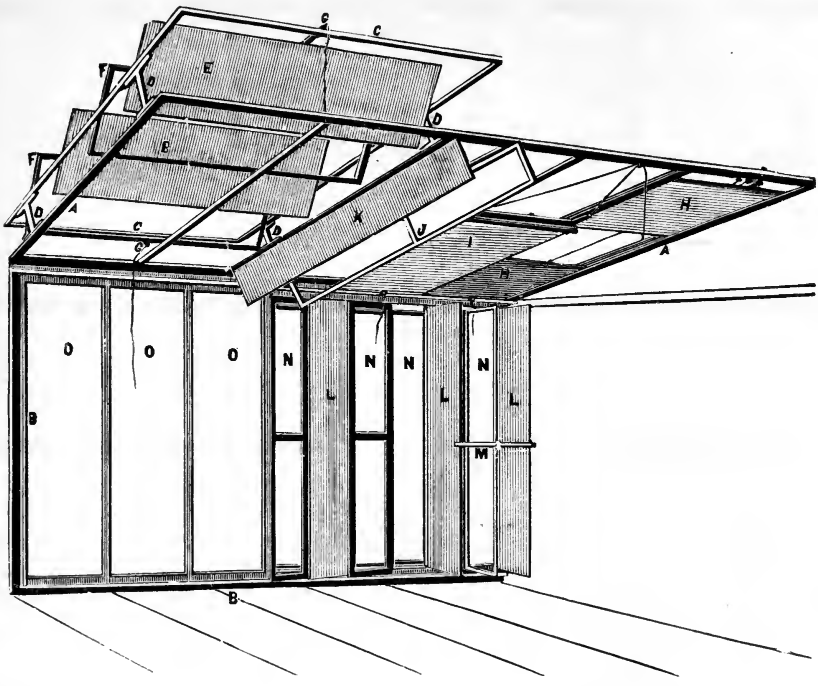
FIG. 98.



Plan of studio for first floor: Size of floor, 19 x 36 feet, and 11 feet high. *P*, dressing-room. *Q Q Q*, heat registers. *R*, dark-room. *S*, dumb-waiter. *T*, lead-lined sink, with yellow window in front of it. *U U*, tables. *V*, shelves for negatives from stereo size to 17 x 20. *W*, silver baths of sizes marked. *X*, drawers. *Y*, printing-room. The main space represents the studio. North light, 20 feet wide by 18 long; side-light, 20 x 8 feet high. Inclination 40 degrees.

32. At the convention of the National Photographic Association, held in Philadelphia in 1871, a model for a skylight was exhibited, of which the accompanying cut (Fig. 99) is a representation. It was partly suggested by a

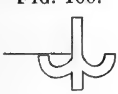
Fig. 99.



hailstorm. *A A*, the framework of the top light, all glazed, which is made so that it can be used as shown in the cut (top inclination and side light to the

32. To prevent leaking, I use an iron sash made of the shape of the little diagram annexed (Fig. 100), the hollows of which I fill with a thick paste made of white and red lead and copal varnish. The glass is then imbedded in the paste, and is perfectly water-tight at the sides. The sash is made for both inside and outside use. To prevent water entering the room, where the lights overlap, get some pieces of sheet-lead, and run them through the roller-press to make them very thin. They are then cut into strips, say half an inch wide, and bent hook-shaped,  like the figure. They are placed between the glass in a manner easily understood, where they overlap and entirely prevent capillary attraction by allowing air to pass between the glass.—Elwood Garrett.

Fig. 100.



north); *B B*, the frame of the side light, all glazed; *C C*, the frame of the top blinds; *D D D D*, the upright supporting the frame *C C*; *E E*, top blind frames, covered with canvas; *F F*, ditto, uncovered; *G*, a glazed top sash, without inside curtain or blind; *H H*, wooden sliding frames, covered with tissue-paper; *I*, a spring-roller curtain; *J*, movable-top blind frame, uncovered; *K*, ditto, covered; *L L*, ditto, for side light; *M*, same as *L*, uncovered; *N N N N*, side frames, uncovered, and outside sash showing through; *O O O*, side sash, glazed, and exposed inside, and may be covered by either of the arrangements, *H*, *I*, or *J*. For coolness in summer and warmth in winter the outside blinds are helpful, and may indeed also be used to modify the light.

These arrangements for shades and blinds are not all for use on the same studio, but are given here that parties may choose whichever is best adapted to their individual requirements.

This style of skylight is probably more generally used, in modified forms, than any other, and, in about the proportions here represented, has been worked with uniform success. The size of the light must be governed by the size of the room it is expected to illuminate. A room 12 feet wide will not require the top light more than 8 or 9 feet up the roof; while along the room it should be not less than 10 feet nor more than 15 feet, and placed in the centre. The side light should be not over 10 feet from the floor, where it intersects the top light, and, for a small studio 8 feet would be better. The bottom of the side light should be about 2 feet from the floor.

Particular attention is drawn to the outside construction—to the shades for protection in storms of rain and hail, to the sash bars, and to the glazing. The reader is also referred to Lesson J, in *Wilson's Photographics*.

33. Many itinerant photographers use a car, on wheels, or a tent. For

33. On the new atelier of Loescher & Petsch, in Berlin, to the supports of the roof corner-irons, *e* (Fig. 101), $\frac{3}{4}$ x $\frac{3}{8}$ inch, are riveted, and these carry the frames for inside blinds. The irons have three grooves, in each of which a frame can be moved without

FIG. 101.

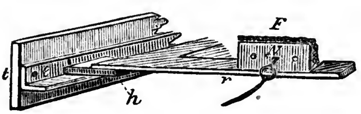
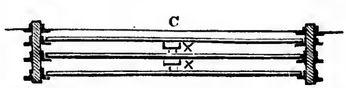


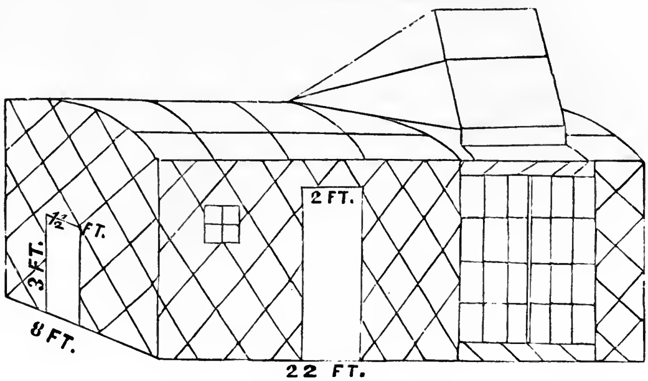
FIG. 102.



touching the other one. Placed side by side, they cover the glazed three-quarters of the roof completely; placed one above the other, and pushed under the covered quarter of the roof, the glazed part is unobstructed. See Figs. 101 and 102.

plans for building a photographic car I am indebted to Mr. C. U. Stevens (Fig. 102.) First the sills are laid and bolted. There are five. The two

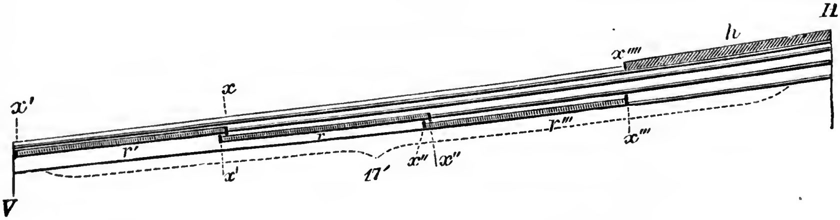
FIG. 103.



which are bolted at the bolsters are 2 x 6, the other three are 2 x 4. Next put in cross braces, made of one-inch boards, ripped two inches wide. The floor is

Fig. 104 will show this arrangement—cross section. *H* is the rear wall; *h* a wooden covering for the roof; *r r′ r‴* are the frames which move in the guides as shown in Figs. 101 and 102. Each frame has two small hooks, *x′ x″ x‴*, etc. The frames are moved by cords, which at *H* and *V* pass over rollers, and which at *V* are fastened to the first frame. In admitting light, *r′* will move backward; first the hook *x′* will catch the corresponding hook *x″* of frame *r′*, and take the second frame along, and so all the

FIG. 104.



frames will be caught in succession. Friction is partially overcome by strips of wood, *h*, Fig. 101, which are covered with plumbago, and placed under the frames; so also are the hooks *F*, Fig. 101, covered with felt to avoid jarring.

The movement of the frames is easy and certain, and the exclusion of the light complete.

The side light is regulated in a similar manner.—DR. H. W. VOGEL.

then laid. Next put up a frame, made of the same stuff, like the diagram. Where the strips cross they are halved, and a screw put in. They are also screwed at the top and bottom. The roof is bowed with a pitch of 8 inches. The frame is then covered with a felt-paper and half-inch sliding running up and down, and matched. Where the boards cross the frame there are two screws in each crossing. The car is smooth on the outside, which gives a better chance for fancy painting. The roof is covered with half-inch stuff; then a layer of tarred felt-paper, then a layer of half-inch stuff on that again, and well painted with mineral paint, both between the joints and between the paper and outside covering, and then four coats of the same on the outside. There are two side windows, north and south, and skylight facing north. The side windows are two common sash windows, side by side. The glass is 8 x 14. The skylight is 5½ x 7 feet. The rear is raised, when in position, 4½ feet. There are two doors for entrance on each side; also a small door in the forward end, to accommodate the driver when moving. The truck-wheels are 30 inches in diameter. The forward ones 2 feet from the end, the back ones 4½ feet from the rear end. The skylight is 3 feet from the rear end, and pitches to the side. The side windows are 3½ feet from the rear end of the car, and 1 foot from the floor. It is 6 feet from the side light to the door. The dark-room is 3 x 4½ feet, and the work-room 4½ x 5 feet. The car is 22 feet long, 8 feet wide, 7 feet high at the eaves. Four thousand screws are needed to fasten it together. It is lined inside with quarter-inch stuff, and papered with wall-paper or Lincrusta Walton. It should be covered overhead with the same, and painted drab.

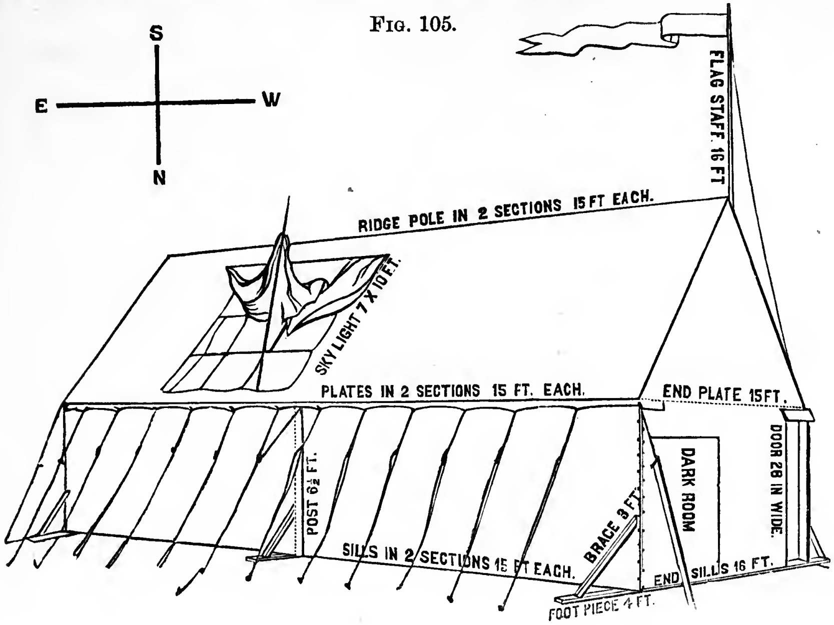
34. In the southern sections a tent will be found cooler and more portable.

34. An apparatus for keeping the operating-room cool in summer, warm in winter, and always protected from hail, was devised by Mr. L. M. Whitney. It consists of blinds or shutters so arranged that one can from the operating-room open or shut them in a very few minutes. When not using the light they can be drawn, keeping the room cool. The slats are fastened together with webbing, one strip over and one under, making a joint that will fold either way without any trouble; will pack themselves away as perfectly as seen in the drawing (Fig. 106). The box they fold into is covered up, keeping them dry when not in use. Any good workman can apply them to most any skylight. The cords pass over pulleys down into the room on both sides; the one under the slats, when drawn, passes over the roller in the groove made for it to draw off the blinds.

For a light say 12 x 16, the blind should be divided into three or four sections.

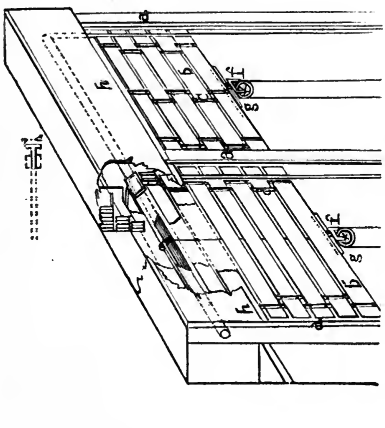
It is made entirely of pine; the end rails, *a a*, are 1½ x 5 inches, the middle ones 2 x 5, The plan below was made from one in actual use. (Fig. 105.) The following instructions will enable others to construct a similar one.

Fig. 105.



grooved ½ x ½ inch, ¾ inch from top of rail (Fig. 106), and fastened to the skylight with irons to fit the angles, and screwed on. The blinds, *b b*, are ⅜ x 3 inches, hinged snugly together with heavy boot-webbing, *c*, over and under alternately, making a perfect hinge, the webbing well fastened with good-sized tacks driven obliquely near the edge, webbing and all well painted; they are drawn by cords, as seen in Fig. 106, passing through the pulleys, *f f*, which are screwed to the strips *g g*, under the first slat, back through the other side, over a pulley down into the room below. The strip *h h*, covers the space over the pulleys when down. The cord that draws the blinds off is fastened in the strip *g*, passing back under the blinds, over rollers (which are four inches in diameter at ends and centre, with groove for cord), and passing down into the room. In drawing them back they fold nearly as per-

Fig. 106.



The frame of the tent is made of spruce pine 2 x 3 inches, except the six posts and foot pieces, which are 3 x 4 inches. The mortises and tenons are cast-iron. The posts are screwed into the mortises. The tent is pitched with the ends east and west, the skylight to the north. The dark-room is in the west end of the tent, in two apartments, size $4\frac{1}{2}$ x 8 feet, by 6 feet high. It consists of a frame with one upright post, and two arms, one $4\frac{1}{2}$ and the other $8\frac{1}{2}$ feet, making the length and width of the room, and fastened to the posts with strap hinges. On the end of each arm is a hook, which fastens to an eye in the plate. The frame is covered with double brown Canton flannel.

The tent frame is covered with twelve-ounce canvas, lined with brown Canton flannel to exclude the light. Over and around the skylight are blue curtains, to soften the light. We level the ground with saw-dust, and cover it with cocoa matting. It takes fifty-two yards. The interior is divided into four rooms; three of them are 8 x 15 feet, and one 8 x 10 feet. The reception-room, ladies' dressing-room, the skylight, and the finishing-room, are the four apartments.

The other measurements will be found by referring to the drawing.

35. It is no uncommon occurrence now for the photographer to be summoned to the homes of his patrons for the purpose of making portraits. There should be no objection to this when he is very generously paid.

fectly as shown in the cut, upper section, the partition between being removed to show the end of slats. The figure also shows end of rails cut out back of roller to let blinds down. The third section could not drop, but runs up an incline of 10 inches, forming a box above the rail, working but a trifle harder. I have braces over the centre rails, with a rod passing through the sash, making it very firm; also, blocks fitted over the pulleys *f f*, to keep the cord from running off.—L. M. WHITNEY.

35. One of the best things I did this summer was to place screens on the outside of my skylight. Any photographer can do the same and at a trifling cost. They not only keep the sun off the glass, and by so doing make your rooms at least 10° cooler, but your light is much softer and easier to manage. The idea is not mine, but comes from one who has used it for several seasons, and who has recommended it to many others.

I obtained ten pieces of pine, one by one and a half inches wide and twelve feet long, and fifteen pieces of same size, sixteen inches long. I made from these five frames by tacking the sixteen-inch pieces between the long strips—that is, one piece at each end and one in the middle to strengthen them. I used bleached muslin to cover them, a strip four yards long making enough to cover two fans, or frames. This I tacked on as I would a background. After I had my frames covered, I fastened a board, twelve inches wide, on each side, running from top to bottom of my skylight (outside, of course). I then fastened my frames at each end to the boards by boring through the board and

The annexed cut (Fig. 107) is of a tent, forming a posing-room. Use a gray-blue cloth background, about six feet wide by seven feet high. In

Fig. 107.

travelling, it is rolled around the supporting pole; the top and the sides, forming curtains, are made of thin stuff, and held by rings to the rods of the framework, which are taken apart with great ease, to be packed into a very small compass.

In this portable atelier excellent portraits may be obtained, and the time of posing one-half less than in a glass-house. The professional photographer and the amateur will be able with it to work with advantage in the open air, and obtain very fine negatives of portraits, with a baggage relatively light and easy of transportation.

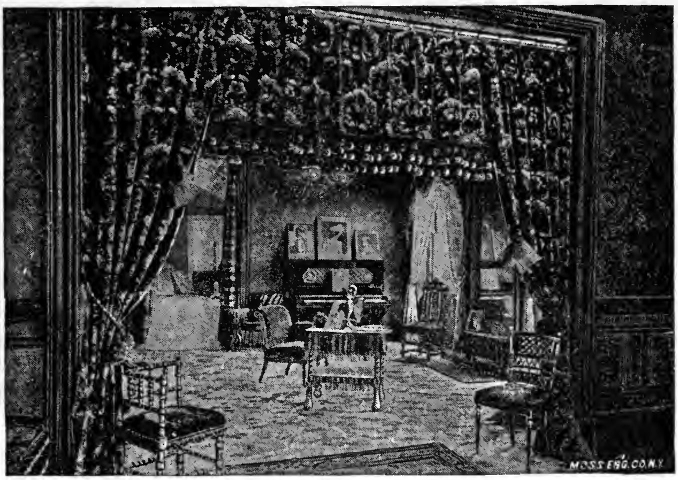
frame and driving in a small iron pin. My frames when closed down are about ten inches above the glass, which allows a nice current of air to pass under. When in use they stand nearly upright or at any angle desired to keep the sun from shining on the glass. I placed mine so they lop on each other about an inch, and open and shut with a connecting-rod like our window-blinds. To sum up, make muslin slats, eighteen inches wide, the length of your skylight, fasten them in a frame, connect them together with a rod, carry a line from each end of the rod into your room, and work them at any angle you choose.—M. P. Brown.

36. During certain seasons of the year the light from the south shines too directly upon the roof of the glass-room. This is overcome by wooden screens placed upon the roof, and so arranged with block and tackle that they can be raised and lowered at will. See the N. P. A. plan on page 96.

The ventilation of the glass-room should not be forgotten, and can be best secured by the architect.

And now, lastly, I add engravings of the reception-room and interior of the skylight of a most approved studio, that of Mr. P. H. Rose, Providence, R. I. The splendid study of the two young ladies which embellished the *Philadelphia Photographer*, for February, 1887, was made here.

Fig. 108.



The waiting-room is a beauty spot, a place of rest, rather than a place for the anticipation of impending torture. If one comes to such for the purpose of

36. I employ for cooling my atelier an apparatus which is called a refrigerator. An India-rubber bag, supplied with valves, is placed on the floor, and by stepping on it with the foot it acts like a pair of bellows, and forces the air into the bag; the air passes through an India-rubber tube, and passes next into a glass tube; this sucks at once water from a vessel and distributes it through a point as a fine spray through the room, and by evaporation the temperature becomes at once lower.

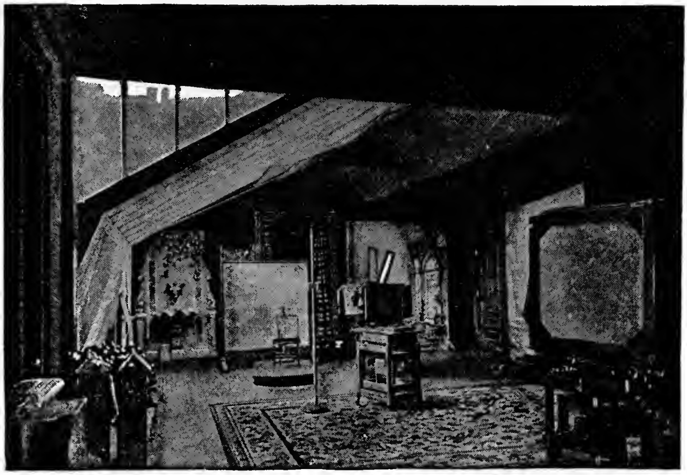
I employ this apparatus not only for cooling the atmosphere, but I moisten with it also the interior of the camera, and since its employment I have not been troubled with drying spots.—Mr. Prumm.

procuring a portrait for posterity, with a sort of martyr-like feeling—like a lamb led to the slaughter—all that feeling will take its departure at the moment of entering, and so it should be.

Here, all that excellent taste and artistic judgment could suggest in the line of furniture and draperies has been supplied, in order to secure a homelike appearance and to create a subduing, homelike influence upon the visitor.

From the waiting-room the skylight or studio is entered. Here, too, we see the evidence of a master head and hand, for all is well accoutred and in excellent order.

Fig. 109.



No description can make this more plain than does the autoglyph. The dimensions are 14 feet 6 inches, by 17 feet 6 inches, and the side light is 6 feet high, by 14 feet 6 inches wide. The angle of the top-light is about 40 degrees. It is constructed after the working plans given (with drawings and estimates) in *Wilson's Photographics*, Lesson J, page 154.

CHAPTER VIII.

UNDER THE SKYLIGHT.

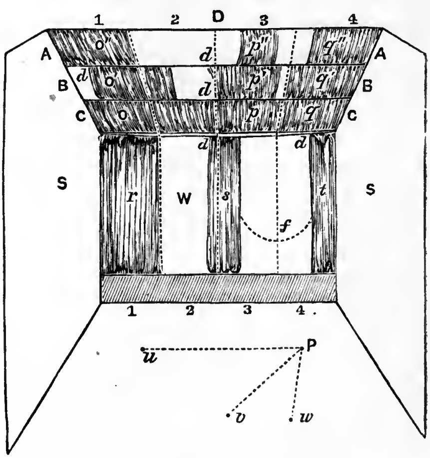
37. AFTER the studio is constructed and ready for camera-work, a great many needful things must be supplied to manage the light which enters.

All sorts of odd "tools" have been suggested and are used by photographers to modify the light as it falls upon the sitter. Among these are screens in frames, hand-screens, curtains, reflectors, and even "shadow producers."

There can be no objection to this, for in photography, as in painting, it is perfectly proper that the artist should give more attention to securing the desired effect than he does to debating over the means by which his effects are secured.

37. The inside curtains used by Messrs. Lœscher & Petsch are arranged as in Fig. 110. *S S* are the side walls of the atelier; *W* is the glass side; *D*, the glass roof; the curtains on the glazed side, *W*, consist of several suspended pieces of stuff, *r*, *s*, *t*, which can be moved by sliding them over the supporting wire *d d*; one or two openings may be made to admit the full light, which will be sufficient.

FIG. 110.



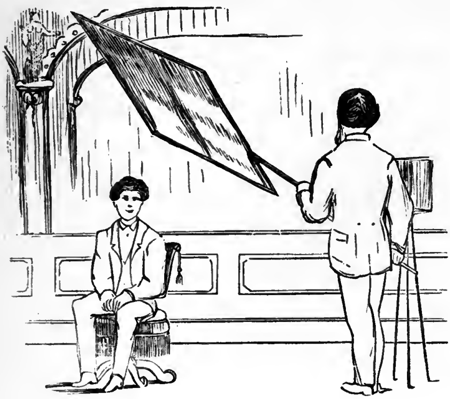
Along the longest direction of the skylight wires are stretched in such manner that three sets of curtains are placed side by side, *A A*, *B B*, *C C*; each set consists again of three pieces, *o*, *p*, *q*, which can be moved along the wires at the pleasure of the operator; by extending the curtains, the skylight may be covered altogether, or by drawing them together, the skylight may be made to admit all the light without obstruction; or openings of any desired size may be made.

Let us suppose that a person stands at *P*; we can easily obtain, by the above-described arrangement, an illumination like Lœscher & Petsch's, by covering the portion 4 of the glass side and the skylight, and by opening the portions 2 of the glass side, and 2 *B B*

The use of curtains or screens overhead and at the side light is an absolute necessity in most studios. Suggestions as to these were given in the last chapter.

38. The hand-screen is also of great advantage. By means of it effects are often obtained which could not be had in any other way. Shadows may be thrown upon any part of the face during the whole or a portion of the exposure. By its careful manipulation the edges of the shadows may be so softened into the lights and middle tints as to render the whole effect harmonious. It gives a moulding power of great value to the operator.

FIG. 111.



Mr. J. H. Kent, Rochester, N. Y., is its prime champion, and he has taught its use to many. (Fig. 111.)

and 2 *C C* of the skylight; when more front light is required, the part 1 *A*, *B*, *C* of the skylight is opened also. When we desire to keep the light from the feet of the sitter, we take the lower corner of the side curtains (as at *s t*, *s t*) and fold them together, keeping them in that position by means of a clamp. Rembrandt effects are produced by placing the camera at *V* or *W*. An important point in this construction is that neither cords nor rollers are employed, which, by breaking or getting loose, cause the photographer frequently a great deal of trouble.

The curtains are moved by pushing them with a rod.—DR. H. W. VOGEL.

38. I have found the hand-screen of much greater value than at first I supposed it would be. At first I only used it to get effects that could not be obtained by means of sliding screens and curtains. Now, however, I use it on all occasions, and can hardly make a negative without it.

Leaving my light entirely open, I sit my subject down almost anywhere, and get just the effects I desire, with no trouble or delay in arranging screen and reflectors and curtains.

I have been to hundreds of dollars' expense in putting up various contrivances by which to control the light so as to get the desired softness in the negative, but have been unable in any other way to produce such results as are obtained at once with the hand-screen.

I also find my sitters invariably do better than in the old way, saying they never sat for pictures so comfortably, and with so little fatigue to the eye.

On the whole, as simple as it seems, there is no doubt that it is the most valuable

39. A hundred methods have been adopted for constructing head-screens and for using them. None give the artist the power he has with the hand-

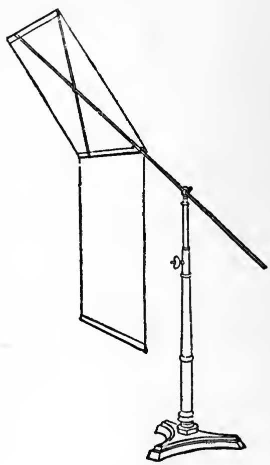
invention for the management of light that has been gotten up since photographs were first made.

In my gallery I could better afford to pay a thousand dollars a year than do without it, and I am sure it would make more than that difference in the business, to say nothing of the ease and facility with which the work is done.—J. H. KENT.

39. The one difficulty I find with the screens generally in use is the amount of timber used in their construction, rendering them cumbersome and unwieldy, and impossible to get out of the way when not in use. The object of this is to illustrate my method of overcoming this difficulty.

The accompanying cut (Fig. 112) tells nearly the whole story. An iron rod $\frac{3}{8}$ of an inch in diameter and $5\frac{1}{2}$ feet long is secured in a head-rest. One and one-half feet from its upper end a $\frac{1}{2}$-inch hole is worked, through which an iron rod $\frac{1}{4}$ inch in diameter and 3 feet long is tightly driven to its centre. This makes a cross, with its three short arms each $1\frac{1}{2}$ feet in length. A small hole is drilled in the ends of each of these three arms; also in the long arm $1\frac{1}{2}$ feet from the point of crossing of the two rods. A light, pine curtain-stick is secured to the small hole in the long arm and to the end of one of the short arms. A piece of suitable cloth about two yards long and one yard wide has a similar curtain-stick sewed in each of its ends. One end is then fastened to the upper ends of the cross, passing over the stick already fastened to the cross and hanging down below it, as shown in the cut. Different covers, or pieces of cloth, may be prepared to use as occasion may require, as they can be changed in a moment. When not in use the cross may be removed from the head-rest and hung up out of the way, taking up no room at all. The upper part may be readily inclined at any angle, and the whole may be raised or lowered as desired. It has all of the advantages of the old style, cumbersome wood-frame contrivance without any of the disadvantages.

FIG. 112.



Covered with some light color, it is all that can be desired as a reflector; if covered with some transparent material it is efficient as a screen, and especially so if the color be slightly yellow and freckles are plentiful in the subject. If used thus, due allowance must be made for the depth and color of the shadows. The exposure would be necessarily longer, but there would be considerable saving in the retouching. If, however, covered with dead-black or very dark slate, relieved, when required, by any movable, light-colored material, such as is generally used to reflect light, being hooked on two pins, it would be found the most useful, particularly if employed in the place of blinds for subduing light, producing shadows, shading the figure, or for almost any use to which blinds are now put.—JAY DENSMORE.

screen, but several other forms are useful. Some are head-screens and side reflectors combined. They are mounted on stands.

The continuous lines I use to hold the screen in place are of white, and some of red, to throw back or act in opposition to the white lines, by which I turn it in any manner

FIG. 113.

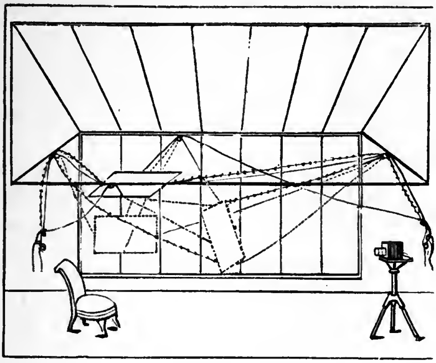


FIG. 114.

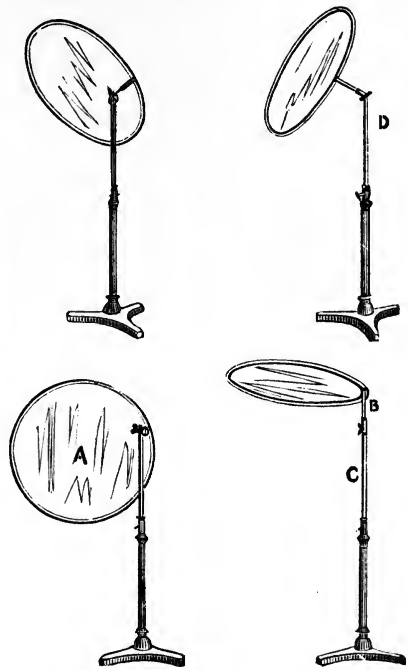
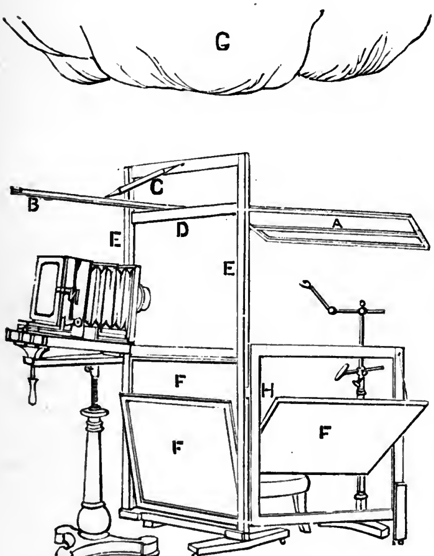


FIG. 115.



conceivable. These red lines I have marked with crossed lines in Fig. 113.

The dotted screens represent two of the many positions they can be put into, either directly over the sitter, on his side, in front, or, in fact, with six lines, *four white and two red,* I can use this arrangement anywhere about the room.

The lines are better run through four smooth rings, for on pulleys they are apt to get foul sometimes. The four rings are fastened to either side and ends of the lower part of the skylight *well,* and run down to pins or nails at either side, or all running to one point, and then by having different

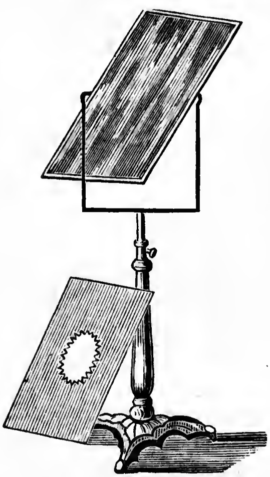
40. These stands are often made available for other purposes. This plan saves floor obstruction, and, as the changes can be quickly made, it will be found a convenient one.

colored cords you can, after getting used to them, work them very quickly.—JOSEPH W. KING.

I have used the plan represented in Fig. 114 to my satisfaction. *A* is a screen made of ordinary white printing-paper, pasted neatly over a large wire hoop, in the same manner as a boy makes a kite. *B* is a tin socket about six inches long, attached to one side of the wire hoop, and made to fit snugly over the end of a jointed bar, *C*, which stands in an ordinary head-rest column. *D* is the joint in the bar made with a thumb-screw. The above arrangement makes a universal joint, by which any angle can be given and retained in the screen, which I use either as a modifier or reflector of light, as the case may require. It is capable of doing all that a hand-screen should be required for, and is *not so objectionable* to the sitter. and can be used in taking pictures of children, which I think would be difficult with a hand-screen.—B. F. HALL.

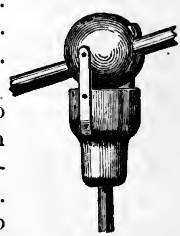
Mine embraces everything in the shape of reflectors. Five years' experience teaches that it is the best thing yet invented. (Fig. 115.) *A*, head-screen; *B*, handle to head-screen; *C*, brace with two screw-eyes at each end to keep head-screen level; *D*, cross-bar. At *D* there is a bolt, so that the handle *B* can be moved at the right or left. The handle *B* runs to the centre of the head-screen *A*, and is fastened with another bolt, so that the head-screen *A* can revolve, thereby making the light play on the face at one's will. *E E* is supplied with holes, so that the cross-bar *D* can be raised and lowered. *F F F*, side reflectors; *G*, a large white screen of unbleached muslin, that is supplied with rings at each side, and runs on wires. It can be moved on or off at will.—W. A. MANVILLE.

FIG. 116.



40. My device is used for vignetting in the camera and as a screen for softening the side and top light. I use a frame covered with tissue-paper, fitted in a frame of iron wire, so that it will play and can be used at any angle; it is fitted in the standard of a head-rest. I have another frame covered with cardboard, with an oval opening, and painted a suitable color, for a vignetter; they both fit in the wire frame, and can be changed in a moment. I send you a sketch of the apparatus (Fig. 116.) It has the merit of cheapness, anyway. —W. H. KIBBE.

FIG. 117.



A small screen over or near the sitter, to regulate the light, has now come into such general use, that every photographer considers it necessary either to buy or make one. To those who like to tinker and fix up things for themselves, I have a suggestion for mounting one of these screens, which may be of service.

The combined *head-screen and "point of sight"* has been much in use. Of the former the standard is 6 feet high, 2 inches wide, and $\frac{3}{4}$ inch thick. The feet are 2 feet long, 2 feet wide, and $\frac{3}{4}$ inch thick. The braces are $1\frac{1}{2}$ inches wide and $\frac{3}{8}$ inch thick. The screen-frame is 22 x 26 inches outside, $\frac{3}{8}$ inch thick, and the handle 22 inches long by $1\frac{1}{2}$ inches wide by $\frac{3}{8}$ inch thick.

Operation.—Fig. 118 shows the screen as it is when not in use. Fig. 119 shows the screen in position. It is hinged at *a* to a little block, and that is fastened with a shoulder-screw to the standard, which allows it to be turned

FIG. 118

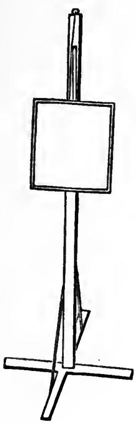


FIG. 119.

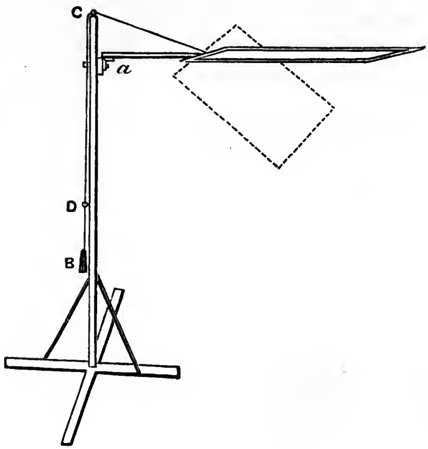
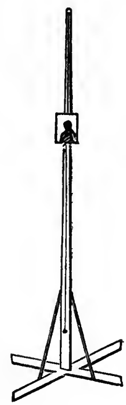


FIG. 120.



either way as you wish; and it being balanced by the weight *B* with the string which goes through the two screw-eyes *C* and *D*, attached to the handle next to the screen, allows it to move up and down and to stop at any point.

The stand is that of an ordinary head-rest, and on the rod is placed the arrangement shown in the cut (Fig. 117), the whole being fitted so as to turn as desired. The rod which passes through the ball has the screen on one end, and a small weight on the other to balance it, so that it may be placed horizontally or inclined, either way, and it retains its position.—J. S. MASON.

The advantage of the portable screen and stand over the usual blinds or curtains is twofold—first, the rapidity with which changes in the mode of lighting can be made; and secondly, the convenience of having a screen always at hand ready for use in any position and in any place, suitable to be employed in any unforeseen emergency. It frequently happens that some considerable adjustment and readjustment of the blinds are

Point of Sight.—Fig. 120 is made of any light wood, with a standard 6 feet high, 2 inches wide at the bottom, $\frac{3}{4}$ inch at the top, $\frac{3}{8}$ inch thick; the feet are 20 inches long, $\frac{3}{4}$ inch square, braces light. At the top and bottom of the standard is a $\frac{1}{4}$ inch hole, and a string put through both holes and tied, then a cabinet card is fastened upon the string; being endless, it moves up and down easily to any point.

41. Our next consideration is given to reflectors or side screens.

needed before the artist can satisfy himself as to the exact direction and style of light most suitable to a subject being photographed; and as the larger the studio the greater is the amount of blinding to be altered, and the greater the amount of time lost, so it is evident some instantaneous mode of producing the same effect with an equal, if not greater, amount of nicety must be of considerable help on occasions when time presses; and, indeed, at all times, for the shorter the period the sitter is kept waiting the better is it for his expression and general amiability.

If the arrangement be provided with a semitransparent and an opaque screen it would give considerably more power to the operator.

For occasional use in unexpected contingencies it is of considerable service. In groups where one face received a greater proportion of light, and so would require less exposure than the other, the semitransparent screen would be found a useful help. Sometimes a stray gleam of sunlight creeps into the best-arranged studio, and requires a vexatious amount of pinning up of paper and of general "dodging" before it is got rid of. Again, it may happen that a sitter may come who requires an unusual amount of top-light, such, for instance, as one whose eye cavity is but faintly marked, but with whom side-light cannot be entirely dispensed with —or an extra gleam of light from a bright cloud low down on the horizon may fall upon a face and interfere with the first illumination already devised; these, and a multitude of other occasions, will occur to the thinking photographer to show the usefulness of movable screens.—*British Journal.*

Fig. 121.

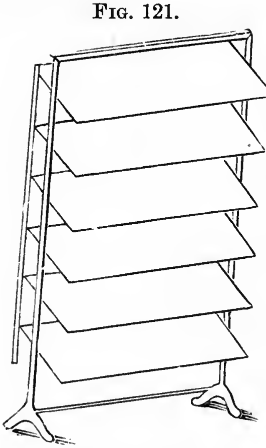
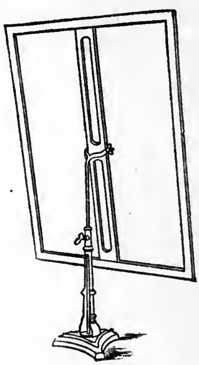


Fig. 122.

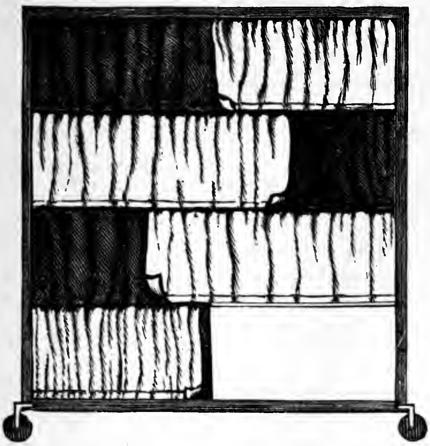


41. I have been annoyed a great deal, and have seen others annoyed, with the old-fashioned side screens. I send you a drawing of one (Fig. 121) I have substituted, and find it admirable and a great power in my hands. The cut explains the whole thing and its use. Being in a light frame, it can readily be moved about from place to place. By closing all the blinds it can be used as a single "solid" screen.—H. Noss.

The accompanying cut (Fig. 122) shows the construction of a very simple and com-

In St. Louis, in the studio of Mr. G. Cramer, I saw a very useful contrivance used as a side screen for modifying the light on the subject. It consisted of a frame of the size and height of an ordinary background frame, mounted on castors, as shown in Fig. 123. From side to side two rows of heavy iron wire are stretched. On one row white cloth is hung and on the other black cloth, the one back of the other.

Fig. 123.



Now it will be seen that if less light is wanted, the screen is so placed to the source of light as to intercept it, and the black screens are drawn, and *vice versâ* if more light is needed. Or the effect may be modified to any degree simply by arranging the cloth screens to suit, or the cloth may be pushed aside altogether or in part, above or below, just as you please, or according to the object you have in view.

Very often, when the illumination is too great on the side of the model next to the light, a white screen is placed on the other side, in order to reflect the light in the direction desired. A screen covered with silvered paper is sometimes used, and occasionally a mirror for the same purpose, but the white screen of muslin or paper is the best. Blue screens are sometimes used for a like purpose. It will be understood that care should be taken that the light does not fall upon the sitter vertically. This is, as all know, prevented by the use of the curtains.

42. It has been suggested that the solid, plane reflector directs the light too

plete reflector, that can be made very easily and cheaply by any photographer. The frame is three feet wide and four feet long. It is covered with bleached muslin stretched tightly. The iron rod in the head-rest base is clamped to the centre-bar of the frame with a bolt and thumb-screw, allowing the frame to be tilted to any angle desired, while the rod in the head-rest base allows it to be raised or lowered as required. A more convenient, cheap, or effective reflector it would be difficult to devise.—Jay Densmore.

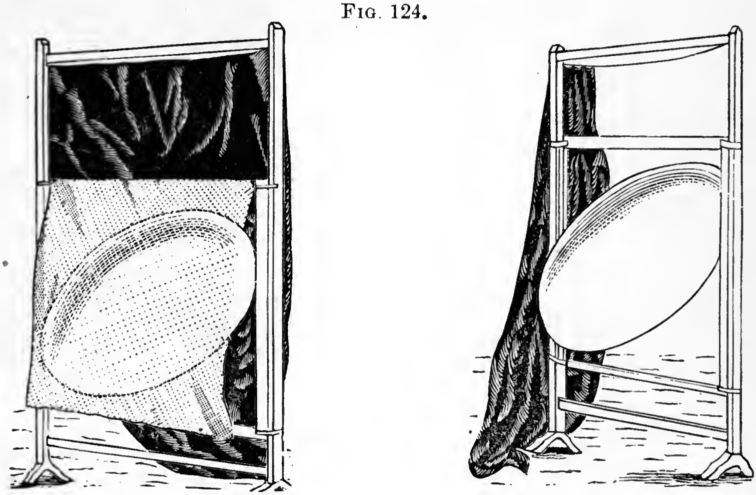
42. I have designed a reflector that is concave, thirty-six inches in diameter, and made of one sheet of tin, hammered into shape and afterwards planished. It swings on pivots within a frame just large enough to admit of adjusting it to any angle. This frame runs

violently; that it is not under the quick control of the artist, and should therefore be used with extreme caution. Of course, this is a good suggestion, especially when the screen material is white and the direct light intense. The color should be governed by the studio in which it is used. Thought and care must be given to all of these things.

To prevent harsh reflections, several forms of reflectors have been presented

up and down like a window-sash, within another frame about six feet high, which stands on legs like any background-frame, thus enabling one to throw the light up or down as the case may be. On the back of the outer frame I have a black curtain of calico which can be drawn across the outer frame to cut off all reflection except from the reflector itself. When the light is strong I hang a piece of tarletan or other gauzy material over the face of the reflector to soften it. See Fig. 124.

Fig. 124.



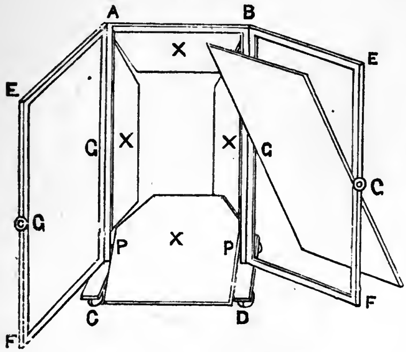
You would be surprised, upon using this contrivance, at the pretty effects that can be produced by it. I am working by a small sky- and side-light, and I find it indispensable. There are many useful effects which can be produced by it by using differently colored gauze over the reflector. For instance, for a round, smooth, light face and light hair, a buff color gives pretty shades, greater strength or contrast in the negative. For sharp features, sallow or tanned, a blue color is useful. The inner frame can be fastened at any point desired.—M. M. Griswold.

In making "Rembrandt" pictures the usual routine of operations is abandoned and reversed. Instead of at the side of the subject nearest the camera, the main light comes from *behind* the sitter, as it were, or falls upon the side of the subject *from* the camera, the side toward the camera being in shadow. To get detail in this shadowed side it is

—"concave," "compound," "eccentric," and what not, selections from which are described in the notes below.

necessary to reflect *some* light upon it, and to avoid a multiplicity of screens and reflectors. For this I have contrived the apparatus described below. (Fig. 125.)

Fig. 125.

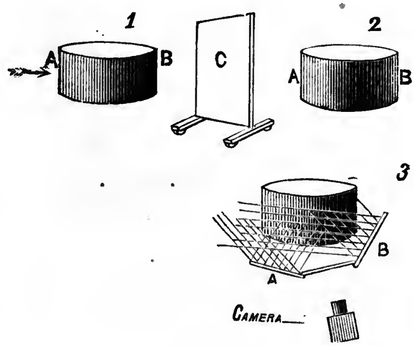


A B C D represent a light frame of wood, about six feet high and three and a half feet wide. *E F E F* are two doors or wings turning on pivots at the points *A* and *B*, and also on two other pivots at *G G G G*, consequently giving a universal movement. *X X X X* are four inner wings moving on hinges on the frame, whereby you may enlarge or decrease the size of the opening, the lower wing moving on two pivots at *P P*. All this is lined on the back with strong paper and black muslin, and on the front with pure white paper.

The application of the counter-reflector may be better understood by the accompanying drawings.

Let *A B*, Fig. 126, 1, represent a block of wood, and the light shining on it in the direction of the arrow—any attempt to photograph this in its present state of illumination would be impossible. The dark shadow at *B* would be devoid of all details, and the high light at *A* would be too intense. Upon bringing up the reflector at *C*, the effect is to drive, as it were, the shadow back again toward *A*, producing an unnatural lighting, as shown in Fig. 126, 2, causing a squinty appearance in the sitter, caused by being *raked between two fires*. Now the counter-reflector has the effect of doing away with this completely (Fig. 126, 3). It throws the light in the direction of the lines, and we have the *natural* effect of Fig. 126, 1, only greatly subdued, with perfectly transparent shadows, offering no strong nor harsh contrasts against the high light; *A*, as it were, *counter-reflecting* the reflection of *B*, thus preventing that shadow which otherwise would have hung over the centre.

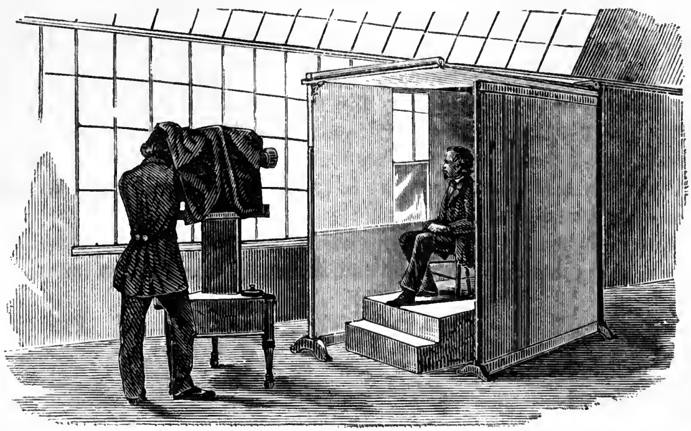
Fig. 126.



This arrangement also serves a good purpose when making pictures in the usual way, and is specially useful where there is no side-light, in scattering the shadows that are apt to occur in such cases under the eyes, nose, and chin, and in relieving the frowns of unwilling sitters. It is patented by Mr. Henry Kurtz.

43. Sometimes when a skylight is found uncontrollable, use has been made of a sub-studio, so to speak, constructed inside the larger one. Such a plan was suggested some time ago by Mr. E. J. Foss, Boston. It was contrived as described, and is illustrated below. (Fig. 127.)

FIG. 127.



It is called a "shadow chamber," and is a conglomeration of sliding curtains which can be moved quickly, securing an endless number of effects.

Mr. Foss's studio has a side light, thirteen feet wide and ten high, connecting with the skylight, which is thirteen feet square; the glass is all ground; the angle of the skylight is thirty-five degrees; there is a space from the side and skylights to the back wall of nine feet; in the ceiling of this space is a window

43. My illuminating apparatus is only intended for busts and the general figure, although children can easily be taken full length. Neither is it intended for use in a very small operating-room, for it would only be in the way, and the light in such small rooms can be easily regulated by top and side screens and blinds. In using the platform I generally let in all the light I can get from the sky and side lights (but not sunlight), and then regulate the screens, blinds, and reflectors attached to the uprights on the platform. By moving it to different positions under the skylight, in conjunction with screen, etc., I can get any light I want with very little trouble.

The platform, or floor, is made of six-inch fencing-boards, one inch thick, planed off on one side, and two layers are running crosswise, and nailed firmly together. It is five feet square, with the four corners cut off and set on common bedstead castors three inches from the edge on each side. Near the corner are bored four two-inch holes three feet apart, into which are put four uprights two inches square, with stanchions at the bottom; the uprights are seven feet high, and are framed together at top by pieces some three feet wide, which extends clear across the room; this light is used for the purpose of lighting up the backgrounds, of which there are several on rollers, fastened to the ceiling; the three-feet light does not reach the sitters, they being in the shadow chamber. It is said to work very satisfactorily.

seven-eighths by one and a half inches, to hold all steady; they are also braced at top and bottom, as shown in Fig. 128.

Between the uprights on each side are two movable frames two feet ten inches by two feet three inches long; the four screens or reflectors are inserted between the uprights, and a two-inch wood-screw passes loosely through them six inches from the bottom, and screwed firmly into the upright post. Fifteen inches from the platform is the bottom frame, marked *X*, and four feet from the floor are the two top frames marked *O*. In front, hung on the face of the first are two long frames eighteen inches by six feet long, hung on common door-hinges.

The background is five by seven feet, painted as described in *Mosaics* for 1877, page 48; on top is a frame, marked 5, two feet ten inches by four feet six inches, and turned

Fig. 128

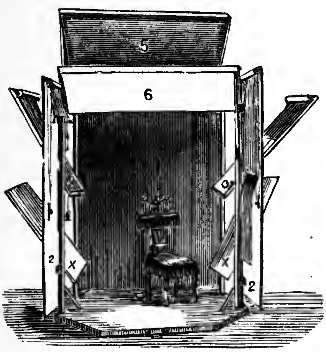


Fig. 129.

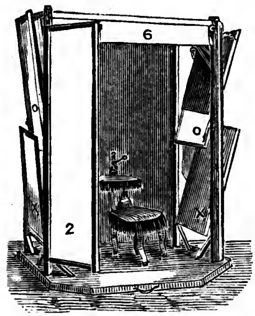
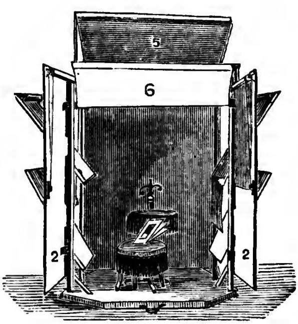


Fig. 130.



on two screws at the back, the same as side screens. It acts as a head-screen. This screen is raised or lowered to suit with a notched stick; all the top frames are covered with thin, bleached, yard-wide muslin.

The two bottom side reflectors, which are opaque, and painted a light blue, act as reflectors to light up the shadows under the eyes, nose, chin, etc. On the two, side top and long front screen, marked 2 and *O*, are four green opaque curtains, that roll up the same as a common window-shade, and can be pulled down to the floor, shutting off all light from the sides. On the back corners of the four reflectors, marked *O* and *X*, is fastened a small band that passes over a small pulley fastened in the upright post, and at the other end is a small weight to counterbalance the weight of the frame when thrown back, which makes it stay in position. In front is also a thin white curtain, marked 6, which can be pulled down three feet, or rolled entirely up. The background

The real fact is that the slightest interference with the light as it comes from the glass above or at the side will change the effect upon the sitter and in the negative.

44. And now, since photographing colors is understood, we may also use them reflected carefully upon the model. The artist-photographer uses, or endeavors to use, light just as he would use paint on his brush. Light is his paint; and in the proper distribution of it over his subject largely consists the true art of the photographer. But the acquirement of this art, like everything

sets back one foot from the back part, and is fastened to a two-inch post behind, which fits in a two-inch hole bored in the platform, and turns on a pivot, so that the background can be turned freely around to or from the light, and thereby graduate it more or less, and leaves room to go in to arrange the head-rest, etc., which is no small item. All the frames are made of stuff seven-eighths by one and a quarter inch wide; the whole is very light, and can be shoved or pulled about at pleasure.

Here we have a set of frames so arranged that they are reflectors, counter-reflectors, transparencies, or non-reflectors, at will, and all under your thumb. Here you have the control of direct, diffused, and reflected light, and you ought to be able to control with it any kind of front, top, side, or back light.—G. W. Coddington.

I wish to call attention to a prevailing source of error in the lighting of white drapery, a careful consideration of which would necessitate a change in the *modus operandi* of some of our operators in handling this class of subjects.

Take a lady sitter, with little or no color in the face. Pose her some distance from the lights; draw your curtains; trundle up your head-screen, and—study that face carefully. What have you got? Marble! And marble you will get in your negative. This illumination might answer for a swarthy face; certainly not for a fair one. And if this be true of the face, how much more so in the case of white drapery, which must have light, and plenty of it, or you get no shadows? A few experiments with a white statue will show you that a strong light, properly controlled, will give you better detail than a weak one. Head and side screens *may be* good servants; they are certainly bad masters. A soft light is not indispensable in the production of a soft negative. Brilliancy and hardness are by no means synoymous terms.

There is another thought in this connection which may be worth considering. You sometimes notice a face on the street which fairly sparkles with animation; but when you come to photograph that face, it seems dull and insipid. Is the sitter altogether to blame for this? May not the subdued light of the studio be somewhat responsible for this lack of expression? The scale in the gamut of expression contains an indefinite number of octaves. A weak light may fail to detect the beauties that a strong one reveals.—George Sperry.

44. For heads and half-length portraits it is quite unnecessary to use the side-light so largely as is usual; the top-light, when under judicious control, will give the better and more artistic effects of light and shade. In order to be really useful, a side-light must be taken on a level with or above the horizon; the best light is one that falls on the sitter

else, demands much study and long experience, as well as adaptation to times, seasons, colors, complexions, etc.

M. Klary, a veteran Parisian photographer, professes, by the aid of a "screen with a movable colored head to it," to have put into the hands of photographers just the "brush" which they require wherewith to "paint with light." I shall not attempt any minute description of the apparatus. It is described to me as extremely simple, consisting of a screen of white, blue, pale red, or pale orange calico, according to circumstances, fixed on a stand with an ingeniously contrived motive power. This, placed behind the subject, enables the operator to regulate and distribute the lights absolutely at will,

at an angle of 45 degrees. It is necessary that the light be balanced in accurate proportion, the time of exposure sufficient to set forth the lighting, and the development adjusted according to the exposure. The lighting of the face should be balanced in such a way that the contrasts may not be simply black and white, but a soft gradation of all the intermediate tones, as well in the lights as in the shadows, so as to produce a graceful and artistic picture. The greatest distance from the eye of the beholder should be darkest in tone, the nearest portion the lightest, and every graduation between.

Of the three lights used in the studio, the diffused may be employed in the greater quantity, the reflected must be more restrained, and the direct used more sparingly and judiciously. The position of the sitter should be under the principal and strongest light. It is best to employ a soft and slightly diffused light, combining in due proportions the top and side. This is readily obtained by use of the head-screen (which, being constructed with various movements, will enable the operator to have this light under perfect control). It should be placed by the side of the sitter, nearest to the light, and, of course, outside the focus of the desired picture. It must be elevated above the head, raised or lowered and turned to the required angle until the operator observes the true and best effect upon the shades and lines of the face. There will now be seen a general and diffused light over the whole of the figure, but a little predominant on the side nearest the light; then open a small accidental side-light quite in front of the sitter, which will fall upon the prominent parts of the face; if the eyes are sunk deeply, lower the screen a little, and move it slightly toward the shaded side of the face; it will thus increase the top-light, and bring the face into bold-relief; the shaded side, though slightly darker than the other, will remain soft and full of detail.

Observe that the reflex of the eyes must be the same in each; these luminous points have their place on the upper part of the eye and nearest the side-light—not in the middle. If the reflex appears in one eye only, the face is too far away from the side-light; then move your camera and turn the face toward the side-light until these luminous points appear on both eyes; the head will then be well lighted, and the classic outline of the nose well rendered. A beautiful and often unforeseen lighting will be discovered by the movements of this screen. Being made of translucent materials, it softens, filters, and slightly diffuses the light over the head of the sitter, and is an immense power in the hands of a skilful operator for obtaining in any studio those fine until all is brought into due harmony and good keeping in the "picture" which he is about to reproduce. The above instrument, combined with the use of a concave reflector of a pale rose or yellow tint, enables the operator to bring out, in relief, all the features of a portrait which require to have more light thrown upon them. The productions of M. Klary, obtained by the above process, are very pleasing, and have been much admired in Paris. Another part of his system also is that the whole face, in a photographic portrait, should be more or less shaded, none of it left absolutely crude or white; just as in playing the violin, to borrow an illustration from the sister art, no string is ever left

effects of light and shade which produce a perfect picture and which could not be easily produced by any existing arrangement of blinds or curtains. With taste and a little practice its use will become intuitive.

It is necessary to soften the edges of the shadows, in case of need, with a pure and delicate reflected light; this is done very readily by means of the concave reflector, used in accordance with the judgment of the operator. It should be turned towards the sitter in such a manner as to throw a concentrated light upon that part of the face under and behind the eye, as well as the darker portions of the neck, and you will thus avoid the spot of reflected light appearing in the eye. A perfectly exact position of the reflector is as essential as for the head-screen, in order that the proper balance of lighting may be obtained.

For lighting *à la* Rembrandt do not change the position of the face, but move your camera so as to obtain a view of the other cheek, and with some slight modifications of the head-screen, this lighting will be as perfectly rendered as the other; it is not here necessary to use the reflector, the head-screen alone will regulate the top-light, which must be used sparingly, so that it may not fall upon the points where the middle tones are wanted.—C. Klary.

As regards the best position of the camera, it has already been stated that no lens has a perfectly flat field; hence, for a standing figure requiring a flat field, it is of the utmost importance that the camera should be so positioned as to favor the lens. This, for card portraits (equivalent focus of lens about nine inches, back focus six inches, and distance of subject eighteen feet, the camera without a swing-back), is as follows: Height of centre of lens from the floor, about four feet ten inches; rising front of camera to be elevated one-quarter inch; and then the image made to occupy the centre of the plate, *i. e.*, equidistant between the top and bottom of the screen. To effect this the camera will require to be tilted forward slightly, which insures a more natural view of the face than when placing the camera lower and level, in which case the view of the face obtained is, as it were, that of looking *up* into it. Having got the image in the centre of the plate, focus for the eye, and then for the chest, or some prominent object on the chest, as a watch chain. Now halve the focus between this and the eye, when it will be found that the resulting picture will be evenly defined throughout its entire length.

A sitting figure requires the camera to be placed at a proportionally lower elevation, and here a swing-back is of great advantage. Indeed, portraits beyond the half-plate entirely "open," nor any true note produced without the feeling and action of the finger of the musician. In a word, the system of M. Klary was intended to replace advantageously the whole clumsy apparatus of curtains, blinds, shutters, reflectors, counter-reflectors, headscreens, etc., but it has not yet found general adoption.

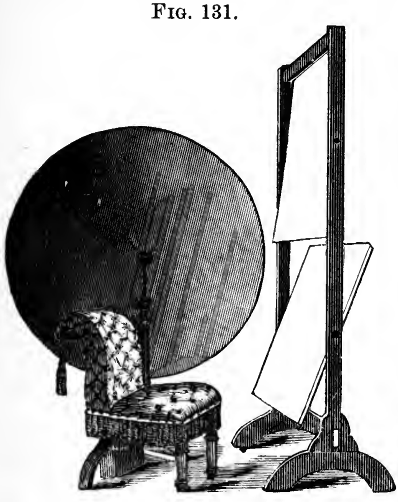
45. Almost as countless as the stars is the variety of backgrounds in use.

size should never be attempted without this adjunct to the camera; for, as has been shown already, larger or longer focus lenses are much more sensitive to differences of distance; and in a sitting figure the feet are often as much as twenty-four inches or more in advance of the face. This occasions nearly a quarter of an inch of difference of focus for a twenty-inch focus lens, and, therefore, without a swing-back, allowing the top of the screen or slide to be pushed out that distance, definition of the legs and feet simultaneously with the head cannot be secured.

Photographers accustomed to work with short-focussed lenses, *i. e.*, at short distances from the subject, often complain of lack of brilliancy and roundness in their pictures when taking to the use of longer-focus lenses, or working at greater distances from the subject. Now, in most cases, this is simply a question not of lens, but of lighting, for it is obvious that the direction and amount of light suitable for a subject at twelve feet distance requires considerable modification for one at twenty feet—JOHN L. GIHON..

45. I use a circular background. As will be seen by Fig. 131, it consists of a muslin disk, mounted on framework, which revolves on an axis affixed to an ordinary head-rest. The diameter is 4½ feet. Unbleached muslin is used, painted with a neutral tint and gradated. It is started on a revolution at the moment of exposure.—C. W. MOTES.

FIG. 131.



It is not my intention to rob Mr. Motes of any laurels that may be due him, but simply to mention that I have made a similar background. My modification is as follows: Instead of being a "revolving background," it only works half-way round, or less, as the case may be, by a pendulum. It is made with four arms, about four inches apart. It is graduated with a light color (or a darker one than the background) from the bottom to the color of the backgronnd at the top. Then, by setting it in motion, you get a graduated shadow on one side of the head, and thereby save time and trouble in "wooling" the negative during printing.—W. R. HOLYOAKE.

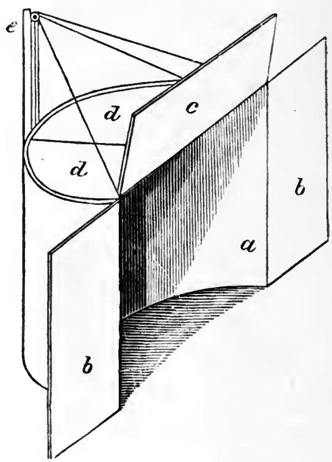
I was showing M. Salomon some examples of the work of Mr. Kurtz, and describing to him the cone background and its value in securlng light and shade to relieve the

Almost as hard as the stars to comprehend are the reasons why photographers use such backgrounds as they sometimes do.

One general fault is the use of backgrounds of too large dimensions. Not only this, the desire seems to prevail for "wide-angled" backgrounds—*i. e.*, such as include trees and plants of the various climes of the world; architecture of various periods; lakes, rivers, mountains, parks, villas, and "all out doors"

figure. He informed me that he had been using an arrangement with a similar end, but somewhat different in construction, and having also a somewhat more comprehensive aim. His background forms a curve, or the arc of a large circle, the chord of which arc would be about nine feet. Attached to this is a ridge-shape canopy of semitransparent material. This canopy opens at the ridge, and is hinged to the background at each side, so that it can be opened to admit a portion of direct light. As, however, it is chiefly by a high side-light that M. Salomon illuminates his figures, the curved background plays the most important part in his lighting. At the back is a rod, *e* (Fig. 132), terminating in a series of loops or pulleys. Through these pass cords which are attached to the canopies *c* and *d*. The cords are all brought to a position behind or at the side of the background, where the operator can readily manipulate them, each cord having a counterpoise attached, so as to maintain the canopy in any position into which it is pulled by the manipulator. The wings and canopy *b* and *c* are light frames covered with thin, transparent white muslin, transmitting some light, but arresting or breaking up direct rays of sunlight. At each end of the canopy *c* is attached a piece of thin muslin, which we have not figured, as it would have somewhat confused the diagram. It is the same width as the wings, over the top of each of which a piece hangs, to maintain the continuity between the wing-screens and the projecting canopy. The canopies *d* are also light frames covered with thick white calico, transmitting very little light. The background rests on three feet, one at each side and one in the middle; these each project behind about eight inches, to give firmness and steadiness; each foot has a large castor, to permit the whole to be wheeled round easily into any position. The wings are hinged so as to hang an inch or two from the ground, and are very easily moved backward and forward. The background is papered—in that used by M. Adam Salomon, with salmon-colored printing-paper. The sitter is placed within the curve, and the background, which is made to run easily, is moved round him until the right effect is produced, the curved screen being used to regulate the amount of light admitted on the lighted side, and to act as a reflector on the shadowed side, as well as to form a background, which by its light and shade gives space and relief to the figure.—G. WHARTON SIMPSON.

FIG. 132.



crowded upon one 10 x 12 sheet. If a full figure of a bride is taken, the chance is good for including all this in the picture. Then it might harmonize with her "bridal tour." But if a seated subject is offered, what must become of the background if the lens is brought up to any proper approach? Try having pretty "bits" painted for your backgrounds on sheets 5 x 6 or thereabouts, and you will like them better.

Revolving, oscillating, curved, circular, and swinging backgrounds are among the novelties.

The Kurtz cone background did not seem to secure many adherents, though deserving a better fate. Fig. 133 represents it entire. It is made of papier-maché, six feet in diameter by three feet deep, mounted on a rod which fits any ordinary head-rest stand; the latter is fastened to a wooden platform on castors, and is furnished with a handle, *A*. As the whole affair weighs but a few pounds, it can readily be moved and adjusted to any part of the room or light. The interior is painted or sanded to any degree of shade desirable. It will be readily understood that any light coming from one side, must illumine that part of the interior furthest from it, and per contra leave the nearest side in comparative shade. By turning it full to the light, there is no shade, and you get a very light background; then upon turning it from the light, you get it *almost black*, if you wish it so. An example of its peculiar and extraordinary effect will perhaps be better understood by contemplating Fig. 134.

FIG. 133.

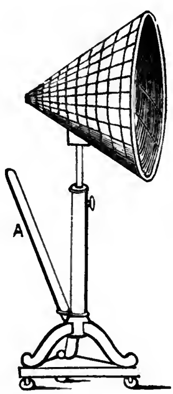
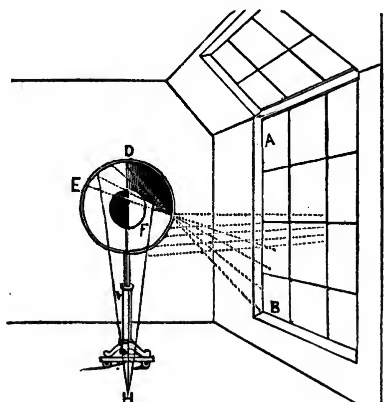


FIG. 134.



Let *A B* represent the side-light, *D E* the background, *F* the sitter's head, and *H* the camera. Now you plainly notice that the rays of light from the window *A B* illumine only about that portion of the background at the left of the line *D*, whilst the portion at the right of *D* is left in its own shadow. Now as the light falls on the sitter F, the side turned towards the light only is illuminated. The sitter, as viewed from the camera in

46. All careful observers, and all good photographers, know what a flat, repulsive effect is given to a face when the light is evenly diffused all over it. There is no contrast, no gradation of half tones, and the effect is spiritless.

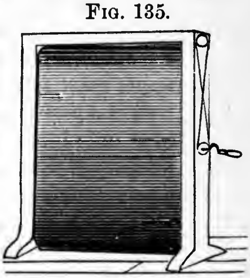
It is just so with a background of one unbroken tint; and our eminent artists have resorted to several means by which they can easily secure a gradation of tint upon the background.

To get a little shadow on the *top* of the background, a stationary screen is

the direction of *H*, has the high-light *F* admirably relieved by the darker portion, whilst the shadow part of the sitter is as well relieved by the lighter portion of the background. No matter from what direction your subject is lighted, the background immediately assumes the opposite lights and shades, and an extraordinary relief is at once obtained. By a little judgment and management it can be made exactly suitable for all complexions. In the case of a group of two, the darker person should be placed against the lighter portion of the background.

A background for all gradations of tints was invented by my good Italian friend, Cav. Ottavio Baratti. A few words and the accompanying figure illustrate it in a sufficiently clear manner. Take a strip of muslin of suitable width, six metres long, and colored progressively and with continuous gradation in such a manner that at the opposite ends there shall be one metre of white and one metre of black. These two ends are joined together and thus form an endless band. This is placed on a wooden roller supported by a framework and put in motion by two wheels; at the bottom another free roller keeps the cloth stretched.

Fig. 135.



The motion may be communicated by hand by means of a crank, or by clockwork.

If the operator wants a dark ground, he brings the black part to the front, and keeps it there; should he wish it rather lighter, he begins at the white and passes gradually to the darker tints.

Another advantage of this apparatus is to keep the backgrounds of the pictures free from spots or stains, as the cloth being in motion during the pose, it can leave no traces of them.

The construction is simple, presents no difficulty, and also costs but little.

46. The numerous ways in which a background or accessory may be used are not apparent at first sight. Frequent use, continued experiment, and study alone reveal them. Much pleasure is afforded me when I see that my works have been used understandingly; and pleasure, mingled with surprise, when they are put to new and good use upon which I had not calculated. My respect for a photographer increases with his advancement, and I feel more firmly bound to do for him my best when executing his commands.

We are all stimulated to our highest activity when much is demanded, and we are interested when working out an idea above the level of our everyday pursuits or thoughts.

suspended horizontally; it is partly over the head of the sitter, and raised and lowered by means of cords and pulleys. Another shadow is thrown in *behind* the sitter by moving a very dark triangular screen, about one-half the size of the background (which, by the way, must be white, or very light), up and down during exposure between it and the sitter.

This will account for the time which some of our enthusiastic friends spend when the presence of a good model or sitter offers the opportunity.

The professional artist-painter of landscapes or figures is not content with the practice found in the execution of his usual subjects, but periodically takes days and weeks for the close study of nature, in order that he may advance to a higher plane.

Recently I have seen great improvements in the work of an artist friend after only an eight days' sketching trip on the Hudson; and I have no doubt but that photographers will find themselves benefited if they will frequently practise posing, composition, and landscape photography solely as studies. The real falls short of the ideal, and the photographer should in his ideas be in advance of his power of execution. When he is satisfied with his results, then he may be certain he has struck his highest level, and is in danger of receding or being eclipsed by a more ambitious and persistent worker. I would urge study, because the mechanical photographers are being gradually dropped from our ranks, and ere long it will be generally conceded that the portrait and landscape photographer must, in fitting himself for his profession, study the arts of design, drawing, perspective, composition, and, possibly, color.—L. W. SEAVEY.

I am especially interested in the varying effect which dark and light backgrounds have on the intensity of the negative, because I have satisfied myself of the truth of the theory as to the actual increase of intensity in the lights when a dark background is used. In such cases, there is comparatively little demand upon the free nitrate on the plate during development, and it is, therefore, liberally deposited on the lights, giving them an actually larger proportion of silver, and hence, greater intensity than they could have had if a light background or light draperies had been present, demanding a large share of the silver deposited during the development. The presence of a dark background is, in fact, equivalent, in its effects on the lights, to the addition of a little more silver solution to the developer. At first sight many will be disposed to affirm that the increased brilliancy of the light in pictures with dark backgrounds and preponderance of dark draperies, is more apparent than real, and that the appearance of brilliancy is due to the effect of contrast, the class of pictures produced by M. Adam Salomon being possibly instanced as illustrating this. The dark background and preponderance of masses of shadow in the draperies will be pointed out as manifestly giving, by contrast, an unusually intense effect to the lights. This is, to a large extent, undoubtedly true; skilfully managed, contrast is a very legitimate source of brilliancy, and the purity and intensity of a light can at any time be forced by placing it in juxtaposition with deep shadows or dark masses. But Mr. Anderson points out another cause, from which it will be seen that the lights in such a case not only seem to be more brilliant, but that they actually are more intense. In this, as I have said, I fully agree with him. I remember the circum-

The figure is softened and a light shadow thrown over it from the face downward, by a small square pasteboard screen, covered with black velvet, with a semicircle cut out of one side. This is held in the hand and moved during exposure, covering the figure from one-third to one-half of the time; the time varying with the light, of course.

Another method was suggested by Mr. R. Gillo, viz.: "Provide a background about four feet square, on a frame, with a cross-piece at the back, in

stances which first called my attention to this fact in the early years of the collodion process. I was at the time in question taking some collodion positive portraits, and was struck with the low tone and general grayness of the lights when a white background was used, compared with the lights of pictures with dark backgrounds produced with the same chemicals, and under all the circumstances, except the change of background. I noticed the fact that the white sheet which on a daguerrotype plate gave a white background, on the collodion positive gave a dull thin deposit, which was far from white. This satisfied me that it was not simply the effect of contrast, and after some reflection and a few experiments, I learned that it was due to the even deposit of silver in development, and the insufficiency in the quantity of silver present to give a dense deposit where so much white occurred. The continuation of development and addition of a few drops of silver—a very rare circunstance in glass positive work—gave the lacking intensity to the whites in the picture with a white background, and established the theory of the cause to which Mr. Anderson has referred.

It is a fortunate circumstance that the class of pictures in which the use of light backgrounds is most imperative, vignettes, least require intensity or contrast, but is most suitably rendered by softness, delicacy, and harmony. It is also fortunate that when the presence of much dark drapery, and small portions of white or of a very light character occur in a subject, the operator has the matter somewhat under control. By using a strong developer, he can lessen the tendency to aggregation of deposit on the lights. The strong developer will quickly do its work, leaving little time for aggregation, and will, at the same time, throw down on the half-shadows their full share of deposit, and so help to harmonize the tendency, otherwise inevitable, to crudeness from excess of contrast.—G. Wharton Simpson.

Since backgrounds and accessories of such elaborate nature have come to be so extensively used in photography, there follows the necessity for the study of such laws of use, beauty, and fitness as pertain thereto.

Experience alone will not always give to the photographer that nice discrimination between truthfully artistic effects and those which at first thought seem quite appropriate and satisfy the sitter. Culture will do much, very much; but a little natural endowment is essential.

Truth, Mr. Ruskin teaches, is the first consideration in art; harmony and beauty will follow.

The most glaring faults of the average scenic backgrounds lie in their foreground. The objects are nearly always too small; trees, especially, are diminutive and wholly the centre of which is a hole to allow the horizontal rod of the head-rest to pass. It will be seen that when the rest is placed against the head of the sitter, the face appears in the centre of the square. There will be found no difficulty in painting this small background with a gradation from dark on one edge to light on the other. Lampblack and whiting, with a little size, answers for the color. When you have arranged the sitter, you can turn this around any way you please—light at the top shading into dark below, or *vice versâ;* or a diagonal gradation, to suit circumstances and your own feeling. The different effects thus produced are astonishing. Sometimes the effect may be improved by shielding a part of the light from the background with a blind or curtain. From the fact of this background being so close to the head of the sitter, you often get a boldly cast shadow from the head or shoulders, which is very effective.

The standing of the background diagonally is also a plan by which very

lack character, both in bark and foliage; they are neither elm, oak, birch, or apple trees, so far as any of their natural characteristics are discernible. Perhaps it may seem trivial to pay attention to these matters, but a *real* artist is he who either *truthfully* imitates nature, or originates from his own mind that which represents some principle, thought, or emotion; while he who mixes the attributes of several objects of nature neither imitates nor originates.

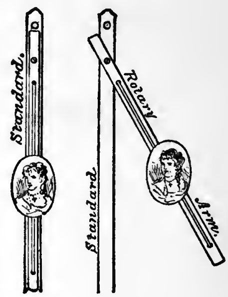
Photography is no longer a trade; it is an art. The last few years have witnessed wonderful achievements, and the next few will not fall short in this march toward true art. And if photographers could have the aid they deserve in accurate, truthfully painted grounds and accessories, to what excellence could they not attain?

Some photographs which find their way into my hands attest that even good accessories are frequently so misplaced as to appear quite absurd; pictures which otherwise are very fair, having proper lighting, easy posing, and with finish fully up to the average, are utterly ruined by a poor choice of accessory combinations. As an instance, I recall a cabinet photograph of a young couple whose dress suit and orange blossoms bespoke a recent wedding; the background was a forest scene, with a winding foot-path leading off into the distance. The long "matted" grass at their feet was another proof of sylvan surroundings. But the first thing which arrested my attention was the very plump, handsomely upholstered gallery chair in which the groom was seated, and I vaguely wondered what power had transported this wholesome-looking product of civilization into that rural wilderness.

Many people have an idea that the more pieces of furniture and knickknacks appear in the picture, the more effective it is, and this is true, but "effective" only in so far as to render it a matter for conjecture which is the accessory, the sitter or the furniture.

One great difficulty under which the average photographer labors is the expense of procuring such an array of scenic accessories, and the amount of room requisite for their storage; as an alternative, therefore, he must see that the few he considers necessary good effects may be had, as the part farthest away from the lens will be in deepest shadow, and *vice versâ*. I would suggest, then, that the background be swung by its centres in a framework, with a pin at each side for it to swing upon, and also pins at the top and bottom for the same purpose. The pins could be used to keep the background in place, when not used as above. This plan would also enable one to have a background on each side of the frame, and it could be quickly changed at pleasure. Of course, the backgrounds should be on the *sub*-frame, moving inside the larger. The latter should be mounted as usual on castors.

FIG. 136.



47. In the matter of usual apparatus the buyer will secure the best information from the catalogues and stock of his dealer.

The best in the world is procurable, with all wished-for attachments.

There are a great many *special* appliances, however, which the operator can contrive for himself, and a few pages devoted to them cannot prove unacceptable.

The annexed cut (Fig. 136) represents Mr. S. L. Platt's adjustable rotary eye-rest. You will see by the figure that the rotary arm will allow the picture to be right side up anywhere within the radius of the arm.

are of the best—and the best are nature's own work. For example, instead of using an upholstered chair with a forest background, take a holiday trip out into the woods, some day—photographers work hard enough to earn many such luxuries—and bring back enough wild grape-vine and suitable tree-limbs to make a graceful rustic chair; then use the spare hours and construct one for gallery use. Improvise something that will take the place of those painted rocks on castors. Study nature and the pretty indoor designs which are found in one's own home, and those of the various friends, and discourage the use of all accessories which savor in the least of artificiality when seen in the photograph.—MRS. CLYDE EHINGER.

47. Why will not a camera that will make a whole-size picture from life make one the same size from a card picture? I will explain. When about to purchase a camera, always bear in mind that the size, no matter what it is, will only reproduce a picture its original size. That is to say, a half-size camera and half-size tube will only reproduce a picture its original size, no matter whether it be a card picture or a half-size picture. If you wish to copy a whole-size picture to its original size, you must have a whole-size camera and lens—an 8 x 10 box and lens for an 8 x 10 picture, and so on for the different sizes. This plan of working would require one to have a number of boxes and tubes, which would be both expensive and troublesome. There are two ways to obviate this,

The plan for a good copying-board comes from Mr. W. G. Smith (Fig. 137.) To the frame, or head-piece, is attached a cord which runs in a groove underneath the bed, and works with a thumb-screw at the end. It enables one to get the picture in position on the ground-glass without removing the head from under the dark-cloth.

Fig. 137.

Another little dodge comes from Mr. R. Benecke (Fig. 138.) The object is to see at one glance whether a plan, map, etc., to be copied, stands parallel with the instrument. It is nothing but a straight board about six or eight inches square, in the centre of which a round stick is fastened perpendicularly. Thus: Let the board be of a dark color, and the stick white. Now hold it or hang it by a string in front of the drawing; let the stick be there where the two diagonals would cross each other. Next point your camera at it. Now if you see in *the centre of your ground-glass* a white circular spot on dark ground,

Fig. 138.

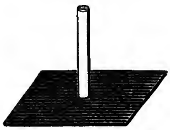
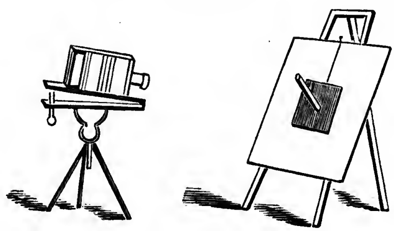


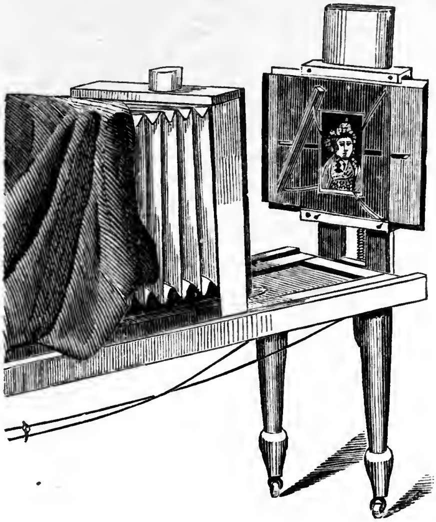
Fig. 139.



your drawing-board and camera stand correct; if not, that is, if you see the picture of this contrivance too high or too low, lower or raise your instrument, and shift it until you see no more of the stick but a white spot on black ground. Fig. 139 will explain it at once.

viz., either to have a long-bellows camera (Fig. 141) made on purpose for copying, or to have a simple contrivance called a cone (Fig. 142) made to fit on your ordinary portrait box. The camera represented in Figs. 141 and 142 is one of the 11 x 14 size of the American Optical Company's make, and is capable of being drawn out thirty-four inches. This box, with a double whole-size lens attached, will only make a 11 x 14 picture its original size. If, now, we take off the double whole-size tube and replace it with a whole-size tube it will make a 11 x 14 copy from a whole-size original. Again, if we replace it with a half-size tube, we can make a 11 x 14 copy from a half-size picture. If now we wish to copy a card picture to a 11 x 14 size, the camera will not be long enough, The novelty of Mr. F. M. Spencer's copying apparatus (Figs. 140, 143, 146) lies in the arrangement of the *target* for holding the picture to be copied, and for adjusting the picture to the field of the lens, in its desired position on the focussing screen. It consists of a slotted upright of ash, seven inches wide and twenty-four inches long, screwed firmly at one end to the centre of the end of the table; upon this there is a jacket, sliding vertically, to which the movable block of a wood screw is attached. This block plays vertically in the three-inch wide slot in the upright; the rigid block near the pulley of the wood screw is screwed fast to the bottom of the upright slotted post. A strong cord band plays upon the screw-pulley, and around another pulley near the opposite end, and underneath the table, which serves as a tightening pulley to keep the band taut, which, it will be observed, is attached to the centre of a bar transverse to the table, pivoted at one end, and held in place by a panel of heavy wire at the

FIG. 140.



and we must either have a longer box made specially, or use a cone as in Fig. 142. Fig. 141 is the camera with a half-size lens attached, and is capable of making a 11 x 14 copy from a half-size picture, an 8 x 10 from a card picture or medium-size ambrotype

FIG. 141.

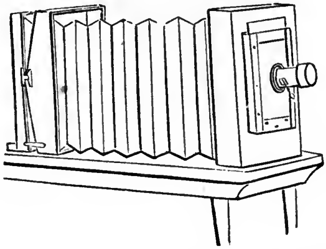
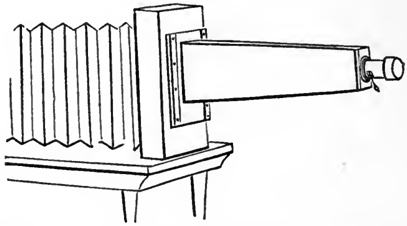
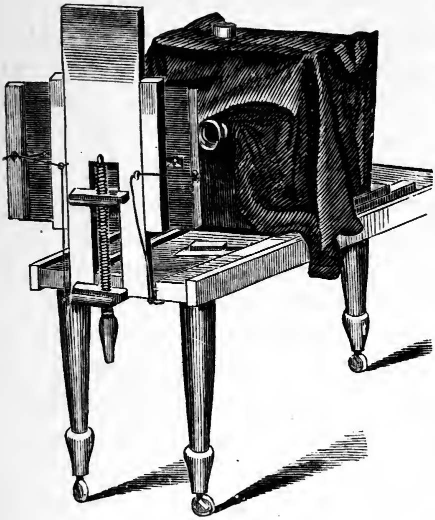


FIG. 142.



or daguerrotype, or the whole size from a $\frac{1}{9}$th size. Fig. 142 is the same camera with the front taken out and the cone put in its place, and the same tube on the end of the cone. The cone is 24 inches long, which with the box drawn out its full length, gives a other. Now, by pulling upon the cord the wood screw is rotated, causing the jacket upon the slotted post to move up or down, at the will of the operator, by which means the perpendicular adjustment of the picture is secured. The face of the jacket facing the camera has a rabbetted bar screwed to the upper, and one also to the lower end of it, forming grooves, in which the target (or easel) slides horizontally; the target is made of half-inch pine, twelve inches wide, and eighteen inches long, rabbetted on the edges so as to fit easily into the grooves of the jacket-front; a piece of pine wood, five-eighths of an inch thick and one inch wide, is screwed or nailed to each end of the target, on opposite sides, to prevent warping. Midway from the edges of the target are two slots, bevelled on the back, and separated by a space of three inches at the centre, the purpose of which is to allow the passage of a common screw of wood, which is passed from the back of the target into strips of hard wood half an

Fig. 143.



focal length of 58 inches. This length will give a 11 x 14 picture from a $\frac{1}{9}$th size or even smaller ambrotype. The same rule holds good with all cameras. If a whole-size box is the largest you have, a quarter-size tube will give you a whole-size picture from a medium ambrotype or card picture; but if the picture to be copied is smaller than that, you will need a cone, which, however, need not be over 12 inches long. Before concluding this subject, I cannot too highly recommend, to those who have not tried it, the use of the swing-back camera.—George H. Fennemore.

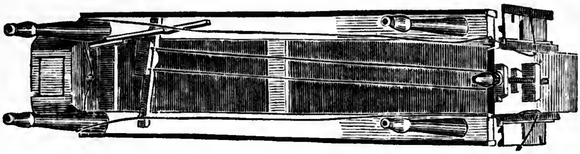
A convenient copying-table is made as follows: *A*, an ordinary table, having legs three feet long, with a solid top hinged at one end. Underneath this top is a sliding-board *B*, full length of top, and six inches wide, held by dovetailed pieces screwed to the top.

Near each end of this sliding-board are two half-inch holes, into which fit corresponding pins attached to a shorter board *C*, which stands at right angles to *B*. Upon this shorter or upright piece is placed the small blackboard, on which are fastened the pictures desired to be copied. This is also made adjustable by dovetailing on *C*.

To get rid of the granulated appearance of copies from paper pictures, which is caused by lights and shadows on the uneven texture of the paper, tilt the camera as shown in Fig. 145, so that the light falls as near at right angles as possible.

inch thick, one inch wide, and ten and a half inches long, entering the strips at their centre, and drawn sufficiently close to sink the head of the screw in the bevels of the slots on the back, but not to prevent the sliding of the screw freely in the slots; the inner edges of these strips are bevelled down to obviate their casting shadows, and the springs that hold the picture to be copied are screwed at one end to the ends of these strips; by this arrangement the springs and strips, or bars, to which they are made fast, may be quickly adjusted at any desired angle, to obviate casting a troublesome shadow, and to hold the picture.

Fig. 144.



Now, to control the horizontal movement of the target, a cord is made fast to screw-eyes in the ends of the target, and passed through other screw-eyes in the

This tilting is done by a device plainly shown in the illustration, viz., by a couple of pieces hinged to the underside of the table cover, and resting on notched pieces fastened to the inside of the rails of the table.

Fig. 145.

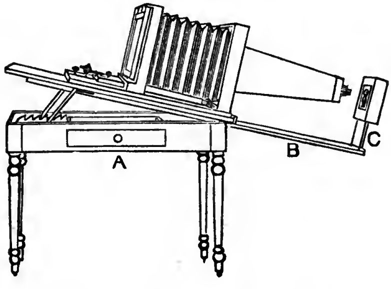
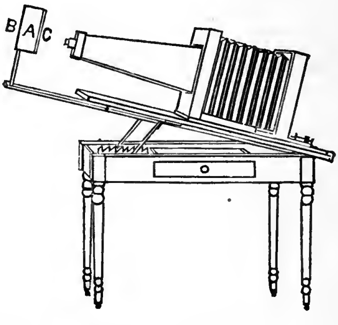


Fig. 146.



It will readily be seen that it matters not at what angle your camera may be, the picture to be copied will be parallel to it. Have a narrow cleat fastened to the end of the table to prevent the camera sliding off; it also serves as a guide to keep it and the picture at right angles to each other laterally.

Fig. 146 represents the same table as I use it for making magic-lantern slides, porcelain pictures, and reproducing negatives.

edge of the slotted post, and at the bottom of the table on each side, and so back under the table through another eye at the back end of the table; this cord must be slack enough not to bind the vertical movement of the target. Now, by pulling upon this slack cord, the target and picture are made to move horizontally toward the opposite side. It will be seen that the picture to be copied, having been placed upon the target by means of the cords, may be adjusted and focussed without once removing the eye from the screen, until both position and focus have been obtained; which, when many copies are to be made, will prove a great saving of time.

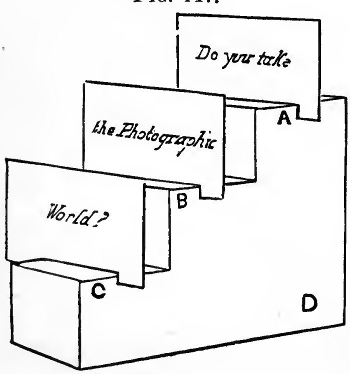
48. An inside shutter for the camera is suggested by Mr. R. A. Hickox. The slide is permanently attached to the inside of the camera front. When placed in the camera, it is opened by pulling the string, which is hooked to the under edge of the slide, and passes through a hole in the bottom of the front of the box and the top of the camera-stand; a cloth screen tacked to the front of the camera-stand hides the position and movement of the hand while making the exposure. This arrangement is especially useful in photographing children,

The camera is of course reversed on the table this time, pointing upward and toward the light. *A* is a box, which replaces the sliding blackboard used in copying, with its open side toward the lens. The negative is placed at *B*, and a vignetting diaphragm at *C*. The open side of the box being toward the lens sufficiently, shades the near side of the negative, and secures the transmission of all the light coming from that direction.

The upright piece upon which the box *A* slides has a large oval hole cut out of it for this purpose.—B. F. HALL.

48. One of the best methods for testing the correctness of the focus, is to take an arrangement of this kind (Fig. 147); *D* is a piece of board, a foot long and six or eight inches wide, cut in this shape; *C B A* are good stout business cards, wlth printing on them, of course, put in slits at right angles with the edge of the board, and the face of each card toward the letters in the diagram. This we place in front of the camera, at about the distance we would make an ordinary sitting, and focus on the middle card; the others will then be out of focus, and it is important that you have them both alike—that is, taking it for granted that the cards are equidistant. Now prepare and expose a straight plate, and if the focus comes the same as on the ground-glass we are all right, but if *C* is sharper than *B*, or *vice versâ*, then the ground-glass must be regulated till it is right.—R. J. CHUTE.

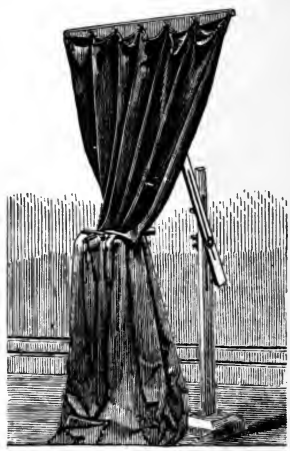
FIG. 147.



as the exposure is made without attracting their attention. It is very simple, and can be made by any operator who has any mechanical ingenuity. The slide is made of a little strip of wood, half or three-fourths as wide as the diameter of the lens. A strip of black silk is pasted to the lower edge of the slide, and made fast to the bottom of the front. When the shutter is up, all light is shut out of the box; when down it is open. There is no use for a cap or cover for the front of the lens.

Mr. C. N. Stevens communicates his method of making medallion masks as follows: I first had made a frame, 30 by 40 inches, of strips half an inch thick by two inches wide; then a piece of building-paper was tacked to the frame, and trimmed the same size. Now lay the frame on the floor and get the centre by laying a straight-edge across from corner to corner each way. Make a pencil-mark, and you have a × in the centre; now measure from the × the longest way of the frame, $7\frac{1}{4}$ inches each way, and drive a nail through into the floor; now take a string and pass around one nail, carry it by the other one, and tie it just $3\frac{1}{4}$ inches beyond, then take a pencil, put it inside the string, mark around, and you have an oval 16 by $21\frac{1}{2}$; take a sharp penknife and cut it out carefully, then get a piece of bleached muslin, and paste it on smooth, cut it in the centre, and paste it on the opposite side, turn the cloth in and put it down smooth. Now get four pieces, six feet long by two inches wide, hinge them at the top, mount your frame, and you are fixed for making medallion ferrotypes. The paper will warp when you paste on the cloth, but never mind, it will be all right when dry.

Fig. 148.



Mr. F. M. Spencer's curtain stand supplies a support for a curtain that can be easily moved and properly adjusted. The accompanying illustration (Fig. 148) explains itself, being, as will be seen, readily adjusted to any height, and convenient to move into any position. The arrangement of the curtain on the cross-bar is such as to cause it to hang in folds, so as always to produce a good effect.

49. Photographs are as often defective from bad focussing as from any other cause. When a good lens is perfectly focussed, and the resulting negative is printed upon highly albumenized paper, pressed firmly against it, there

results a picture with a brilliant clearness of outline, which no engraving, no artist's sketch, can in the least rival. The effect is extremely beautiful. It by no means interferes with softness. It would be as reasonable to say that a landscape could have no softness with a clear atmosphere, and that the best time to view natural scenery is in foggy weather; such a position would not be one whit more absurd than condemning sharp photographic work as necessarily hard, or even tending to be so.

Doubtless much imperfect focussing depends upon the defective surface upon which the picture is focussed. A good piece of ground-glass is not always obtainable, and one must often temporize.

One method consists in applying a layer of *starch* upon the plate, which in drying leaves a thin opalescent pellicle. The other consists in precipitating sulphate of baryta in a solution of gelatine, by which means the baryta salt is kept completely suspended in the liquid. A plate of glass coated with this opalescent gelatine and allowed to dry, makes an excellent focussing surface.

Dr. M. Carey Lea details another substitute as follows: "Prepare a varnish which should itself have the necessary opalescence. That I have succeeded in doing, and, thereby, have prepared focussing plates free from all tendency to peel off. The substance which I employ for this purpose is *tartaric acid.*

I take a good negative varnish made with alcohol, and saturate it thoroughly with tartaric acid. It does not dissolve a great deal, and to get a sufficient quantity into solution, the acid must be finely pulverized, added in considerable excess, and the vial well shaken at intervals for several days. It may then be allowed to settle for a day or two, when the clear liquid is to be poured off.

It is to be applied precisely in the same way as in varnishing a negative—that is, the plate is to be gently warmed before and after the application of the varnish."

50. A few more camera contrivances and then the subject of actual work will be treated.

To make a small figure on a large plate, Mr. James Mullen directs as follows: "A short time since, having occasion to make a small standing figure on

50. I can best explain my method of copying statuary in varied positions on one plate, by giving my first experience. I had occasion to make some card copies of a small marble statue of the Greek Slave, and thinking it would make a much more attractive picture if it could be copied in a variety of positions on one card, I attempted it. I took

a 14 x 17 plate, and my ceiling being low back of the skylight, preventing my getting the desired height of plain ground above the head of the subject without showing the top of the background and ceiling, or finishing in vignette, which was not desired, I finally hit upon the following plan, by which I accomplished it perfectly:

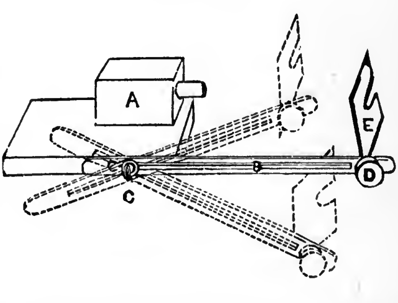
"I took a piece of straw board and attaching it to a head-rest, placed it a little above and in front of the lens, in such a position as to blend perfectly with the background above the subject's head; thus I obtained all the height desired. You will observe this method will admit of graduating the background, making it either lighter or darker, as may be desired, by simply changing the position of the board in front of the camera.

A simple means for producing a number of pictures with a single lens comes

for the background a strip of dark brown cotton-velvet, arranging it so that the lower portion covered the top and hung a few inches over the edge of a small stand. Placing the image on the centre of the stand, I got the proper size and focus with the ordinary camera, and made a faint mark around the base on the velvet, then moved the image to the right and left of the first position, being careful that one position should not interfere with the other, and marking around the base each time, that I might know just where to place it in the subsequent operations. I then prepared and exposed my plate, covered the camera, moved the image to the next position, and exposed again as before. On developing my plate, I found I had a remarkably fine negative of one object in three positions. Almost any number of positions may be obtained in this way.—George William White.

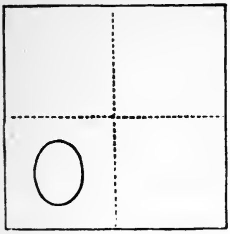
For vignetting in the camera, I use the following device (Fig. 149). *A* represents the camera-box, moved to one side of the top of the stand, in order to delineate the other parts more easily. *B* is a strip of one-half inch walnut, of any proper length, with a slot in it nearly the whole length. *E* is a piece of stiff cardboard, cut to the shape in the drawing, and attached to the end of the strip *B* by the screw-knob *D*, by means of which it may be turned at any angle desired. The strip *B* is fastened to one side of the top of the camera-stand by means of another screw-knob at *C*, on which it is also worked back and forth. It also enables us to control the whole apparatus, and by loosening it we may move it up or down, as shown by the dotted lines. If you wish to prevent an abrupt line, work the card *E* back and forth gently during exposure, by means of the knob *D*.—G. W. Edmondson.

Fig. 149.



from Mr. Henry W. Brown. (Fig. 150.) Cut a piece of pasteboard just the size to fit tight in the camera, closely in front of the ground-glass or plate-holder. If you want four gems on a one-quarter plate, cut an oval in your card just in front of, say, the lower left quarter of your plate. Now make your exposure, and turn your card from left to right, and make your exposure on the lower right quarter of your plate; now turn it from bottom to top, etc. In this way, with one or more cards, you can make as many gems on a plate as you want to. It will be found particularly useful in taking pictures of the little folks.

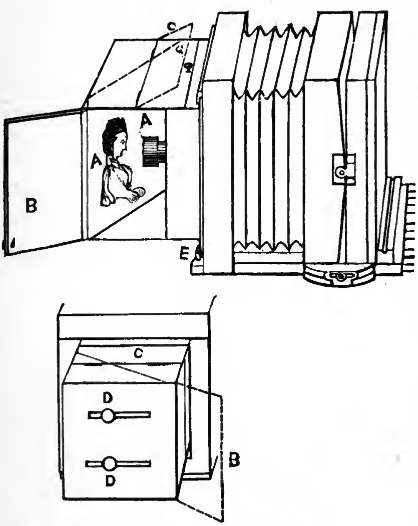
Fig. 150.



Below is a German contrivance for making medallion portrait cartes. The

Another method follows: Fig. 151 will show the arrangement of the needed apparatus, which is simple enough, being only a box without a bottom, which can be fastened over the lens by means of a rim of wood and a button. The box has a hinged lid on one of its sides (this may be dispensed with), and is square as to the opening at the bottom, so that it may be fastened on the camera with the side opening, pointing either upward or downward, or to the side. The mirror, fastened on a wooden frame, is fixed at an angle of 45 degrees with the front of the camera. The mirror must have a perfectly plane surface, and may be made of speculum metal, carefully polished, or of glass silvered on its surface. A convenient general size for the mirror is 4 x 3 inches. At the upper part of the box may be a small door for insertion of diaphragms. It is not at all difficult to silver the mirror, several methods having been published in the books on photography. There should be no difficulty in using this arrangement for ferrotypes, as speculum mirrors were commonly used by daguerrotypists for the same purpose. The same contrivance may be used for copying articles on the ground which cannot, without much labor, be fastened to a plane board—a lot of shells, for example, or fruit, or an engraving which you do not wish to mutilate, etc. The advantages of *copying on the ground* by means of the mirror are really very considerable, as you will readily understand.

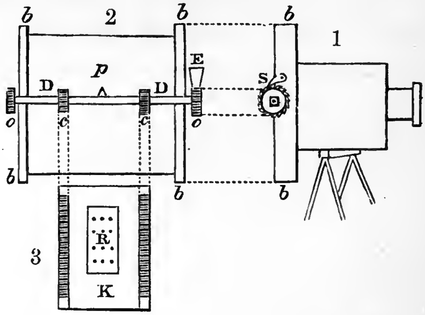
Fig. 151.



A, mirror supported on wooden frame.
B, door to mirror-box.
C, small door to change diaphragms.
D D, screws to slide mirror up or down slots.
E, button to fasten mirror-box on front of camera.

camera (Figs. 152, 1 and 2) consists mainly of a draw-box, with frame, *b b*, for the plateholder and ground-glass. A grooved shaft (Fig. 152, 2), *D*, *D* is attached to the frame *b b*. With this shaft two pinion-wheels, *c c*, are connected, which work into the racks, fastened to the plateholders. If the shaft is turned by the buttons, *o*, the plateholder will be raised or lowered in any required position, and their position retained by the ratchet and wheel, *S* (Fig. 152, 2). Both the pinions, *c c*, are movable on the shaft *D*. The plateholder, *K* (Fig. 152, 3) may be placed in any position by such an arrangement. To make different exposures in a required order, the back of the plateholder, *K*, is provided with a corresponding pattern, *R* (Fig. 152, 3), and the plateholder moved by the racks and pinions, until the pin (index), *p*, which is fastened to the middle of the shaft, *D D*, and precisely in the optical axis of the lens, corresponds with a required point of the pattern; then the plate is exposed, shut, the plateholder moved to another point corresponding with the pattern and again exposed, etc.

FIG. 152.



A novel baby shutter comes from Mr. G. W. Coddington. Fig. 153 shows a front view of the block and tube. The block is about one and a half inches

FIG. 153.

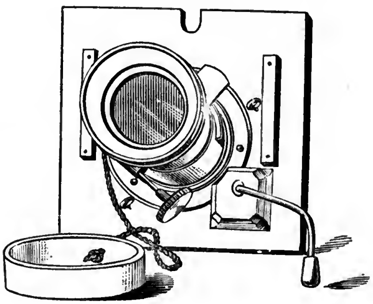
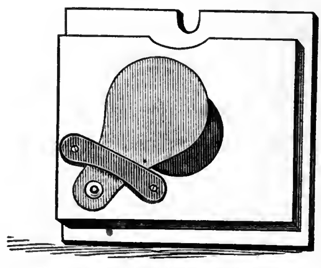


FIG. 154.



thick, or as thick as the length of the movement given by the rack in focussing the instrument, so that the back lenses shall not go clear through the block. At any lowermost corner through the block is passed a rod or wire one-eighth of an inch thick, with a shoulder or flange soldered on it where it enters the wood, to keep it from playing backward in the block. The wire is bent at right angles, so as to form a lever to operate the shutter behind the tube.

Fig. 154 represents the back or shutter, which is soldered fast to the opposite end of the wire forming the lever, and is made of sheet-iron or zinc. Over this is passed a strap of sheet zinc, which is secured by two screws at the ends, to keep the shutter close up to the face of the wood block, and excludes all light when closed from passing through the lenses. The shutter being slightly larger than the hole in the block, the two screws that hold the strap at the end act as stoppers to the shutter in opening and closing the tube in making an exposure. Fig. 154 shows the shutter partly open, with the knob on the lever projecting at the side. As the shutter is always closed after making an exposure, it keeps out all dust and dirt from settling on the back lenses.

Mr. Frank Thomas has devised a very useful hood for protecting the lens from extraneous light, and for convenience in making the exposure.

The nature of it will be seen by reference to the accompanying cuts (Figs. 155 and 156), the first being a front view and the next a side view. It is so

Fig. 155.

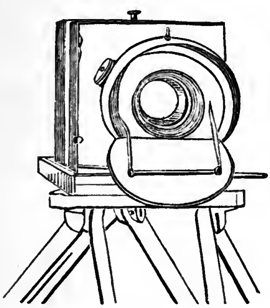
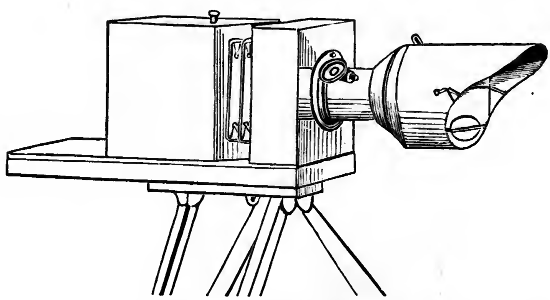


Fig. 156.



constructed that the rack and pinion of the lens and the central stops may be used without hindrance, and without removing the hood from the lens. The hood, as is seen, is supplied with a shutter, which is simply hinged to it, and a rubber band attached to it, which acts as a spring.

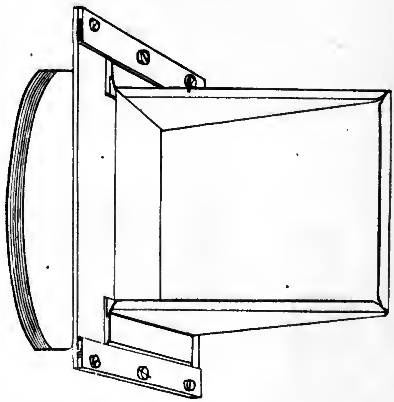
Mr. Thomas gives the following directions for making the hood, which will enable almost anyone to procure its advantages at little cost:

Make the hood to fit the back part of the lens, and about one inch longer than the lens. When it is run out then take off the front part of the lens and slip your hood on, and replace the front, when it is ready and always on the lens.

It gives you free access to the stops and ratchet, allowing you to focus as usual. For a $\frac{1}{4}$ tube, which is $2\frac{1}{2}$ inches in diameter, the hood should be 5 inches in diameter, and for larger lenses in the same proportion.

There is a good deal of inquiry as to the means by which ferrotypes are made non-reversed—*i. e.*, so that the figure will appear upon the plate as it is in nature. While this class of picture has only the one advantage of showing the figure non-reversed, there are certain drawbacks in making which are hardly compensated for by the advantage spoken of.

FIG. 157.

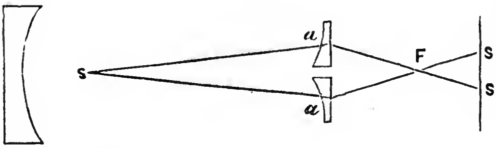


In the first place, a costly prism must be obtained, with which to invert the image as it passes through the lens to the plate. A very quick-working lens must also be used. The prisms alluded to are arranged as shown in Fig. 157.

The idea of making several pictures simultaneously with a single lens was worked upon considerably a long time ago by Mr. D. W. S. Rawson, who has since died. As a first result, he gave us his multiplying reflector, which consisted of a group of fourteen tiny mirrors the images on which were copied with a single lens. The amount of care and skill required to adjust the mirrors, and the loss of light attendant upon their use, were objections to the plan. These objections Mr. Rawson claimed to have overcome, by the use of direct light bent out of a straight line with the sectional parts of a concave lens, arranged as follows:

Fig. 158 represents, first, a concave lens, which may be cut into two, four, or more pieces, and the position of each section exactly reversed, as shown by *a a*; now the pencil of light from the subject *S*, falling upon *a a*, is refracted so as to cross at *F*, at which point the camera lens is placed, when the images *s s* will be formed on the object-glass; the number of images thus produced will correspond with the number of sections into which the lens is cut.

FIG. 158.



A four-inch diameter concave lens may be cut into four parts, each forming a square of about one and a half inches; or plain wedge-shaped lenses, with a refractive power of about ten degrees, may be used. These lenses or sections are mounted in a frame in the position described, placed in front of the camera, on a board. No other adjustment is required, except to point the instrument to the subject, and focus in the usual way. The size of the picture is varied, by altering the distance between the multiplier and the camera lens.

The position of the subject, multiplier, and camera are shown in Fig. 159.

The arrangement of the four sections proves the most practical, whereby four pictures are made at one exposure; a greater number may be made by the use of an ingenious plate-holder, with which four exposures secure sixteen small

Fig. 159.

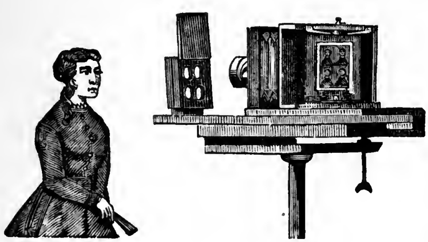
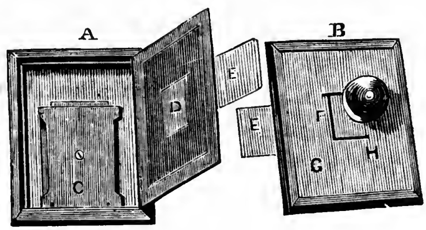


Fig. 160.



pictures on the plate. (Fig. 160.) *A* is a holder, opening from the front instead of the back. In the middle of the door is an opening of one-quarter the size of a one-quarter plate. The plate-block *C* is of the size of a one-quarter plate, and the inside of the holder is of a size to allow it to move one-half its length vertically and laterally, by which means each quarter of the plate-block may be brought under the opening *D*, when the door is closed; the plate is fastened to the plate-block by slipping it up through two iron-wire clasps at the top, and down into two similar ones at the bottom. When the plate is fastened to the block, the door is closed, and the opening is covered with the slide *F*, which slips out through a slot in the side of the frame, that it may be opened and closed while the holder is in the camera. The plate-block is attached to the knob on the back, shown at *B*, and the screw or rivet that connects them works freely in the slots in the back of the holder; when the holder is placed in the camera, the knob is moved around to the top right-hand end of the slots, when the first exposure is made; it is then moved to *F*, where a notch prevents its falling, and so on around to *G* and *H*.

CHAPTER IX.

THE APPLICATION OF ART PRINCIPLES.

51. In the first lesson of *Wilson's Photographics*, I devoted seventy-six pages to the *treatment of the subject.*

.Following the best of instructors in art, John Burnet, I tried to make plain the principles of art, and to exemplify them by means of words and about fifty illustrations.

I began with "lines," "circles," "angles," and "perspective;" then the subject of light and shade was pursued, and followed by an explanation of the various forms of composition adopted by all good painters in the production of their works.

These were the *outer* lines of thought. They were seconded by considerable attention given to the *inner* lines, such as "breadth," "harmony," and "relief."

The various points were practically illustrated by·numerous diagrams and engravings from famous paintings of "old masters."

The student was thus started on the way, and then the subject was dropped, lest my desire to interest him in art should be defeated by overwhelming him.

But now, I propose to lead him further into the mysteries, depths, and delights of art's enchanting principles.

And for illustrations, this time, I shall use only engravings from the paintings of some of our best modern painters.

Let us begin.

51. It must, of necessity, be, that even works of genius like every other effect, as they must have their cause, must likewise have their rules; it cannot be by chance that excellences are produced with any constancy or any certainty, for this is not the nature of chance; but the rules by which men of extraordinary parts and such as are called men of genius work, are either such as they discover by their own peculiar observations, or of such a nice texture as not easily to admit being expressed in words; especially as artists are not very frequently skilful in that mode of communicating ideas. Unsubstantial, however, as these rules may seem, and difficult as it may be to convey them in writing, they are still seen and felt in the mind of the artist; and he works from them with as much certainty as if they were embodied, as I may say, upon paper. It is true these refined principles cannot be always made palpable, like the more gross rules of art;

52. Once the principles of art are fairly understood, the faculty of artistic sight should be acquired.

By that I mean the ability to discern not only the proper pose and balance of the lines, but every tint and gradation of light and shade on the face.

This faculty of seeing is only acquired by close observation and careful study. Anyone may observe the lights and shadows of brilliant sunshine, such as are produced in nature everywhere, especially, as we have all seen, when the shadow of a great cloud goes sweeping over the landscape; it requires no particular cultivation of sight to see these, but in the studio, and on the human face where the soft light is blended with the flesh tints and forms of features, the faculty of seeing must be cultivated.

We all recognize the conditions necessary to success in the use of chemicals, and are careful to work them according to certain rules, but no condition of chemicals, however carefully manipulated, will compensate for a badly lighted model; hence it is necessary that as strict an observance of rules in lighting should be practised as in the management of the chemicals.

Mr. Robinson, in his excellent work, *Pictorial Effect in Photography,* says on the subject of "artistic eyesight:" "There is a tendency among young artists to despise rules, and to trust to instinct and feeling for art; but it is not only well to do right, even if that were possible, by instinct alone, but it is also pleasant to *know* you are doing right."

Thus it is with the subject before us; we may have, or acquire, a sort of instinctive faculty of seeing what we do, but in that case it is guess-work in a

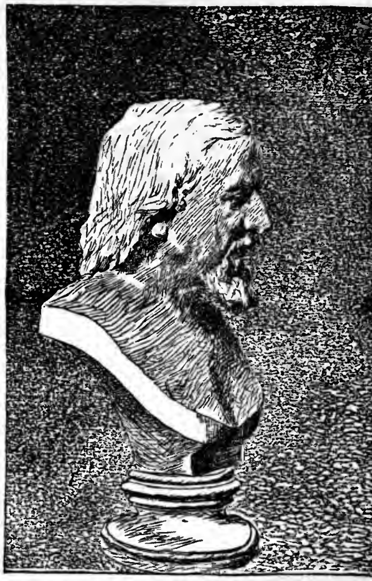
yet it does not follow, but that the mind may be put in such a train that it shall perceive by a kind of scientific sense, that propriety which words, particularly words of unpractised writers such as we are, can but very feebly suggest.—Sir Joshua Reynolds.

52. As the best practical hints are derived from accidental combinations in nature, whose sudden changes prevent the possibility of sketching, the mind ought to be trained to the most regular and even mechanical mode of arranging the ideas; that in an instant we may be able to determine whether the effects, which we perceive, depend upon a particular form, or upon particular arrangement of the light and shade. By thus tracing effects to their proper causes, we secure the principal points as a sort of short-hand notes to guide and assist the memory. This practice will also open a road of communication between the eye and the operations of the mind, which neither a hasty sketch nor the most learned dissertation can, separately, produce. At first it may seem more difficult than it really is; but a few trials will convince the student of its practicability, especially as the effects that strike him to be the most pictorial are generally the most simple.—John Burnet.

great measure; the uneducated artist makes his movements in a sort of experimental manner; he looks this way and then that, hesitates in one motion, and then another, till finally he takes a grand survey, and guesses it will come out all right. Now this guessing it will come out all right is a delusion, and almost inevitably results in failure. The only surety that a sitting will come out all right, is to see that it *is right* before the camera.

And this desirable faculty is as needful in portraiture as it is in outdoor photography.

FIG. 161.



53. The beauty of a picture depends so much upon its treatment. For example, a beautiful face may be made to look flat, uneven, and unamiable by photography, if under a full front light. An architectural ruin may be made all the more a ruin, and its picturesqueness utterly destroyed, by flooding it with light.

Let us see these points demonstrated. The drawing (Fig. 161) is by Mr. W. R. Donovan, from a bust of Thomas Le Clear, N.A. It is a fine example of the

53. The application of photography to portraiture has reformed, and almost revolutionized, that art throughout the world; yet ninety-nine out of every hundred photographic portraits are the most abominable things ever produced by any art, and the originals of them may often truly say, with the old Scotch lady who saw her own portrait for the first time: "It 's a humbling sicht; it 's indeed a sair sicht."

Photography is a noble profession, although it is a mean trade. Photography has hitherto been a refuge for the destitute,

> "A mart where quacks of every kind resort,
> The bankrupt's refuge and the blockhead's forte."

The photographer has not often the advantage, enjoyed by the painter, of making the acquaintance of his sitter before he takes the portrait. He often sees him for the first time as he enters his studio, and has done with him in a short quarter of an hour. It requires great perception of character and great fertility of resource to enable him to determine at once, and at a glance, what is best to be done, what expression he should endeavor to call up, and what position would best suit his sitter.—H. P. ROBINSON.

judicious management of light and shade. The peaceful, benign look of the face of the gifted teacher in art could all have been destroyed by simply changing the main light to the front.

Fig. 162.

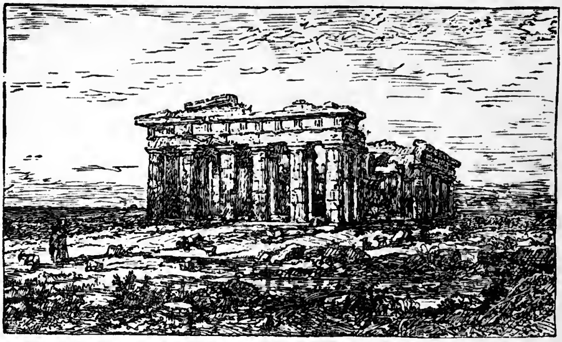
From one of Mr. L. de Forrest's paintings of the ruins of Gertassy, on the Nile, a drawing has been made to show how all the roundness of the columns, the rich details of the capitals, the mysterious hieroglyphics, and the light and shade of the wonderful cornice are æsthetically ruined by bad lighting (Fig. 162). Moreover, the rich ruins round about have no chance to play their part in a choice composition, because the artist chose his study at the wrong hour of the day for the best effects. I once did likewise and could be accused of committing an unpardonable blunder, were it not that I purposely chose such a light that I might procure a "moonlight effect" for my lantern.

54. Otherwise I should have treated my subject after the style of the

54. "Almost every one has seen examples of these transparencies in biscuit ware which produce the effect, when hung up at a window, of a drawing in light and shade. Such effect is caused entirely by the varying thickness of the plate, which is so moulded as to be exceedingly thin in the highest lights, and very thick in the extreme darks—*i. e.*, the picture is made up of gradations of light and shade. Just the same is the case with the photographic negative. It is made up of varied thicknesses of a film which is the product of sundry chemical mixtures that have first been rendered sensitive to light, and then, after submission to the action of the light, exposed to the influence of other chemicals until the image is developed. Unlike the biscuit-ware picture, however, which gives you the effects of black and white as they are in nature, our photographic negative is reversed—*i. e.*, the dark parts are white, and *vice versâ*. Therefore, in order to secure an approach to nature, we must place the negative on paper or other material sensitive to light, and expose them together to the sun, when we have a resulting image on the paper the reverse of that on the negative. This is fugitive, however, and would soon be

"Temple of Paestum," by Mr. Jasper F. Cropsey (Fig. 163). In nature this ruined temple is not nearly so picturesque as the lofty pile at Gertassy, and yet how much more so it has been made to appear, by correct lighting. The one recalls our historical memories of the ancient Greek cities on the Gulf of Salerno, celebrated by the Latin poets, while the other scarcely attracts a passing thought, let alone our careful study.

FIG. 163.



55. Having acquired the ability to see things in their best light, the student must exercise his ability by permitting it to mould his tastes and to guide him in his choice of subject.

A friend has truly said: "The great requisite for taste is simplicity. Now, by simplicity, don't understand tameness. Tameness is always an indication of poverty of resource. Simplicity is best expressed by temperance, because taste will venture much, sometimes very much that is not quite compatible with conservatism, but this venture is always attended with success, because the bounds of temperance are never overstepped. Good taste never seeks merely to astonish—this is the province of sensationalism. Violent lighting, bizarre posing, and affected composition are not the material with which it constructs that which is chaste and beautiful. Taste does not search in every corner of the globe to find something new. No; it is content with the material which its own age and generation supplies. It requires far less ability to invent something, the indigest of the fancy, something which the world has never seen before, and which perhaps the world will be sorry that it has seen, than

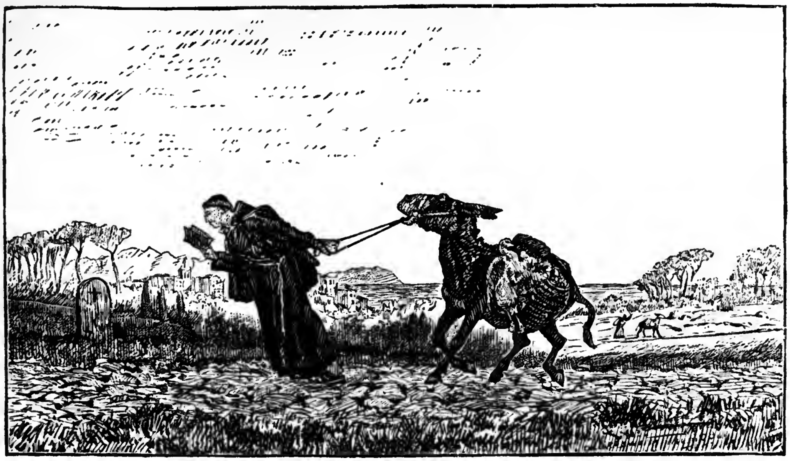
discolored and destroyed by exposure to the light, were it not submitted to the other chemical processes of 'toning' and 'fixing.' Before it is finished, the smallest photograph must pass through some thirty-two operations."

55. I am certain that what we require is more study of art-rules and principles, so that there shall be more intelligent working and less dependence upon chance for success. And by study I do not mean wholly the study of books and treatises upon art, but let each study the works as well as the writings of other masters, and reap the advantages to be drawn from imitating their examples. In union is strength, and the strength comes to each individual by the union because each has access to all the knowledge pos-

to select with taste from the great storehouse of nature's beauties. It is sometimes argued that fashion controls taste, but good taste never finds any obstacle in the most arbitrary dictates of fashion, because it is superior to them."

Do not think, however, that taste despises all rules. The indolent photographer, no matter how much of inherent talent he may have in matters of taste, will find his vanity a poor prop to depend upon for judgment. If genius alone discovers laws, surely she will not despise their value. Genius is never lawless either in science or art. Yet she never obeys the letter but the spirit, which quickens to greatness of result.

FIG. 161.



"The Pursuit of Knowledge under Difficulties" (Fig. 164), by Wordsworth Thompson, N.A., supplies an apt illustration right here of how individuals vary in their tastes.

sessed by those with whom he is united. No one person, however much of genius he may possess, can arrive at any great degree of excellence independently of others.

When the art was in its infancy, the power to make a likeness was thought to be something wonderful, and the discoverer was justly regarded as a genius; but he would himself be greatly astonished at the perfection to which his discovery has been brought at the present time. Yet no one has gone very far at once. The first who gave the hint did not know how to pursue it methodically. He worked as far as he was able, and others availing themselves of his experience have pursued it further. In fact, our only road to success is in imitating others and building upon the foundation they have laid.

There are people whose only inbred principle seems to be to oppose—to act "contrary" as the ecclesiastical donkey in our illustration appears to do. But there are more who will pursue and obtain knowledge upon artistic principles, no matter what difficulties oppose them, like the studious monk whom the donkey would lead. Such persons are the ones who usually have taste and the understanding to exercise it.

56. Do not understand that the photographer should be a slave to method, or make pictures by the rule of three. Let him use his own selective ability, and if the conception dawns upon him that his picture may be made more beautiful—a group, for example, by disobeying the rule of pyramidal construction—let him regard it as an inspiration and follow whither it leads him. He can trust himself if he is a student of art. And yet, he should never set out with the intention of violating all the set rules in the belief that he will produce something effective.

I am myself *an imitator*, and am free to confess that I have borrowed much from such men as Kurtz and Notman and Ryder and Rocher, and many other shining lights in our profession. They, too, have borrowed from still others; and thus, by imitation and study, is progress made. I would not be understood as meaning imitation in its literal sense, or simply the copying of the productions of others, but to avail ourselves of the advantages that may be drawn from any and every source within our reach.

If we exclude from our work everything that is not wholly and entirely our own, and make ourselves the beginning and ending of all excellence, asking no instructions from others, and seeking to convey none to them, we shall throw away all the experience of our predecessors, and will soon find ourselves distanced by those whose egotism has not led them into such folly.—J. H. KENT.

56. There will always be two factions in the artistic camp. The idealists and the realists are always at war. But, in this country, the realists now have the best of it, and the majority wins. Creative art, in its highest conventional sense—that is, in the sense of working through pure imagination and fancy, does not belong among us. Reproductive art, in the sense of depicting human life and nature as they exist, is the foundation of the modern American art-idea. Photography is simply a form of reproductive art. Realism and reproduction are one—with the difference of the informing spirit of intellect and feeling, which in some subtle, indefinable way raises the artistic above the mechanical. This difference holds good in literature no less than in art. Flaubert's "Madame Bovary" is a magnificent piece of realism, while the *New York Herald* contains every day examples of excellent reproductive writing.

Photography is, however, no less realistic than reproductive, and the barriers between modern art and modern photography are every year being broken down. A photographer may be an artist or an artist may be merely a photographer, in the ordinary trade meaning of the word. A man of genius does not trouble himself about methods or vehicles of expression, and he will accomplish as much with one set of tools as another. He will

In the "Testy Old Squire's Complaint" (Fig. 165), by Mr. George H. Story, we find a fine illustration of our last points. It happens to be a literal illustration of the taste of the small boy who stands on the left. The arrangement of the figures is effective and natural; the lighting is carefully artistic and the sketch makes its story easy to understand, without very much telling.

Fig. 165.

The apples on the floor, to which the enraged squire is pointing with his cane, have been purloined by the boy from the squire's orchard. And as it is probably not the first offence, the parental home has been invaded to make complaint.

The father, tilted back in his chair, seems to be saying, "Well, what are you going to do about it?" The woman, with her hand on the door-latch,

do more with the camera than a man of mediocre ability will accomplish with all the color-tubes, palettes, and brushes in the world. Therefore let photography take its place among us as one more recognized and legitimate form of artistic expression, equal in value to any of the other known and accepted vehicles.—Charlotte Adams.

The two gravest, and, it must be admitted, most just charges brought against portrait photography, are these: 1. It gives only the outward appearance of the man, a map of the face, as it were, as the constraint of the head-rest, and the rigidity of the muscles resulting from the necessity of keeping perfectly still while the exposure continues, deadens the expression. 2. Its almost mathematical exactness and sharpness, its undue accentuation of light and shade, and the consequent lack of unity and tone, deprive it of those artistic qualities which are the charm of the work of the true artist.

The first objection has quite lately been removed to a great extent by the introduction of new processes, which have shortened the time of exposure very considerably, and I shall not, therefore, dwell upon this point at present.

The second difficulty has engaged the attention of artistic photographers for many years, and quite a number of attempts, more or less ingenious, have been made to overcome it. I say, advisedly, "artistic photographers," for there are at least two other varieties besides: the handicraftsman, or, possibly, more correctly speaking, the scientific looks defiance at the complainant and seems about to open a way of escape for the defendant, while the other members of the family are variously posed as impartial listeners.

The entire picture is full of naturalness, and with the rapid plates of to-day would not be impossible for photography to repeat. We can all see that the painter has been swayed by the rules of art, and yet his taste has been led by Nature.

57. If we take Nature as our guide, and exercise the gifts which have been imparted to us, we shall advance much more rapidly towards the power of good judgment and good taste than by the blind obedience to set rules. All

photographer, and the mere tradesman, to whom photography is simply a question of so much a day. With this last variety we have nothing to do. The scientific photographer, however, is a very respectable person, quite ambitious, and often of high attainments, but entirely mistaken as to the aims of photography so far as portraiture is concerned. The great object of the scientific photographer, next to the discovery of chemicals which shall be more reliable and more rapid in their action than those hitherto in use (an effort in which he is seconded to the fullest extent by the artistic photographer), is definition, to improve his lenses his greatest care. "See how sharp and clear this picture is; how every detail is made out into its minutest particulars; how every pore of the skin shows in this face; how brilliantly the lights and shades are set off against one another." In vain will the artistic photographer plead with him that these are precisely the qualities least wanted, that half of his detail ought to be suppressed, that the pores of the skin ought not to show, that these brilliant contrasts of light and shade are destructive of harmony and tone; in vain will he endeavor to explain the merits of his own work. His colleague persists that it is blurred, gray, weak, and, therefore, good for nothing. It is the same war between craft and art, between skill and—pardon the presumptuous word—genius, which has lately divided the ranks of our wood-engravers.—S. R. Koehler.

57. Let me quote from an essay I read some years ago, and which made such a strong impression upon me that I preserved and read it again and again, and which will elucidate my meaning better than anything I can say. It is worthy of being printed in letters of gold, and hung where every operator in the land must see it daily and hourly:

"*The two great main considerations which should occupy the mind of every photographer are these: What is the best view he can take of his sitter, and what the effect of light and shade? Which will be most becoming to that sitter's countenance? On these two considerations the success of the portrait entirely depends.*"

Now as to the question of view there is some tolerable amount of understanding manifested by the great body of photographers. The sitter is generally so placed that the most favorable aspect of his face comes before the lens, and so that the rapid perspective to which he is subjected shall distort him as little as may be.

Such rules as these applying equally to all sitters are then pretty well understood, but laws are really Nature's laws, and all things affecting us as beautiful are but the varying phases of Nature. Art itself is but selections from nature, and even genius is only the preëminence in the power of perceiving what is beautiful in nature, else how would men who are not geniuses see the beauties which genius discovers and reveals to them. Nature is inexhaustible in her resources, and the revelations she manifests to great minds must not be called the creations of their intellects. The superior intellect first perceives, but others less gifted can also appreciate, and justly; it is therefore no excuse to say that we live in an unpoetic age, or in a period unartistic. Poetry and art never die. And another thing is true: The photographer lives more intimately in the present,

this is not enough. The photographic artist who would wish to produce a really successful portrait, should study the special defects and special beauties of the individual before him, and consider in what view the faults of such physiognomy will assert themselves least strongly and the merits show the most.

This is the function of an artist; of a man of considerable natural abilities and immense experience. It is exercised by some of the best French photographers in an eminent degree.

In conclusion, do not be afraid of shadows, proper transparent shadows which lie in such agreeable masses on faces which come in the range of our skill. I do not mean those fearful innovations that have lately come into fashion, fostered by those who ought to know better than to take every one in a style misnamed Rembrandt, and which in most cases consists of patches of black and white haphazardly distributed over the human face divine, and when analyzed amounting to nothing but a smudgy dirty thing; but lights and shadows as solid, as bright, as round, and as finished, as when the sun flashes brilliantly and warmly; which are as different as such sunshine is from a wet, dull, cheerless, monotonous day.—Daniel Bendann.

I remember when I first began to pay attention to painting I used chiefly pure colors, and not long ago I was reminded of my former method by hearing an artist say that the same was true of all amateurs; hence their pictures are usually crude; and delicate only after they have had experience. They subdue their colors and mix them with white, making them more neutral; the result of it is that when you examine a good oil painting or a water color, you hardly see traces of the pure colors of the palette. The tints are almost indescribable. You don't know exactly how they are made. After you have had experience in handling these colors you can then perhaps solve the problem.

I remember in my early experience looking through a camera at a sitter; I could not see where the shadows were that afterwards developed themselves on the plate, and I have no doubt that many young photographers, in posing their subjects, put them in certain positions because they know a good effect will be produced, although they are not able to see in the camera the shadows just mentioned. Now, a painter learns to arrange lines and shadows by drawing figures, landscapes, and architecture; and were the photographer to draw his figures, he would realize the necessity of a good arrangement of light, shade, and the principal lines. As photographers you can scarcely appreciate that, feels more its full force and value, and constructs his pictures with more originality from the material at his hand, than the painter, though the camera may be a more humble instrument of art than the brush and palette. When some man of genius shall show the modern world the beauties which its heavy eyes have not seen, it will, on looking back, be conscious of the fact that more true originality in art is in the picture by the artistic photographer than in the one by the painter of the nineteenth century. Necessity has compelled him to grasp the present, and art to extract beauty from it. Moreover, the more he exercises the faculty of seeing things, the more individuality will there appear in his productions.

58. And this brings me t[illegible]
great thing in art, *individualit*[illegible]
be, let it show his own study [illegible]

I am afraid. I know that in pa[illegible]
stand prominently forward as the[illegible]
shadow behind it, and put the fi[illegible]
process. Doré's pictures, if you e[illegible]
constructed, so far as light and shade is concerned. [illegible] to photography as much as to painting, is that the artist's character is impressed indelibly on his work. If he is a refined, intelligent, and cultivated man, you will see it in his pictures. If, on the contrary, he is gross, boorish, uncultivated, you will see that. If he is an awkward man you will see the same in his pictures. He will pose his subjects as he feels himself, and according to his understanding. Notwithstanding his subjects may be awkward, if he is an intelligent and a refined man, if he has a high idea, it will still be manifested in the posing.—L. W. Seavey.

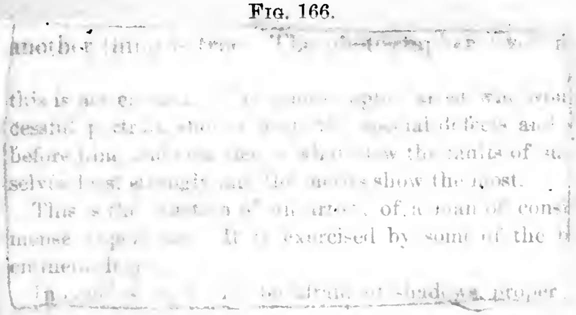
But there is yet another stage of progress in an æsthetic direction to be mastered by portrait photographers. We want, as a rule, a greater variety of treatment, more regard for individual characteristics, glass-room arrangements which enable us to experimentalize with our light and shade on living models as readily as if we had them on our palette or at the end of a brush or pencil before the painter's canvas. The wonderful gain newly made in rapidity of exposure should enable us to catch transient expressions of grace, beauty, and feeling, instead of the deadly formal stillness and fixed rigidity so necessary in the old long-exposure days. It is these things which ennoble the art of portraiture, raise it to a loftier standard of intellectual culture, and give it degrees of worth and value to which in their absence it must ever remain a stranger.—A. H. Wall.

58. Individuality I should term the expression of the nature of the artist himself in his work. The strong, as a student, will display evidences of himself in his work, even though the same work contains much that is characteristic of his master. His work will not so literally reproduce that which his master places before him, perhaps, as will the work of a man of less talent but greater imitative ability. For that reason, persons are apt to make great mistakes in estimating the relative talents of art students. The man

a value far above that of the most exact copy or imitation of the work of any great man.

It is very pleasant, too, for one who is familiar with art, to walk into an exhibition gallery and be able to pick out pictures that he can feel acquainted with without the introduction given by a catalogue, though he may never have seen them before. No matter in what form a man's individuality may display itself, when you have once learned its character you may always recognize it, and no signature is necessary. And where there is this individuality, you may recognize it in the merest charcoal sketch, the rough woodcut, or the commonest reproduction. You cannot kill it, however feebly you may undertake to reproduce it. No one who has enjoyed the art exhibitions of New York will fail to recognize the works of the different great painters here, without the help of either initial, name, or catalogue. With none is this more truly so than with Mr. F. S. Church, whose fine, though weird conceptions possess a charming individuality which cannot be mistaken. A "Sketch" by this great painter has been engraved to make my statement better understood (Fig. 166).

Fig. 166.



who draws most literally is not, by any means, necessarily the strongest man in a school, but he who succeeds in appreciating and incorporating the spirit of what he attempts to reproduce into his work, is the man who displays the most evident promise. The imitative faculty, as I have said, is an important element in the artist, but one that is of small value compared to the creative faculty. A monkey is a close imitator, but a monkey does not invent anything. An artist must be able to imitate, but he must be able to do a great deal more, and as he does more, he displays the individuality that distinguishes him from other men, and we enjoy his work because it is different from that of other men.

Thackeray and Dickens are authors whose writings we enjoy, because they are so true to nature; but beyond that there is a great charm in the difference of the styles of the two men. We love Dickens, we love Thackeray, and yet the men are not at all alike. And it is not so much what they tell us as their inimitable way of telling it that we delight in; not so much the books as the men themselves displaying their characteristics to us through their books. And so, in art, the artist's mind, as shown through his work, is much more fascinating to us than the work itself.—William Hart.

59. But let me not be misunderstood. Neither the faculty of seeing, the exercise of taste, nor any certain individuality in your work can be attained without thought and application. For not until these are practised will you feel, and without feeling you cannot be a true artist. Said a veteran artist who is frequently quoted in the foot-notes:

"The highest art is felt, rather than seen or heard. It is the echo in man from the voice of nature, the sympathetic rapport between matter and spirit. Art may be compared to a lofty pyramid whose broad base rests on the ground, its apex being lost to view in the empyrean; between its gross foundation and its iridescent crown steps succeed each other, at first distinctly separate, but seeming to melt into each other above like those upon the famous tomb of Cheops. Truthful representations of nature, by whatever means produced, belong to its higher degrees, but their exact place cannot well be determined, since they seem higher or lower, according to the acuteness or dulness of the vision of the beholder."

59. I must suppose that your skylights have such apparatus, and go on to mention a few of the artistic qualities that should thereby be introduced.

I will confine myself to four, the four chief; all of them should coexist in every picture. It is their harmonious union which creates artistic treatment, redeeming what would else be vulgar and trivial. In a measure they are contradictory and opposing qualities, but, like discords in music, add to the resulting harmony.

They are BREADTH, DEPTH, SOLIDITY, TRANSPARENCY; let me repeat them, *breadth, depth, solidity, transparency.* I ought to add a fifth, *delicacy,* but that will appear incidentally.

Would you ask me for a formula, in what proportions to mingle our four qualities? That cannot be given. Here it is that subtle thing, *taste,* has its play, and transcends rules. This offspring of a chaste, correct, intelligent feeling, operating through a trained eye, must be your supreme court, your place of final appeal.

Endeavor always to refine and balance your taste; in this way alone can the eye be brought to see rightly, for the eye is only an instrument, and does only what the mind sets it to do, and with only the amount of thoroughness that the mind desires; and no mistake is commoner, or more pernicious to art, than the supposition that any and all eyes can see the whole of anything, even the simplest object. No eye sees the whole; the trained eye sees best and most, but even the eye of your camera does not see all, and like other eyes without brains, cannot record all of what it does see.

As a means of elevating your taste, read; study to find out what you ought to admire. The greatest critic of modern times, Sainte-Beuve, says to this effect, that "in looking at any work of art we ought to ask ourselves, not, does this please us, but ought we to be pleased with this?" To this end read; read the literature of your profession.—W. J. BAKER.

The utmost capacity of photography can only be reached when with complete control

Just as a learned musician may spoil all effectiveness by lack of expression in his performances, and an elocutionist or actor fail to move his audiences for want of the ability to "suit the action to the word," so may the artist fail to win applause, no matter how strictly he follows the rules of composition and chiaro-oscuro, if there is no show of feeling in his work.

The rightful effect of all kinds of study should be to exercise and excite the imagination. If they do, then there is growth. In art the effect of study of the works of others is to make us more observant. Browning has said that paintings teach us to notice things in nature that never would have been noticed by us but for the painting. This is most true. Moreover, when we look at paintings we find ourselves comparing the work of the artist with our own knowledge of nature, to see how exactly he has followed nature. This is good discipline, and causes within us a desire not only to follow nature, but to exercise our imagination in bringing out from nature her inmost meaning.

60. All the impressions made upon us by what we see, exercise what is called

of his materials the operator is possessed of a cultivated mind, master of the principles which govern art, and deeply imbued with its spirit. Mere taste is not sufficient; he must have thought, too, and thought is the result of culture. Like the architect, sculptor, or painter, he ought to be a man of observation and able to segregate the essential idea from the unnecessary rubbish which surrounds it. Drawing, modelling, or painting are the means by which poetic ideas are unfolded in plastic art; in photography the chemical action of some of the rays of light upon a sensitized film or medium stands for two of these, and, when within their proper sphere, they are used by corresponding intelligence, bear corresponding fruits. Their results ought to be preferred to thoughtless skill, for they give better satisfaction.

With regard to the claim of the photographer to the name of artist, I have only this to say: I shall always be as ready to acknowledge it in the photographer who possesses the true art-spirit as I shall be unwilling to yield it to the painter who does not. The earnest seeker after truth does not stop to consider by what name he is called. Words without their corresponding sense are trifles light as air. No fear but that the man of genius whose words prove his worth will be known and recognized as artist, while no unsupported claim that professional pride can set up will be likely to be treated other than with the contempt it deserves. Without love and self-sacrificing devotion to art a man cannot be artist in the only sense that can make it worth the aspiration.—L. G. SELLSTEDT.

60. No great art ever was, or ever can be, employed in the careful imitation of the work of man as its principal subject. That is to say, art will not bear to be reduplicated. A ship is a noble thing, a cathedral is a noble thing, but a painted ship or a painted cathedral is not a noble thing. Art which reduplicates art is necessarily second rate. I know no principle more irrefragably authoritative than that which I had long ago

in art, our "feeling." No one who understands art, can be devoid of feeling. He enjoys and appreciates what he sees more heartily than another, and his thoughts are fraught with tenderness and pathos. He cannot close his mind against either the gladness or the sorrow of his fellow-men; and when he looks at paintings he will find that this capacity, this gift of "feeling," will enable him to see and enjoy more than those who are not blessed with it.

Then, when you have so imbibed the principles of art as to *love* them, you will, when looking at pictures or communing with Nature, feel a thrill—a degree of pleasure which those who have no æsthetic sense never experience.

As the fragrant trailing arbutus reveals its hiding-places most quickly to those who love it most, so do Nature and pictures unfold their charms to those who love them in a way which the uncultivated are not privileged to understand.

61. We do not need to go further for an illustration of "Feeling" than to

occasion to express: "All noble art is the expression of man's delight in God's work, not his own." Mr. Ruskin must be understood as applying to the newly made work of man, for further on he again says with truth: "A ruined building is a noble subject, just as far as man's work has therein been subdued by nature's." And further on still he says: "A wrecked ship or shattered boat is a noble subject, while a ship in full sail, or a perfect boat, is an ignoble one; not merely because the one is by reason of its ruin more picturesque than the other, but because it is a nobler art in man to meditate upon fate as it conquers his work, than upon the work itself."—John Ruskin.

61. Art knowledge depends upon the study of nature in its aggregate relations. In a good picture these are judiciously preserved; everything is in keeping and harmony; not any one object or part is absolutely true to the extent of deception, for if it were, the others could not be, but all are true with relation to each other. Such a representation of nature may not satisfy the mind that has recorded only some isolated facts and is ignorant of others, but to him who has kept his eyes open to God's works in their harmonious unity it will be a revelation of their author. Said a recent writer on art, whose works may be read with pleasure and profit: "Nature is very rich and art is very poor; nature has a million to spend where art has five hundred. What is the most precious thing for art to do? There are two ways of imitating nature. Art may spend side by side with nature, degree for degree of light, coin for coin till her resources are exhausted, and then confess herself a bankrupt. Or she may establish a scale of expenditures suited to her resources; and, abandoning all hope of rivalry with nature, set herself to the humble task of interpreting her. And here is the first essential difference between photography and painting; a difference which of itself is sufficient to separate them forever. Poor photography spends degree for degree with rich nature, and is of course very soon exhausted, but poor painting husbands her resources and spends a penny for light where nature spends a pound." I may remark here that in my allusion to photographic art I refer to pure photography, at least as the impression comes from the retouched and perfected negative. In the case of pictures finished by hand in India-ink, colors, or char-

refer again to "The Testy Old Squire's Complaint." But we shall have other examples, which I have selected from my store of such things for that special purpose.

Fig. 167.

62. The first is "First Come, First Served," by Mr. Frost Johnson—a composition not beyond the ability of the camera to follow very closely. The law of the street fountain prevails here as is well declared by the figures, and yet the feeling artist has taken care so to provide for the horse and dog that they may not be deprived of their turn. Likewise he has so painted the old man as to cause you to wish you could make way for him first, and bear his burden for him while he drinks.

coal, it is often difficult to determine to whom the honor or disgrace belongs, whether to the operator or the poor artist who finds his bread in his employ.—L. G. Sellstedt.

62. If a man is destitute of the ability to create anything, it is his misfortune; and if he experiences pleasure in making imitations of the work of other men, there can be no possible objection to his doing it; only we should not dignify his performances by calling them works of art; and when writers, from ignorance, or something worse, laud such men to the skies as great artists, it is no wonder that the papers have so little influence in such matters.

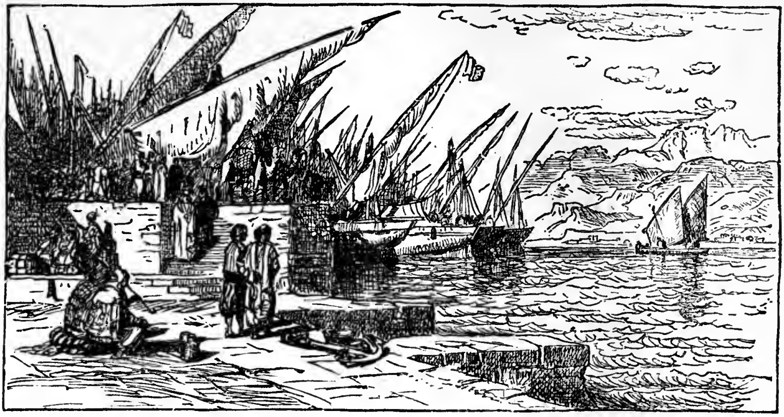
No great artist is a copyist, and no man of real power will hold very long to the characteristics or mannerisms of his master. Van Dyck was a pupil of Rubens, but he did not paint like him; Gerome studied under Delaroche, but his pictures do not, in the least, resemble those of his master.—William Hart.

Now, what we want is to be able to *see* these effects of a face fronting the light, and of excessive top-light, and *know*, at a glance, how to remedy them.

As I have already said, it is perhaps only necessary that attention should be called to this matter to have its importance understood and appreciated. It is not necessary that you should wait till you return to your various studios before you begin to practise a suggestion of this kind, but it may be commenced here, if it has not been commenced before, and be made a constant study everywhere you go. A careless, uneducated observer would look over this assembly, from the seat of any one of you here, and notice

63. Again have we a study of "Feeling" in Mr. Samuel Coleman's "Sunny Afternoon in the Port of Algiers." If ever presented to you, you will not even focus on the charming line of dahabeëhs until you have added to the sense—

FIG. 168.



the feeling of repose—rest—by placing in your foreground two or three groups of picturesque Arab sailors. This is feeling—yielding to impression. The very element which causes somebody to pay $30,000 dollars for a picture of

no peculiarities to arrest his attention, but the artist photographer, as he glances around, takes in not only the various styles of features, with the profiles, three-quarters, and front views, but he *sees* every variety of light and shade; he sees a brother photographer between him and the window, illuminated by a fine Rembrandt effect: he sees another with wonderful relief by a peculiar effect of side-light. Some are pleasing, some are repulsive; some he admires, others he condemns; so there is a constant study and criticism going on in his mind. When he goes home and goes to work he makes no uncertain moves; he has a *reason* for everything he does, and his work testifies that his eyes *see* before his hands execute.—R. J. CHUTE, at N. P. A. Convention.

63. When you see a print of great excellence, or a peculiar effect, endeavor to find out by experiment the means that produced it, and note them. Make a study of effects in different lights, artificial light, the light of a room; when any of these seem good, try for them in the operating-room. In making such experiments be careful that you obtain as accurately as possible the effect that the eye sees. There will always be a great divergence, but be sure that you come as near as you can.

Do not let yourself be a mere imitator and lose your own individuality. In this way you are in danger of cultivating faults, for if you start out to make pictures like so and so's, you may make them like his bad ones or may be misled by a reputation above merit.

two swarthy Arabs kneeling by their camels in the desert, in answer to the Muezzin call, or $10,000 for an old drummer and fifer tramping along a dusty road in '76. Let your art take possession of you, and do not be ashamed to allow the fact to be seen in your work.

Fig. 169.

64. In viewing a picture which pretends to be any sort of a composition our first effort should be to interpret and understand the meaning and intention of the artist in producing it. And then, using the rules given us, by analysis, discover whether or not he has succeeded in carrying out his object. A good picture by which to test your ability in this direction is Mr. Wm. Magrath's "Girl Spinning." There is a close following of nature here, in action, in accessory, in composition, and in the light and shade. All are in harmony and make a real picture. There is an airy cheerfulness about the model, too, which indicates that she is a maiden of that dispensation when the youth of her sex were expected to spin their own bridal outfits.

Rather seek to form in your own mind a type of beauty, the approximation to which will stamp all your work with the seal of your individual purpose. Be true to yourself. Admit no half work; make it your first object to please yourself, or rather to gratify your artistic instincts, and the pleasing your customers a secondary consideration. There is always a conflict between taste and ignorance; carry it on as courteously as you may, but yield no jot. In time you will be supported by those who really can discern, whose opinion is received by many who do not judge for themselves.

When you find that the public have faith in you, keep faith with yourself and them by doing always your best.—W. J. Baker.

64. Now, the skill of the artist is to find its exercise in the remedy for all these various conditions; and his taste in the evocation of expression will be called into great and constant demand. The subjects, alas! cannot see how themselves appear. They think they are doing the fine thing, just when they are making themselves appear most ridiculous. The operator must manage them to his own taste, and must do it without offending their vanity, or treading upon their peculiarities, of which we all have a good share. How to do all this is of course a problem, and one as diversified as the persons who

65. The sentiment or conception of a picture, however, does not yield the only opportunity for the artist to display feeling. As was indicated in the very beginning of this chapter, everything may be ruined, all picturesqueness destroyed, by the careless or ignorant management of the light. Therefore the arrangement of the light and shade in a picture offers the artist a good opportunity for the display of feeling. What better example of this do we need than the lovely composition of Jennie Brownscombe—"We all do fade as a leaf?" The faded leaf is the subject of consideration. All eyes are directed to it; and the principal lights are upon the faces so directed as to give full value to the sentiment of the composition. How deftly too are the shadows managed—each mass caused to bring out the value of some corresponding

Fig. 170.

present themselves before him. He has to render into respectable appearance all the variety of human character itself, and he cannot be expected to succeed in this without careful and perpetual reflection. Every sitter is, therefore, a new and independent study.

The mouth is easily arranged into respectable expression. The nasal organ expresses itself in spite of everything; and so does the cheek. The brow is dependent upon the eye, and the eye is the most refractory and defiant of all. When one sits down to look quietly at nothing, the expression of the eye naturally subsides into blank vacancy. There is a sort of excitement in sitting for a picture like that of having a tooth drawn, though without the dread of pain. The heart is generally making better time than usual; and the eye, sympathizing, will often remain entirely expressionless, or will fortify itself with a frown. This condition of affairs is aggravated by the necessity of a bright light from above, which taxes its strength, and by the fixed gaze maintained for several moments upon one point, not generally very distinct. The result is apt to be a poor picture, because the eyes are unnatural and meaningless.—Rev. A. A. E. Taylor.

65. I have lately been examining some of the best plain photographic portraits I can find, and they seem to me to be, as the artist says, "out of keeping." At first sight they appear perfect, and all right, but they don't wear well. After a little study they grow

mass or twinkle of light. So much for an outdoor study, not too difficult for the camera to equal in every respect.

weak, and, unlike good art, they do not reveal some fresh beauty every day. The likeness is there, but it is thin and spectral—the inner light fades out of them, and in a little while they are lifeless and automatic. Looking carefully for the cause of this, I think it is found in the lack of artistic cultivation in the photographer. Of course, I am not competent to say how much of it is due to the imperfections of machines and materials, but the difference between an artistic photograph and a bad one is already so great that I believe much more may be accomplished with the material now in use. Whatever improvement may be made in the means, I still think true progress is to be gained by the study of photography as a fine art, using exactly the same methods employed by the great artists of all time. Often a work of art is easier to study than nature. One needs sometimes a teacher, and the best pictures are the best masters. If every photographic artist could have one of Titian's portraits hanging in his studio, the result would soon be seen in our likenesses. In these portraits there are no dead surfaces, there is no distortion; the soul looks forth from its windows with a lofty tranquility.

In these likenesses there is no striving for any transitory effect. No part of the face or head is put in deep shadow, all is clear and sunny. There is no flinching from hard work. Wherever shadow is used, the modelling is continued perfectly throughout the whole. In the best faces of Titian no shadow is apparent, yet there is no flatness; they are full and round, like nature herself. And some of the best heads of Rembrandt, fond as he was of shadow tricks, are painted in this broad and sunny way. These great artists studied to give the sum of human life—not five minutes of it. We feel in the presence of one of their portraits that we have the whole individual before us, his achievements and his possibilities. They are as beautiful as infancy and as immutable as death.—*A Sculptor.*

Long experience will show that the two sides of every face differ. This is very evident in many faces, and in all, however regular the eyes may seem, or however straight the nose may appear, close observation will discover that one side is better than the other. It is this side that should be taken.

In photographic portraiture the face should, as a general rule, be turned away from the light. If the face is turned to the light, however delicate the half-tones may be, the line of the nose will be partly lost in equal light on the cheek behind it. The only exception to this rule, that the face should be turned from the light, is in the case of a profile, or the profile showing a glimpse of the off eye when the nose comes clear against the background. For these reasons, that is, because it is necessary to choose which side of the face is to be represented, and because the face must be turned from the light, it is well to have a studio so constructed that the light can be obtained from the right or the left. It is also well to have it sufficiently wide to enable the operator to work diagonally, and thus get a modification of the shadows without the use of reflectors.

As regards the position of the head, Burnet observes: "Every one who takes the trouble to reflect must perceive that all faces contain two points of view, where the character is more or less developed—a profile, and what is termed a front view; and that the

66. An interior illustration of the same import may be found in "The Sabot Maker" (Fig. 171), by Mr. E. M. Ward. This shows how a strong light

seat of a strong likeness lies sometimes in one greater than the other. They must also perceive that what is called a three-quarter view of the head gives the artist an opportunity of representing both." A full face is seldom so agreeable in photography as one slightly turned away.—JOHN L. GIHON.

66. There are a few fundamental rules which regulate the harmonious disposition of pictorial light and shade, and from which no successful departure is possible. These are so absolute and apparent that I may state them as axioms.

Axiom 1. The general scheme of light and shade must be simple.

Axiom 2. The point (or region) of greatest interest shall be the point (or region) of greatest intensity, or of contrast.

Axiom 3. All other contrasts must not only be subordinate to this, but shall tend to give it value or prominence.

Axiom 4. The transition from light to shade, and *vice versâ,* shall be gradual.—HUGH BREBNER.

Shadows are natural attendants of light, and the student of nature will observe how one always balances the other. This is in accordance with the law of compensation that follows in everything throughout the universe, and it is only by a careful study of nature that we learn to distinguish the causes that influence us in viewing a scene, to pronounce it grand or insipid.

In reproducing what we see in nature by what is termed art, extensive shades contribute greatly to the beautiful as well as the grand and majestic result of the whole together; they equally serve to give richness and grace to the middle tints, and brilliancy, beauty, and animation to the masses of light; they also afford a repose no less grateful and necessary to prevent the fatigue and overexertion of the sight on the illuminated parts. To this end, all the obscure or dark parts should be so arranged as to form one general mass, and its greatest force collected into some one part, where it will have the best effect, and become a principle on which all the others are in a graduated and harmonious dependence.

The photographic art student will readily understand the application of these suggestions to his daily practice. Whether it be a head, a three-quarter length, or a full figure, the application remains the same. The test of skill, however, is with the first of these, for it is only in that perfect blending of shadow with light, rounding up to the highest part where the pure light is but a mere point, and falling off through the delicate gradations of tints into the deepest shadow, that a head can claim to be artistic in composition of light and shade.

It is gratifying that the days of *white* pictures have passed, and it has been demonstrated that extensive shades are admissible in a portrait, as well as in a landscape where rocks and hills cast their grim shadows and give grandeur to the scene; that a face may receive the same treatment at the hands of an artist that nature accords to her works everywhere, and be more truthful, more pleasing, more life-like. The shadows and middle tints give support and brilliancy to the lights; there is no glare; the eye does may be employed without transcending the laws of taste; and in this case the lighting is a large part of the charm of the picture, because the interior of the workshop is dark, and the light is only directed where it is wanted—upon the subject.

Fig. 171.

When we go further into the subject of light and shade, this capital picture may serve us a good purpose again.

Those who are always looking for quaint subjects among the good people of our rural districts will find more than one fine suggestion in "The Sabot Maker."

67. Not only the masters in art but their works, tell us that the management of light and shade in a composition requires great care and study. The adaptation of it to the character of the subject is not only to be considered, but the quality of draperies, acces-

not tire but wanders from point to point continually attracted by the sense of completeness and repose that characterizes the whole. An important consideration in a bust portrait is to give it a well-shaded background, the deepest parts against the lights in the model; this is indispensable to the brilliancy and beauty of the face.—Edward L. Wilson.

67. The photograph is to so great an extent Nature's work that we must always see her individually stamped upon it, and read in it to a greater or less extent those details of character which give such interest to pictures.

Beginning with one figure, one of the simplest subjects that we can have, to make a picture, for a human figure with its component parts of interest, if at all picturesquely clothed, may make a complete picture, we have at once an opportunity to show taste and skill in so disposing the head and limbs that by reversing the lines of action and varying the curves and angles, we get grace and dignity instead of stiffness and vulgarity. Then, suppose we begin to introduce some surrounding objects to give subject for thought and increased interest; we choose those that will be in harmony with the subject of our work. About an intellectual man we introduce features familiar in a library, we would surround a hunter with implements of the chase, a traveller or seafaring man should sories, etc., in regard to their power of absorbing or reflecting light; the mechanical arrangement of light and shade that will be produced, and the force and nature of colors that may affect the composition.

68. Whether the picture be a group or have but one principal figure, the arrangement of light should be such as to give prominence to the principal subject, by avoiding the introduction of anything that will draw the attention

have objects indicative of those callings, and our next aim would be to dispose these accessories in such a manner that, while they added to the fulness and interest of the picture, they would be in entire subservience to our main feature. This simple beginning of telling a story should be led on and built upon as we proceed; for, although a work may be complete and beautiful simply as a work of art and without telling a story, how infinitely wider will its range of interest be if it does tell a story, and this additional interest need never detract from it as a work of art. If we were advancing further and introducing two figures in our picture, we surely would not have them sitting bolt upright and staring at us, but by so posing them as to express the conveying between them of some sentiment or emotion, or by the introduction of some object of interest common to them uniting them, we would have at once made an advance toward a picture; and so we go on introducing more figures and more objects necessary to give point and fulness to our tale. But then our difficulties increase, for in proportion as we gain intricacy, variety, and interest, we are apt to lose that simplicity which makes a work striking and impressive; our various objects begin to scatter the attention and divert it from the main feature or point of our story. So we must ever keep it foremost in our minds that, if it be possible to do so, we must have a main central feature or group, with other features or objects taking second, third, and fourth places, the interest dying out as we approach the edges of our picture.—XANTHUS SMITH.

We now come to the subject of composition. So far as we have gone, we have learned that what language is to the poet so are form, light and shade, color and accessories, to the artist. When we have mastered these elements, we are ready to compose according to the requirements of our art. Nature steps in too, now, insisting upon obedience to her laws, with which one must be well acquainted, before he can proceed far in the art of composition.

Fortunately our work is made easier, from the fact that we are not called upon to make pictures continually of actors wherein we must represent tragedy or comedy, but what we *do* have to do is to make our productions lifelike, *i. e.*, like the living, natural persons before our cameras, and we must see that our poses, lighting, etc., harmonize with the character of the subject in hand. We should never lose sight of this law of unity, for on it, more than on any other, depends the pleasing effect of our work.—M. L. DWIGHT.

68. It depends as much upon inspiration as any human work. We do not know how or why an idea comes to us, and I doubt if any artist who has hit upon a happy arrangement of his theme can state how he found it. Certain elementary notions there are, as that there must be a leading idea to which all the facts of the picture tend—a leading

away from the central figure or figures. If a group is to be photographed, such an arrangement of light must be made as will illuminate the whole, and give prominence to the figures composing the group, rather than to background or accessories. As to the nature of materials that compose a group, violent contrasts, such as black and white drapery, should be avoided. The light cannot be arranged to do justice to such extremes, and the harmony of the lighting, as well as the composition, is often destroyed.

With a single figure, the whole arrangement is more under the control of the artist than with a group, and the various points of the picture can be studied to produce the best possible effect. The nature of the light best adapted for the subject is the first consideration. If light drapery, a much more subdued light will be required than for dark, and the accessories must be arranged so as not to be entirely lost by contrast. The observation in reference to extremes of black and white applies here as well as in groups, and with white drapery, anything that absorbs light to any great degree should be avoided.

69. The source and direction of the light must be considered according to the

light to which other lights are subordinate. But, after all, the composition must depend upon the artist's individual feeling.

There can be no doubt that this feeling, this sense of fitness and harmony, may be cultivated. It may be developed by familiarity with the works of artists who possessed it conspicuously. There are some artists who in their best days could not make a mistake. You will find false composition in their work as rare as discords in Mozart. Any work of a good period of Greek art will also be found faultless in this respect. The Laocoon is *not* of the best period, but it would puzzle a convention of modern artists to rearrange it. The infinitely subtle nature of the art of composition is shown by the failures made in restoring mutilated statues—as, for instance, the utter impossibility of replacing the lost arms of the Venus of Milo.

This art of composition is a part of photography, just as it is of music or architecture, or of any other of the fine arts. It enters into the construction of the simplest picture. One view of a face, unless it is well chosen, is often of little value as a likeness. Suppose we catch a swift glimpse of a stranger's profile; it is very little we know of his face and character until we have seen more of him. But a momentary glimpse—one look of the face—is all that a photograph likeness gives us. The moment you begin to arrange your sitter to get the most of him before the camera, you are studying the art of composition. Every change of position, every object you introduce, every bit of light and shade augments or diminishes the value of the picture.—L. G. SELLSTEDT.

69. First of all screen off the direct top-light. The face is still flat, but the many downward shadows have disappeared. Now screen off one side as well as the top-light, and the face is not like the same. With the light all round the face it would appear broad, flat, and altogether deficient in character. Now it is just the reverse; there is too

nature of the composition. According to the rules of art, a top light produces the best effect, by allowing every part of the picture to be more clearly defined. An oblique or side light casts the shadow of one object upon another, and sometimes runs them together in confusion. In portraiture, however, care must be taken with a top light, to avoid heavy shadows on the face. In landscape photography, where the principal points are much separated, an oblique light is very effective in giving force and expression to the composition.

Unity of light in a picture is an established rule of art, founded on a law of nature. This rule is not so applicable to groups for portraiture, where we are obliged to light all equally well, as far as possible, as it is to the style of grouping known as *genre composition*. But in pictures of the latter class, as well as those of single portraiture, the principal figure should be placed in the focus of light, while everything else is subordinate. The centre figure then becomes the centre of observation; for the eye is ever attracted by light, and turns instinctively to it. Gradation, so indispensable to harmony, requires the

much light on one side and too much shadow on the other; every prominence upon the face is exaggerated, and the texture of the skin shows with a coarseness which is far from natural. As Artemus Ward says, "Why is this thus?" Because there is too much direct side-light. Screen off the side-light until you get a delicate shadow upon the edge of the lighted side of the face. This will send the ear and the retiring edge of the cheek into their proper places, and concentrate the highest lights where they should be—upon the forehead, over the eye, upon the nose and chin; but still the shaded side of the face is too dark for photographing. And here come the differences in practice. Some would use a screen to soften the shadow and give reflected lights. This is right enough if you use large screens and keep them far enough away from the sitter to give the reflected lights as they would be if reflected from the side of a room. In my own practice I prefer to use a little of my far-off top-light to soften the shaded side, but then my studio is very small, and I get my reflections from the wall of the studio; in a wider place reflecting screens would be necessary.

There is nothing, I think, so useful as a three-leaved screen hinged and upon castors, white on one side and gray upon the other, and so hinged that one leaf of each color can be brought into the other if wanted. The facility with which the leaves can be placed at any angle for reflection is of great value. Small hand-screens, are, in my opinion, a mistake. They concentrate reflected lights upon the face only, and sometimes only on parts of the face. *The screen should be large enough to give the same reflected lights upon both face and drapery.*

So far, then, in making a portrait. What comes next to make it a picture? A photograph may be a likeness, and yet not be either a picture or a faithful portrait. To make a picture it should have expression, repose, concentration, and keeping.—Geo. Hanmer Croughton.

same attention in lighting the different figures of a composition, so that a perfect blending, from the principal figure in the strongest light, to that of the least importance, in the deepest shadow, may be secured as in lighting a single face, where a harmonious gradation from the highest light to the deepest shadow is now so universally sought for and obtained. It will be readily seen that, under the proper regulation of laws, light is to the artist a language or medium of expression, the due observance of which enables him to make clear the plan of his picture, and give the interpretation he desires.

70. Objects receiving light should not be extended to the margin, because,

70. There is no better test than your having made the white in your picture precious, and the black conspicuous. I say, first, the white precious. I do not mean merely glittering or brilliant; it is easy to scratch white sea-gulls out of black clouds, and dot clumsy foliage with chalky dew; but the white when well managed ought to be strangely delicious, tender as well as bright, like inlaid mother-of-pearl, or white roses washed in milk. The eye ought to seek it for rest, brilliant though it may be; and to feel it as a space of strange heavenly paleness, in the midst of the flashing of the colors. This effect you can only reach by general depth of middle tint, by absolutely refusing to allow any white to exist except where you need it, and by keeping the white itself subdued with gray, except at a few points of chief lustre.

Secondly, you must make the black conspicuous. However small a point of black may be it ought to catch the eye, otherwise your work is too heavy in the shadow. All the ordinary shadows should be of some tint—never black, nor approaching black. They should be evidently of a luminous nature, and the black should look strange among them; never occurring except in a black object, or in small points indicative of intense shade, in the very centre of masses of shadow.—JOHN RUSKIN.

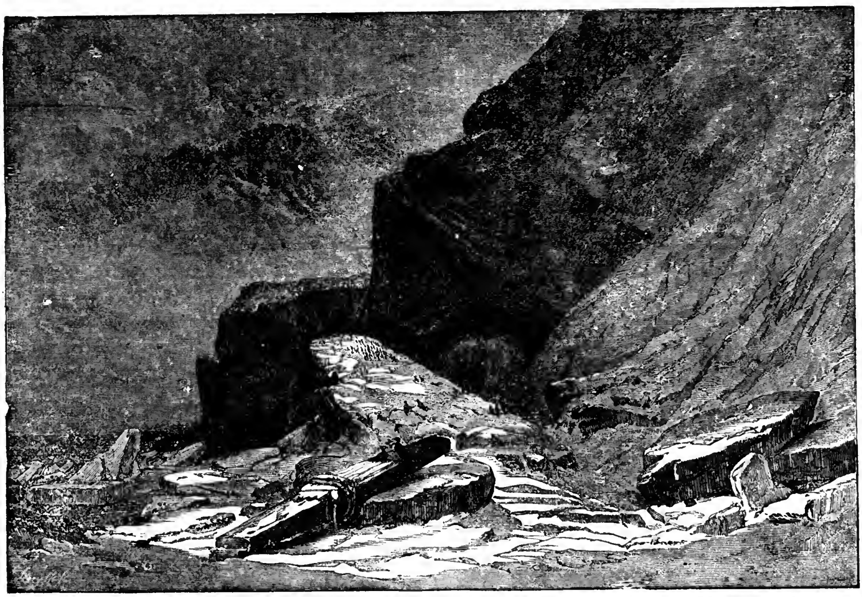
Pictures that are composed nearly or entirely of half light or half shadow are always tame. And when high light predominates, there is a flimsiness and weakness which cannot attract or produce a fine impression. And again, where all is in shadow, there is a sombreness which is only suited to certain gloomy scenes where all is wrapt in darkness and mystery. It should be the aim of the artist, therefore, in those subjects where he has to deal with high light over nearly his entire picture, to introduce a few well arranged spots of dark, seeing, however, always that they be not equal in importance. Some of the Flemish painters, during the best period of their art, made beautiful pictures of open daylight scenes on the coast and in their flat country, by the introduction of a few well disposed figures, or a group of picturesque boats, which, as distinct points of deep shadow, gave sufficient force to what would otherwise have been utterly valueless works on account of the monotonous light of the gray sky and sea or marshy country.

In pictures where half shadow and deep shadow predominate over the whole subject, the introduction of a spot of high light with a little supporting half light, will so set at naught the monotony as to make most interesting and powerful works. The high light though should be of an agreeable form, especially in that portion where it comes in greatest relief against the dark.

in the first place, the lights cannot be well supported by the shades; in the next, extending the lights quite to the boundary gives the effect of an unfinished picture, which destroys the unity so essential to the harmony and completeness of the subject.

The most agreeable pictures are generally those in which half light or half shadow predominates, with a small portion of very deep shadow and brilliant high light; and perhaps the most complete arrangement of light and dark is that in which the work is divided into about one-half of half light and one-half of half shadow, with a sum total of high lights amounting to one-eighth of the surface of the work and as much deep shadow. This to many, at the present time, I know, will seem like conventional stuff; but, if any one of good taste will look over a lot of photographs of either landscapes or interiors or figure pieces, and lay aside those which strike him as being agreeable pictures, and then note the proportions of light and dark which they contain, I think he will find that they conform more or less to the above. I will give an example. (Fig. 172.) It is a view on the western coast of the Island of Heligoland, by Hermann Eschke. The work is composed largely

Fig. 172.



of half light and half shadow. The highest light and deepest shadow come in immediate contact, and the artist has so adroitly managed to diffuse them that there is an entire absence from those patches of flatness and harsh relief which give what is called hardness and dryness to a picture, and his masses are everywhere so broken by variations of depth, The lights, as well as the figures, should vary in form. This depends much upon the management of the drapery. In the infinitely various modes of arranging draperies, the artist may contract or extend his lights at pleasure, varying the general effect to any extent.

71. If the light and shade in a picture are well arranged, and in due quantity, the effect will be pleasing, even at such distance from the eye that the subject cannot be distinguished. It is then a mere correspondence, or a balancing of light and shade. On a nearer approach, its force and powerful relief attract

that while there is no baldness, the force and breadth are fully preserved. It is a fortunate circumstance too, that his points of greatest force and interest are about the centre, and all die off nicely as the outer edges of the work are reached, for it is generally considered that busy spots of light and dark close to the edges or in the corners of a picture distract the attention injuriously to the main central effect. How the poetic grandeur of the scene depicted is heightened by the treatment which the artist has given it!—XANTHUS SMITH.

71. In the department of art known under the general name of *genre*, especially with simple subjects, the photograph may be more successful, though the best specimens that have come before my observation have been immeasurably inferior to the same kinds drawn by the hand of real masters. *Genre* pictures may represent scenes in open air, or they may be interiors; they may represent action or repose, animal or still life; but whatever the motive, successful treatment requires not only a picturesque arrangement, graceful lines, and chiaroscuro, but a harmonious relation of parts too subtle for any instrument but the thinking brain and accommodating hand. Only living thought can envelop common nature in that atmosphere of poesy without which any picture in vain addresses itself to the mind; without this divine aid the most judicious selections and poses, *secundem artem* though they be, fail to give real poetic interest even to objects of beauty, while with it the skilled hand gives to squalor, poverty, nay, to vice itself, an interest or pathos which appeals to the finer feelings of man so as to call out his most delicate sensibilities and sympathies. This is art. Rules of composition in art form no exception to rules in general. They are simply laws which reduce the imagination to order and translate its visions. Their use even in tasteful groupings from nature no more produces pictures worthy of the name of art, than a strict adherence to the rules of grammar gives birth to poems.

Is photography, then, incapable of producing poetic pictures? No. She, too, has her possibilities.—L. G. SELLSTEDT.

When making a group, the principal figure should receive the principal light, and the picture should not be crowded any more than the lens in use compels. If the group be a large one, it should be broken up into smaller ones. When a mass of people are crowded together and no prominence given to any one person, or any number of persons divided from the rest with reference to the effect of gradation, it is then merely grouping, and not composing.

Figures should be more or less varied in attitude, too, because exact repetition of lines the eye, and fix the attention of the spectator. It will not have this effect, unless it possesses the essential requisites of *chiaro-oscuro.*

72. Having now considered the inside principles of art, so to speak, such as we set out to study at the opening of the chapter, let us go a little further into the depths of one very vital point, namely, *technique.*

One may be armed with a full knowledge of art principles; seized with a wholesome fear of transgressing the laws of art; possessed of all the apparatus and accessories needful to produce good pictures; own a splendidly arranged studio—and yet prove a miserable failure as an artist, unless careful heed is given to the technical requirements of his work.

73. I have already hinted at some of these, but the lesson cannot be made too plain, and I will endeavor to push it further home.

As a word, technique is an art term rather than photographic as distinguished from art, but, according to our politics, photography, *true* photography, must be and is and ever shall be art. Therefore after all technique is a photographic

produces monotony and formality. This variation should be governed by the subject and by the prominence of the figures. If you are making a family group, although the members thereof may wish the *baby* to be the most prominent figure, the correct way is to give the parents the leading position, and around them group the rest harmoniously. The principles of nature and the laws of art both frown upon making the figures all equally prominent.—M. L. Dwight.

72. Fit it with such furniture as suits
The greatness of his person.

It shall be so my care
To have you royally appointed, as if
The scene you play were mine.

—Shakespeare.

73. Photography is a true daughter of art. The name of artist, implying technical skill above the common craftsman's, a dexterity of hand guided by high intelligence, a glorious marriage of manual and mental excellency, has always been a proud and honorable one. It is none too high and honorable for those who faithfully follow her. Art meant, originally, handwork. Painting, now so haughty, was once considered simply a superior kind of artisanry, as some would have our art now. The artist in colors and the artist in gold or glass were quite on a footing. Michael Angelo asked only the title of "master-workman." As fine art with pleasure alone, not use, its object, developed, the idea became higher; yet still, skilled handwork is art. Photography is surely this. Indeed, if the question were to be waged on definition it would be easily won. Ruskin himself opens a gate wide enough to let in photography with all her tools when he says art is the "expression of man's delight in the work of his creator." Hamerton says art is "selection;" that is exactly the main idea of good photography.

term, and we may use it without being considered outlaws. And it means *workmanship*—the manner in which things are done. The technique of a picture is its drawing, light and shade, color, and perspective, or, more plainly, their management, in contradistinction to its sentiments or ideas, or conception, if you will. Given a gentleman who is overly fat, or who has an inconsolable nose, and who desires a photographic portrait made to hand down to posterity that will show his deformities of size and shape the least. He is willing to go to some trouble and expense to secure the fulfilment of his desires, and therefore wisely tries several photographers. No two treat him alike, but in whatever way they do pose, light, and generally manage, that is the technique of their picture.

74. As an illustration, "Autumn," by Mr. F. Granberry, drawn from the

But suppose painter and photographer out in search of a picture; with equal artistic perception they choose a scene, a bit of landscape. Figures and accessories are posed and arranged; and they will find the photographer's the severer examination to pass, as his work must be done before the execution of the picture. When both are finished, although the painting may be very like the photograph, save in its colors, yet it may claim a place of distinction in the gallery, while the aspirations of its companion may not soar above the parlor table. Where did their ways separate? Where did this difference begin? "With the first stroke of the brush," answers the unbeliever, "when the painter began to modify crude nature by his art." There is the key to the whole question. "Nature does not compose, and the photographer could only take her as she is." But what of the careful choice of the view-point, the posing of the figures? Why did he lop off that branch and put that dark stone in the foreground?—F. H. Wilson.

74. Daguerre jogged the world into a new path; the eyesight of the people was sharpened, their intellects were brought to a focus and were thrown upon nature, the fountain-head of all knowledge; the reflection back upon their minds gave a new understanding, a command of thought, of ideas, a positive knowledge of size, shape, light and shade, distance, foreshortening, perspective, unity, congruity, and placed every observer upon a pinnacle from which to survey the world, hitherto absolutely unattainable. Everyone became an embryo artist, and as this new faculty did not interfere with the power of speech, but seemed to give it new and advanced ideas to work with, the powers of description, so lacking in many, began to feel the influence of the hour, and good drawings, good descriptions grew so fast that now, at this day, there are many persons who are first-rate writers on subjects not often even considered by those previous to Daguerre.

A man who can see no faults can see no beauties. His ideas, his faculties, his ability to think, his power of expression even seems to lie dormant; he is a stick, a log, built to be an active, living member of society; he is a mere clod, he has innately all the machinery of mind necessary to constitute him a "man of mark," but he has no in-painting by the artist himself, will serve well (Fig. 173). The technique is magnificent. The lines (which you now understand all about) of the leafy background are so carefully curved, twisted, and turned as to make the crisp leaves stand out in fine perspective just as they do in autumn when the tender juices of summer are exhausted, and they begin to be stiffened by the frosts of fall. How rotund is the fruit. The peaches and the plums turn over on their sides from their weight of richness, and the grapes lean over against one another from sheer fatigue, as though the juice all ran over to one side like the weight inside a Japanese puzzle-egg. Now if the leaves hung lank and limp, and the peaches and plums stood over on their stem ends., and the grapes were scattered at random here and there over the floor, we should say that the destructiveness of winter had begun to play upon them, and that it was not a picture of "Autumn" at all. The technique would then be bad enough—so bad that even the admirable light and shade of the picture would be without avail.

Fig. 173.

centive, no stirring influence, to rouse his faculties; he is a mere lucifer match, of no earthly use till some one rubs his back.

Education is a cultivation of the faculties with which we are amply supplied. Curiosity is the most powerful incentive of the human mind, and the boy who is constantly asking questions proves his possession of a mind which demands education and will have it, and the parent who is able, by the tendency of his replies, to lead the boy to the truth, will never feel that there is any danger of a wicked tendency.

Let every child learn observation; drawing, by directing the mind to minutiæ, best develops that faculty. Pictured illustrations are now so common that criticism of art is universal, and as a picture tells more in a few square inches than whole pages of letterpress can, let us encourage pictures, the power to produce them, and the ability to discuss them fairly and artistically. I give Daguerre the whole credit of inaugurating this great boon to mankind.—Prof. S. Rufus Mason.

75. A picture is technically good if it gives a distinct indication or impression of the natural model. It is technically incorrect if it gives us false information as to the shape and form of nature, or such shape or form as is transmitted to our brains by the optic nerves.

Fig. 174.

The next illustration is from a drawing of his "Return from the Ridotto," by Mr. A. H. Baldwin (Fig. 174). The technique is so bad that until we are told it is a Venetian lady in a gondola, we could hardly guess the conception.

No photographer would pose a lady in this manner, for he knows full well that he would secure such enlargement of his fair subject's feet as to bring down on his head her eternal malediction. Even a Venetian photographer, with a subject desiring to be represented pillowed up in her gondola, perhaps sick with jealousy, tired, returning from a ball, would scarcely dare pose her in this way lest all her green-eyed rage fall upon him. If he did, his technique would be bad.

75. We sometimes feel that photography is too literal to be artistic. From a client's point of view, its tendency is to exaggerate the imperfections rather than the perfections of face and figure. Should you have a stout figure to photograph, the neck, as a rule, will appear short. To obviate this appearance in the portrait, it is best to adopt a standing pose, with the camera a little below the level of the head. If a sitting position is chosen, undue height will be given to the shoulders, and the shortness of the neck will be emphasized. In treating the opposite extreme—a thin figure with sloping shoulders (not so objectionable in the gentle as in the sterner sex), I would recommend a sitting pose, and in the case of a gentleman, especially when the head is large, a little drapery, in the form of an overcoat, loosely thrown back. The head should be turned in the reverse direction from the angle at which the body is placed, which will help to give the appearance of substance and harmony to the figure, and altogether make the picture more pleasing.—Wm. Crooke.

A much better specimen of technique is "The Courier," by Mr. C. F. Blauvelt. (Fig. 175.) Here is a possible picture for the photographer to render under his skylight. The courier is duly accoutred for his day's work of guiding the tourists who have employed him, through, say, the noisy streets of Naples. He stands at the stairway of the albergo in easy attitude, perhaps conversing with some of his party above stairs as to the day's pleasure. The handling, the technique in pose, in drawing, in light and shade, in perspective, is perfect. Perfect because there is a true rendering of the pictorial facts of nature, so far as the limitations of the material will permit.

Fig. 175.

An untrue rendering would be bad technique. You need but turn the man's head in any other direction than it is to have a bad rendering.

76. Now we leave portraiture for a little, and step up to a class of subjects that is becoming quite the rage with camera lovers. We choose for our pointer Edward Moran's breezy picture "Off Cape Hatteras." (Fig. 176.)

76. A work of art is, as we have said, an expression by means of pictures of what is beautiful, and the points to gauge in a picture are to notice what a man wishes to express, and how well he has expressed it. I know Switzerland, and love it well; but I would no more attempt to make a picture of a peak than I would of a donkey-engine. A peak, shrouded and accentuated by aërial turbidity, and just peeping into an Alpine subject, might, from its mystery and sentiment, add to the artistic value of a foreground subject. But the usual photographs of peaks could be of interest only in a Bædecker. This turbidity can be well rendered in a photograph. Painters, as we do, use optical instruments, such as Claude glasses, prisms, and the camera itself. The whole point, then, is that what the painter strives to do is to render, by any means in his power, as true an impression of any picture which he wishes to express as possible. A photographic artist strives for the same end, and in two points only does he fall short of the painter—in color, and in ability to render so accurately the relative values, although this is, to a great extent, compensated for by the tone of the picture. I here use the word in its artistic sense, and not in its misused photographic sense. How, then, is photography

What a brilliant effect of light through breaking clouds there is here—just such an effect as one naturally expects to see off Cape Hatteras and at kindred spots. And what a sense of *motion* is given by the bellied waves, the rolling vessel, the incline of the spars, and the "noise" of the clouds. Here, observe, the same rules and forms of composition are followed as are taught for portraiture. If the picture is measured by "feeling" then we find it to come up fully to the requirements. Is there not a feeling of "*go*" about it which is most charming which would be *gone*, if the wind was hushed and the masts stood straight and the water was calm? It is a lovely example for the catcher of marine camera views. Rarely can we secure such admirable technique in our instantaneous views. There are a few good reasons for this, which can only be partly obviated.

FIG. 176.

superior to etching, wood-cutting, charcoal drawing? The drawing of the lens is not to be equalled by any man; the tones of a correctly and suitably printed picture far surpass those of any other black and white process. An etching, in fact, has no tones, except those supplied by the printer. As I have said before, if it falls short anywhere, it is in the rendering of the relative values, but the perfection of the tone corrects this in a great measure. There is ample room for selection, judgment, and posing, and, in a word, in capable hands, a finished photograph is a work of art. Again, it is evident that the translation of pictures by photogravure, for the same reasons given above, will be superior to that of any engraving. But we must not forget that nine-tenths of photographs are no more works of art than the chromos, lithos, and bad paintings which adorn the numerous shops and galleries.

Thus we see that art has at last found a scientific basis, and can be rationally discussed, and that the modern school is the school which has adopted this rational view; and I think I am right in saying that I was the first to base the claims of photography as a

77. One of these is our modern plates. And our drop-shutters are in such a hurry that we catch the subject between breaths, as it were, and do not secure the sense of motion. One reason of this is, as a rule, the photographer posts himself upon shore and points at his models from their sides. An end or three-quarter view would be better. The only difficulty is to find a place to post the camera. From a long pier is best. But we are trying to understand technique now, and when we do we shall the better secure its correct rendering in our work.

78. One more example, and this time by a lady: the "Amsterdam" of Miss Eliza Greatorex. (Fig. 177.) With our eyes blindfolded, as soon as the name

fine art on these grounds, and I venture to predict that the day will come when photographs will be admitted to hang on the walls of the Royal Academy.—PROF. P. H. EMERSON, B.A., M.B.

77. Modern art is under great obligations to photography. There was a time when the artist who employed the camera in painting pictures was regarded as a person who made use of illegitimate processes. That time has now gone by. How far the use of the camera may go is a matter that depends on individual bias and conscience. A mere mechanical worker in paint will let his tools, whether camera or brush, do all they can for him, while an artist will always hold the thing expressed higher than the method or vehicle of expression. A great deal of what appears to be the best work shown at our National Academy of Design is primarily camera work. That is, the camera has been used to make studies or photographic sketches—to seize poses or expressions that are too fleeting to be grasped by the brush and to convey general impressions of parts or the whole of the composition. Here the legitimate use of the camera, as an accessory of easel painting, stops. By all means let us have good camera pictures. Let us work from nature with the camera as freely as with the brush, but do not let us attempt to make one do the work of the other. Let us not make a photographic foundation on canvas and then color it with oil paint. Honest camera work is a good thing, and the time will come when it will be recognized as art. Honest brush work is also a good thing, but the union of the two with intent to deceive, only brings the feeblest side of each process to the surface. Artistic insincerity always carries its penalty with it, and this kind of mongrel work, although it is often effective at first sight, is rarely satisfying after a few glances have been bestowed upon it.—CHARLOTTE ADAMS.

78. A true photographer seems to me to rank with, and resemble, the troubadour of the middle ages—poets who poured out their impromptu verses to the call of the audience. He ought to be a reader of faces—a close scrutinizer of the inner workings of the subject before him; catch with an eagle glance the peculiarities of gait, the tricks of motion; and be gifted with the rare discrimination which can separate the natural habits from the society affections. I think a photographer ought never to be in the studio when the sitter first enters. He or she ought to be left a little time alone, or, rather, a special

Amsterdam is heard we could almost formulate the technique of any good picture of it in our minds. We should expect no rocky banks with sea birds resting in the crevices, or foregrounds rich in clover or daisies or fields of golden grain. Neither lines of tall oaks, or castled crags hiding the blue sky

FIG. 177.

from our view. On the contrary, we should begin to picture what the fair artist has so finely represented by her splendid workmanship, a foreground broad in water, with bits of turf here on the left, and a city whose sunken-down-into-the-lagoon effect is accentuated by the low line of the horizon and the unusual height of sky. And how she gives charming variety of light and shade in masses arranged with feminine subtlety by the deft manipulations of the brush.

I have used the word technique broadly, as covering the whole construction of the picture, rather than—in the narrower interpretation of the painter—the mere brush work. For if there is one subject above another which photo-artists want more light on, it is their technique.

The artist who attends to all of the technical details in his work need not necessarily resort to artificiality. He believes that the highest art should

chamber ought to be set apart where the sitter may enter, with attractive objects to attract the attention placed about the room, while the artist, for a few moments, from an unseen point, may watch and study his subjects when they think themselves unobserved; afterward let an employé enter and address the sitter while he still watches from his point of observation, by which means he may judge and learn what the sitter is in a natural state alone and the sitter in society. And so he may wait, after the instantaneous plate is in the camera, for the moment when the sitter unconsciously looks natural, to flash the light upon her; indeed, I have thought if the studios could be so constructed always hold a soul of truth within its body of beauty. The body may be never so beautifully rendered, if the soul of truth is obscured. If the likeness is gone, the beauty is also departed. And likeness does not consist alone in the counterfeit presentment of the body. As much as possible, the carriage of the body and of the head must be as nature controls it, but quick, like a flash, at sight almost, the artist must not only discern the temper of the man but he must deftly bring the very scintillations of the soul beaming out upon the face. He must make them create the delicate elevations and depressions, curves and lines, which make up the modulations of the flesh, and while they catch the light and receive the shadows under the lighting he has arranged, they must be seized upon his sensitive plate. And is his work done then? No. He must repair to the darkness lest the very element which helped him should destroy all. Then there, with wondrous patience while with agile hand he pours the potent lotions upon his plate, he watches and applies, and retards, and accelerates, and moulds and forms, as the painter with his brush, as the potter with his clay, and with brains alert, until lo! the man, in the likeness of his own image. His eye for the beautiful, guided by his love for the beautiful, has enabled him to bring out the beauties of the soul of the man upon his face, and thus he is a promoter of refinement of the highest type. The man who sends out a bad picture into the world is a doer of evil. If he is a poet and a true artist he will never permit that.

He must be as a magician who, from sources unobserved and not understood by others, brings out the soul and spirit upon the face.

One has written as to the poet, "If he leave the body untenanted, it is well, for it is a body of beauty; if he beckon in an angel of light, it is noble, and he has done well for his kind; if the devil of darkness have taken possession at his word, he has earned for his name a place on the scroll of the enemies of our race." It is precisely so with the artist—if he be a *true* artist.

And, as I have said, what a magician he must be, since during the day he must originate some means of developing visibly what soul he intuitively feels must have existed within the beauty of the bodies presented before his camera.

that the operator need never enter the room at all, but have the camera so adjusted from an outside room that the sitter might not know the moment they were taken, it would be best—for, to me, naturalism is always before even a first-class sighted likeness; however, if the photographer knows the peculiarities of his sitter, and these be comely peculiarities, he will pose so as to bring them sufficiently out for his purpose.—HUME NISBET.

79. "Originate? Can there be anything original in photography?" it has been asked over and over again. Do not the workmen of this guild all have the same tools of light and shade to build up the image upon the sensitive plate? Verily, but originality does not consist in swinging them at random until their trickery astonishes you by the maudlin results. Nature must be rendered truthfully and yet surprisingly. The elements of character held dear by relatives and friends must be not only secured, but with a degree of refined intensity that will make them appear more lovely in the picture than they are seen even in nature. No two persons see alike. It is a rare thing for both eyes of one person to see exactly alike. Remembering this, the quick artist seizes upon the elements of character which he sees and adroitly brings them to the surface. He cannot tell how any more than the orator can tell you how he holds his audience. He can—he does—and therefore he is an inventor, an artist. No more passes before his eyes than before others, but he *perceives* more, because his mind is more susceptible. How many thousands and tens of thousands could say that they had *seen* the lovely effects of light and shade, which Master Rembrandt painted with such effect, after he had placed them in rich masses

79. As mechanical photography deals with material beauty, so let art photography treat with intellectual beauty; and when deep and earnest minds, seeking to express their ideas of moral and religious beauty, employ *high*-art photography, then may we be proud of our glorious art, and of having aided in its elevation. And where does art come in?

You may find this query admirably answered in a beautiful poem by Mr. Longfellow, entitled "Kéramos," which is none other than the history of the ceramic art, and which beautifully closes as follows:

"Art is the child of Nature; yes,
Her darling child, in whom we trace
The features of the mother's face,
Her aspect and her attitude,
All her majestic loveliness
Chastened and softened and subdued
Into a more attractive grace,
And with the human sense imbued.
He is the greatest artist, then,
Whether of pencil or of pen,
Who follows Nature. Never man
As artist or as artisan,
Pursuing his own fantasies
Can touch the human heart, or please,
Or satisfy our nobler needs
As he who sets his willing feet
In Nature's footprints, light and fleet,
And follows fearless where she leads."

So let us walk and work and live in Nature's footprints.—EDWARD L. WILSON.

of harmony upon his canvas, but none *revealed* their charms before him. Why do we fall back overcome with emotion when we enter the stanzes of Raphael in the Vatican? It is because he saw so much more in a human face than we can, and could translate it into paint upon canvas with feeling which we do not have. But, like a puzzle, we can partly understand it when it is put before us even in such a bewildering way.

The objects then are given to all of us to see. But the power of perceiving the soul—man—of bringing it out upon the face, is reserved for the mind of the true artist. And the photographer may be a true artist.

Painters usually are loath to permit photographers to make any claim to artistic merit. Their works are crowded out of exhibitions and collections, because they are not considered as the productions of art. Those who paint, those who cut and carve, however, are becoming more reconciled to the thought of allowing photography to walk alongside, and are becoming more lenient than they were. Doubtless they begin to feel that our art is a necessity to theirs. It is art, and an incomparably expeditious one. Where is the painter or sculptor who would not quail at the thought of reproducing such lively representations of nature as are produced by our blessed art, in the same time? The subject is presented to the photographer, grumbling and growling and complaining and fretting because of the unpleasantness of sitting for a photograph, and our artist is expected in the few moments at his command to produce the most lifelike counterfeit that the exactions of an impatient nature can claim; while the painter or the sculptor is permitted to have ten times as many sittings, each ten times as long, with no complaint and no rebellion. Who then is the greatest artist but he who produces the most natural result in the shortest time?

80. And not only is all this expected from him, but he is likewise held more or less responsible for the expression of his subjects.

80. When, fifty years ago, the new baby, Photography, was born, Science and Art stood together over her cradle, doubting what they might expect from her, wondering what place she would take among their other children. Science soon learned that she had come with her hands full of gifts, and her bounty to astronomy, microscopy, chemistry, made her name blessed among these her elder sisters. Art, always more conservative, hung back. The gifts at first were fewer, and she seemed an ominous rival to the others. She threatened to leave them nothing to do. But slowly jealous Art, who first frowned and called the rest of her brood around her away from the parvenue, has let her come near, has taken her hand, and is looking her over with questioning eyes. Soon, without a doubt, she will have her on her lap with the rest.

Why has she been kept out so long? Almost from the beginning she claimed a place

Some time ago the noted French scientist, Chevreul, reached the age of one hundred years. *La Nature* devoted the entire space of an issue to a series of

FIG. 178.

photographic interviews with the scientist, in which, while the famous Parisian photographer, M. Paul Nadar, conversed with him, a stenographer took the

in the house beautiful of art. In spite of rebuffs she knocked at its doors, though the portrait painter and the critic flung stones at her from the house-top, and the law itself stood at the threshhold denying her entrance. Those early efforts were not untinctured with a fear that if she did get in she would run the establishment; but the law long since owned her right, and instead of the crashing boulders of artistic dislike and critical conversation and an operator a series of instantaneous photographs of the two noted personages. These so set forth the variety and quickness of the changes of human expression that I add a selection of them here (Fig. 178), with some suggestions as to what feelings the different expressions in conversation may indicate: 1. Amusement; 2. Argument; 3. Disclaimer; 4. Challenge; 5. Doubt; 6. Attention; 7. Triumph; 8. Seeing is believing; 9. Profundity.

When my practical readers are told by their patrons "I never looked like that!" these phases may serve to prove that the camera catches exactly and truthfully whatever comes before it at the moment of exposure.

indignation the volleys that drop at her feet now are mere mossy pebbles flung by similarly mossy critics or artist-bigots. Still the world at large hears them rattle, and does not yet give her the place and estimation she has won.—F. H. Wilson.

Art began with the first touch of a man to shape things toward his ideal, be that ideal merely an agreeable composition or the loftiest conception of genius. The higher it is the more it is art. Art is head-and-hand-work, and a creation deserves the name of art according to the quantity and quality of this expended on it. Simply sit down squarely before a thing and imitate it as an ox would do if an ox could draw, with no thought or intention save imitation, and the result will cry from every line, "I am not art, but machine work," though its technique be perfection. Toil over arrangement and meditate on point of view and light, and though the result be the rudest, it will bear the impress of thought and of art. I tell you art begins when either man, with thought forming a standard of beauty in his mind, commences to shape the raw material toward it. In pure landscape, where modification is limited, it begins when the artist takes one standpoint in preference to another. In figure composition, where modification is infinite, it begins with the first touch to bring the model into pose. When he bends a twig or turns a fold of drapery, the spirit of art has come and is stirring in him. What matters his process? Surely it is time this artistic bigotry was ended.—F. H. Wilson.

CHAPTER X.

OUTDOOR OPERATIONS.

81. The student has already discovered that the same principles and laws which should influence the photographer under the skylight, should be permitted to have even fuller sway when working under the broad canopy of heaven.

There are, however, some special lessons needed by the out-door worker, which it will be the purpose of this chapter to suggest.

The choice of subject being made, if there is time for deliberation its composition should be carefully studied. Then Old Sol should be consulted as to what time of day he can be relied upon to give the best light upon your choice.

These points are all-important.

With emergent cases, such as subjects on the way, "snap shots" and "hit or miss" chances, of course there is no time to deliberate; but there is always a choice: Be greedy, and take the best.

A hint or two as to this.

81. It does not always require a grand scene of rock, river, and mountain, to make up a picture. Very simple things, which a person not accustomed to observe would pass by unnoticed, will in the hands of one who has the knowledge and tact to properly picture them, be made very attractive and artistic too.

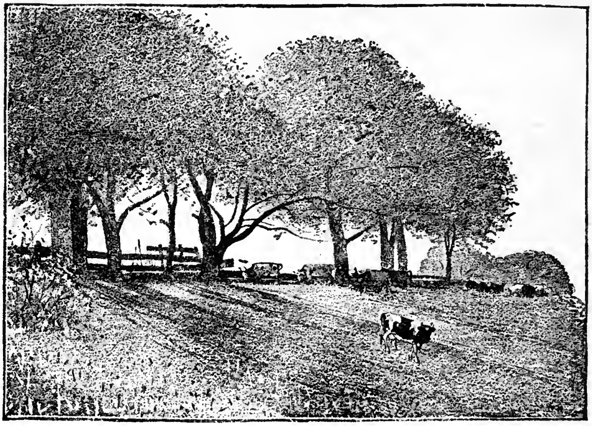
Small bits of landscape I would advise as preferable for the beginner as being more simple, and a variety of composition and effect can be produced with greater ease and simpler means.

The foreground being one of the main points in a picture, and generally required to be bold and effective, can, if not naturally so, be made so in a great measure by a little labor in the way of rolling up an old log or stump in an effective position, or placing a bush or clump of large-leaved weeds where they will be of service in making a proper balance or contrast as may be needed.

And let me advise you here to always have with you on your photographic trips, a spade and a good axe; the latter particularly will often be found "a friend in need," when it is desirable to cut a small tree or remove a branch that would otherwise obscure some important point of your view.—James Mullen.

82. You are out with your camera as eager to gather some food for it as a hungry lion prowling about seeking whom he may devour. Thank you for your enthusiasm. It is one of the first requisites.

Fig. 179.



By the roadside, ahead, long before you reach them, you are attracted by some fine trees, and you determine to gather them in. You observe that the light is against you, but the other side must be just as beautiful, and you climb over the fence into the meadow for your view. Some patient cattle are there chewing their cuds. The light is lovely, but the meadow inclines toward the sun, and your proper standpoint gives an ugly foreground. Instinctively your art principles come to your help and (mentally) you offer your kingdom for—a cow. You drive her down to where she is most needed, and your result is as artistic as "A Landscape," by Mr. Winslow Homer (Fig. 179), because you have broken up the monotonous foreground by the aid of the cow.

82. As we advance to scenes fuller of interesting natural objects, we have less need of incident to give interest. Distant mountains, with a river or lake, fine trees and rocks, go to make up the sum of a beau ideal landscape, and when we can get the mountains and water near the centre, with a fine large group of trees on one side and a lesser group of trees or rocks upon the opposite, we have the most complete arrangement. And it is not necessary that the features should be large or the scenery on a very grand scale, for where there are no figures or buildings by which to measure the comparative size, scenes composed of smaller features, well disposed, make just as good pictures, and to my fancy sometimes better, because in the case of the large scenery, there being generally no means of measuring, one is not impressed with the grandeur, as he would be in the presence of the scene itself. And with small features, provided they are picturesque, there is more rural poetic sentiment, more variety, and the proper point for the forming of an agreeable picture is more easily obtained.

It is true that some painters often took great liberties with views, and in order to carry out their bent so changed not only the proportions of important objects, but their true

83. If, instead of a meadow, a river forms your foreground, as we see, for example in the painting of the "Bouquet River in Winter," by George B. Wood, Jr. (Fig. 180), you could not break it up, unless it be by a broad mass of light such as the daring artist has used in his picture.

Fig. 180.

Most careful attention should always be given to the foreground. Even though it is necessary to place an old stump or a log or a cow there, rather do it than allow it to be monotonous. Good lessons on this score may be had by studying the illustrations which follow. Attention to light and shade, balance and harmony, and composition, is what gives one landscape photographer better success than his competitor.

relative position with regard to each other, as to make the picture almost unrecognizable as a view of the place it was intended to represent; but the photographer need never have the slightest fear of falling into error in this direction, as his views must necessarily be always too realistic and matter of fact, and exaggeration of the picturesque, in examples, can do him no harm. Besides, such study will be a great aid to him in making his selections, first, of the kind of objects or scenes most worthy of his attention; and, secondly, of the most proper point of view from which to seize all the salient points and to take them in the most harmonious and agreeable manner.—Xanthus Smith.

83. If you have time reconnoitre the place previous to working. Pick out your standpoint, and look out for what will make views; mark down the time of day the light is most suitable. In this way you can start in the morning with your traps, keeping the sun two-thirds or three-quarters on your work, and follow him all day, except for strong cloud or moonlight effects. For these you will require a box with the lid over your lenses, and will have to work directly towards the sun. Watch until the sun is capped on the edge by a cloud, and then expose for one or two seconds for the clouds. Then close the lid half down, and keep slightly moving it up and down between the horizon and foreground for detail in the picture. As a general thing, this class of views is intended more for cloud effects than a picture full of details or half-tones. The best moonlight effects are got near sunset; then you have to work almost instantaneously.

My latest mode of working is to give a good exposure for details; and, in developing, get out all you can, but do not overexpose or develop so as to get a foggy or flat negative.

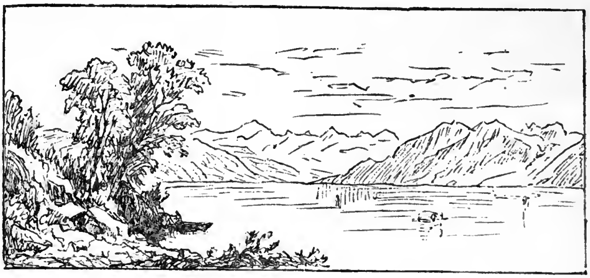
84. The introduction of water is always desirable, if it is possible. It not only affords variety to the subject, but it supplies light and snap to a picture as a rule.

No more charming bits for the camera can be found than those which are offered by the lovely tree-lined brooks, lakes, and rivers of our country.

The low sun is usually best for such subjects, when the light enters horizontally and diffuses itself among the shadows of the foliage. There is great room for choice here—the greatest room.

85. If mountains are in the distance and you desire to secure atmospheric effect, such as we see in the charming "Lake Leman" of Mr. J. H. Casilear (Fig. 181), then a little sacrifice of principle is allowable so as to secure a good expanse of water in the foreground, at right or left. Then variety may be secured and the atmospheric effect assisted by selecting a point where rocks, trees, or a part of the beach or a boat at anchor may be included. If the external atmosphere is

Fig. 181.



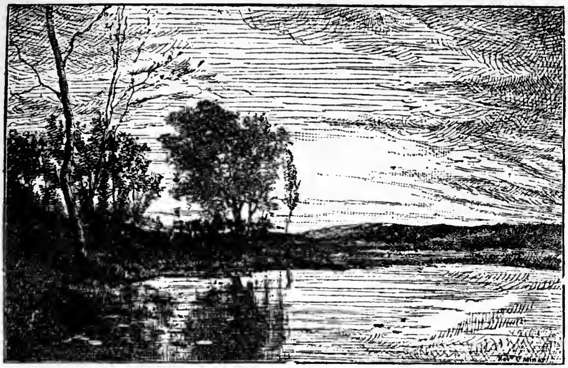
For general work a well-lighted picture will not require, if your chemicals are in good working condition, any redeveloping or intensifying.—B. W. K.

84. In a river view strive to get a good mass on either one side or the other of the subject, and do not let it extend far enough into the picture to cut off too much of the distance, if the latter is good. If there should be so much of interest in a side group that you must extend it very far across the plate, make it the subject, sacrificing the rest. When you have a fine side group of trees with a good profile, an agreeable combination of curves, straight passages, and angles, for instance, do not cut the top off it, but let some sky appear above, by retiring further; or if this is not practicable, using a wider angle lens. In other instances, where there is a high blank wall of uninteresting or monotonous foliage, with a very interesting passage of stems underneath, then advance closer, cut off much of the top, and aim for one of those pretty compositions in which a passage of distance is seen beneath overhanging or overspreading boughs. The deep, quiet passages of shadow cast upon the earth under spreading trees give breadth and effect to a subject, and when it happens that a stump, or rock, or cow, or some such object can be relieved in high light, by being a little nearer and cutting against such mass of shadow the effect is greatly heightened.—Xanthus Smith.

85. A considerable amount of atmosphere will be found of advantage in extended river

in proper condition, the time of day and light agreeable, and the water calm, lovely reflections may be caught as we see them in Mr. R. C. Minor's poetic view of "Evening" (Fig. 182). I have more than once waited an hour for the water to calm and for the sun to move where I wanted it, in order to secure such a choice as this.

FIG. 182.



86. But we cannot have one favor without yielding another, and so, sometimes, to get reflections like this we must break the rules.

scenes, as it separates different passages, causing the more distant to recede, thereby adding to the look of perspective or retiring of the distance; and, moreover, it gives mystery, which is an agreeable quality in art. It is of great advantage to have calm, or very nearly calm, water, the reflecting of passages of deep shadow preventing too sharp cutting of shore lines, and also removing the difficulty of the whole water in the picture being a cut-out light patch of equal brightness all over. It is a fortunate time if water can be got perfectly calm under hills or rocky bluffs, with their deep, quiet reflections underneath, and streaked by puffs of air, causing strips of bright light, making it appear more level. Boats or skiffs are a great improvement in water scenes if they happen to be in a fortunate position. In the middle distance they measure the size of the scene, by comparison, and as foreground features, with their deep touches of shadow form good points of interest, but will always be preferable if not full side view or directly end on.—XANTHUS SMITH.

86. To-day, while I write, the air is as clear as in the White Mountains in June, and as mild as Newport at the same season; out of my window are the vivid green meadows of the "garden of England," here and there dashed with clouds of daisies and buttercups; the trees in their tender first green, with silvery willows and hedgerows of hawthorn like green waves on a green sea breaking into foam of blossom. In the distance, the rolling downs with great golden drifts of gorse come up against the sky, blue, almost cloudless, but with a misty tenderness which we so rarely find in the American half of the blue expanse.

I look out of my window and despair of photography, it gives so little of all that is most entrancing in nature. But a little glimpse here and there is my consolation; a farm-yard, just seen amongst the towering elms; a bit of a lane where the trees overarch, and where we may sometimes catch a carter with his heavy train, and stop him

The more strictly artistic composition is found in another painting by Mr. Casilear, "A Scene in New Hampshire" (Fig. 183). The group of noble

FIG. 183.

elms, the alders close to the river, the shrubs on the right, and the stony bottom, give us a pleasant variety for an unbroken foreground. Then comes the

long enough to get the pose; a nook of green field where the brook borders it, with flag and wild flowers rich in details of vegetation. These crumbs of comfort fall to me from the broad table, and I am consoled that though the higher motives are to be realized only by the infinite labor of art and the complications of the palette, I can render justice to some of the qualities of these minor beauties, such as no man can give with the pencil; and if it were not for my duty to the *Philadelphia Photographer* I should be to-day on a cruise amongst the farm-yards, and nooks and corners aforesaid, with the comfortable satisfaction of trustworthy dry plates and a Scovill Company's dry-plate box, knowing that I have a dozen and a half chances for a picture on the full size of my plate.—W. J. STILLMAN.

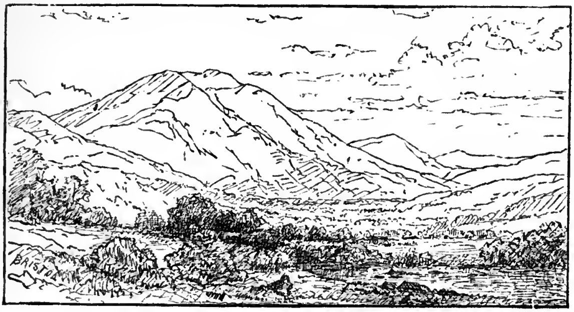
The ability to climb is one to be cultivated by the would be successful mountain photographer. A great many pictures I have seen made in mountain regions are imperfect and unsatisfying, because the camera was placed at too low a standpoint.

The foregrounds are filled with incongruous and badly composed rocks, or trees, or roadway it may be, and there is no feeling of atmosphere or distance whatever, though it is true there are the mountains in the beyond.

To correct these evils you must climb—climb to a point where you can overlook the immediate foreground, and secure a good expanse between you and your principal point of interest, the mountains.

I might illustrate my meaning by reference to Mr. J. B. Bristol's "Mount Equinox." (Fig. 184.) With half an eye one can see that if a camera picture of this scene was brilliant light of the placid lake, with the varied outlines of the gray mountains beyond. There is not the atmosphere that we see in the "Lake Leman," but ordered of the photographer, he would terribly miss it if he attempted it from a low point. As it is we have a foreground full of pictorial value, a splendid sense of expanse and distance with a charming view of the mountains.

Fig. 184.



But to secure such a combination the artist must climb, perhaps two or three inclines before he can find a proper standpoint. And yet there are exceptions to all rules. There are occasions where it is best to remain lowly, but only when the best picture can be so obtained. Such an instance is exhibited by Mr. Albert Bierstadt's magnificent painting of "Mountain Lake." (Fig. 185.) This is a picture of a lake hedged in among the richest accessories of tree and mountain which nature ever provided. Here are a hundred pictures possible in one; but it is a picture of a "Mountain Lake" and must not yield to the things which are about it. It will be observed, however, that it was not the policy of the artist to paint "the whole" lake "or none." He has chosen one of its most beautiful curves, with a shore line decorated by such accessories only as are found there in nature. And after all somewhat of an elevation must be reached in order to get just such a combination.

Fig. 185.

Fig. 186.

there are other qualities just as charming. Rarely may we hope to get *all* the elements of beauty in one composition.

Climbing comes good also when you have to master marine pictures as well as those in the mountains. "The Gull Rock," of Mr. W. T. Richards (Fig. 186) shall be used to help here. It is of one of those occasions when, just before the fog pays its visit to the shore, the waves, seemingly angered, come rolling in as if

Fig. 187.

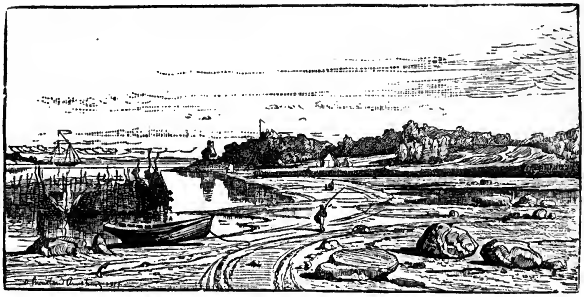
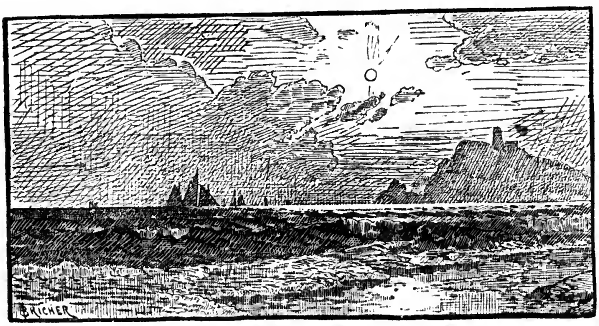


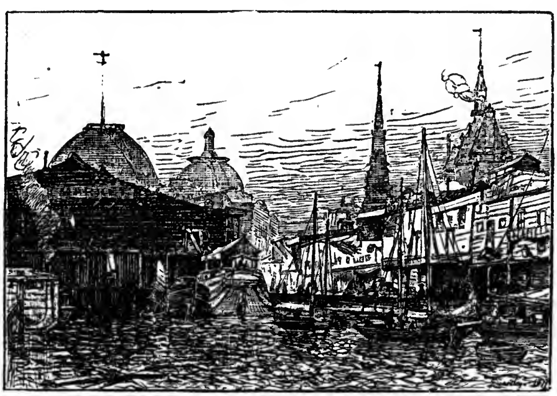
Fig. 188.



to forewarn, and where, to get the full sense of the picture your highest tripod or the top of a bath-house must be used.

In the attempt to get an interesting foreground, the photographer is sometimes led to overdo. In other words, crowd in too much. I might help you to my meaning by referring you to a picture that is very beautiful, and yet, I consider, faulty in the direction I speak of. I allude to Mr. D. M. Armstrong's painting of "The Harbor Bar, Mount Desert." (Fig. 187.)

Fig. 189.



It is true, this is a "bar," and with such accessory objects as belong to a "bar," yet it strikes me with the feeling that there are too many objects crowded in, and the effect of the whole gives trouble to both eye and mind to puzzle out the artist's reason for their introduction. The swirl of the lines

87. From things terrestrial, let us look skyward a moment and take a lesson.

To obtain clouds with the landscape when there are any, is often desirable, and yet, so eccentric are they in form and lighting that they do not always occur in harmony with the landscape in hand.

A good plan is to devote a day or more when occasion offers, to securing some negatives of clouds for the purpose of printing them in the views by the process of double printing.

The sky, as a rule, only requires as many seconds' exposure, comparatively, as the foreground may require minutes; there is little hope, ordinarily, of

is also too tame. If I had been photographing in that locality I should have chosen a different combination.

A much more poetic feeling pervades "Off the North Head, Grand Ménan," by Mr. A. T. Bricher. (Fig. 188.) It is full of lovely suggestions, and would require an elevated standpoint to secure its full sense in a photograph.

Of course, I am only to be understood as making suggestions—as simply giving you a receipt for a developer but not mixing it or not manipulating it for you. I use the word climb in its literal sense, and its typical as well. You must *work* if you would secure pictures.

Even if you stand on a wharf-pile and fire away, should you want to get such a picture as "From a North River Pier," by Mr. Arthur Quartley (Fig. 189), you must climb up to the art-rules and must seek a place for your camera where all incongruities and inharmonious objects will be left out. I hope I have not led you too high.

P. S.—Oh!—Don't forget about the time of day.—B. W. K.

87. The best arrangement for permitting the sky to be secured in the same negative as the foreground, which I have met with, is simply this: I put, in place of the ordinary back to the slide, a pane of the red glass used for operating windows set in a narrow sash —a red glazed slide-back, in short—and make the focussing-cloth into a hood at the back, so as to shut out all outside light. I am able, in this way, to see the image on the sensitized film with almost as much distinctness as on the ground-glass. I then, with one of the flap shatters, or a movable screen, the edge of which is, if necessary, adapted to the parts to be kept longest exposed, cover the sky and extreme distance over rapidly, and more and more slowly as the view darkens and the foreground passes into shadow. So far as the view permits this simplicity of treatment, the operator may work with as much certainty as if he were shading a print. If a dark object comes up against the sky, that must be treated with the closed foreground by a screen with an aperture properly arranged, and can best be done by a subsequent reopening of the lens by the reverse operation, inclosing the foreground and the dark object first, and not letting the sky be exposed at all. It is evident that the range of subjects which can be masked in this way is mainly limited to those in which the division of sky and land is simple and broad; but in the view exhibited there were slight irregularities of outline in the darker planes, which were met in this way perfectly, and the foreground, which was very dark and green, had more than as many minutes' exposure as the sky had seconds.

securing skies and clouds as well as foreground at the same exposure. Hence the separate printing from a sky negative becomes, ordinarily, necessary. This necessity under many circumstances is not an evil. Nature does not select; art does; hence the capable artist will select such a sky for his landscape as may best complete his composition without violating natural truth. At times, however, the landscape is found with a sky which yields the highest pictorial conditions, whilst the play of light and shadow on the landscape is inseparable from the sky above it. In such a case the landscape and sky ought to be obtained at the same time, even if printed separately. To meet such cases, and secure, if possible, the result in one printing, various contrivances have been devised to give the sky a diminished exposure: stops with graduated aperture, allowing less light to reach the sky; means of controlling development, so as to give little to the sky, much to the foreground; shading a portion of the lens during exposure; and shading a portion of the plate

There is nothing new in the use of the screens, but, so far as I have learned, no one has employed the red glass slide-back in this way to direct the screening.—W. J. STILLMAN.

By a skilled hand artificial clouds may be made on the negative, but this would not at all apply to stereo work.

The plan that I have for years adopted—and in no case has the reality of the effects produced been for an instant doubted—is as follows:

I first take, as opportunity offers (and with the same lenses and camera used to take the views), a series of cloud negatives—merely shadows, if I may so express it—instantaneously, so that sky, and sky only, is the result, letting the shadows of the clouds be nearly transparent, as this saves much time in the printing.

When about to use these sky negatives (we will suppose that the prints, which are stereoscopic, have been printed), the print should be laid on a piece of wood, covered with cloth (the back of a printing-frame will do), and on this must be placed the cloud negative, placing it where it will most harmonize with the view, and also taking care that it is parallel with the lines in the print. It is now taken out in the sun, and a piece of card, which covers all but the sky, is kept moving slowly from a little above the highest portions of the view during the exposure, which, with such a negative as I have described, would not take more than one or two minutes.

No fear need be entertained of allowing the clouds to print a little over the top portion of the picture, for this will not show unless under very extraordinary conditions, such as a white church spire against the sky. A gradual lightening of the sky toward the horizon, arising from the movement of the card allowing less light to fall on that part, gives a very artistic effect, the same as is given in merely shading a sky, as is often done.

Anyone who will try this method will, I am sure, no longer have chalky masses on the upper part of his pictures to represent a sky. Never mind if the sky prints rather dirty to begin with; the clouds will hide it.

during exposure. The latter plan is manifestly the best when it can be satisfactorily managed.

With modern dry plates skies are more readily obtained, and the latitude afforded in development by them makes it easier to secure landscape views with clouds than it was in the "wet" days.

88. The inclination of the camera, up or down, is a fault which the novice is apt to overlook. In portraiture you may easily study the effect of placing the camera too low or too high, by observing the face of friend or foe, as you sit down before him, stand face to face with him, or, upon a chair, look down upon him. For portraits, as a rule, it is better to work with horizontal or nearly horizontal apparatus, and to secure the want of sharpness of the front parts of a sitting figure by inclining the ground-glass (swing back).

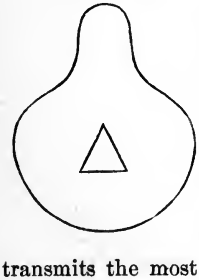
In landscape photography a horizontal position of the camera is almost a necessity; particularly is this the case with architectural objects. If we neglect this and give, for instance, an upward direction to the apparatus, we will find that the vertical lines converge toward the top.

A great many pictures now in existence will explain this. A landscape which has no architectural objects in it will show these errors a great deal less, and it may often be of advantage to raise the front of the camera a little. I

Much has been said on the fact that clouds and landscape taken at different times are not proper and cannot be artistic. This, I think, is not the case, as with a dozen cloud negatives, taken under different aspects of light, half the negatives ever taken might be suited. They may be printed from back or front, to suit the lighting of the view, and, if more variety be wanting, may even be turned upside down; but this I should hardly recommend.—WALTER B. WOODBURY.

Another plan is to regulate the influx of light into the camera by means of a folding door in front of or within the camera. This helps to remedy the evil only partially; besides this, it cuts off the light too abruptly, and is apt to form a line or division where greater intensity takes place. The method which I here present has been tried very successfully, so much so that it becomes an earnest recommendation to lens makers to supply, with their lenses, a set of diaphragms that assist in producing this good effect.

FIG. 190.



Instead of having a round aperture in each stop, let it be of a triangular shape, that is, a circumscribed equilateral triangle, with the apex upward, as shown in Fig. 190.

It is evident, from the shape of the aperture, that the sky sends through the lens the smallest quantity of light, whilst the landscape transmits the most; the increase of light, too, from above downwards, is gradual, thus producing no harsh line between the sky and the landscape.—PROF. J. TOWLER.

have often done this in taking an avenue of trees, and it gave me a much deeper view into the foliage.

Much liberty is gained by placing the apparatus above ground. Go to the first, second, or third story of a house, or even climb hills or mountains, that you may overlook a larger area. Very high or large and imposing structures often appear so distorted, when taken from the ground, as to render them painful to the æsthetic eye.

An example in portraiture where the lens has been too low, will be found in the last chapter, page 172. The notes below supply some useful suggestions on this point.

89. This brings us to the next topic for discussion, namely, *perspective.*

Photography—poor, abused art—has always been a most "willing horse" among its kindred. This has rather spoiled its votaries, and caused them to be more exacting sometimes than is reasonable. In the matter of exposure, for example, as I shall presently try to show, the gourmand disposition of the disciples of Daguerre has led them into quite a hole of error.

So is it in the direction of the amount of subject it is proper to desire in a

89. If we take a photograph of a cube one foot high, and place the objective on a level with the cube, the edges will separate but little, and the cube will look as represented in Fig. 191. If, on the other hand, we photograph a cubical building which is sixty feet high, and place the camera at the foot of the building, then the lines of the cornices, *a e* and *a c*, will "tumble" very considerably, as the artists call it; and the higher the building is, the more marked will this appear.

I once saw a photograph of a monument which appeared exactly as Fig. 191. The lines of the cornice did not fall sufficiently, and did not give the same impression that high structures would make.

The question arises, could this be avoided? At first sight this seems impossible. And still it can be done. If we photograph a cube, and place the objective at various distances

Fig. 191.

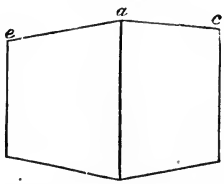
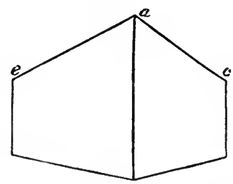
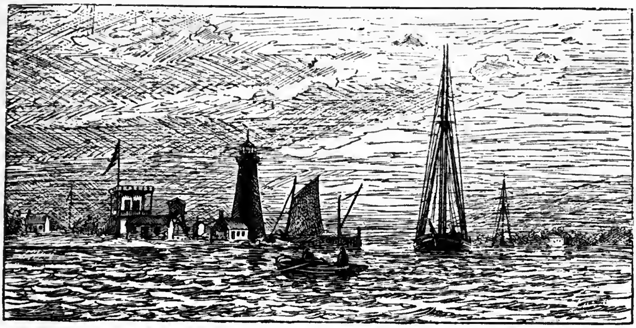


Fig. 192.



from the camera, we will find that the lines tumble more and more the closer we get to the cube. When we get very close, and the objective is on a level with the base of the model, we will obtain a picture like Fig. 192. Such an approach is possible with a correct-view. If a wide-angle lens, the focal length of which is less than eight or ten inches, is employed, the distance is distorted—near objects are enlarged and distant ones brought too close in appearance. Let me illustrate. Cut a hollow rubber ball in two, and turn the hollow side of one-half toward you. It presents the half of a globe—a hemisphere. Carefully seize the sides and pull. You thus destroy the spherical form and bring the extreme inner surface nearer to you. So acts the lens, when one of too short focal length is used. Painters have more liberty in this direction. For example, in a picture like "An August Morning," by Mr. R. Swain Gifford (Fig. 193), there

FIG. 193.



working wide-angle lens, as, for instance, the Zentmayer. Such lenses have sufficient depth, and make it possible to work at very short distances.—DR. H. VOGEL.

To obtain a correct *small* picture of an object, the reduction in size must not be accomplished by using a short focus lens, but by taking one of a proper focal length to a distance such that the object is thereby reduced to the size desired; unless intervening objects render such a course impossible. I mean that if we want a picture of three inches by four of an object, we shall not do well to use a lens that gives images of that size, but we should take a lens of longer focus, say an eight-inch lens, and go to a distance such that the object is brought into the required limits. With natural scenery very pretty pictures are often obtained by these short-focus lenses. But they are incorrect representations; the only difference is that the eye cannot detect, as in the case of architecture, the faults that have been introduced, unless previously familiar with the scene depicted.

It is not improbable that some of my readers may doubt the fact that I have here so positively affirmed of the equality of the perspective angles produced by different lenses of different focal lengths when taken from the same station-point. It is common to speak of the sharp angles produced by lenses of short focal lengths, and those views which we are accustomed to see produced by short focus lenses are habitually taken from station-points too near the object. So that two causes concur to make these sharp angles painful, first, that they are rendered additionally sharp by being taken from too short distances, and second, that short focus lenses produce small pictures in which, as above explained, the eye refuses to tolerate sharp angles.—M. CAREY LEA, M.D.

is an amount of subject which it would be impossible to secure in a photograph from the same point of sight, and at the same time preserve proper perspective.

When proper distance can be had and the correct elevation for the camera secured, as illustrated by the fine view of "Harbor Islands, Lake George," by Mr. H. W. Robbins (Fig. 194), then we can obtain quantity of subject and quality, though, of course, the objects must be diminished.

Fig. 194.

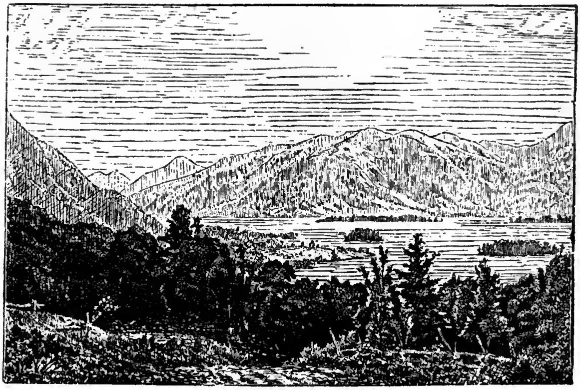


Fig. 195.

90. As you see, in photography one quality or element of beauty is secured usually at the expense of another. We may only hope for measured success by carefully averaging. This is true, no matter whether we are photographing by the seaside, among the lakes and mountains, "On the Desert" with Mr. Frank Waller (Fig. 195), where the camels and the Bedouin combine with the dead wadies and the fertile oasis to make us picturesque

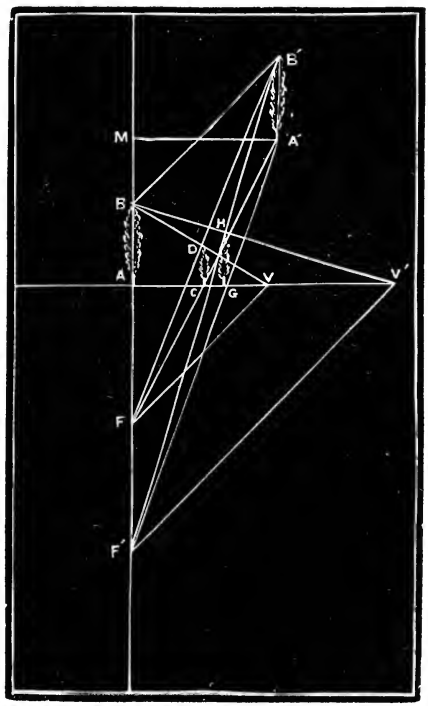
90. Supposing that two lenses of different focal lengths are so placed that a given dimension is equal in the two pictures, what law will govern the size which any other dimension will have in each?

Let us suppose that a poplar tree stands in the centre of the picture, that is, directly before the eye, and that another of equal height stands to the right, and further back; for simplicity let us say that it is as much further back as it is to the right. The line joining the two will then make an angle of forty-five degrees with the line of sight, that subjects, or in view of the "Cedars of New England" with Mr. R. Swain Gifford (Fig. 196), whose brush has given us so many admirable lessons in composition and color.

Fig. 196.

The work of the painter and that of the photographer are largely akin where the principles of art are involved, only the photographer is expected to tell the truth, while the painter is not so apt to be questioned.

Fig. 197.



is, in Fig. 197, *A M* is equal to *A′ M.* Also, we can simplify the figure and construction by supposing that the base of each tree is on a level with the eye.

The tree *A B* has, by condition, the same height as *A′ B′*, but the latter being farther will be represented smaller in a perspective drawing, and the amount of this reduction *is wholly dependent upon the focal length of the lens.*

Let us take *A F* to represent the focal length of any lens. Then determine the vanishing-point of the line connecting the two trees by drawing *F V* parallel to *A A′*, the intersection of *F V* with the line *A V′*, perpendicular to the line of sight *F′ A*, viz.: *V* will be the vanishing-point. Draw the line *B V*, and connect *F* with *A′*. At the point *C* where this last line cuts *A V* erect a perpendicular till it intersects *FB′*. The length, *CD*, of this perpendicular will be the comparative height which the distant tree will have, as depicted by the short focus lens, the nearer tree having the fixed height, *A B*.

Let us take *A F′* to represent the focal length of a lens of twice the focus of the preceding. The new vanishing-point *V′* is determined in the same manner as before. Connect *F′* with the top and base of *A′ B′*, and in the same way as before determine the height, *G H* of the tree.

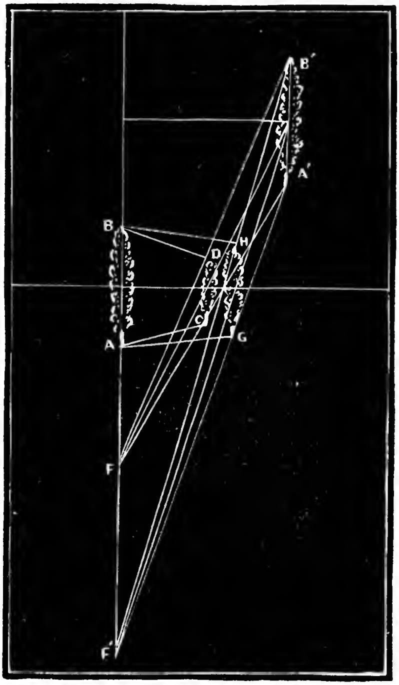
Photography has had to bear a great deal of unjust criticism, simply because critics are ignorant of what it means to produce a photograph—what is in-

We see, then, that the two lenses being so regulated in distance that both give the nearer tree the same height, *A B*, the more distant tree is reduced in height by the shorter focus lens to *CD*, whereas the longer focus reduces it only to *G H.*

The difference of these two heights is very striking. But this is not all; everything else, as I before remarked, is changed. The lateral distance, *M A′*, in actual dimension, is reduced by the long focus lens to *A G*; by the short focus, still more, and is brought in to *C.* The perspective angle of a line joining the summits, is also altered. Suppose the lines *A B*, *A′ B′*, represented, not trees, but the nearer and farther end of a building, of which *B B′* was the eave, the perspective angle would, in the one case, be *A B D*, in the other *A B H.*

The relative distance from the front is affected in the same way, but in Fig. 197 this is concealed in consequence of the assumption which we made that the bases of both trees were on the level of the eye, *i. e.*, the horizontal line *A V′*, which was done to simplify the figure. To show this further point, let us suppose the level of the eye to correspond with the middle of the height of each tree, then the effect of the two focal lengths upon the image will be exhibited by Fig. 198, in which the vanishing-points are omitted.

Fig. 198.



Here it will be seen that the short focus lens not only diminishes the size of the farther tree much more than does the longer, but it brings it nearer laterally to the line of vision, and throws it farther back. On the contrary, the longer focus lens draws the distant tree further forward and further outward, and increases its apparent height: effects that all photographers see constantly taking place within their own experience.

And if we imagine that *A B*, *A′ B′*, represent, not trees, but the nearer and farther end of a building seen obliquely, then the lines *A B CD* will represent the side of that building as it will will be reproduced by the shorter focus lens; *A G H B* as by the longer, producing the same comparative effect as shown in Fig. 197 of the first part. If the lines *A C*, *B D* (Fig. 198), were extended, they would give the vanishing-point, and so with *A G*, *B H.*

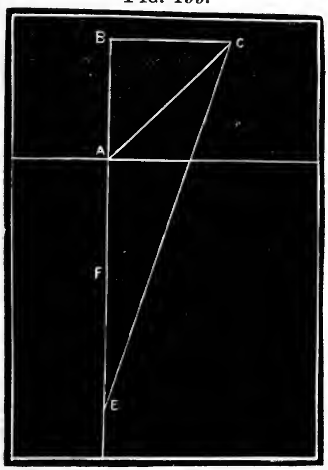
An objection may be made by some readers that the height of the trees, *A B*, *A′ B′*, is volved in making a photographic picture. A person who attempts art should be well versed not only in the principles of art, but should thoroughly understand the technique. And so should the photographic critic not only under-

not represented upon the same scale in the figure, as the focal lengths. To explain this, it becomes necessary to say a word on *apparent magnitudes.*

Suppose we are working with a lens of 6-inch focal length, and that the tree is 75 feet from the lens. This ratio of 75 : $\frac{1}{2}$, or 150 : 1, represents the scale on which the tree will be depicted on the ground-glass. If the tree be 50 feet high, then its height in the picture will be $\frac{50}{150}$ feet, or 4 inches. Now, if, in Fig. 197, *A F* represents the focal length of the lens, to with, 6 inches, *A B* may be taken as representing the correct height of the tree, or $\frac{2}{3}$ as much.

The same reasoning will enable us to determine in every case what size an object of a given height and distance will have on the ground glass with any lens. It must be rigorously borne in mind, however, that the tree or object is here supposed to be exactly on the central line *F M.* If it is not, we must take as the basis of our scale, not the other oblique distance, measured from the eye to the tree, but from the eye to a point on the central line opposite.

Fig. 199.



Suppose we place a lens of 12-inch focus at *E*, and have at *A* a tree 200 feet off and 50 feet high, this tree will be depicted on the ground-glass $\frac{50}{200}$ of one foot or 3 inches high—that is its height divided by its distance *A E.* Suppose another tree of equal height at *C*, the line *A C* making an angle of 45 degrees with *A B*, what will be its height?

Here we must not divide its height by its distance *E C, unless we intend to turn the camera round so as to bring it to the centre of the picture.* If the camera remains pointed in the direction *E A*, we must consider *E B* as the effective distance of the object. If we suppose *A B* to be half of *A E*, or 100 feet, then the size of the farther tree upon the ground-glass will be $\frac{50}{300}$ feet, or 2 inches. In this case, the relative height of the two trees is as 3 to 2. It may not be uninteresting to observe how this proportion will stand, supposing that we substitute a lens of half the focal length of the former, and bring up the size of the image of the nearer tree to 3 inches, by moving the lens to *F*, one-half the distance from it.

The nearer tree is now but 100 feet off, but our unit being reduced from 1 to $\frac{1}{2}$, the scale will therefore be $\frac{1}{200}$, the height of the first tree $\frac{50}{200}$, or 3 inches, as before. The second tree is now 200 feet off, its scale will be $\frac{1}{400}$, and its height $\frac{50}{400}$, or $1\frac{1}{2}$ inches. The perspective heights of the two trees, therefore, as given by the smaller lens, in place of being as 3 to 2 as in the case of the larger focus lens, will be as 2 to 1. These results agree approximately with those given in Fig. 197, although that figure was not drawn for such a purpose; it still, however, illustrates pretty well these measurements.

stand the principles of art but the photographer's methods of producing the technical excellences of his work should also be understood. Otherwise the critic can have no "feeling" for his work, and without feeling one may as well get "out of focus"—diffuse—at once.

And, finally, since outdoor operations give the camera worker a wider field, so do they give him larger opportunities for the exercise of art information. Faces may be lovely and beautiful, but to work amid the loveliness and beauty of nature, is a privilege above all which photography affords. Let it be measured from a lofty standpoint and treated accordingly.

Briefly, then, we conclude that all lenses (setting aside such imperfections as belong to their construction) will, when placed at the station-point, give pictures varying only in scale. But that when the same scene is taken from two different station-points, everything is changed. If we increased our distance from any given object in the picture, to double or treble, and yet keep that object of the same size in the image, by using a lens of double or treble the focal length, as the case may be, though that one object may remain unchanged, everything else will be. Also, that short focus lenses cannot give correct results, which, in small pictures, are only to be obtained by using lenses of sufficient focus, and retaining the central portion of the picture corresponding to the size required.—M. Carey Lea, M.D.

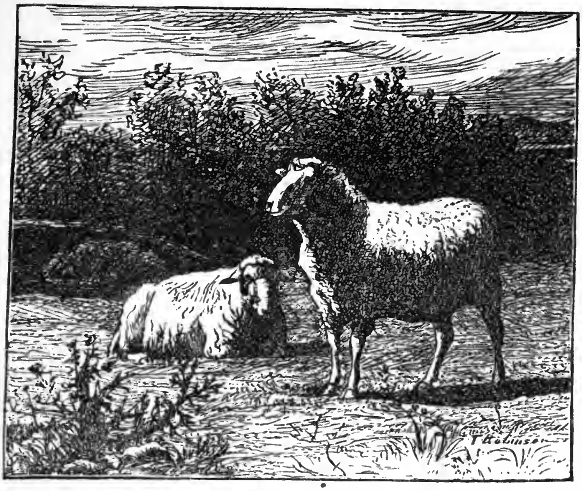
I usually carry four pairs of lenses, varying from 2½ to 10 inch focus, for stereoscopic work, and a 10 inch Morrison for single views, each fastened on its separate front, fitted to my camera, and all contained in a light wooden box with space for each. This box I carry in my hand to each point of view, and select lenses to suit the subject, invariably choosing the longest-focussed instrument that can be used in the prescribed limits, as wide angles fill the foreground with unimportant objects, and dwarf stately mountains down to insignificant lines.

For landscapes, I prefer single (achromatic) lenses, as the slight curvature at the margin is ordinarily of no account, and more than compensated for by the greater sharpness and detail obtained. They are also (when perfectly clean) free from a trouble which sometimes goes with the very best of combination lenses, a centralization of light, and a fuzziness at the edges where a dark object is brought against a strong light. Some of my best work has been produced with a pair of object-glasses taken from an ordinary opera glass (3 inch focus), mounted in rigid settings, and properly diaphragmed in front.

For architectural work, something better is needed, and found, in the "Morrison" and "Dallmeyer" wide-angle, rectilinear lenses, which take in an angle of nearly a hundred degrees; they are expensive but invaluable and perfect in their way; in my mind there is little choice between them, and an outfit would be incomplete without a pair of either one kind or the other, 2½ inch focus for confined situations, interiors, or mountain gorges and waterfalls, such as I have often found among the Adirondacks. Of course, the rule requiring as long a focussed instrument as possible, holds good and applies with even greater force to architectural subjects, but this smaller kind of lens is often necessary for field work simply because a single lens cannot be found of sufficiently wide angle.—S. R. Stoddard.

91. Next to clouds, the most unreliable objects which can be imagined to test the patience of the photographer are living animals. I need not speak of the number of their legs. Sometimes the fewer the legs the more the trouble. But it will console tried and tested operators to know that art principles will here also come to the rescue. Even a "Group of Sheep" may, as we see by a drawing from Mr. T. Robinson's lovely picture (Fig. 200), be treated so that the masses of light and shade and the arrangement of the figures shall comply strictly with the rules of art. And so, Mr. J. Wells Champney, in "The Arrival of the Stage" (Fig. 201), has so grouped aud lighted

Fig. 200.



91. It is only of late years that artists even are growing to appreciate fully, in this country, the beauty of picturesque figures in many subjects. Partly from the character of our grand wild scenery which has formed the field of study for our landscape painters, and does not require the addition of human life, being, indeed, often better without it, and partly from a want of training of landscape painters in the figure branch of the art, those interesting rural home bits which are so much enhanced by suitable figures and domestic animals, have been to a great extent neglected, and I think with loss to the art of the country, because works of this class, while they illustrate so much that is interesting and dear to us, and full of poetic sentiment of home, are capable of showing the highest degree of talent and skill in all the best art qualities.

Much more is attainable in landscape photography in the way of small rural scenes than in grand extended landscape. And one reason, in addition to such bits that compose well being infinitely more numerous than scenes more extended, is that the principal objects are all near, and consequently admit of the finished rendering of those exquisite details which constitute one of the principal beauties of photographs. But such rural bits are almost invariably greatly enhanced in their interest and beauty by suitable groups of figures. And here exists one of the greatest difficulties that the earnest worker after agreeable pictures, got with the camera, has to contend with, for while, as I say, there is nothing which so enhances the completeness of such pictures, there is, on the other hand, nothing which so completely mars, I may even say destroys a picture as his figures as to secure a very charming and natural effect. Every one seems to be doing something, all with a unity of purpose, which is delightful. Not a soul there who is not employed in some way in the consideration of the "arrival" of that stage There, see, the pleasant greeting, the helping hand, the busied baggage handler, the interested old man in the chair, the children resting from play while they look on—all, all helping to tell the story in the most natural way, and yet all composed in the most artistic way. Ten years ago a photographer, when attempting to picture an "arrival," would pose every available person at the rear of the stage, in a line, all looking in the camera,

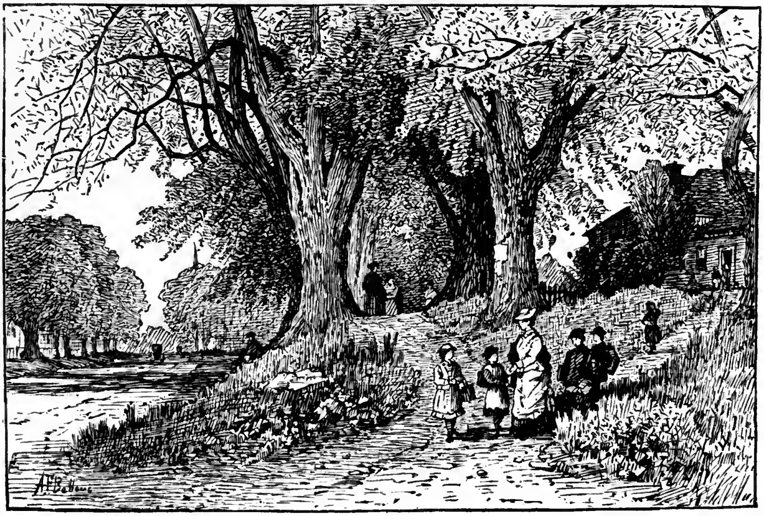
FIG. 201.

figures which are ill adapted to it, or badly placed, or unsuitably clad, or awkwardly posed, Even the getting them of a proper size in a photograph is a very difficult matter always. If retired to such distance that they become buried in insignificance, of course they are useless, and the nearer we approach them, not only from their increased size, but from the inevitable distortion caused by the lens, the greater become our difficulties.

When groups of figures attain so much importance as to balance equally the attention with the landscape, the effect is not apt to be good, one or the other must be subordinated, and in the character of work of which I am now writing, the figure groups, while they play an important part in the picture, should at the same time be entirely subordinate to their surroundings. It is a difficult matter to manage a single figure, especially a man; standing he is like a post, and sitting he is an unpleasant conglomeration of angles. The drapery in the skirts of women and girls, and their more varied hues of attire, are a great assistance. Two figures are better than one, and three still better. Occasionally a group of a half a dozen will come in, but rarely. The more you have the greater become your difficulties in posing them. A grown, or nearly grown person and one or two children make a picturesque combination, and they should be clad in such garments that those on the upper portion of the figure be in light and the lower in dark mass, or *vice versâ*. This will enable the getting of the light portion of the figure relieved from a dark shadow back of it, or the dark from a light backing, which adds greatly to the relief and picturesqueness. A person clad in gray, or black, or white from head to foot is absolutely useless to introduce into a picture, for in coming against a varied background one each eyelash sharp—before exposing his plates. The camera can do just as well, now, as the brush can.

92. Now if the subject is a wide-angled one, such as comes to us in a "New England School," by Mr. A. F. Bellows (Fig. 202), we find a great deal of

FIG. 202.



life is added to the picture by the introduction of the figures. Without them we would obtain a fine landscape, but the sense of quiet would so pervade the whole as to render us sceptical—all jokes aside—as to whether that could really be a New England school. The harmony of things must always be considered first.

93. One more allusion to the subject of illumination and this lesson must end. From a want of knowledge of the principles of art a morbid admiration

half or the other is sure to be absorbed in its backing, and you have only half of your figure, or if in entire relief against an opposite ground, from head to foot, you have a cut-out patch which is dry and hard.

A very difficult matter is the posing. Even with figures in repose there should be a certain kind of action, I mean a reversing of the direction of the upper and lower portions, and of the limbs. This may be carried to a much greater extent in figures in landscapes without an appearance of affectation than it can in figure subjects.—XANTHUS SMITH.

93. We will now take a picture that has been really produced by photography, and see how it was conceived and finished. To analyze and dissect a picture in a cold-

and reverence for unnaturally *minute definition* tends to lead the operator away from what should really be the end and aim of his study. Instead of "going in" for the broad, vigorous effects of *light and shade* in the landscape, he is led to look upon a "mechanical, organ-grinding" kind of exposure consequent

blooded way, as I am going to do now, is to rob that picture of any poetry it may contain, and leave nothing but a mechanical interest, but I know of no better means of conveying the information; I will therefore take one of my own—that one I have called "A Merry Tale" will be suitable for the purpose. I have made an ink-process reduction of the picture (Fig. 203), which will assist the student in understanding what follows.

Fig. 203.

In the drawing-room of a country house in North Wales five young ladies in evening costume were amusing themselves after dinner. One of them was relating some funny circumstance to the others, who arranged themselves in a picturesque group round the story-teller. Here was the germ of the picture. A few seconds sufficed to make a sketch of the composition. The illustration is a reproduction of the jotting in my note-book, and I may remark, by the way, that the practice of making rough sketches of composition and light and shade is very useful, especially if accompanied by a few descriptive notes. It teaches the student how to observe, if it does no other good. Correct drawing is by no means necessary; the "effect" is what should be noted. To return to the picture. By an easy transition the mind easily changed the young ladies into peasant girls and suggested suitable surroundings. A sketch was made of the arrangement, and the dress for each figure decided on. In selecting the costumes, the light and shade of the group, and its relation to the landscape, were not forgotten, neither were the accessories—the basket, jug, and stick. The colors were taken into account only as to how they would translate into black and white.

It was arranged that the group should form part of our work for the next day. Arrived at the selected spot, the camera was unpacked, and the models placed approximately in the proper places, interfering branches cut away, and everything got ready, so that the last moments might be devoted to the quiet final touches, expressions, and other little things.

Now for the arrangement of the group. The girl to the left was sitting up at first, as will be seen in the sketch, but being a young hand at the business, she could not control herself, and, enjoying the fun, threw herself back on the bank screaming with laughter. This was a happy accident, which much improved the composition, and was seized upon absurdly reduced aperture as the correct thing, whilst to the eye of the artist the much vaunted result appears like a landscape carefully black-leaded, and then executed in minute needlework, qualities which are no compensation for the effects named, which have been given by the lens when skilfully applied to this class of subject.

immediately. She was at once shouted to, to keep her place, which, being an easy one, required little further thought on the part of the photographer, who could now turn his attention to the other figures. The seated figure, the one in the straw hat, was a steady old stager, with plenty of experience and no nerves; she required but a moment's attention. The next figure, always dramatic in pose, and with a charming expression, is, perhaps in consequence of other good qualities, rather shaky as a sitter. She required a rest of some kind. The stick was useful here, and was of immense value in the composition. A bit of straight line to contrast a number of curves is always effective. This settled the three figures that were easiest to keep still. The standing pose being by far the most difficult to keep—for a standing figure without a rest often sways like a pendulum—was left until last. The figure telling the story was now settled; the pose came easy, the model being an admirable story-teller, and thoroughly up to her business, but it was necessary to give all possible effect to the hand, for the hand, if well placed, would do more toward showing the intention of the picture than anything else in it. It, in a way, leads the chorus of expressions. It emphasizes the situation—it makes you feel the girl is speaking. It was so arranged that, to make it more conspicuous, it should appear partly in sunlight and partly in shadow, and every leaf or twig that came behind it was hurriedly removed. The standing figure, who could not be expected to keep the pose for above a minute or two, was placed last. The jug, basket, and fox-gloves, which form the keynote of the composition in the foreground, had been previously arranged, and all was ready. But a last glance from the camera showed the photographer that the tree was exactly over the head of the standing figure, and cut the composition into two parts. This would never do. But instead of moving the model the camera was moved. This corrected the error to some extent. It would have been better to move it a little further, but it was feared the other tree would interfere with the story-teller. A few last words—at the special request of the models I use fictitious names—"Now, girls, let this be our best picture. Mabel, scream; Edith, a steady interest in it only for you; Flo, your happiest laugh; Mary, be sure you don't move your hand, or all the good expressions will go for nothing; Bee, I will say nothing to you, but leave you to your fate. Steady! Done!" and two seconds' exposure settled the matter. I scarcely expected a successful result, the thing was so difficult; but as the wind was blowing almost a gale, I did not care to try another plate. As it happened, I found, when I developed the plate a fortnight afterward, I had got a good negative. The sky was white and blank, but the use of a second negative, delicate and not too obtrusively printed, soon put this matter to rights.

This seems a long story to tell, but the picture was exposed in under six minutes from the time the models first took their places. The quickness is one of the secrets of success, but when your picture is to include figures it should not have the appearance of hurry, The student should note distinctly, that however astonishing and captivating good definition or detail may be in *studies of foreground*, etc., in the *general* landscape fine, broad effects of light and shade will supersede it all. Mere clean mechanism on the plate grows monotonous, and will always succumb to the sentiment conveyed to the mind of the spectator by representations

for "hurry hinders haste," and, besides, has the effect of flurrying your models; it should be the result of a perfect knowledge of what you want to do. A model should never be kept waiting longer than is absolutely necessary. It is better to give up little things rather than to lose a fine effect.—H. P. Robinson, in *Picture Making by Photography.*

One of the first things to look at, of course, is to invent the story you want to tell. It should always be something that will touch the feelings of all classes, if possible, or, as Lord Bacon has said, "come home to the business and bosoms of most men." In doing so the mind, as much as the eye, came into play. Let me illustrate by a picture that it is possible to imitate wherever harvest fields grow. It is called "The Harvesters at Rest," by Mr. Wyatt Eaton (Fig. 204), one of the choicest compositions of its kind I ever saw.

Suppose you were going to photograph the "Harvesters at Rest." You would choose the shady side of a shock of sheaves; you would pose the tired husbandman in a restful attitude; you would send the housewife to him with his noon-day lunch, and, of course, she must bring the baby, because there is no one at home to leave it with. The mother and child should be placed where the husbandman can admire them, and thus help him rest better, where they will help most in your diagonal composition. The basket you would use also to complete the exterior lines and toss the old hat down where it would best break up the empty foreground, and break up a rather too broad expanse of light; would you not?

Fig. 204.

Or, if you are in a grass-growing country, where it is the custom to blow the horn to call to lunch the mower and the good wife, who tosses the new-mown hay, that it may dry in the sun, another group would come to your mind, such as "Answering the Horn," by Mr. Winslow Homer (Fig. 206). Now you might see a dozen such couples as this in a day's ramble, looking awfully picturesque, and yet you (photographically less perfect), in which any of the changing effects of light and shade may have been successfully rendered. The artist should likewise consider that *careful and discriminating selection* will make itself felt in this as in every other description of subject, and must not go out with his camera as to a sort of photographic battle, in which *one well studied picture* seems not to be the desideratum, but *quantity* not *quality* is sought for. Now the truth is, that one little bit of well selected foreground, a bank with a

Fig. 205.

would be puzzled to know how to pose them, unless you could invent a story to work them into. "Answering the Horn," does it. The parties halt at the sound; the answering hand goes up with a shout from the mouth of the man, which closes that of the woman, and the picture is worthy of the camera.

In attempting larger groups, as "The Washing Place—Brittany" (Fig. 207), by Mr. E. M. Ward, or any group where the figures are numerous, the effort should be to give variety to the ocupation of the persons, and with them all and what accessories you can—tell the story to the best of your ability. This is not an American or English picture, or one likely to be found in either America or England, but it is full of sugestion all the same.

The next illustration will be more "to the manor born." It is Mr. Edward Gay's "Penfield's View" (Fig. 208), and is from a celebrated spot beloved by artists near Mount Vernon, New York. I am sorry the reduction is so small, but there is enough of it to show that the painter was influenced by the rules of art, though he has applied to nature to give him the means of securing variety and originality in his work. The arrangement of the wagons and carts and people and sheep was by no means accidental, but intentional in a great meas-

Fig. 206.

few docks and thistles, with the bright sun-ray glancing from the tufted grass to the gray ivy-grown stump of the gnarled pollard, is worth a hecatomb of such things.

ure, though he has evidently a quick eye enough to guide him in taking advantage of accidental arrangements, and the power of methodizing his ideas. All these you must acquire by study and hard practice.

Fig. 207.

"Cannot drive sheep where you want 'em in a photograph," you say?

Well, I have seen sheep better grouped in a photograph than these are. It is this class of photographs, my friends, that is going to lift your art up to the top of its ladder. Remember what I say.—C. Walton Hill.

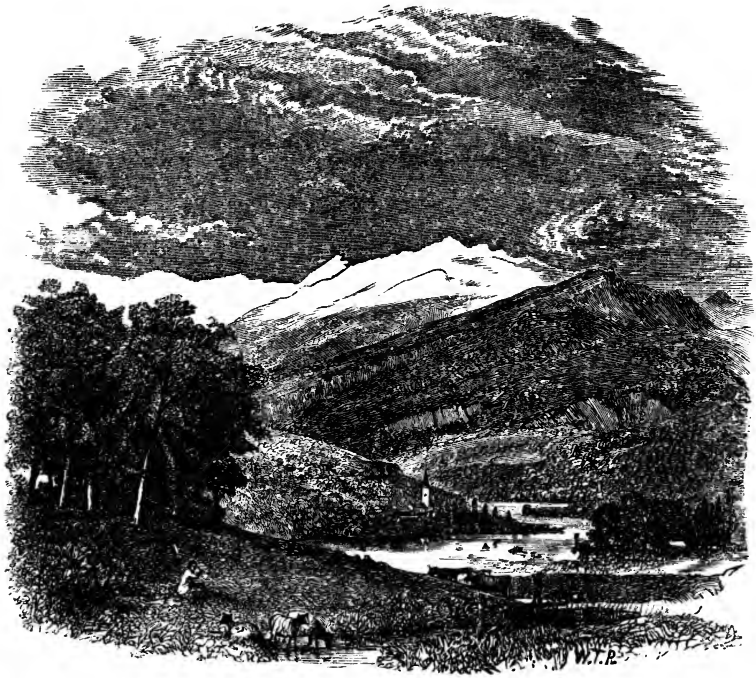
It is to be feared that much of the indulgence in extraneous appliances is the result of doing the work by the easiest methods, irrespective of truth and taste. If there be difficulties in any department, let us fight with them, and not resort to spurious methods because they happen to be easier or more convenient.

I have always regarded photographic art and its requirements as being more allied to dramatic art than to that of fine art. For the construction of a scene, having several figures in it, see how carefully the arrangement of them has been made by actors, each individual, each group of figures, varying in position and action, and this every night reproduced because the subject has been fully felt and understood. I do hope the day is not far distant when stage effects may be photographed. Indeed, it would be worth the effort if rehearsals were made in the open air, under sunlight, and during the course of action instantaneous impressions taken. —Norman Macbeth, R.S.A.

Fig. 208

I have selected two pictures bearing as much contrast to each other as possible, in order to illustrate my point. The first is "Noonday in the Pasture," by A. D. Shattuck (Fig. 205), and the other an ideal landscape (Fig. 209).

FIG. 209.



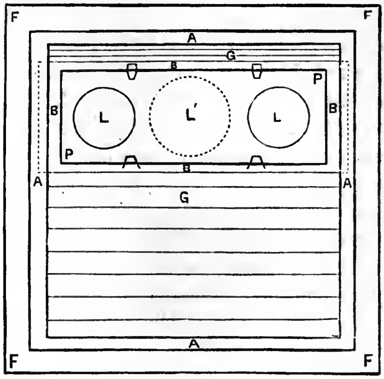
There are always difficulties and drawbacks in out-door work, so that it is seldom that a photo-landscape is quite perfect as a whole, though exquisite in the detail of its parts; and when by dint of careful selection and study, anything approaching a satisfactory result is attained, it should be valued in proportion to the difficulties overcome.

There is much to encourage work and effort in this most delightful branch of our art. The great mistake which many have made who have aspired to success has been in supposing that any bit of landscape which might happen to present itself conveniently to the camera would "make a picture." This is a fatal blunder, and has wrecked the hopes of many a one without his having any knowledge of the cause. Be encouraged to try again.

94. A hundred and one expedients are resorted to in the practice of photography outside by those to whom necessity has revealed them. It would require

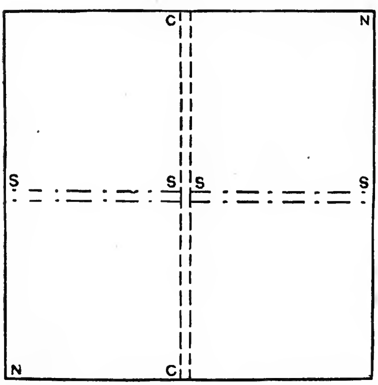
94. My manner of getting several pictures on one plate is in certain respects quite my own, and in all is original with me, though subsequent to having had it made for myself I found that J. R. Johnson, the inventor of the pantascopic camera, had anticipated the principle and had made a multiplying front, on it.

Fig. 210.



It may be applied to any form of camera, but I invariably use a square one, which, after trying several forms, I find to offer the greatest conveniences. But whatever the form, the camera front must be nearly or quite the size of the plate; as will be seen by the diagram (Fig. 210), *FF* is the front of the camera, supposed to be here of the same size as the plate to be worked, as shown in *NN*, Fig. 211. *AA* is a rabbeted frame screwed on to *FF* and raised half an inch or so from it, so as to allow the smaller frame *BB* to slide up and down in the rabbets at each side; a small brass spring at each end of *BB*, sufficing to keep it at any given point by its pressure. At top and bottom of *BB* are attached narrow gussets, like those of the bellows-camera, but very thin, so that as the frame *BB* moves up and down in *AA*, the lenses, which are on a movable panel, *PP*, fastened into *BB* by studs and buttons, may range from a point a little less than a quarter of the height of the plate from its upper edge to about the same distance from its lower, so that it will answer as a sliding front for the horizontal halves of the plate as well as for the whole plate.

Fig. 211.



The camera is fitted with internal gusset-partitions, as shown in Fig. 211, the longer one, *CC*, being capable of dividing it into two, vertically or horizontally; the side slips *SS* being arranged to divide these sections into two each, as shown in Fig. 211. The flanges of the lenses are screwed on the panel or on a set of panels, one for each flange or pair of flanges, if small views or stereoscopes are wanted, and the panels can be changed at a moment's notice.

As will be seen from the diagram, Fig. 211, the main partition will give, when placed at *CC*, two vertical pictures simultaneously on the lateral halves of the plate, using a pair of lenses; if placed at *SS*, with one lens in the position of *L*, in Fig. 210, it will give two horizontal views by successive exposures, with admirable effect for panoramic pictures, as the camera a long chapter to detail them. The ingenuity of the landscape photographer who is determined to succeed will not forsake him in emergencies. Apparatus makers have most generously met whatever requirements have been made

may be turned round to match the two halves of the negative together. In this way, with a five inch focus wide-angle lens, one may get on one plate, 8 x 8 inches, two views fairly matched in exposure with the same development, which will include 180 degrees on the finished prints mounted as one. Or by putting the main partition horizontally, with one of the short partitions below, the upper half of the plate may be given to one view and the lower half to a stereoscopic negative. In this case all three flanges should be on one panel, as suggested in practice by Mr. Taylor, of the *British Journal of Photography*, who adopted my plan and improved it by this arrangement of the lenses on one panel. (Care must be taken that the wrong lens is not uncapped by accident or mistake.) Or by the use of all the partitions we have two stereo negatives, necessarily duplicates, with wet collodion, but of different subjects if working dry plates, or, with four exposures, we may have four views of widely sundered subjects on one dry plate.

This arrangement also gives me a mathematically precise method of testing the comparative sensitiveness of dry plates, by coating the two halves of a full-sized plate with the different preparations to be tried, and putting them vertically into the holder, so that, with a pair of similar lenses, I can get simultaneous exposures on the two slips of glass; giving the maximum exposure on one end and the minimum on the other. This arrangement gives also the greatest range of sliding front which can be got on any given camera.

The front of the camera must be fixed rigidly at right angles to the bottom and the front and back parallel, when using the partitions for duplicate negatives, or the focus must be adjusted for each, which perhaps would not be lost time on the whole.

In my camera the wood of the frame *A A*, at the sides, is only half the thickness shown in the diagram, or to the dotted line, and instead of being rabbeted has a brass slip screwed on it on the face. This is stronger with the same weight. The inner front of the camera should be open as far as the outer edges of the flanges *L L*, and the inner surfaces carefully blackened, to prevent light turning the corner.—W. J. Stillman.

There is in the minds of many photographers the thought that it is possible to combine two or more negatives, and join them together perfectly; that by a careful arrangement of the camera, a building or view may be photographed in sections, and so joined together that all the lines and points will fit perfectly.

Combinations of that kind have apparent correctness, but are false, in truth. All objects, to be drawn truthfully, or photographed correctly, must be made as seen by the human eye. But by this method of making pictures, embracing an angle of 90 degrees, in sections of 30 degrees each, there is a change of the point of sight as well as the horizontal line. The perspective of the photograph must therefore be false. In making a view including an angle of 90 degrees, the base line is central to the view; but in the sectional view, the axis of the lens is turned obliquely to the two wings of the object, and, of course, the perspective is changed.

In some subjects, there would be one part parallel, and the other parts, in very acute known to them in producing most exquisite cameras, light tripods (from which spare *me*), rapid exposing shutters, and objectives with angle so wide that it is dangerous to stand alongside during exposure, lest you be caught. There are

perspective, dependent upon the nearness of the object to the lens; and, of course, it would make an absurd picture.

Fig. 212 is supposed to represent a stone wall, as seen in correct perspective. The wall is parallel; and after marking one section parallel to the wall, the camera is turned to the right, with the following result. The dark dotted line marked *B L* is the base line, and location of the camera in both views.

FIG. 212.

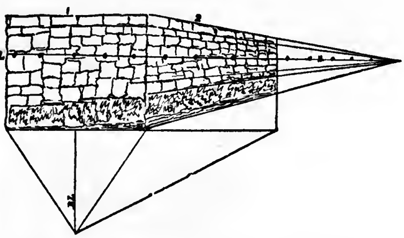


FIG. 213.

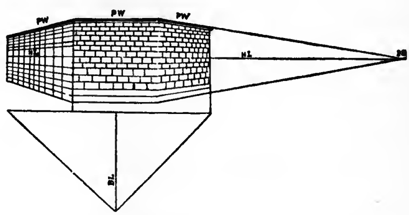
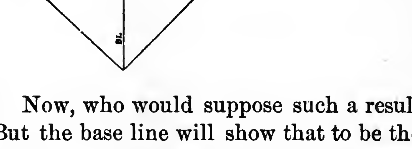


Fig. 213 represents a section of a brick wall. Now, who would suppose such a result could be made from a wall that is parallel? But the base line will show that to be the case. Could anything be less like the truth than this? Yet it is the exact appearance that would be presented from a given point by the camera to the wings of the view. The line *H L*, *H L*, is the horizon line; *P W*, *P W*, *P W*, is a parallel wall; *P S*, the point of sight.

Ridiculous as this diagram seems, it might be made still more so by still further exaggerating the perspective. The camera would make just such a perspective, if the view was made in three sections, and at the given angle of the diagram.

Fig. 214 is more instructive than either Fig. 212 or 213, as it explains, I think, the difficulty that is frequently met in the course of our work. This diagram represents a storehouse which I was obliged to photograph in two sections, as the street was too narrow to do it on one plate. It was then joined together, with the above result. The dotted lines are the perspective lines of the first picture. It will be noticed that the vanishing point is outside of the picture. The crossed lines are the perspective lines of the second picture. The vanishing point, it will be seen, is in the picture. But in the picture on the left, it is taken at a much less acute perspective, and the vanishing lines are far out of the picture. This shows very clearly the impossibility of making a building in two sections, and combining them so as to give correct perspective.

FIG. 214.



but few things unprovided for. One of these is a simple and cheap apparatus for making panoramic views. Of course, we all know of the Johnson panoramic or pantascopic camera, which moves the objective laterally over the plate during exposure, but it is intricate and expensive.

95. Exposing shutters are offered in great abundance now, so compact, so ingenious, and so complete as to enable the operator to regulate the exposure quickly, at will, to suit the light and subject of the occasion.

If a ruler is tried on the drawing, it will be found that the lines above the horizon are heaped up where they join, while those below are crushed down, looking slightly concave.—JOHN MORAN.

95. My shutter is simple, cheap, and sure. Fig. 215 shows the shutter complete, ready for action. The string runs through an opening at the top, and may be of any length.

The case for the shutter may be of tin or cardboard. The drop should be of Russia iron or copper.

FIG. 217.

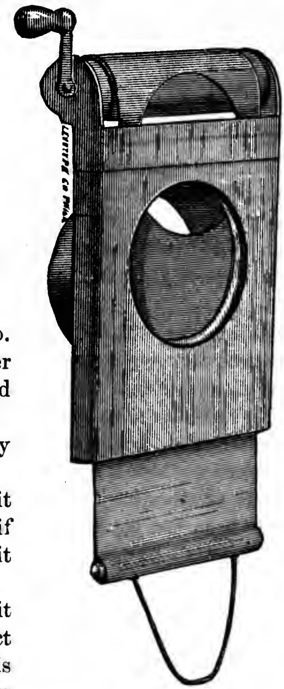


FIG. 215.

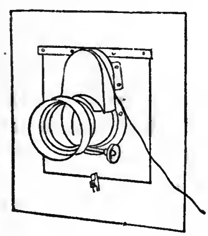


FIG. 216.

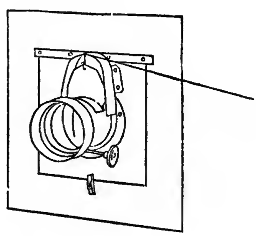


Fig. 216 has the sliding front removed to show the drop. It is suspended in the picture about two-thirds of its proper height. It works in the slot of the diaphragm, and should work very freely.—WILLIAM R. WRIGHT.

I send a photograph of a very easily made shutter of my own contrivance (Fig. 217).

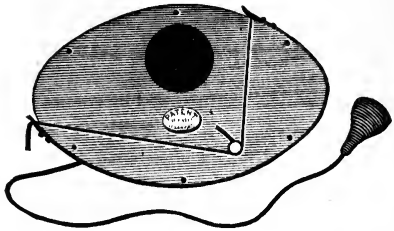
Its construction will be understood at once. I find it convenient on every occasion. It will act instantaneously if you desire it, and very slowly if you wish it. Moreover, it is easily made at little cost.—COL. OTTAVIO BARATTI.

A very ingenious stop, invented by Mr. Klein, the merit of which lies in its great simplicity, as well as in its perfect adaptation to the end to be obtained, is, viz: The motion is given by an India-rubber string (Fig. 218), more or less distended, according to the duration of time required. The opening is made centrally, by an increasing and decreasing motion. The mounting of this stop is very light, and its volume does not exceed 19 x 12 centimetres ($7\frac{1}{2}$ x $4\frac{3}{4}$ inches). It is placed before the

The matter of exposure, however, must be treated separately further on. For the majority of subjects the well-known, old-fashioned "drop" or guillotine

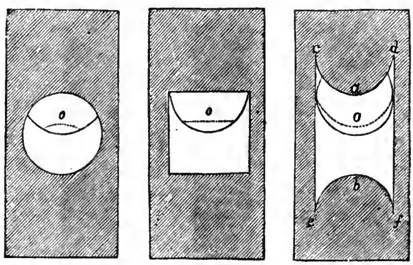
objective by means of three screws; a patch of black cloth attached to the socket of the objective prevents the introduction of any luminous rays except those which penetrate by the opening of the stop itself.—LEON VIDAL.

FIG. 218.



Mr. Quidde has made good suggestions on the action of instantaneous shutters, the apertures of which are of different shape. He gives the following diagram. Fig. 219 shows a shutter with a circular aperture of the size of the objective. Fig. 220 shows a shutter with a square aperture, the depth of which corresponds with the diameter of the objective; and Fig. 221 shows a shutter, the aperture of which is wider on the margins than in the centre. The distance from *a* to *b* is equal to the objective diameter, and the radius of the circular arc *c a d* and *e b f* equal to that of the objective aperture. If the three boards are moved with the same degree of rapidity, the time of exposure, in regard to the vertical diameter of the objective, will be identical for all three boards, for all three have to move the same distance, but the effect of the light differs very much with all three; a moment occurs in which the whole objective is free, the effect of light being in consequence the same with one as with the others, but this is only for a moment; in every other position a very material diversity is manifested, which becomes more marked at the beginning or conclusion of the exposure.

FIG. 219. FIG. 220. FIG. 221.



In the above diagram the moment is represented when the top edge of the aperture has arrived in the centre of the objective opening. In Fig. 210 we see less than half of the objective aperture *o*; in Fig. 220 we see exactly the half, and in Fig. 223 more than half of the objective aperture. The difference is shown in a still more striking manner just before the conclusion of the exposure, as indicated by the dotted lines. One can easily calculate in this manner that the effect of light of the three shutters in Figs. 219, 220, and 221, with equal movement and all other circumstances identical, stands in the same relation as the superficial contents of the respective apertures, which is approximately expressed by the relation of the numbers 11, 14, and 17, to each other. The latter form of shutter is, therefore, the most advantageous, for it exposes the margins of the picture which have relatively less strength of light, longer than the centre. Both other forms expose the margins of the picture too short a time. There are also shutters in which two boards with circular apertures pass by each other. Here, again, the centre shutter answers admirably. Of course, it is not recommended for "instantaneous" exposures with "lightning" plates.

of the objective has the advantage over the margins. The shutter opens in the centre, the aperture enlarges toward the margins until it has reached its highest possible extension, when it is shut all at once again from the margins, so that in case the aperture of the shutter is not larger than the objective, it may be said that the time of exposure of the margins of an objective is almost too short to count at all. As in consequence of the introduction of highly sensitive plates instantaneous shutters come more and more into use, these indications are of special interest for practical men.—DR. H. W. VOGEL.

Lenses, such as are used for instantaneous landscape work, are almost all fitted with diaphragms, which slide into the body of the tube between the two lenses. I believe this system is known as the Waterhouse diaphragm (see Fig. 222, 1 and 2). A similar slit is made in the under portion of the tube, and a long, thin piece of steel, with a hole in the centre, replaces the ordinary diaphragm (Fig. 223). After having focussed, the steel slide is placed into the slit and held in an upright manner by means of a catch or spring under the lens; when this is pressed the steel slide slips rapidly down through the grooves, and the image is thrown but for an instant upon the sensitized surface in the camera. The length of exposure can be

FIG. 222.

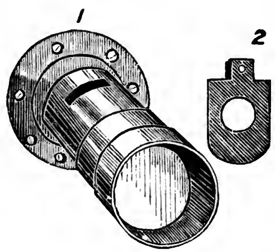


FIG. 223.

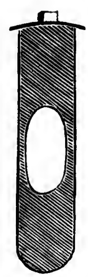


FIG. 224.

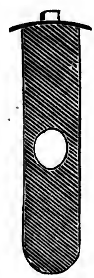
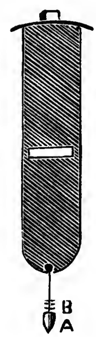


FIG. 225.



regulated by having two or three slides with different openings (Figs. 224 and 225). If more rapidity be required, a small weight can be attached to the slide by means of a strong silken thread (Fig. 225, *A*). If this is insufficient, a number of small metal disks or quoits can be made to lay on the top of the weight (Fig. 5, *B*). No shaking of the whole apparatus, as with the old system, need be feared, for the steel slide slips through its brass guides in an easy and uniform manner, and, when the shock arrives, the impression has been already obtained. The shock itself can be softened by lining the flange at the top of the slide with India-rubber, or by some mechanical contrivance, such as a spring, etc.—PROF. E. STEBBING.

I have no intention of recommending any particular shutter; let the reader exercise his own judgment in making his selection; but I would say a word or two in favor of the *description* of apparatus I think the best for nearly all possible requirements both in studio and field work.

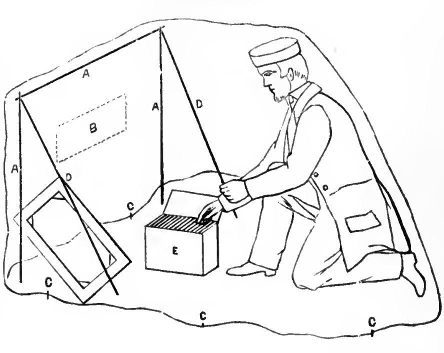
96. Even with the Eastman roll holder and films, which enable one so comfortably to work outside, one sometimes finds it necessary to change plates or

There are very many photographers who yet make exposures in the studio with cap in hand. They have always been accustomed to it, and never troubled themselves to try any other way. Let me advise them to get a flap-shutter, working on the pneumatic principle, and I have no doubt they will be so well pleased that they will never do without it again. To expose by hand ties the operator close to the camera in a sort of side posture, and causes him inconveniently to divide his attention between the physical operation of exposure and the physical eccentricities of the subject, which, in the case of a child, may be considerable and perplexing. Whereas, if he possesses a flap-shutter, which he can open and close at once, or sustain open as long or short a time as he pleases, he can give his whole care to the little sitter.

As to field work, unless an express train be the subject, which, by the way, is seldom worth the trouble of taking, or a galloping horse, extreme rapidity of exposure is not wanted, and is not very often of much use or excellence when made. The quick movement of a flap-shutter is perfectly equal to most occasions, and the same advantages which accompany its use in the studio follow it to the field; while in addition it may easily be adapted so as to act in the manner of a sky shade. Such a shutter should be light and portable, and there seems no good reason why it should not be made very little larger than the hood of the lens.—G. G. Mitchell.

96. A modification of the tent for working dry plates, or any plates that are *only* exposed and changed in the field, the other operations being reserved for home, is very simple and effectual. Thus: three light rods of bamboo or other material are required—two of them shod with iron for driving in the ground, and the third to lay across the top, and fastened to each upright by pegs or otherwise. When these are fixed, a large sheet—impervious to light, except at a window let into the material, of yellow—is, when required for use, thrown over the operator, frame and all. The window is allowed to fall between the uprights in front, to supply the light in the proper position. The operator can very easily adjust the sheet when underneath it, so that it will keep out the white light, the frame in front at the same time preventing it incommoding him during the process of plate-changing. When not required, it can easily be folded and strapped round the plate-boxes and frame for carriage. If waterproof, it forms a capital protection during a shower of rain.

Fig. 226.



I have not tried a sheet made expressly for the purpose, but I know that it would answer well for my tent-covering; and a branch cut from the nearest tree did, when "spools" when in the field or on the road. For such a necessity a number of suggestions have been made (see notes). The only requirement is that the place where the changes are made should be light-tight. A tripod erect, covered properly, with a red window or two, the material sufficiently long to cover the "floor," was what I used in my Oriental adventures.

97. The old-fashioned tent for wet-plate purposes has also been used as a

used in a similar manner, though it would be a sorry makeshift compared with a sheet constructed expressly for the purpose.

FIG. 227.

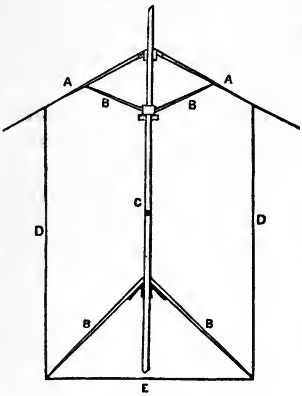
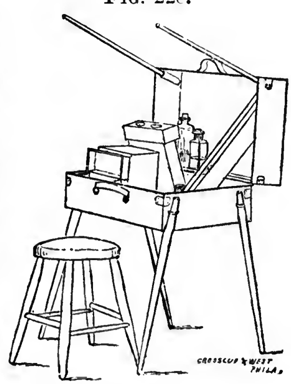


Fig. 226. *A A A*, light rods of bamboo or other wood, made to peg into the ground and form a frame, supported by the struts *D D*, which are hinged to the uprights *A A* for the purpose of obtaining rigidity. *B* is a window of yellow material. *C C C C*, pegs for the purpose of fastening the cloth to the ground. *D*, dark slide. *E*, plate-box. —EDWARD DUNMORE.

I find the annexed (Fig. 227) an excellent plan of constructing a photographic changing tent. *A A*, upper arms of the lower braces, may be hinged stationary. *B B*, lower arms; table butts may be used to hinge the arms. *C*, centre pole, triangular, or better square. *D D*, duck or canvas, lined with yellow. *A A*, duck or canvas, over the upper arms. *E*, stay rope at the bottom. Tuck in the material close at the bottom.

It will be found very convenient, especially for city use. It can be set up on the street, sidewalk, platforms, floors of cellars, warehouses, or depots, and needs no staying if sheltered from the wind.—R. M. LINN.

FIG. 228.



97. The accompanying cut (Fig. 228) will explain itself. The valise is made of $\frac{5}{16}$ inch bass wood or pine, and measures 25 inches long, 15 inches high, and 10 inches broad on the inside when closed. It contains everything but the tripod for making twenty-four negatives. I use no water for washing, but flow the plate after developing with glycerine, 2 ounces; acetic acid, 4 ounces; and water, 6 ounces; and put the plate into a plate-box to be intensified and fixed after returning home. The cover is made of water-proof (ladies' cloaking) lined with yellow calico, with two thicknesses of the calico at the right hand, and when I receive the light for developing, the amount of light is regulated by raising the water-proof up, and pinning the corner more or less as necessary. I use a 10 x 12 rubber pan to develop over, and carry my developer, saturated solution, and reduce as necessary. The valise opens in halves, so that the part raised up perpendicularly forms a shelf for the bottles, plate-holder, etc., at the bottom. I have

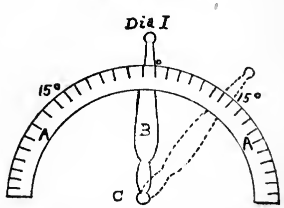
changing-box. And not to forsake an old friend, I must mention that such "tents" are still in use by some who pertinaciously adhere to the "wet." A hundred suggestions for constructing such an antique convenience have been made. I trust to the notes to provide one of the simplest forms for all that is necessary.

98. A great deal is added to the pleasure of receiving a view from a friend, if the title is thereupon. If you have an amateur printing press, you can easily manage it. With type of good face, not too bold, set the title and print with black, dense ink upon fine "French folio post" paper. Render the slips transparent by soaking in Anthony's "Diamond" varnish. Then, with a

had two other dark-tent arrangements, but prefer this very much, being light; it forms a receptacle for necessary things, and two sides of the tent when set up.—Irving Saunders.

98. To show the possibility of dispensing altogether with the focussing-glass and cloth when out of the studio, I have had inserted into the back of the camera an oculaire, or eye-piece, like that of a microscope. In order to find the focus once for all, a ground-glass is inserted into the place of the dark-slide. The centre of this ground-glass is polished and marked as a chessboard, by means of a fine diamond. A newspaper is placed before the lens, and its image is therefore reflected on the ground-glass. This oculaire is drawn in and out until the image of the letters and the diamond marks are both perfectly sharp. When this result is obtained it suffices to fix the oculaire in its case or telescopic tube by means of a screw, or to make a mark round its circumference, so that the same place can easily be found again when required. It is true that only the central part of the view can be focussed in this manner, but in practice it suffices.

Fig. 229.



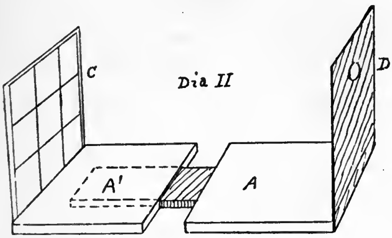
A, brass semicircle divided into degrees.
B, alidade.
C, pivot upon which the alidade is fixed.

Not having a focussing-glass, it may be asked, How can the operator know the length, breadth, and depth of the image, as reflected on his sensitized plate? The answer is, every person knows the angle of his lens. So I conceived the idea to have a little instrument placed upon the top of the camera. (See Fig. 229.) Supposing the angle taken in by the lens to be 30 degrees, the alidade or hand is moved toward the right hand until it lies upon the 15 degrees of the semicircle. Now, in looking along it, the operator can easily see what he takes in on the right-hand side of his camera. The alidade is then turned to the left, until it lies on 15 degrees. What will be reproduced upon the sensitized plate can thus be easily seen. In order to know whether or not too much sky or otherwise will be taken in, another similar instrument is placed on the side of the camera.—Leon Vidal.

I compliment Mons. Vidal for having found means to focus without a ground-glass, for most landscape photographers, whether amateur or the trade, have known the inconvenience of a broken focussing-glass. But I beg Mons. Leon Vidal's pardon for suggest-camel's-hair pencil lift them to the negative and carefullly place them, using more varnish if necessary to make them adhere. It will be seen at once that the title will print with the picture.

ing a slight change, not in the focussing, but in the means of taking the angle, which I think is a little too complicated. I would propose a kind of instrument as given in Fig. 230. If this instrument be placed on the top of the camera, and the eye of the operator be placed close to the opening *D*, in looking through the metallic frame *C*, the whole of the view embraced by the angle of the lens can be seen at once, and the camera moved about until the most pleasing and artistic part of the landscape is in view. Let it be supposed that the distance from the eye to the frame coincides with the angle of the lens. In fact, it can be used with any lens, for if a short focus one be employed, there is only to approach the visual hole *D* to the frame *C*; if a long focus lens be required, the two supports are to be drawn asunder as far as required. The frames *C* and *D* can be joined to *A′ A* by hinges, so when not in use they can lie down flat, which will be very convenient for packing.—PROF. E. STEBBING.

FIG. 230.



A′ A, two pieces of brass or wood.

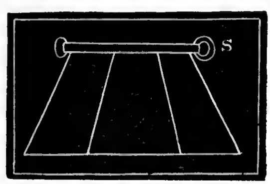
B, a plug or drawer to enable the two pieces, *A′ A*, approach each other, or *vice versa*.

C, a metallic frame, having four silken threads dissecting it like a chess-board.

D, a hole for the eye to look through.

If the attempt is made to photograph bright objects with dark surroundings in the same picture, failure in one or other is quite certain; and yet the artist is induced to try it, as the object is beautiful, and he may never see it again; or if he can wait till he has no sunshine, he knows he will get only a flat, unrelieved picture. I herewith send you a drawing of such a supposed case, and my remedy, which I have found very successful, indeed, much more so than I expected it would be. It consists of a split sunshade (one of which I have roughly made and send you). The shade is divided into three separate flaps, as shown in Fig. 231; these are all loose or tightened in any position by the screw *s*. The size and division of such a sunshade will require to be adapted by the optician to different lenses, according as the lens is large or small in aperture, yet only as to distance from the optical centre.

FIG. 231.



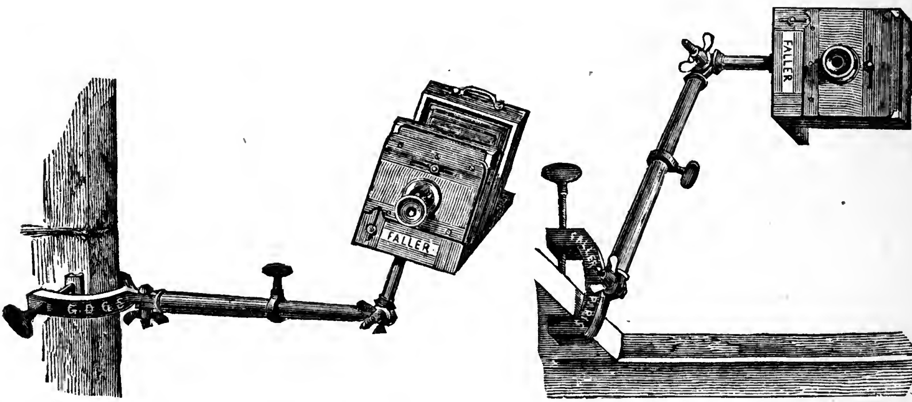
The use of such a sunshade will be at once apparent. In my sketch the camera (of ccourse disproportionately large and not in exact position) is trying to take a white stone mansion surrounded by dark trees. In ordinary circumstances the house will either come out a white patch with black holes for windows, and the roof, if slate, impenetrably mingled with the sky, or the trees and grass will present an outline inclosing a black space without foliage or detail. But now the camera says—"I have got three eyelids

I do not pretend to have covered the ground entirely in this chapter. The faculty of observation should be cultivated by every live camera lover. I never saw another person at work without learning something from him.

instead of one; and if I wink a little with the centre one whilst I keep the two outer ones wide open, I can gain a minute or two on the dark sides and grass before I open upon the white house for thirty seconds." "But how will the image come out? What about the shadow of my lower eyelid on one portion of the picture?" Well, I shared my camera's fear on this point, and thought it might have been necessary for him to keep winking and moving his eyelid, to prevent a line or marked division in the picture. I find to my delight it is not so.—Rev. St. Vincent Beechey.

"The Indispensable." I find this device made plain by the cuts, in a French paper. This support, for cameras, which has a clamp joint, allows the apparatus to be placed in all possible positions, even in the reverse position (aërostatic photography), in

Fig. 232.



fact, in all cases in which the use of the tourist's tripod is inconvenient and even impossible. The facility with which it can be solidly attached to the top of an ordinary ladder, allows the landscape photographer who possesses this appliance, to do away with the annoyance and impediment of the tripod stand.—C. J. W. in the *Moniteur*.

After varnishing I cut my stereo negatives, and fasten on other glass at the edges with gummed paper, placing the right-hand picture on the left side, to save the trouble of transposing the prints in mounting.

The negatives I keep in long grooved boxes set up one on the other like shelves. Each negative is numbered from 1 up, and has its corresponding place in the box. I have a large book containing the views arranged in numerical order (extremely handy to select from and in making out printing lists), and large cupboards with pigeon-holes arranged in the same way to contain the finished pictures.—S. R. Stoddard.

CHAPTER XI.

EXPOSURE, OR THE QUESTION OF TIME.

99. To secure the right exposure of the plate in the camera, always, has puzzled the wisest of photographers. It continues to do so. But the reasons have changed. With emulsion photography the danger is in *over*-exposure, while "in old wet days" the difficulty was to secure enough. All sorts of methods were resorted to in order to accelerate the exposure.

All those old-time methods have fallen into "innocuous desuetude." Nevertheless it may be interesting to mention them here, though without any attention to chronological order.

Mr. Charles Waldack recommended the action of diffused light upon the plate for very short exposures. This was an old-time Daguerrotype dodge.

Mr. Ernest Krueger advocated a secondary illumination—for example, after the plate had been exposed to the subject say one second, a red-colored paper was held for some seconds before the objective and thus was obtained as good a result as with a six times longer exposure to the model.

99. A recent writer says: "The time of exposure must often be guessed at in the vaguest manner," and again, "then in our uncertainty about strength of light and stops."

If this view of the subject be general, it is not surprising that the guessing should be so often wide of the mark. Although I will not assert that absolute precision is attainable until we have a perfect actinometer (which we shall soon have), I will say that with care and calculation a degree of accuracy and certainty is possible of which many have not dreamt.

The most important conditions are six in number, viz., Diaphragm, Light, Time of Day, Time of Year, Plate, Subject.

Diaphragm: The rapidity of a lens is governed by its aperture and focus. As the intensity of the light from any lamp or window is four times as great at one foot as it is at two feet, so the intensity or brilliancy of an image on the focussing screen is four times as great at six inches as it is at twelve inches from the lens, the aperture of the lens being the same. And as the area of a circle of two inches diameter is four times that of one, one inch in diameter, so a lens of six inch focus and one inch aperture will have the same intensity, and consequently require the same exposure as a lens of twelve inch focus and two inch aperture. It is simply a question of the relation the aperture bears to the focus and is easily determined with the utmost exactitude. But if any one thinks that

Henry Grosshof, after the exposure in the skylight, gave an auxiliary exposure in the dark-room to a petroleum lamp whose light came through a ground-glass.

Mons. Bogin proposed to reduce exposure by placing in the camera-front cells containing a red liquid, thus securing the admission of red light to the film.

Dr. M. Carey Lea colored pieces of cardboard with carmine and lined the least illumined parts of the camera with them.

Mr. Blair recommended lining the camera with white card.

Mons. Scotellari proposed the use of extraneous violet light.

Mr. Charles Gutzlaff proposed bichromate liquids as a means of securing extraneous light to be used similarly.

Mons. Blanquart Evrard proposed to reduce the exposure by using what he called the *light camera* (*chambre claire*), a camera which had been painted white on the inside. The light of the parts of the image on the edges of the field would then strike the white sides of the camera and be reflected, thus producing a much more brilliant image on the ground-glass; and as a consequence, a shortening of the exposure.

two and two make five, let him think so and go on guessing. If the actinic value of light could be as easily determined as the diaphragm, there would then be only one important condition left for the exercise of judgment, viz., the subject.

But since we have, as yet, no instrument from which we can read at a glance the actinic value of light, we shall have to get at it in a somewhat roundabout way, by estimating the apparent brightness of the light, and then at its photographic value by a consideration of the time of day and time of year. Until we have the perfect actinometer, which shall give us the measurement of light in degrees as a thermometer measures temperature, it will be convenient to describe the light on the subject as: very bright (sun or cloud), bright (sun or cloud), bright haze, overcast, dull, and very dull. Now let each of these conditions of light be measured by an ordinary actinometer (which every one had best do for himself) and their relative values noted for future reference.

Time of day: You are aware that within two hours of sunrise and sunset the photographic value of light is often very different from its apparent brightness, that, in fact, the light is very yellow near sunrise and sunset. A very good clew may be obtained by a consideration of the time of day. Some use a table showing the allowance to be made for each hour of the day and for every month in the year. This answers very well, but it is a little complicated. A simpler and more scientific method is to measure the altitude of the sun. This can be done with sufficient accuracy with a common tape-measure held at arm's length. Then measure with a common actinometer the actinism of the sun and diffused light at various altitudes from the horizon. Taking bright midday sun as one, we will find the sun at twenty-eight degrees above the horizon is relatively 1½ at seven-

Mr. F. B. Gage proposed in cases of bad illumination and underexposure, to allow the light reflected from the black velvet camera cloth held in front of the lens to act for a short time on the exposed plate This proved in the hands of many a very useful dodge in making portraits of children; but it is quite forgotten by the present generation of photographers.

Mr. H. J. Newton admitting, it is supposed, the correctness of the Becquerel theory in regard to the continuating action of the red rays, allowed the light passing through a red glass inserted in the front of the camera to act on the plate, thus obtaining a reduction of the exposure.

A Paris photographer constructed a lens cap into which a piece of violet glass was inserted, allowing the light to act through it on the sensitive plate for a few seconds, and he succeeded in reducing the exposure considerably.

The dodge of allowing the light to act slightly on the plate, to be able to do with a shorter exposure, was not despised, but was made use of largely. A means often used was to cover the largest stop with white paper, and cut out an opening the size of the stop generally used. The result was a softer negative, with one-third or one-half less exposure than if the opaque stop had been used.

teen degrees, 2 at thirteen degrees, 4 at ten degrees, 6 at seven degrees, 12 and so on. This will give value for both time of day and time of year at once, but the sun may be obscured by cloud, or the horizon may not be visible. Another method which suggests itself and which works well in practice, is to make a table showing the hour of sunset for each month in the year, and another showing the relative light value at, say, two hours from sunrise and sunset, ninety minutes, sixty minutes, forty-five minutes, thirty minutes, fifteen minutes, and ten minutes, as compared with midday in midsummer. The rapidity of plates must be measured either by the plate maker or operator with a sensitometer.

The subject will give plenty of scope for the exercise of judgment. Subjects should be classified, and experiences (both successes and failures) will, if noted, give valuable data to assist the judgment.

We have decided on the view to be photographed, the exact spot which will give us the best foreground, planted the camera, selected the lens which will give the desired angle of view we wish focussed, decided on the stop to be used, inserted the plate-holder, but before we draw the slide let us calculate the exposure carefully on scientific lines and thus save any quantity of plates spoiled by incorrect timing and oceans of time consumed in timid development.

As a basis for all our calculations, we will suppose that we have ascertained that the correct exposure is one second for a normal subject, which will be a landscape with light foliage in the foreground, with a plate sensitometer number 20 and diaphragm value *f* 22 full sunlight. This is the standard to calculate from.

This action of diffused light, lighting up the image, and thus reducing the exposure, often takes place when the photographer is not conscious of it. Years ago, when it was customary to make negatives for vignettes against a white background, it was found the exposure was considerably reduced.

Again, the image may be lighted by reflection from the sides of the camera and from the surfaces of the lenses. The lighter parts of an image—the sky, for instance—will reflect diffused light on the inside of the camera, and thus light up the darker parts. Any landscape photographer may have observed that a view with much sky will require a less exposure than one from which the sky is nearly excluded. This point is a very important one to remember when using "quick," or, in fact, any emulsion plates. Long exposure reduces contrast. Suppose we have before the camera a country residence, with overhanging porticos illuminated by a strong summer sun. The contrast is painful to the eyes; and still, by giving a sufficiently long exposure, we can reduce it so that the house appears to be bathed in the mellow light of an Indian summer day. How much of this may be owing to the diffused light reflected from the more illuminated parts?

Example.—Subject, open view with heavy masses of foliage in foreground—double the standard or two seconds.

Stop, *f* 30—double the standard, 4 seconds.

Plate, sensitometer number 16—four times standard, 16 seconds.

Time of day, 3 P.M., October—four times standard, 16 seconds.

Light, full sun with patches white cloud; no allowance; correct exposure 32 seconds.

Example 2.—Subject, sea and sky—$\frac{1}{5}$ standard, $\frac{1}{5}$ second.

Stop, *f* 16—$\frac{1}{2}$ standard, $\frac{1}{10}$ second.

Plate, sensitometer 24—$\frac{1}{4}$ standard, $\frac{1}{40}$ second.

Time of day, 2 P.M., April—normal.

Light, light sunshine, hazy sky—$\frac{1}{2}$ standard, $\frac{1}{20}$ second; correct exposure, $\frac{1}{20}$ second.

Where the angle of lighting is unusual or extreme, allowance is to be made; for instance, if the lighting is very much from the side, the exposure should be the same as for diffused light, as the golden rule is to expose for the shadows and let the lights take care of themselves; this rule has exceptions of course, but where the shadows are broad they must have plenty of detail always.

It will frequently be found at midsummer, especially in photographing perpendicular objects in sunshine, that less exposure is required an hour or two before and after midday than at midday; not because the sun is more powerful, but because the angle of reflection is more favorable. It is generally necessary to give more exposure with sunshine and a clear blue sky than with the sun shining between patches of white sky, as the shadows are then better illuminated and contrasts less violent.—*Read before the Philadelphia Amateur Photographic Club.*

It is an unquestionable fact that the most brilliant image on the ground-glass is produced by lenses having the smallest reflecting surface adapted to a well-blackened camera. It is also evident that when all the rays but those forming the part of the image depicted on the ground-glass are excluded by means of a hood or cone, the image will gain in vigor and brilliancy. The question whether it will not, in certain cases, be an advantage to sacrifice some of this brilliancy for the sake of rapidity of action, is one which the practical photographer is called upon to decide promptly. Happily all the methods of acceleration are rendered useless now, but we are compelled to be more than ever on the alert, lest overexposure give us flat, foggy, insipid results.

100. Suggestions were made by several experimentalists to secure similar advantages by chemical means.

Their methods have a bearing on present manipulation, also, and some of them are therefore added to the notes.

100. Instead of using spirits of wine, use wood spirit (methylic alcohol). Formula: Water, 300 grammes; sulphate of iron and ammon., 8 grammes; glacial acetic acid, 15 grammes; wood spirit, 15 grammes. The strengthening solution is prepared as follows: Water, 200 grammes; pyrogallic acid, 0.60 gramme; citric acid, 0.60 gramme; wood spirit, 0.10 gramme.

By using wood spirit instead of spirits of wine, the exposure, under the same circumstances, of 43 and 58 seconds, can be reduced to 10, 8, 6, and even 4 seconds. I attribute the extraordinary action of the developer to the circumstances that it penetrates the collodion film, while the developer with spirits of wine, only acts on the surface.—G. NOELL.

Have a solution of protosulphate of iron, acetic acid, and water, which has been heated to 100°, in a closed vessel for several days. By adding to the ordinary iron developer one-tenth of its volume of the above developer, it will be found, after several days, to have obtained the following qualities:

a. Shortening the time of exposure one-third.

b. The developed picture is more intense.

c. The developer will not spoil in a few days as that without this preparation added, but will work more regular the older it gets, without fogging. Moreover, these results change according to the condition of the collodion, and principally the silver bath. It must also be noticed that the valuable qualities of this developer show themselves on cloudy days. In clear weather its superiority is less noticeable. On this occasion we will mention another preparation of iron which is sold under the name of carbolate of iron. This preparation consists, according to an analysis of Dr. Jul. Schnauss, of protosulphate of iron and carbolic acid. Whether the carbolic acid is mixed chemically with the iron, or is only a mechanical mixture, could not be ascertained with certainty. Of course, carbolic acid will combine with metallic oxides to form crystallized formations. It will reduce for itself the nitrate of silver, and its addition to the developer is theoretically correct.—DR. D. VON MONCKHOVEN.

101. While an overtimed picture is to be deplored, yet, be it remembered, there is more likelihood of such an one being "saved" in development than there is of an underexposed picture. You cannot hope to bring out by development beauties and qualities which you have not allowed to be started into existence by sufficient exposure.

102. Exposure is largely a matter of inspiration, of feeling. There is no royal road to its proper attainment. You must learn how, just as you must acquire musical excellence or master a language. You must go through the experience and the plate-spoiling with the disappointments incident thereto. Then it will come to you—to stay.

101. Undertimed photographs are to be seen everywhere, and from all places, nearly. It seems to be a common disease among photographers; *stopping off the light just a little too soon*, thereby spoiling what would have been a good production. Every photographer should examine every photograph he comes across, his own work as well as the work of others, with an eye of inquiry; if it is good, find the cause of its being good; if "better," why it is better; if "best," there is certainly a reason for its being so, and an examination by an experienced eye will soon determine wherein it is better, and why it is better. Short exposures in most cases produce startling effects. As a general thing, however, there is a lack of detail which nearly ruins the work. A little more time given the exposure would have produced a first-class photograph. On the other hand, too long an exposure produces a flat, low tone, worthless print. Too much or too little are equally bad, but the failure in the latter is much more frequent than in the former.—I. B. WEBSTER.

102. No rule can be laid down, but the photographer must use his own judgment as to the position of the sun that will produce a good picture. It may be almost invariably accepted that the sun should not be in the same position as the photographer; that is to say, with its rays parallel with the lens and camera. In landscapes a side light is, as a rule, to be chosen, with modifications according to circumstances. In the case of a river with trees on both sides, the chief care is to expose when the sun is in such a position that any very dark patches in the foliage do not exist, or at least not inharmoniously; also, that the shadows from the trees of one bank of the river do not darken the foliage of the other bank to such an extent as to rob it of its pleasingly clear definition. Clear definition must not be confounded with hard effects; most beautifully soft and yet clear definition with atmospheric effect may, and should be, obtained without any tendency to hardness. In the majority of cases it may be taken as positive that foliage is better rendered without the aid of the direct rays of the sun; in cases where water forms part of the picture, it is *almost* always so. But very often very fine and most desirable effects may be produced by dividing the exposure, giving one part while the sun is shining and another with diffused light. We generally find that the lighted or partly lighted side of a landscape is taken, and, of course, in a large number of instances it is a most suitable proceeding; but there are sometimes most beautiful exceptions to that mode of procedure, such as taking a view with the shaded side of the picture toward the camera.

When to expose is the first consideration.

The *art* side we have looked at, and we have considered the lenses. The light side, too, we understand. All these in order, the atmosphere may cast a dozen wily influences over things generally that will hold success with a grip that will baffle our best brains to unclasp.

Then the inspiration will come in, and, if you are watchful and quick, you will come out the victor.

103. *How* to expose becomes the next anxious inquiry. It might be answered with a single word—enough.

The time of exposure, like many other features in photography, cannot be learned, as can a process; it requires a true artistic feeling in the photographer, strengthened by experience.

A few remarks under this head on portraiture. The time at which to expose is a point quite as important in portraiture as in landscape photography. I have always found that it is a good thing to allow the sitters some time to look at specimens, and stroll about the studio or place of sitting, as that allows time for their nerves, heart, and muscles to get more composed after their walk or ride. By giving them a number of interesting photographs to examine while you prepare, their imaginations and temperaments get generally a little more calmed, and the chances are much more in favor of a good picture.—H. A. H. Daniel.

103. *How to Expose.* For views, I maintain that always, if practicable, *a long exposure and weak developer* give far the best results. I am of opinion that when a strong developer is used there is a much greater likelihood of hardness, and as a strong developer requires a quick exposure, I do not think that such detail is secured as with a long exposure; that is to say, in taking, for instance, the case of a landscape with fairly lighted parts, and also very dark portions in the depths of the foliage, presuming a short exposure be given and a strong developer used, I believe that the well-lighted parts assume a certain degree of hardness, and the dark portions of foliage do not contain so much detail. But suppose we use a weak developer and give a long exposure, the details in the deep shadows get a longer time for impression on the film, and can be brought out slowly but surely by building up the negative, at the same time the weakness of the developer prevents any hardness in the well-lighted parts.

In making exposures there is one thing that should be continually studied. It is to endeavor to gain a tolerably accurate idea of the actinic power or value of different colors in nature, such as the light and dark greens, browns, grays, yellows, and reds. This can only be acquired by carefully noting the exposures and examining afterwards the negatives, carrying the landscape in the eye as well as possible. By so doing a far better idea of the required length of exposure is obtained than by any other method I am acquainted with. We cannot rely on apparently equally lighted subjects, or recollecting the exposure of one subject and applying it to another. What appear to be equally lighted subjects are very often not so. By making this a little point of study many a negative will be saved from under- or over-exposure.—H. A. H. Daniel.

I have already hinted at my belief, that a long exposure is preferable—*i. e.*, relatively long. It is my habit not to employ "lightning," nor very quick plates, if my subject will permit me to use slower ones.

Neither do I think it a good plan to use quick plates with a very small diaphragm for ordinary subjects.

104. Quick plates are a splendid reserve power, but they were never intended for general use.

104. For landscape work, pure and simple, where an instantaneous exposure is not required, I believe, and always advise, that a slow plate of fourteen to sixteen degrees Warnerke will give better and more satisfactory results than a very rapid plate, and for the following reasons: A slow plate gives great contrast and a brilliant image, while a rapid plate gives a soft effect and a certain flatness, which are not easily overcome. In portraiture, where hard contrasts should be avoided, these rapid plates are very suitable. The brilliancy and intensity in a slow plate are, of course, largely due to the inherent chemical quality of the emulsion.

Again, more latitude is allowable both in exposure and development with a slow plate. A photographer may be perfectly acquainted with the capabilities of his plate and lens, and on ordinary subjects will hit pretty nearly the right exposure nine out of ten times. But the image on the ground-glass is deceptive, and there is an endless variety of subjects where the most expert photographer is puzzled, and hardly knows what exposure to give. For example, dimly lit landscape under trees; autumn foliage with non-actinic red, yellow, brown, and dark green leaves; heavy black foregrounds with well-lit distances, need all the latitude possible, and here is where the advantage of the slow plate comes in. In doubtful cases, like those mentioned, a very full exposure may be given, and five or even ten seconds too much will not prevent a good negative from being obtained, while with a rapid plate a difference of two or three seconds may ruin the resulting negative, for it is almost impossible to get anything but a flat picture on an overexposed rapid plate.

It may be suggested that by using a small diaphragm the same latitude of exposure may be obtained with a rapid plate as with a slow one. This may be so to a limited extent, but working a very small diaphragm lessens the atmospheric effect and gives a certain flatness and lack of brilliancy. Diaphragms ought not to be used as a means to lessen the light, but only to get a sharp picture all over the plate; the largest diaphragm that will effect this is the right one to use, a smaller one will give only monotone pictures without any advantage.

Then, again, in development a slow plate will stand more variation and rougher treatment without fogging. It is easier restrained, and can be forced, without losing its printing qualities, to an extent which would be total ruin to a rapid plate. The greater intensity of a slow plate allows one to use a very dilute developer, thus keeping the plate under perfect control, and saving many negatives that would otherwise be lost through overexposure, but with a rapid plate no such treatment is allowable, and overexposure cannot be corrected by diluting the developer, as the resulting image will be flat and thin, and worthless for printing without intensification. Such a plate can only be saved

The doctors agree on this point, therefore I need only refer to their notes, rather than expatiate myself.

105. What light gives us the best effects? is another common query. The answer is—sunlight. I do not mean a blue sky, for we all know that we do

by the addition of plenty of bromide from the very beginning, and even then it is necessary to vary the component parts of the developer so often that the whole operation becomes perplexing and uncertain.

My advice, therefore, is, use a slow plate for landscape work, give generous exposure, and dilute your developer.—DR. S. C. PASSAVANT.

It is a fact that the great sensitiveness of dry plates facilitates in an extraordinary manner, the taking of instantaneous pictures, and that there are even cases when it seems impossible to give short enough exposure.

Dr. Neuhaus, who has recently returned from the Sandwich Islands with a number of remarkable pictures, declares, that he found it necessary to make use of a Steinheil wide-angle lens with the smallest stop—that is, the smallest opening which can practically be used in operating upon open, sunlit landscapes. All views not so taken with the instantaneous shutter, showed themselves over-exposed, so brilliant is the light in that region. But it does not follow that we should always use for instantaneous work and under every circumstance a wide-angle lens with smallest stop. What would do well enough for open landscape will not serve in shady forests, or narrow places, or rocky cavities where the light of the broad sky is only filtered, as it were, through small openings, and what is possible in the broad light of noon is not possible when the sun is declining or when the sky is overcast with clouds. Finally, a point of great importance is the distance of the passing object from the camera; the manner of its passage, and its position, whether perpendicular to or nearly in the direction of the camera.

Every professional of experience is well aware that an express train which impresses itself upon the field of vision with a velocity of thirty feet with an objective of six inch focus at a distance of twenty paces, and which lasts for one-twentieth of a second, makes a motion of one-twenty-seventh of an inch upon the plate; that is, almost a half line, which will give the impression of a blur. At double that distance, forty paces, the blurring is only half as much; at three times, one-third; and much less when the direction of motion is oblique to the axis of vision. Such facts are usually overlooked by the amateur.

Photography is at present an easy thing, but a certain amount of mother wit is necessary when we expect to succeed with difficult subjects.—DR. H. W. VOGEL.

105. I will ask this question: How many pictures, amongst the thousands painted by first-rate men and authorities in the artistic world, representing daylight scenes, have been painted without sunlight represented as shining on some portion or other of the work? Unless for some very exceptional effects, I am inclined to think sunshine is always a factor in the arrangement. I cannot call to mind a single instance of a leading landscape painting quite destitute of sunshine. Take a stroll through our picture galleries—South Kensington, for instance—and try to find a daylight landscape without sunshine effects. The search will, I think, be tedious and unremunerative in this respect; yet there are representative pictures of most of our leading artists to select from.

not always get the best effects under such. The most aggravating sky to work under is a cloudy one, when the white-winged messengers are having a gala day and shifting about, changing the light every few seconds. But on such gala days we may get our richest effects if we but have the patience to watch and wait. But such rare days do not come always when wanted.

106. The shady day, however, is to be avoided. Pictures can be made on

If, then, sunshine be unnecessary for pictorial effects, how is it that it is always adopted? and why are not paintings made to represent nature under a leaden sky, or, at least, where sunshine is absent, in preference?

In answer, the photographic advocates of no sunshine may say that the greater play of color in sunlight is the inducement to painters; but, as color effect is to be ignored as much as possible by the photographer, the less there is of it the better for perfect photographic results. But sunshine does something else besides vary color effects; it quite as much varies form and composition. A bright gleam of sunshine will frequently make a beautiful picture out of what was without it a flat, uninteresting subject.

Brilliancy in a photograph is a mere matter of intensity altogether irrespective of any artistic consideration. It alters neither form nor composition; but sunshine not only supplies this intensity, but especially improves the picture by varying the forms. In illustration of this, take a foreground with nothing but a grass bank and short herbage growing upon it: the advocates of no sunlight represent it as a blank and even patch, which it possibly may be; but, give sunshine a chance, and the shadows of neighboring trees, etc., or inequalities in a ground itself, make a broken and pleasant effect without an accessory of any kind.

What applies here to the small piece of foreground holds good with the whole of the landscape; and I firmly believe that no landscape was ever taken on a sunless day, no matter how successfully, but would with the same skill of manipulation have been infinitely better done on a sunny one. In fact, it is a mystery to me how anyone who has intelligently studied landscape effect at all could think otherwise. Because there is sunlight there is no necessity for chalkiness or snowy effect in the foliage or want of detail in the shadows. These effects are mere errors of manipulation, and chiefly occur when the plate has had insufficient exposure or faulty development, and are not due to the lighting of the subject.—EDWARD DUNMORE.

106. These remarks, of course, are intended to apply to general landscape work. Special instances do undoubtedly occur now and again where the absence of sunshine is advantageous. When, for instance, from the exigencies of the situation, one is obliged to work with the sun directly in front, then there is no doubt of the advantage of cloudy weather; but, from an artistic standpoint, such subjects would not be photographed at all. Still, as they have to be done occasionally, the least objectionable conditions are, of course, selected, but this only proves the exception.

In architectural subjects—say some building in its entirety—when the position of the camera is entirely under the control of the artist, a *satisfactory* picture could not be made without sunlight. Architects themselves carefully consider the effect of cast shadows on such days, it is very true, but their quality is inferior; the results are flat, shadowless, void of snap, brilliancy, and vim.

107. Another influence upon the exposure comes from the lens or objective used. It has already been hinted at, and is one that should be considered at all times. Enough instruction, surely, has been given to render anything more

their works as a means of enhancing the appearance of the structure, and giving relief and prominence to some ornamental or architectural feature. The even-light photographer, trusting to intensification, would make but a poor hand of such a subject. It is true little bits of detail may occasionally be rendered better without direct sunshine falling upon them; this has, however, nothing to do with landscape work, and comes under an entirely different set of conditions. Again: most works giving instruction in drawing and painting go deeply into the matter of shadows and their perspective and of *chiaroscuro* generally. What would be the use of all this knowledge if effects were better without direct sunlight? No; depend upon it, sunlight in landscape work is as absolutely necessary to perfect pictorial results as the reducing agent is in the development of the photographic image.—EDWARD DUNMORE.

107. President Barnard says: "Before attempting to construct a formula which should express the relation of intensity of light to the duration of exposure required to produce a definite amount of chemical change, we should require to know more than we do about the laws which govern chemical changes during their progress, for the law which you find to fail takes it for granted that the resistance to change opposed by a chemical compound to the action of light is uniform from beginning to end—a thing which we have no right to affirm. I know of no better means of determining this relation between area of lens and the proper duration of exposure than careful experiments, systematically conducted with lenses of various areas, and with similar illumination throughout. An empirical law might thus be ascertained, which for practical purposes would answer quite as well as a theoretical formula mathematically expressed."

The laws governing the rapidity of the lens, neglecting its color and the number of its reflecting surfaces, are: First. The relative rapidity of two lenses having the same apertures is inversely as the square of their equivalent foci. Second. The relative rapidity of two lenses having the same equivalent foci is nearly as the areas of their apertures.

For example, take two lenses having the same sized aperture, one having an equivalent focus of twelve inches, and the other of six inches; the lens with the six-inch focus will be four times as rapid as the other. Or of two lenses having the same equivalent foci, one with an aperture two inches in diameter, and the other with an aperture of one inch; the two-inch lens will be approximately four times as fast as the other.

The Photographic Society of Great Britain, in order to overcome the great confusion arising from the different systems, or rather lack of systems, used by different opticians in numbering their stops, have adopted a "universal system," based upon the ratio between their diameters and the equivalent focal length of the lenses with which they are used. As the basis of their system, they have taken a portrait lens the diameter of whose aperture is one-fourth its equivalent focal length, calling that stop or aperture than a reference to the few notes below unnecessary on this topic, especially when read with the offerings concerning lenses and diaphragms.

108. A great deal of guesswork is spared the beginner by the modern

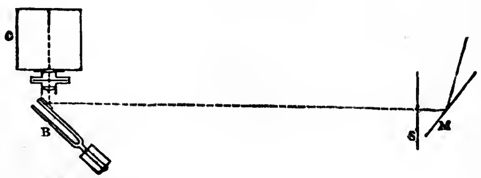
No. 1; stop No. 2 is one of half the area, and, therefore, requires approximately twice the exposure. In this "universal system" the number of stop represents the number of seconds exposure required by the stop, when stop No. 1 requires an exposure of one second.

I think a modification of this system would be of the greatest possible advantage to amateurs in enabling them to express the duration of exposure in terms which are common to all lenses.—C. W. DEAN.

108. The usual method adopted for the measurement of the speed of photographic drop-shutters, depends on photographing a white clock-hand revolving rapidly in front of a black face. The chief difficulty in the case is to maintain a uniform rotation at high speed. To avoid this difficulty, and to determine the uniformity of exposure of any particular shutter under apparently like circumstances, the following method has been suggested. In carrying out the experiment in practice, I have had the assistance of Mr. J. O. Ellinger.

A tuning-fork, *B* (Fig. 233), with a mirror attached to the side of one of the prongs, is placed in front of the camera-lens. This mirror is so arranged as to reflect into the camera, *C*, a horizontal beam of sunlight, which, before reaching the fork, has passed through a hole in the screen, *S*, placed about ten feet distant. This produces on the ground-glass a minute brilliant point of light. If the fork be set vibrating, the point will become a short, fine horizontal line; if the fork be rotated about its longitudinal axis, the line will become a sinusoidal curve described on the circumference of a circle of long radius. A photographic plate is now inserted and the drop-shutter attached. On releasing the latter, it will be found that a portion of the sinusoid has been photographed, and the precise exposure may be determined by counting the number of vibrations represented on the plate.

FIG. 233.



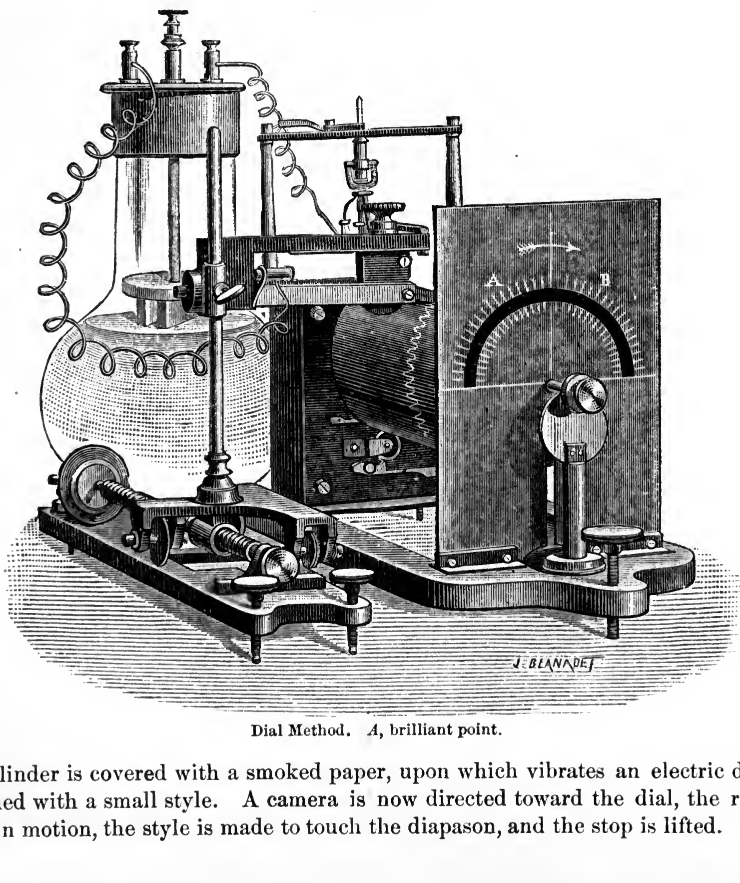
The mirror employed should be somewhat larger than the lens to be measured, so as to cover its edges during the whole exposure. The mirror may be glued directly to the prong of the fork with strong carpenter's glue, after first scraping off a little of the silvering at the edges of the glass. The rate of the fork is then determined, by comparison with a standard fork, by the method of beats.—W. H. PICKERING.

Measuring the Time of Exposure. First Method.—The diapason as an instrument for measuring time is the only one that has an indisputable value; and we believe that, instead of leaving it to scientists, we should, on the contrary, utilize it in the interest of our investigations. The objection may be urged that the divers methods that we describe are not within the reach of all. This is not to be denied. But it seems to us, if we are exposing shutter. With the pneumatic holder in his hand he may learn to spell out the riddle tolerably, and gradually grow up to the mastery. Or, he

to measure hundredths or thousandths of seconds, instruments of high precision are indispensable. To measure by approximation such small fractions of seconds seems to us as foolish as to weigh milligrammes with gramme weights. If we take up these questions it is necessary to do so with all possible precision, and it is to carry out this order of ideas that I have devised the following method.

Take a registering cylinder put in motion by a Foucault regulator; on its edge affix a brilliant point—the head of a nickel-plated nail, for example. The point is carried forward by the regulator at the same time as the cylinder of which it forms a part; it is its displacement that we will photograph. It moves behind a graduated dial-plate pierced with a circular opening (Fig. 234). The dial is black; the divisions are white

Fig. 234.



Dial Method. *A*, brilliant point.

The cylinder is covered with a smoked paper, upon which vibrates an electric diapason furnished with a small style. A camera is now directed toward the dial, the regulator is put in motion, the style is made to touch the diapason, and the stop is lifted.

may use a photometer or sensitometer to determine the sensibility of his plates, and expose according to what they indicate.

We give here the reproduction of the result of an experiment. We see the divided dial and the track *A B* left by the point. Light commenced to act at *A* and finished at *B*. We have now to see on our sinusoid to what places these two points correspond, and what time has elapsed between *A* and *B*; nothing is more simple. With the hand the cylinder is made to revolve until the brilliant point reaches *A*. This is the commencement of our impression, and we now draw a line which cuts our sinusoid, displacing our diapason on the parallel stand. The point *A* corresponds to the point of intersection of that line and of the sinusoid. We continue the march of the cylinder until the point reaches *B*. We draw another line, which gives us the point *B*. All we have to do now is to count the number of vibrations comprised between *A* and *B* to ascertain how long the light has acted and discover the time of our exposure. In this experiment we have ten vibrations; as the diapason gives 250 vibrations in a second, the time of exposure is, therefore, $\frac{10}{250}$, that is to say, $\frac{1}{25}$th of a second.

By adopting this method, combined with optical and graphical methods, it is no longer necessary to have a regular motor, since we know at every moment the law of motion of the registering cylinder. There is no necessity to have the dial divided with precision, inasmuch as its graduation only serves to give points of comparison. The method then becomes much more simple, whilst at the same time it gives results that are of absolute precision.—ALBERT LONDE.

It requires but little practice to be able to measure off a minute without varying more than a second, and in that case both stop-watch and the device I am going to recommend may be dispensed with entirely, though a novice is liable to become disconcerted by any sudden excitement. I therefore suggest the use of a time-ball, which consists of a half-inch bullet firmly attached to a cord twelve inches long, in which a knot is made just nine and three-quarter inches from the centre of the bullet. Swing the ball, not violently, holding the cord *at the knot*, and the intervals will be exact half-seconds, though for seconds every other beat only should be counted. This principle is based on the fact that the length of a pendulum, beating seconds, measures 39.37 inches, which is a metre, the French standard of linear measure. If one wishes, however, to be quite certain in determining the amount of exposure, one should not permit the common mistake of sacrificing one count, which is done by calling the removal of the cap "one," and for twelve seconds replacing it at "twelve." That is but eleven seconds, twelve seconds being from one to thirteen.—WILFRED A. FRENCH.

To Determine the Relative Sensibility of Sensitive Films.—It is indispensable, if we wish to work with precision, to have at our command a method for ascertaining the sensibility of the films which we use. This sensibility varies according to the emulsions used, and it is necessary to vary the time of exposure, all other things being equal, in accordance with their sensibility. The method most generally employed is that depending upon the use of the sensitometer of M. Warnerke (Fig. 234), which is already very popular and the only one that can be purchased. Its graduation is known, and when we are told that an emulsion gives a certain degree of the Warnerke sensitometer, we know what

The whole subject is an interesting and vital one, and requires careful attention. At first, any way, "go slow."

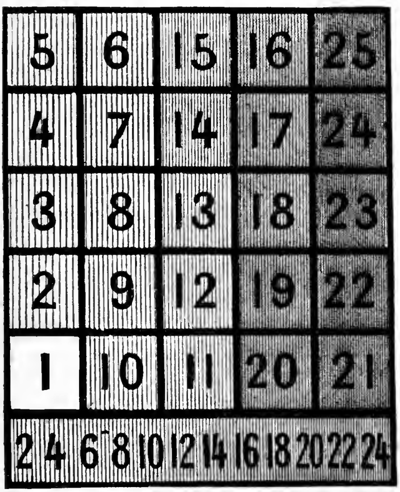
that means as well as if we should learn that the thermometer indicated a specified degree.

When it is necessary to ascertain the sensibility of papers and pellicles nothing is easier than to cut suitable pieces and place them in the sensitometer, a species of pressure frame for whose plate is substituted a translucent graduated scale divided into twenty-five degrees.

The interior of this frame measures but about 8 x 10 centimetres, and can therefore contain but fragments of plates, even the quarter-plate which measures 9 x 12 centimetres could not be used. It becomes therefore necessary to cut with a diamond the emulsion plate to make the sensitometric trial; this is objectionable, as a whole plate must be destroyed to obtain a simple fragment 6 x 7, surface of the graduated scale, and if the trial is made with several different preparations it carries with it necessarily the loss of several plates. To this objection we see but one remedy, it is to add, in all the bundles and boxes of sensitive plates a fragment of plate 6 x 6 at a minimum, to be used in making the trial, say one-sixth of the plate 13 x 18. This useful complement would not cost the manufacturers much and would prove of great service. To sell separately sensitometric plates would not lead to the desired end. In any event it would be better to indicate upon each box the sensitometric degree of the sensibility of the plates, but to verify this may sometimes be necessary, and for this reason the addition of a sensitometric plate would prove very useful to all amateurs desirous of operating with precision. We submit this advice to the appreciation of the manufacturers of plates and sensitive pellicles.

Fig. 235.

SENSITOMÈTRE ÉTALON DE LÉON WARNERKE.



The description of the Warnerke sensitometer is not necessary here, as the manner of using it accompanies the appliance. We may add, however, that it is convenient to use a method of reading the degree which removes all doubt. Now here is what happens: After the development of a plate impressioned in the sensitometer, we often see a series of tints having about the same value, and it is somewhat embarrassing to determine to what degree they belong. This embarrassment will no longer exist if we use a finder consisting simply of a piece of paper of a normal tint pierced with an opening in the centre; it is only necessary to find the tint which, placed under the opening, is more nearly assimilated to the ambient natural tint. Mr. Warnerke has adopted as the normal

After considerable experience one will learn to judge very correctly all that involves the time of exposure, and become more and more expert. Further-

tint that of No. 3 of his sensitometer. Any one may, without difficulty, prepare this little complement to the instrument. It suffices, with a little India ink, diluted with a great deal of water, to produce a uniform tint of the value of No. 3 seen by transparency, and to make a round or square hole in the centre. The sensitometric print, after development, washed and not fixed, is covered successively over the last visible numbers, stopping at the one the tone of which is nearer the normal tint. Why should not Mr. Warnerke complete his charming instrument by the addition of a finder? He has doubtless done so, and if he has not done so, he will.—LEON VIDAL.

Among the various new forms of apparatus, which become more necessary than formerly with the introduction of the highly sensitive dry-plates, there are the so-called "sensitometers." One of the best known is that by Warnerke, which consists of a semi-transparent scale of figures made by the Woodbury process—the transparency of the scale decreasing by regular degrees from 1 to 24. Under this scale the plate to be tested is exposed a certain time. The manner of exposing is remarkable. Warnerke employs for it a normal light—that is, a glass pane coated with phosphorescent paint. Before the same two and a half centimetres of magnesium wire are burned, then the whole is left undisturbed a minute, when it is placed upon the scale under which the dry plate lies. Warnerke states that the light obtained thus is always uniform. I did not find this to be so, however, as the temperature acts in such a way upon the power of phosphorescence of this paint that totally different results may be brought about. So, for instance, I obtained with a warmed phosphorescence-plate upon an emulsion-plate the number 20; in the cold, however, only the number 19, making a difference of 25 per cent. The mere warmth of the hand increases the power of phosphorescence. It is further to be objected, that it is not possible to detect small degrees of differences of sensitiveness with the instrument; the smallest measurable difference is $1 : 1\frac{1}{3}$—*i. e.*, 3 : 4; but among dry plates of different kinds, differences of sensitiveness like 8 : 11 or 4 : 5, not rarely exist, and these cannot be measured accurately with the instrument in question. Furthermore, the yellow color of the scale is a drawback, for it modifies materially the quality of the light, as the blue rays are partly absorbed. For these reasons, I have constructed another sensitometer, after an idea published at least thirteen years ago by A. Taylor. The scale of this photometer is formed by a metal plate with holes. This plate covers a wooden block in which twenty-four cylindrical cells are drilled. Above the first cell one hole is made, above the second two, above the third three, and so on. Under these cells, the plate to be tested is exposed in a dark, slide-like contrivance, and it is obvious that the relative clearness under the different cells must be in exact proportion to the number of apertures made over the respective cells. When, therefore, two plates are exposed equally long under this instrument before an object uniformly illuminated, and then developed, it may be that one plate will show the effect of light up to cell number two (with two holes), and the other up to cell number four (with four holes). With half the strength of light the same result was obtained with the first plate as with the whole strength in the second plate, and the first plate is, therefore, shown to be twice as sensitive as the second.

more one will very soon learn how to correct any errors or miscalculations in exposure by means of the dark-room manipulations.

In order to clearly indicate how far the effect of light has progressed, a thin tin is fixed under the cells, in which figures are cut out to indicate the number of the holes made above. For exposing, I use a sheet of white photographic plain paper, which is drawn upon a board, *B*, Fig. 236, which board is exactly one metre distant from the photometer, and which is lighted by a small window, about twenty feet distant, facing directly the sky, or through an aperture in the studio protected with screens. As the

FIG. 236.

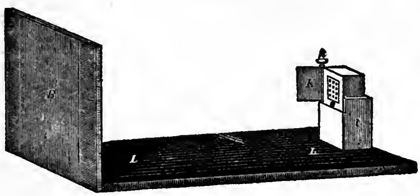
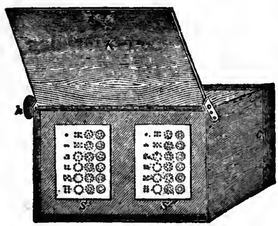


FIG. 237.



strength of light of the daylight is very variable, even during the time of exposing of two plates, I use a double instrument, as shown in Fig. 237, and in which the two plates can be exposed simultaneously. Of course, the plates are also developed simultaneously and equally long. The temperature of the developer is of special importance. With a warm developer often three or four figures more are reached than with a cold one, and it is therefore necessary to keep the developer as nearly as possible at the same temperature (66° Fahr.), which can be done by using ice in summer and warm water in winter. Of course, this must be done only when it is intended to compare the results of summer experiments with the results of experiments made in winter. If the two plates are exposed simultaneously, and also developed at the same time with the same developer, the temperature does not modify the results.—DR. H. W. VOGEL.

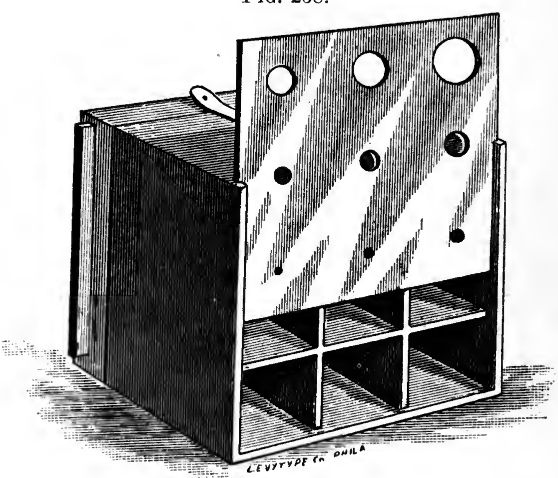
For some time after the modern gelatino-bromide dry plate came into general use, it was customary to describe the relative degrees of sensitiveness as so many times that of wet collodion; but as this standard varied in the hands of every operator, something more reliable was felt to be a desideratum. To meet this demand, Mr. Warnerke, of London, England, introduced the instrument to which his name has been given, and, notwithstanding its many faults, it is the only one that has received even a limited share of public notice, or been in any degree considered authoritative. For the private comparison of various batches of one variety or make of plates, the Warnerke, or any one of the various forms of sensitometer that have been suggested, may do well enough, but as means of conveying information as to the sensitiveness of plates in general, it is utterly useless: a pretty toy, and nothing more. The alkaline sulphide from which the so-called standard light is obtained varies in its power of absorption and of evolution almost as much as did collodion in sensitiveness, and the screens sent out with the instruments seem to vary as much as the luminous tablets.

With what has already been hinted at in the notes and in the text, it hardly seems necessary to say more. There is no real rule for exposure. There are thousands of chances to do right.

The conditions essential to a really useful sensitometer are that the light employed shall be uniform in quality and quantity, from whatever source it is obtained, and that the graduated screen shall be a mathematically correct mechanical production that can be made by anyone trained to exact work. The light should also approach as near as possible to that of pure diffused sunlight. It is well known that the light produced by the oxidation of magnesium approaches more nearly to ordinary sunlight than any other form of artificial light, and that the quantity emitted from the rapid combustion of any given weight is a constant quantity. I believe, then, that a convenient and thoroughly practical standard light for sensitometer purposes will be found in the flash produced by the ignition of an accurately weighed quantity of a uniform mixture of magnesium in powder of a certain degree of fineness, and chlorate or nitrate of potash in fine powder. The degree of fineness, and the proportions in which the nitrogen should be mixed, should be matter of careful experiment. It should be undertaken by one of our photographic societies.

The kind of screen that recommends itself to me, as likely to answer most perfectly, is a mechanical arrangement that appeared in the *British Journal of Photography* some years ago (Fig. 238). Practically it consists of a square box so divided as to represent any desired number of square tubes—nine, of two inches square and three inches deep, should answer admirably, and would assume the form of a box 6 x 6 x 3 inches.

FIG. 238.



One side of the box, or one end of the tubes, is fitted so as to receive a plate holder or dark slide, in which the plate is placed, and the other side, or end of the tubes, is covered by a metallic plate in which are drilled nine holes, each in the centre of one of the square tubes, and each exactly twice the value in light-admitting area of its predecessor. The size of the openings, distance of the flash from the plate, and quantity of magnesium flashed, could easily be arranged, so that the nine numbers would include plates from the slowest to the most rapid in use at present; and while a sensitometer thus arranged might not be altogether perfect, it certainly would approximate more nearly to

Keep on the alert for these chances—draw on your fund of knowledge to help you when they are presented, then your results will surely do you credit.

perfection, and convey a more correct knowledge of the true sensitiveness of a plate than any form of instrument that has as yet been proposed.—DR. JOHN NICOL.

My photometer is a simple prism made of yellow glass (Fig. 239, side view), framed in such a manner as to become an ornament for a watch chain. Upon the inner surface of this yellow glass prism lines are drawn beginning from 1 to 10; No. 1 represents the finest part of the prism, and No. 10 the thickest. A piece of sensitized paper is intro-

FIG. 239.

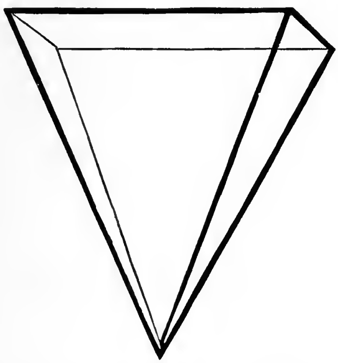
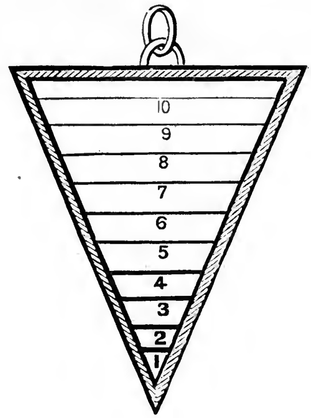


FIG. 240.



duced under the prism and allowed to remain one minute (in the shade it is then examined), and according to the number that the impression has reached, it is very easy to calculate the photogenic power of the light.

In order to give my readers a correct idea of this photometer, I inclose two sketches of the exact size of the instrument. Fig. 239 is a side view of the glass prism before being mounted; Fig. 240, the front view of same when framed.—J. FLEURY HERMAGIS.

CHAPTER XII.

CONCERNING CHEMICALS.

109. The next halt in our picture making pilgrimage must be made at the chemical hostelry.

Rough treatment is sometimes visited upon both novice and veteran in this quarter.

The glacier of the Rhone does not twist and turn, and break up and change with more eccentric independence than does the vast out-pour and down-pour of chemical elements, equivalents, and combinations.

And yet, where is there anything more grandly beautiful than the Rhone glacier—where anything so superb as the actions and reactions which occur in the chemistry of photography?

It would be advantageous if all brave enough to enter our art's discipleship, were well versed in the outlines at least, of chemistry, but it is not within the province of this work to supply such information. It can be had readily in the books if it is desired.[1]

110. The number of substances which are chemically decomposed by light is great; when the product of decomposition, as ordinarily, has another color than the original substance, a picture by effect of light, so to say a photographic picture, can be produced with any of these substances, by exposing a surface covered with it under a pattern, or photographic negative, or in the camera. The juices of many plants and flowers may be used in this way. In fact, nature herself is one of the most agile photographers. Like much of her work, however, her pictures are fugitive—or her latent likenesses go undeveloped. The pictures on silvered paper, the common photographs, are sufficiently colored, but pictures produced in this way on paper impregnated with the salts of oxide of iron, uranium, chromic acid, etc., are very weakly colored. However, the products of decomposition, the suboxides of iron, uranium, etc., may, by simple chemical reactions, be transformed into other compounds of intense color. In that manner pictures in Berlin blue, in aniline colors, and

[1] See "Outlines of Chemistry," by Henry M. McIntire, M.E., in Philadelphia Photographer, 1878, vol. xv.

others are produced. In *all* these processes a long time and intense light are necessary to obtain a sufficiently colored picture.

It is Daguerre's and Fox Talbot's great discovery, that iodide, bromide, and chloride of silver have *the faculty of photographic development;* this enables us to take a picture by a short exposure, and has engendered the art of photography. The sensitive Daguerrian, collodion, or emulsion-plate gets, by exposure, the so-called invisible picture—that is, a very weak picture of slightly decomposed iodide or bromide of silver. By development, the invisible picture is coated with a proportionate deposit of silver; the silver deposit which constitutes the developed picture is not the product of a chemical reaction with the invisible picture, but originates by a *peculiar physical property* of the latter; *namely, photographic attraction.*

111. The photographic development is only rarely known with any other substance than the iodide, bromide, and chloride of silver. The development of the picture in Poitevin's process with tartrate of iron, which consists in sticking any powdery substance to the exposed parts, cannot be paralleled with it, neither can the bichromate solutions used in carbon and kindred processes be considered in the same category.

Dr. Shultz Sellack found that *the haloid-salts of copper, iodide and bromide of copper, have the faculty of photographic development* like the salts of silver. A plate of pure copper, iodized or bromized as in Daguerre's process and exposed in the camera, develops a picture in mercurial vapors. Also, when the bromized or iodized copper-plate is sufficiently exposed under a photographic negative, a picture is produced which can be fixed by hyposulphite. The sensitive copper-plate, therefore, acts exactly like the Daguerrian plate. A process similar to the wet collodion or emulsion process is impracticable with the salts of copper on account of their solubility in water.

112. A good deal of discussion has taken place among photographic ex-

112. A month ago I took a view upon a 7 x 9 plate. After development, I heated it with a weak solution of acid pernitrate of mercury; with a clean wooden spatula, I scraped the film off the glass into a clean porcelain crucible, and placed it over a Bunsen burner. After slowly drying the film, I raised the heat gradually to redness; portions of the film, as the heat increased, flashed slowly off like wet gunpowder, and at last it was completely consumed, leaving *no ash whatever behind:* a slight yellowish stain about a quarter inch long, and a sixteenth wide alone remained. This stain I treated with chlorine water, without producing any change in its color, and next with ammonia and various acids successively, but without any visible effect whatsoever.

Thinking that this experiment indicated very strongly that no salt of silver remained perimentalists as to the nature of the latent image, whether it be chemical or physical. Much industrious experiment was followed by the advocates on both sides, with interesting and curious results but ending with diverse conclusions. Those who enter only into the practical, share whatever advantages

behind, after subjecting the film as described to the solvent action of the acid pernitrate of mercury, I coated, exposed, and developed successively seven 7 x 9 plates, with the same bromo-iodized collodion, and, avoiding purposely the collo-developer, used a plain iron developer, the same for each.

The remaining six films I scraped off with care into a beaker, and added about an ounce and a half of distilled water and a small bit of pure zinc. I then added pure dilute sulphuric acid, and kept up the action for a week, by adding a few drops additional, from time to time, until the zinc was wholly dissolved.

At the end of this time I added twenty drops of pure nitric acid, and gradually raised the heat to boiling. No change in the appearance of the liquid or films took place under the above treatment.

I now filtered off about four drachms of the liquid, diluted slightly, and added to this two drops of dilute hydrochloric acid; not the slightest cloud or opalescence was formed, or any change whatsoever. I then repeated this experiment, after slowly evaporating the liquid to about a quarter of its original bulk, but without any effect of any sort. The transparency of the liquid continued *perfect.*

So far as this mode of investigation will indicate, it is therefore evident that no silver salt was present in a half dozen 7 x 9 films, on each of which an image could be redeveloped after its treatment to perfect transparency by the acid pernitrate of mercury and this experiment also confirms the first.

Now, here is the film, apparently reduced to pure pyroxylin, and apparently deprived of all substances capable of exercising any chemical action on the silver and iron developer whatever, and yet, to it has been conveyed a power to cause the particles of silver as they fall from the developer to assume the form of the picture to which it has been exposed in the camera. What is this power? It is a persistent power, for the transparent film on which it is impressed may be dried, and the image be redeveloped the next day by the usual mode of developing tannin plates.—THOS. P. SHEPARD, M.D.

Simple pressure, I find, modifies iodide of silver in such a way as to make it capable of receiving a development.

An orange-wood ruler was selected, in which the letters composing the word "Sorrento" had been carved in open work, cut entirely through. A plate was sensitized in the usual manner, and then, without removing it from the dark-room, the ruler was laid upon the sensitive film, and whilst the glass rested on a firm support, the ruler was powerfully pressed down upon it by the full strength of the two hands, and kept so for twenty or thirty seconds.

The ruler was then carefully lifted off, and the plate developed with an iron developer. *The word immediately became visible.*

Precisely as I expected, it was the parts which had been pressed that received the silver deposit. Had the reverse taken place, it might have been said that the ruler car-come from such discussion while they move on, giving their best attention to what really concerns their actual work.

113. It should be the care of every ambitious photographer to secure chemicals which are pure and of proper strength. There should never be any variation in the first quality. "The best" is never more emphatically "the cheapest" than in the line of chemicals, for, I might say, a single molecule of badness may upset a whole dark-room.

114. Chemicals are very sensitive to atmospheric influences, and must be carefully humored to adapt them to changes in temperature.

ried away a portion of the silver solution, so that the letters were left with more nitrate on them; or that the faint light of the dark-room had acted on the open part under the letters, whilst pressure was applied.

I cannot but think that these experiments will afford a most telling argument in favor of the physical theory, and one which its opponents will find it difficult to explain away. Here is no possibility of reduction, no possible production of metallic silver, or of sub-iodide, no possible elimination of iodine, and yet a developable impression is produced, which comes out plain and strong under the action of a developer.

It is almost superfluous to remark that the foregoing experiment may be almost indefinitely modified, the one essential thing only, seeming to be *pressure.* Marks made, probably, by any hard body, may be brought out by the development, always the part *receiving the pressure* becoming darkened in the development.—M. Carey Lea, M.D.

113. As another month is close at hand, we are verging into summer's longest days, and the penetrating rays of the great demon of light shine straight down upon us. This, no doubt, is the most perplexing season during the whole year to the photographic manipulators. This is due to intense heat and strength of chemicals. How many of the readers of the *Philadelphia Photographer* can call back to memory the perplexity of working chemicals on a hot sultry day in midsummer? When it was cooler, a day or two before, all worked in harmony, and they rejoiced over their success and flattering results.

I can remember well when the foggy mists first visited me. No richness; no roundness; no beauty. No! Nothing but dead, flat, inexpressive results. Sitters out of patience, and chemicals out of order, and I at my wit's end, almost suffocating, locked up my room, and commenced to make up new chemicals. With care and cleanliness, I obtained results *fac simile* to the day before. I wished I had never seen a gallery or a picture, and my money invested in something else more profitable. But there is "a calm after a storm." My chemicals work smooth and uniformly; the hot weather does not seem to affect them. Why? Simply because I reduced their strength. Since that time I have used my chemicals thirty per cent. weaker in summer than in winter.

Therefore, I say to beginners, as soon as the foggy days come weaken your chemicals, and be careful in preparing them, and you will be rewarded with astonishing results.—W. W. Baldwin.

114. Too much importance cannot be attached to watching the temperature. Those

The solutions should be used weaker in summer than in winter, and at all seasons their temperature is better uniform. You are riding a bicycle while you are handling them. The road is never twice alike—rarely smooth and

who have always had the good fortune to work in first-class rooms, always kept at a warm temperature in winter (for it is at this season that troubles from this cause mostly arise), with every facility, can scarcely appreciate the difficulties that sometimes occur, from variations of temperature, to their less favored brethren; and even those who have first-class facilities often fail to provide for this most important contingency.

It was forcibly brought to my mind this winter by the change caused on account of working in a new dark-room, not provided with the means of warming and keeping warm the silver solution, especially as the temperature fell greatly at night, on account of the fires not being fully kept up then. It was a subject of remark in our establishment—the difference in chemical effects produced in the dark-room attached to the old light, and that of the new.

Every morning, until the temperature of the room had been up to seventy degrees, and for over three or four hours, the plates would coat slow, with liability to streak, work slow, and develop slow; while heating the developer made the liability to streak only more manifest, as, in order to produce good effects, the bath and developer should be of nearly equal temperature.

Nothing has *greater influence on sensitiveness than the temperature before or after development.* Of course, the developer must be warmed also; but the full benefit is to be derived by having this a few degrees warmer than the bath, *but very little.* When a cold bath is used, and a warm developer, the image will develop more rapidly than with a cold solution; *but no more detail will appear than with the latter.* It must be borne in mind that when the chemicals are kept up to the temperature mentioned, the bath must be weaker than when used cold.

I find, in examining our negatives, that the best results are obtained in the spring and fall months, and in summer, when the temperature is not over 80°. Extremely hot weather has its drawbacks, and causes too rapid drying of the plates; but if the dark-room be not excessively hot, very little trouble is experienced, in comparison to that caused by a cold room in winter.

One point must not be lost sight of, viz., that the temperature of the plate, at the time of exposure, exerts a greater influence than any one thing, so far as temperature is concerned. *Using a warm developer on a cold plate helps but little, and often causes greater inequalities in the result.*

The greatest amount of sensitiveness is obtained when there is the least difference in strength between the bath and the salts in the collodion consistent with rapid coating; which result is to be obtained only by keeping the bath solution at a good average temperature.—D. BACHRACH, JR.

Attention has often been called to the fact that chloride of silver is far less soluble in cold than in warm solution of hyposulphite of soda; and, though no evil may be anticipated from using the solution of the usual strength in accustomed operations, the fact remains that more time is required, for instance, to fix a print when the temperature of never the same for a whole day at a time. You are, therefore, required to be on the alert continually.

115. I have spoken of atmospheric changes. The air is one of the worst disturbers of the peace there is, so that protection against its influences is quite an essential thing to look after. It not only deteriorates the solutions, decomposes and discolors them, but in the most wily way sometimes saps their strength.

the solution is low than would be needed under ordinary circumstances. And it is under such contingencies—cold solutions, cold atmosphere, and general cheeriness of working—that assistants, unless with a fine moral sense, are apt to hurry rather than linger over their work, as chemical requirements really would indicate. Hence, during all cold weather it may be taken as a standard rule that the fixing solution should be of a slightly increased strength.

Naturally, it will not be necessary, where perfect arrangements exist for keeping the dark-room at a uniform heat, to make so material an alteration in the proportions, but it must ever be borne in mind that a temperature which, on a winter's day, would be considered warm and comfortable, would in summer-time produce a feeling of chill. Thus no operator would complain of a dark-room at forty-eight or fifty degrees in winter, though in summer he would consider it actually cold. Again, there are very few rooms where, night and day, the heating is kept up.—BR. JOURNAL.

115. When it is desired to protect oxidizable aqueous solutions from the action of air, the best plan is to take advantage of the properties of the paraffines, for paraffine, whether solid or liquid, will effectually exclude the air on the one hand, and prevent evaporation of the water on the other. Few chemical substances will attack it, and among those which do so are none likely to be used in photography. Some photographers already use common liquid paraffine upon the top of their stock developer, to protect it from the air, for then it is safe even from the attacks of the air inside the top of the bottle. A device has, however, to be called into play to draw off some of the developer when wanted; as simple a plan as any would be to use a little glass barrel with a glass tap, and cover the developer with half an inch in depth of liquid paraffine. The tap should be lubricated with another paraffine, namely, vaseline.

The imperfections of common ground-glass stoppers as a means of excluding air from the interior of bottles, is scarcely sufficiently recognized. Ground-glass consists of an infinite multitude of small hills and valleys; consequently, when two such rough surfaces are laid one against the other, plenty of small irregular channels exist, through which air can pass between the pieces of glass. Alterations in temperature exercise a pumping action inside common-stoppered bottles; the interior air or vapor expands by heat, and contracts by cold, thus causing currents backward and forward along the space between the stopper and the neck of the bottle, but the little channels being so very small, the pumping action is much retarded. For many purposes a good cork is in several respects more convenient than a stopper of the common type.

Coming now to the question of the best lubricants for stoppers, the paraffines stand at

Again, air becomes a pest when it finds its way into the solutions in too great quantities, so that its expulsion becomes sometimes quite a matter of labor and anxious care.

116. Pure water is one of the absolute requirements of success in photographic chemistry. It need not always be distilled, but it should be chemically pure.

the head of the list for the protection of all but the few chemicals which attack or dissolve them, their affinities being of the most limited. The hardest of the series, and the one which has the highest melting point, is the mineral paraffine, ozokerit; next come the softer paraffines, produced in the destructive distillation of vegetable matter, and which can be obtained with varying degrees of hardness; next come vaseline and ozokerine, which are of the consistency of soft grease, and, last of all, the liquid paraffines are available. Vaseline and ozokerine are the best substances for lubricating the stoppers of bottles; should the two substances for some purposes not be deemed hard enough, by mixing with them one of the softer solid paraffines, a hydro-carbon paste of any desired consistency can be obtained.—W. H. HARRISON.

116. Pure water is something in which everybody should be interested, but to the photographer it is a necessity, if he would avoid numerous vexations and trouble. There are many methods employed by the disciples of the art for obtaining the necessary article, but most of them are open to more or less objection.

During my recent experiments with bromized gelatine emulsion, knowing the very sensitive nature of gelatine to evil influences, and its proneness to act just as badly as it can under all circumstances, sometimes taking advantage of the slightest departure from the proper course and procedure on the part of the operator to spoil the whole batch, I found myself at a loss to know how to obtain *pure water*.

I had a tin can made three inches greater in diameter than the bottle I used, and three inches deeper. One end of the can was left open, and a tin bottom placed in the other end, with a neck in its centre a half inch larger in diameter than the neck of the bottle, and a little shorter.

The bottle was then placed in the can bottom up, the neck of the bottle inside of the neck of the can. Four tin braces were then soldered to the sides of the can inside, around the bottom, their object being to hold the bottle in place in the centre of the can.

A strip of tin two inches wide, with turned edges to render it stiff, was then placed across the centre of the inside of the can, one edge resting firmly against the bottom of the bottle, and its ends firmly soldered to the sides of the can.

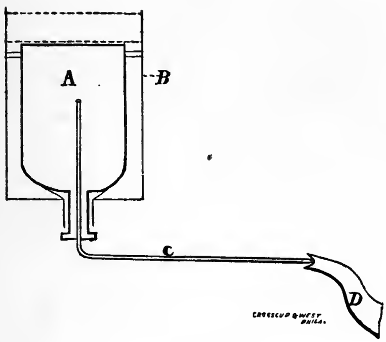
The object of this strip is to hold the bottle down securely when the can is full of water. The space between the tin neck of the can and the neck of the bottle was then filled with plaster-of-Paris cement, rendering it water-tight.

I then took a piece of glass tube about eighteen inches long, and six inches from one end I made a right-angled bend, by holding the tube in the flame of a spirit-lamp until heated sufficiently to bend. The can was then set upright on a suitable support, which, of course, placed the bottle inside of it inverted, with its neck protruding downwards through the bottom of the can. The can was then filled with cold water.

There are many methods in use for obtaining pure water. For some purposes it may be rendered so by easy chemical means, while for others it must be distilled or boiled. The means will be explained as we proceed.

The short arm of the glass tube was then placed upward through the neck of the bottle, fitting loosely, and the other end of the tube was placed in the spout of a boiling tea-kettle, the joint between the spout and tube being wound with a strip of muslin, to render it nearly steam-tight. The steam from the tea-kettle now passed through the glass tube up into the bottle, and coming against the cold sides of the bottle was condensed, and ran down out of the neck of the bottle into a glass dish placed below to receive it.

FIG. 241.



The condensed steam coming only in contact with glass surfaces produces water absolutely pure, provided the manipulation is intelligently and carefully conducted.

The accompanying rough diagram will give a general idea of the construction of the apparatus. *A* is the bottle, *B* the tin can, *C* the bent glass tube, and *D* the spout of the tea-kettle.—JAY DENSMORE.

The published instructions issued by the Eastman Company for the preparation of the developer for use with their negative paper, raise the question in the mind of the reader why the solution does not deteriorate in a very short time; yet I was told that some of it, of light color, which I saw in use on their premises, had been prepared a fortnight before. The official formula is: Warm water, sixteen ounces; sulphite sodium crystals, pure, half a pound; allow to cool, and add one ounce of pyrogallic acid, and then a quarter of a pound of carbonate of soda (not bicarbonate of soda). For use, dilute one part of stock solution with four of water. Thus but one solution is used for developing purposes, except in cases of over-exposure, when a little bromide of potassium is added. Here, then, is a highly alkaline developer which keeps, so I asked the operator why it did not blacken and decompose rapidly. He replied that it depended upon using water which had been boiled; if unboiled water with the normal proportion of air in it were substituted, the developer would blacken rapidly, and go on blackening, he said, after it had absorbed all the oxygen of the air held in solution in the first instance, by the water. The sulphite of soda must also be very pure; indeed, the photographic merits of this salt never come out unless it is pure.

The foregoing facts seem to show that there are great advantages is using boiled water for pyrogallol stock solutions, and this, combined with M. Audra's system of development, will conduce to comfort and efficiency in the future use of this unstable organic absorbent of oxygen. Boiling for a few minutes does not get rid of the whole of the air and traces of other gases dissolved in water, and perhaps the properties of water properly freed from dissolving gases might be worth trying in photography.

Tests for the purity of photographic chemicals are not often rendered necessary in these enlightened days of photography, for the reason that no reputable dealer will dispense a bad quality willingly.

If the photographer is in doubt, however, he is unwise to continue using

Rain water, after a prolonged downpour to clear away the floating dirt in the atmosphere, is the purest water naturally available, it having been distilled by the heat of the sun; but every hundred cubic inches of such water contain about two and a half cubic inches of air and of gases mixed in small proportion with the said air. Water freshly distilled is not free from air. To get rid of this air, it is necessary to boil the water steadily for not less than one hour, with brisk boiling for a few minutes at the close, to drive all the air out of the neck of the flask, when it is intended to close the latter, which should be strong enough to bear the pressure of the external atmosphere, when, by cooling, a comparative vacuum is produced in the upper part of the vessel.

The remarkable instrument, the water-hammer, is made by taking a V-shaped glass tube, say, with each of its legs eighteen inches long, and an inch in diameter; this tube is closed at one end. Thoroughly boiled water is made to fill the tube, and is then boiled nearly half away in the tube itself; when the ebullition is at its briskest the open end of the tube is softened by heat, the tube is then withdrawn from the flame which produces the ebullition, and the moment that ebullition ceases the softened opening of the tube is closed. Thus enough well-boiled water is left in the tube to fill one of its legs completely, and about one-fourth of the other leg. If the water-hammer be turned bottom upwards, thus Λ, when one of its legs is quite full, the water in the other leg will not fall; it refuses to obey the law of gravity unless the tube be tapped, and when the water is made to fall it produces a somewhat metallic sound, like one hard solid body striking another. In fact, air in water acts as a kind of elastic spring, and when that air is removed the particles of the water lock themselves more firmly together. Thus water, scientifically boiled until it is free from air, has curious properties, and whether it will by absorption permeate an air-charged gelatine film more rapidly than other water, or whether it will exercise any influence upon the delicately balanced phenomena of photographic development, is worth trying.—W. H. Harrison.

The carbonic acid contained in ordinary water tends to the injury of photographic prints in the washing stages. Mr. W. M. Ashman pointed out the injury done to prints by washing water containing carbonate of lime, especially when particular samples of paper were used.

Pure carbonate of lime, and carbonate of magnesia, are both insoluble in pure water, but are soluble in water containing carbonic acid gas. A gallon of rain-water usually contains four cubic inches of nitrogen, two cubic inches of oxygen, and one cubic inch of carbonic acid. The latter is the solvent of the chalk and limestone rocks; the minute traces of carbonic acid in water carved most of the beautiful scenery of Derbyshire, cut its river beds deep in rocks and dissolved out its caverns, carrying off in weak solution its limestone and its chalk, to injure the prints of inoffensive and unsuspecting photographers living lower down on the banks of the rivers. Because of the solvent action of carbonic acid in water, the scenery of extensive limestone regions is always beautiful;

what does not seem to give him the very best results. There is no excuse whatever for the production of bad photographs when such perfect appliances and such excellent materials are to be had readily in the best market in the world.

117. In all things be exact—even "old maidish." It is just as easy once the bad habits are broken and careful ones acquired.

the lower Valley of the Wye, about the region of Tintern Abbey, is a good illustrative case in point.

The way water companies usually soften chalk-water, is to add more lime to it; the carbonic acid takes this up to form carbonate of lime, which is precipitated along with the carbonate of lime previously held in solution. This can be done on a small scale, by strring up a very small quantity of lime with the water in the water-butt, taking care not to add more than enough to neutralize the carbonic acid; the whole of the lime in the water will then be precipitated, and time should be allowed for it to settle. Bischof, about the best authority on the subject, says that one part of carbonate of lime dissolves in about 1000 parts of water saturated with carbonic acid. Fresenius, however, states that it dissolves in 8834 parts of boiling water, and 10,600 parts of cold water, a difference from his own results, which Bischof remarks that he cannot explain.—W. H. Harrison.

Water Tests. Test for Hard or Soft Water.—Dissolve a small quantity of good soap in alcohol. Let a few drops fall into a glass of water. If it turn milky it is hard; if not, it is soft. *Test for Earthy Matters in Alkali.*—Take litmus paper dipped in vinegar, and if, on immersion, the paper returns to its true shade, the water does not contain earthy matter or alkali. If a few drops of syrup be added to a water containing an earthy matter, it will turn green. *Test for Carbonic Acid.*—Take equal parts of water and clear lime water. If combined or free carbonic acid is present a precipitate is seen, to which, if a few drops of muriatic acid be added, an effervescence commences. *Test for Magnesia.*—Boil the water to a twentieth part of its weight, and then drop a few grains of neutral carbonate of ammonia into a glass of it, and a few drops of phosphate of soda. If magnesia be present, it will fall to the bottom. *Tests for Iron.*—1. Boil a little nut-gall and add to the water. If it turns gray or slate-black, iron is present. 2. Dissolve a little prussiate of potash, and if iron is present it will turn blue. *Test for Lime.*—Into a glass of water put two drops of oxalic acid and blow upon it; if it gets milky, lime is present. *Test for Acid.*—Take a piece of litmus paper. If it turns red, there must be acid. If it precipitates on adding lime water, it is carbonic acid. If a blue sugar paper is turned red, it is a mineral acid.—*Public Opinion, London.*

117. In the course of conversation with photographers having a large staff of operators, printers, etc., they have not infrequently complained to us of the irregular results that were sometimes observed in a day's work, both in the operating-room and the printing department; while, among those amateurs whose time for photographing is limited to an occasional afternoon, the most common complaint is the uncertainty of processes in their hands. But this need not, and should not be. In an important branch of science, looking at photography from its physical aspect, for the results to be uncertain, and the

Chemicals sometimes seem to be like human beings. We have many of us been employed by others. In photography especially, we know how much more satisfaction there is in laboring for a man who understands the art himself—who is *master* of it in every detail—and, therefore, though very exacting, he understands and appreciates our efforts better. The chemicals seem to feel

exact conditions governing them to be unknown or neglected, is most unworkmanlike, and can have no other tendency than to degrade the importance of photography in the eyes of scientific workers generally.

The vast progress made in chemical science, for instance, during the last few years, would never have been achieved had no more attention been paid to rigid exactitude than is commonly given in the practice of photography; neither would the marvellous commercial production of complicated chemical substances have arrived at its present stage of magnitude and excellence if the strictest watch had not been kept at every stage of the process to insure scrupulous attention to the carrying out of all the necessary conditions. But in even the largest photographic establishments how rare is it not to find such cases! How many operators and printers use their thermometers, their hydrometers, or the simplest form of *burette?* Rule of thumb prevails almost universally, with the result of many thousands of pounds' worth of material being wasted beyond redemption. True it is every one knows that in cold weather his chemicals require strengthening, and that in hot weather stains are apt to occur, and some little alteration is made by guesswork to bring things right.

What is required, however, is a set of tables for strengths of various solutions required for different temperatures, a few days' rigid examination of results under such varying conditions as are likely to occur, and such a tabulated statement of them as would enable each to alter for himself the chemicals he is using, or know from their strength and temperature the effects he is to expect, thus establishing the routine of operation on a thoroughly sound basis.

We may give an example of what we think ought to be possible in the hands of an ordinary and careful manipulator. Every morning he would take the temperature of his dipping-bath, and, as the strengthening or weakening of that solution would take up time, he would best bring it to a uniform temperature, which could very easily be done; but if time or circumstances prevented that being accomplished, he would refer to his table, and find for a given temperature what was the equivalent strength, and could then vary his developer according to the table—a definite alteration in strength of which would be given for, say, each two degrees of temperature. Working with a collodion or emulsion of uniform quality, he would then know at once what would be his results. Then, again, every few days, more or less, according to the greater or less work the bath has had, he might test its strength, and bring it up to the exact strength he considers best. And so, in the printing department, when the greatest irregularity usually is found, his table would show him what difference in strength would be equivalent to a fall or rise of a degree or two in temperature, and every time he prepared for floating the paper he would bring up the temperature or add strong solution of silver in cold, or *vice versa* in hot weather. The effect of an alteration of a few degrees in the temperature of the

the same way sometimes. Be careless with them and they will trick you. When you are exacting they are most apt to yield to your will and pleasure.

With the purpose of mastering them in every detail, let us now enter the mysteries of practical photograph production.

printing bath is most marked. So, again, in making his gold toning-bath; if he makes it of an acid sample on one occasion, and nearly neutral on another, he must expect to find want of uniformity of result; but if he make his gold as nearly neutral as he can before adding his alkali he will know exactly how it will tone.

These remarks are merely meant to give what we might term the skeleton of "practical" modes of introducing exactitude in all departments, and the preparation of such tables as we suggest would only require very careful attention and comparison of results. One set of tables would in practice suffice for all photographers; and, when they were really fairly applied in daily routine, their broad bearings would be thus learned by heart to an extent far more exact than the practical knowledge of even the most experienced operator—so much so that it would only be when results of especial exactitude were required that anything like "calculation"—the bugbear of the rule-of-thumb manipulator—would be needed.—AN ENGLISH PHOTOGRAPHER.

CHAPTER XIII.

DARK-ROOM CONTRIVANCES.

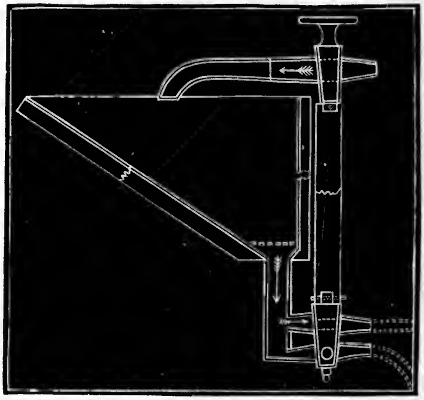
118. As a rule the dark-room is constructed on too small a scale. It should be roomy; arranged so it could be thrown open daily, and the air allowed to circulate freely through all its parts; well lighted and supplied with every convenience. And to entirely suit the emulsion process there should be an annex or secondary dark-room, where the stock of dry plates may be stored, holders changed, in case the dark-room proper is being aired, and where the over-supply of chemicals may be stored, so as to do away with shelves in the larger room as much as possible. I will offer some suggestions as to a model.

It is an old "wet plate" room "made over," we will say, and as will be

118. The sink I use in the dark-room, with a view of saving some of the silver usually lost during the development of negatives, is made thus:

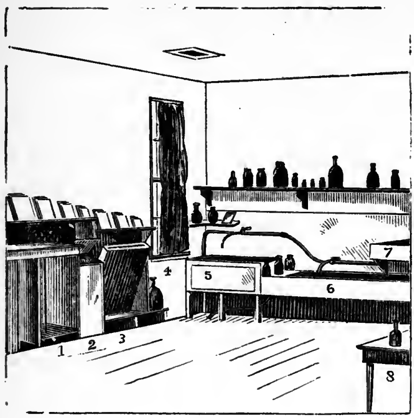
It consists of a box of wood, one side (which when in use forms the back) of which is upright, while the other three slope inwards toward the bottom, forming a sort of square funnel. This is lined with lead in the usual manner. The neck is formed by a piece of lead or brass tubing, about six inches long and one and a half inch diameter, and which is stopped at the bottom. Into this is inserted a sort of double stopcock, the plug of which is so bored that when *one* tube is open, the other is shut. These taps are firmly attached by means of an iron rod to the lower part of the tap used to regulate the supply of water over the sink; and are so arranged that when the water is turned on into the sink that portion of the stopcock leading to the water is turned on also, while that leading to the vessels containing the silver solution is turned off, thus allowing the water used in washing to flow away. The simple act of turning off the water supply at once turning off the escape pipe, and opening that leading to the reservoir containing the solutions which, of course, remains open until the water is again turned on for washing the plates.

FIG. 242



seen by the dimensions given, is suited for a moderate business. It is roomy, amply lighted, and well arranged. A drawing will help. The dark-room is at the northwest corner of the studio, convenient to the operator and yet out of the way. Entering the room we find on the left, or west side, 1, a dumb-waiter, communicating with the work-room on the ground-floor; 2, a small closet, used for filtering apparatus for the bath; 3, is the negative bath; 4, is a window with ruby glass, covered with a yellow curtain, and also furnished with a dark opaque curtain sliding on a rod, so that the room may be made very dark or moderately so, at will. At the north end of the room are three tanks, viz.: 5, 30 inches square, by 12 inches deep, for developing and first washings; 6, 30 inches wide, 47 inches long, 6 inches deep, for final washing of the negatives; and 7, 20 inches x 24 inches, and 3 inches deep, situated on a stand 18 inches over No. 6, as will be seen in the drawing, used for fixing the negatives.

FIG. 243.



No. 5 is always kept half full of water, and instead of having a waste-pipe merely, has an outlet through the floor of the room, down to a barrel on the lower floor, which catches the waste solution. (This waste solution after standing over night, in order to allow the silver to subside, is then drawn off every morning.) The fixing bath, by being smaller than and over the washing

If we now proceed to develop a plate, the overflow of the developing solution at once flows down the tube into the reservoir, and is saved; as is also the solution drained off on the completion of the development. Then the waste being turned on, the opening to the reservoir is closed, while that to the waste is opened, and the water flows freely away. For intensifying (and also for fixing, should cyanide be used), the same operation is gone through, and the solutions are thus saved without any trouble or loss of time to the operator.

A sink of this form possesses also the following advantages: first, there is no splashing, on account of the sloping sides upon which the water falls; and, secondly, that as the sink is kept drained, and is, in fact, washed out in the act of washing each plate, no injurious fumes are likely to arise to cause the ill health of the operator, as in the old form of sink, when the solutions were allowed to mix freely in an open vessel which was never perfectly freed from them.—J. C. LEAKE.

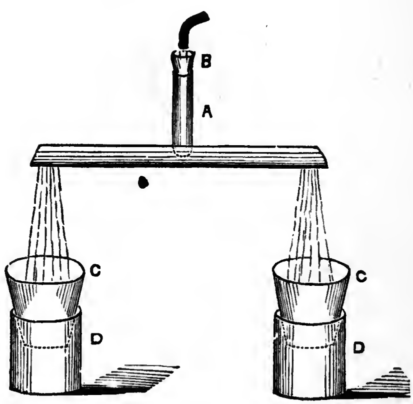
tank, and eighteen inches above it, permits the negatives to be taken out, and the droppings to fall into the washing tank, thus avoiding droppings of hypo on the floor. The developing tank is supplied with one faucet, and the washing tank with two.

119. On the east side is a table (8) on which are kept the plate holders. Between this table and the tanks 5, 6, and 7, is a long tank for plate-washing, 12 inches deep and 5 feet long; an inclined false bottom reaches from end to end, within 5 inches of the top at the back, inclining to the bottom at the front edge. Along the whole length is a perforated water pipe which casts a continuous stream over the plates as they lie one above the other, edge to edge on the inclined plane. Thus many plates may be washed at one time.

Over the tanks are nails to hang the negatives upon. All parts are painted. The floor is covered with brown oil-cloth; wiped with a damp cloth daily, and never swept. The walls are painted. No superfluities are allowed in the

For washing two negatives at once from one faucet, a ⊥ shaped instrument is made of tin. The horizontal part is nearly flat, and is pierced with small holes like those of a rose on the under side, at each end, not in the middle part. The vertical part, *A*, is a tube, about an inch in diameter, which is fitted by means of a cork, *B*, to the water-faucet. The water being turned on, a gentle stream runs from each extremity of the horizontal tube. The arrangement, *C*, *D*, represented beneath, is independent of the upper, and is very convenient for any negative washing. *C* is a tin funnel without any neck, and with sides sloping very gradually. It enters about half way into a large tumbler, or glass jar, *D*. (The large heavy tumblers made for cells for large-sized Grove's batteries are very suitable, and are what I use.) If now a negative be rested upon the upper part of the tin funnel, it will be found easy to arrange it so as to incline to any degree, and in any direction; and it will remain during washing steadily in that position, without shifting. The operator obtains without any difficulty such an inclination that the water falls on one end, and passes off at the other and at the same time keeps up a tremulous sheet over the whole surface.—M. Carey Lea.

Fig. 244.



119. The annexed sectional diagram illustrates a simple but very efficient ventilator, which may be easily fitted to any existing dark-room, with very little trouble or expense.

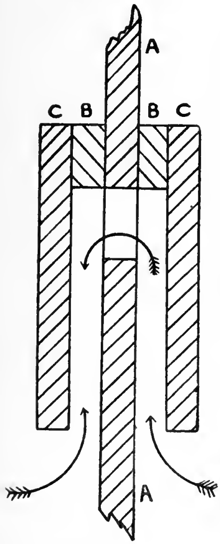
room. Its size is 16 feet wide east to west, by 14 feet long north to south. The tanks across the end of the room occupy three feet, leaving a very comfortable amount of space to work in. It is ventilated by an aperture through the ceiling and roof, and by the dumb-waiter, the mouth of which latter is level with the floor.

120. Between the dark-room and the annex is an entry three feet wide, with

I have long had these "air-holes" attached to my dark-room, and can vouch for their utility.

It is advisable to fix one at each end of the room; the first near the floor, preferably under the sink, for the inlet of fresh air, the other near the roof, for the outlet of exhausted or heated air.

FIG. 245.



A horizontal opening is cut in the wall (*A*) (which in England, almost invariably, is constructed of wood), from 12 to 24 inches in length, and 3 or 4 inches deep. Directly over the opening, at each side of the partition, is fastened a strip of wood (*B*) an inch or more thick, about 2 inches wide, and the length of the opening. To these strips are screwed boards (*C*) not less than a foot wide. All that now remains to be done is to fix strips at each end, so that the air and light can only enter at the bottom, the former following the direction of the arrows, while the light finds some little difficulty in turning the corners. Dust may be entirely excluded by glueing over the opening, at the inside, a piece of fine gauze.—C. C. VEVERS.

The greater part of the chemicals used in photography throw off poisonous fumes when exposed to the atmosphere. The dark-room is generally the receptacle for these articles and where they are most used. Therefore, it should be well ventilated. I have made two boxes two feet square, outside measure, and open at both ends. Have made three light partitions, two extending from one side six inches from either end, and twelve inches apart, extending to within six inches of the opposite side. Now from this opposite side and exactly between the two put another partition, extending to within six inches of the side to which the first two were attached. The partitions will be best fastened to the two opposite sides before putting the box together, but it is easier to explain it as I have attempted to do. Next fit the boxes in two openings cut at opposite points and next to the ceiling of your dark-room. Put the boxes in so that the air passes out at the upper side, as it is safest against defects or strong light this way.—M. L. CORMANY.

120. In the arrangement of large plates in the dark room it will be found convenient to have the light so arranged that a negative may be examined by transmitted light while developing, without handling it or the developing dish.

For this purpose the light must be one-half above, and one-half below a skeleton shelf, and the developing dish must have a glass bottom. Let the light be, say, twenty a window opening to the daylight, and glazed with ruby colored glass. This lights both rooms. On very dark days the gas is lighted in the entry.

inches square above, and twenty inches square below the shelf. Now make two curtains of heavy paper twenty inches square, and supply them with sticks at the top and bottom. Hang the one above the light by means of a cord pulley and balance weight, and suspend the other from the bottom of the upper curtain, so that there is a space of twenty inches between them. When you raise them, the light will be clear above the shelf, and when you lower them the light will be open below and closed above, and you can examine your negative at leisure.—F. B. ZAY.

I would call attention to the value of bichromate of potash solution for dark room use. By it we can obtain an excellent illumination, and at the same time it is very effective in stopping out chemical rays. Four years' experience in its use has confirmed my first impression as to its utility; but I can now give some further hints that may be useful.

In the first place, it is well, as involving less trouble and expense, to depend upon yellow paper, as heretofore, for the general lighting of the room, that is when a window of sufficient size is available; but to have some means of darkening this readily, when danger of fogging is apprehended. Then immediately opposite, and as near as possible to the place it is most convenient to hold the plate while developing, have one or two common cylindrical quart bottles filled with half-saturated solution; each should stand upon a small circular shelf with raised edge, placed at the bottom of an opening in a thin board partition.—JOHN M. BLAKE.

In this connection may be mentioned a device which has proved very useful as an auxiliary in enabling one to judge of the proper development of a negative. A square hole measuring an inch and a half on a side, is cut in the upper portion of the golden fabric, and a piece of red glass inserted between the two thicknesses. If a negative be now held near this hole, a red square of light will be cast upon it. This square can be seen even when the lights of the negative are quite intense, and by noting its distinctness, one can judge of the opacity of the high lights as accurately as he can of the details of the shadows of the picture. If the high lights reach their proper intensity first, he develops for the shadows, and *vice versa.*

As the whole question of the proper medium to use, resolves itself merely into what part of the spectrum to employ, red, orange, or orange-yellow, and all three of these yield nearly equally good results, it is evident that no important improvement can be made in the future. But as the orange-yellow is much the more pleasant light of the three, and seems to give rather less fog than either of the others, it is the color to be recommended. Any medium which will transmit this color will be found satisfactory, but golden fabric is, perhaps, as convenient as any.

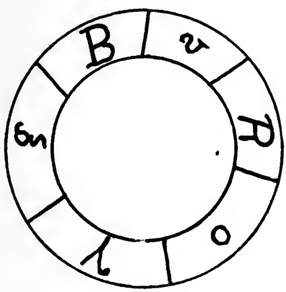
A very portable form of lantern to be used when travelling, consists of a strip of golden fabric a foot wide by two and a half in length. When one wishes to use it, it is rolled into a cylinder a foot long, and five inches in diameter, and pinned. A kerosene lamp with the wick turned down low, or a candle, is then placed inside, and the lantern is complete. The circle of white light formed on the ceiling is not bright enough to do

The communication between the rooms is by means of a door at the inside end of the entry. The holders, etc., are passed through the windows opening upon the entry.

any harm. The lantern is set several feet away from the exposed plates, and they should in general be protected as much as possible from direct illumination. There is then plenty of light, and yet not the slightest danger of fog.—WM. H. PICKERING.

Notwithstanding the old writers, there are but three primary colors—red, yellow, and blue. We know that these, and these only, are primary, because no admixture of any other colors will produce them, which is not the case with the rest; for orange is only a mixture of red and yellow, green is only the shading of yellow into blue, and purple is only blue blending into red. Now, as the last primary color in the spectrum is seen to join with the first in the production of the intermediate shade of purple, or violet, as it is usually called, we may with propriety curl the spectrum into a circle, in order to represent to the eye the inter relation of the triad of primary colors. In the annexed diagram let the capital letters, *R*, *Y*, *B*, represent the primary colors, and the small letters, *o*, *g*, *v*, the compound colors. Now, it is natural to infer that if we establish a certain quality as belonging to a certain color, when we seek for the direct opposite of this quality we should look for it not in any near color but in the opposite side of the spectrum thus returning into itself. It would take too much space to illustrate this at length, but a very pleasing method of testing the complemental colors is to fill the eye for some minutes with some strongly marked colored light, and then retire into the dark and observe the tint of the image presented to the optic nerves. If we have been looking at a pure red light we shall in the dark see a green image; if at yellow, we shall see violet, etc.; these colors, respectively, being on opposite sides of the sprectrum, as drawn in our diagram.

FIG. 246.



Pure blue, or, possibly, blue slightly tending to violet, is known to embrace most of the chemical rays. Hence, to find what rays will operate the least on our plates, we look to the opposite or complemental color, *orange*, and are not disappointed. But, whatever may be thought of the theory, the fact is, briefly, we are now developing our dry-plates in front of nine 8 x 10 orange lights, set back about eight feet from a good-sized outside window, and admitting light enough for one to read the finest newspaper type on a dark day. It must be understood that the darker shade of photographers' yellow glass is to be selected, not the canary, nor yet the very brown. Strictly speaking, very little of this glass is orange—as it should be—but it is near enough to that color.

The pleasure of working in an agreeable light, and plenty of it, will, we are sure, be appreciated by all our readers, and we urge them, after they have satisfied themselves, cautiously, that we are right, to save their eyes.—WILLIAM CURTIS TAYLOR.

I give you herewith my process for the automatic development of gelatino-bromide negatives, giving a coloration as intense as may be desired.

Where there is abundance of room and daylight is not convenient, it is a good plan to have a table in the centre of the room, and on it a huge ruby-colored lantern, lighted by gas or kerosene. A generous supply of light, well diffused, may be secured in this way, and no harm done, provided the color is right. Care and judgment is all that is necessary in a photographer to overcome whatever difficulties may arise.

121. I need not caution the photographer of to-day to be careful not to use

Red light, being the one having less chemical action on bromide of silver, and good red glass being expensive, here is a way to obtain it at very little expense. The window of the dark room, glazed with ordinary white glass, for an opening measuring 1½ yards of surface, dissolve 5 grammes (77 grains) of carmine in 40 grammes (1 oz. 2 drs.) of liquid ammonia. On the other hand, dissolve 2 grammes (31 grains) of picric acid in 450 grammes (14 ozs. 3 drs.) of water, to which 7 grammes (2 drs.) of glycerine have been added; introduce into this yellow water 50 grammes (1 oz. 5 drs.) of gelatine, which is allowed to swell for an hour, and then dissolved over a water bath. When the gelatine is melted, the ammoniacal carmine coloring is carefully added to it, and kept hot over a water bath; this mixture is spread with a flat brush over the glass. As soon as the first coat of the colored gelatine is sufficiently set, it may be covered with a second, and then a third coat; by this means it is possible to obtain a coloration as intense as may be wished.

In order that this brilliant red light should not fatigue the operator's eyes, place before the glass, instead of curtains, two strips of yellow paper, and the light of the dark room will then be in the best possible condition.—M. Cassan.

121. Last winter I began to be troubled with minute black specks being deposited all over the albumenized surface of my paper while washing my prints before toning, and could not discover at the time the cause. I inquired from a number of photographers in regard to my trouble, and all seemed to agree that it was the paper, so I procured a sample of two or three different makes of paper, and still the same trouble. The paper appeared to be clear when printing, but after washing was full of those black specks, which, on rolling after being mounted, would have a metallic appearance. I began to get very much discouraged, having made different silvering solutions, but still the same result, when at last I thought I would silver a piece of paper and not print it, but after drying place it in a porcelain-dish. Leaving plenty of light in my room, I drew some water directly on it from the tap, and by examining closely I could see small particles depositing all over the surface, which on examination proved to be iron-rust, having been loosened from the inside of a short piece of iron pipe by the frost over night, the moisture in the pipes freezing after the water was turned off. I caught and filtered some of the water, and was satisfied from the deposit on the filter that I had found the cause of my trouble.—J. B. Butterfield.

I have found a successful, neat, and durable bath-tub can be made at trifling expense, as follows: Make a box of wood, seasoned, of the size you desire. I would make it a metal pipes or vessels of any kind, which may contaminate his chemicals. To prevent such misfortune and leakage too, the tanks should be lined with asphaltum varnish, beeswax, or paraffine. A hint as to preparing substances for this purpose. Do not melt them at too great a heat. If you do, they become hard or brittle when cold, and are liable to crackle off, fall into the solutions, cause contamination, and fail of their purpose. Use slow heat; melt to the consistence of tar, and apply with a flat bristle varnish brush. The more coats the better. Sometimes a coating of vaseline is better than nothing at all.

little flaring or V-shaped, say three-quarters of an inch wider at the top than at the bottom. It must be tight.

Next, have made of tin or zinc, what moulders would call a *core,* to fit the shape of the wooden box, only about one-half inch *less* than the inside of wooden box all around. This core you will fasten or anchor by soldering double-seamed strips across the top, and let the ends be tacked to the wooden box. Now you see that the tin core is suspended inside of the wooden box with a space all round and at the bottom. Now get you a sufficient quantity of *pure* country beeswax, melt it, and pour around the core into wooden box; watch it carefully, and as it settles, fill up with more wax. Now, you see, you have a beeswax bath-tub with a tin lining. You don't like this? Well, take enough hot water to fill the tin core, first loosening the tacks holding the strips; lift quickly out of its place, and let it cool perfectly; if any asperities appear, shave them off. You now have a permanent, impermeable, insoluble, chemical-defying bath-tub. It will not open by shrinking or swelling of the wood. I would recommend a light coating of tallow inside of the wooden box to obviate sticking, if the wood should shrink, as will almost surely be the case after some use. Let it cool thoroughly before taking the core out. Pour the wax as cool as it will run.—A. R. C.

"I think paraffine can be of great use to photographers. Nothing surpasses it to coat wooden dishes with. I prefer such dishes to hard rubber, porcelain, or photographic ware. A good coating of paraffine for the inside, and two or three of white-lead paint on the outside, will make a wooden dish perfectly watertight. A very good silver bath-holder may be made in the same way. The dish or bath is well warmed, the molten paraffine poured into it and made to move all over the inside surface. Then, if possible, if the vessel be put into an oven just hot enough to keep the paraffine melted, it will penetrate more deeply in the wood and improve its water-tight qualities. Plate-holders made of wood, without glass or composition corners, by being put in the molten paraffine, will forever after refuse to absorb the silver, and will never produce stains. Manufacturers of camera boxes would do well to consider this, and all of the wood-work of the camera boxes would be improved by immersion in this useful protection. A camera-box made of dry wood, as it should be, and well coated in this way, would never warp or corrode by the nitrate of silver. In coating an object, it should be observed that the *hotter* the paraffine the more perfectly will it penetrate the wood.—Charles Waldack.

122. Allusion has been made to the importance of keeping the working solutions of a uniform temperature. In some buildings this is almost an impossibility in winter, while in summer the great trial is to prevent too high a temperature. Ventilation is also a subject which cannot be given too much attention, not only as a matter of health, but as help towards maintaining a uniform temperature. A clear atmosphere is by no means always the coolest one.

What I want to make the clearest, however, is the importance of keeping the various solutions at the proper temperature and to have them all, as nearly as practicable, the same.

Many devices have been offered as helpers, some few of which are added to the notes.

122. I send models of contrivances for cooling the bath, and for keeping collodion and other solutions cool and of equable temperature during hot weather. Fig. 247 represents the bath cooler, which is a simple box or case *A*, so contrived, with a metal case inside, and outlet for water, as to hold lumps of ice underneath and over the glass bath-holder.

FIG. 247.

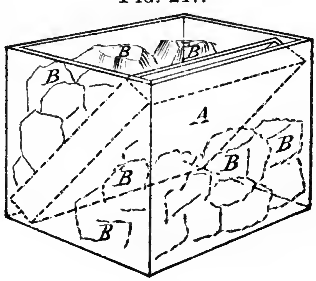


FIG. 248.

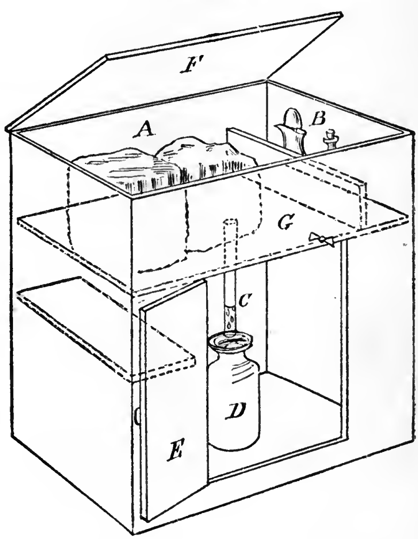


Fig. 248 is the closet or receptacle for keeping collodion, developer, etc., cool, and divided into the ice-box *A*; a receptacle for bottles and vials, *B*; an outlet, *C*, through which the drip flows into the vessel *D*, and the door *E*. Shelves are provided here and there for vials, etc. The size may suit the convenience of the user. This method of using ice for the purposes named, is a good one, and will prove a boon to many who have not thought of it.—SAMUEL ROOT.

First, my lamp for heating the burnisher; I give you an end and side view (Fig. 249).

If lamps are used in a dark-room the subject of ventilation, and clear, clean air becomes all the more important.

It is made of tin, with double flame, and a space between for the burnishing tool. It explains itself further.

Fig. 249.

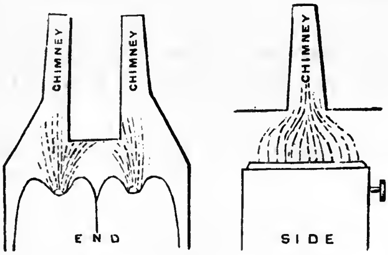
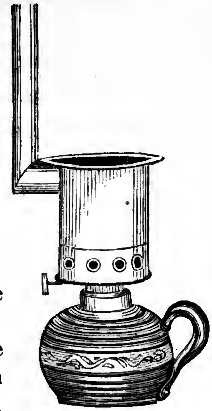


Fig. 250.



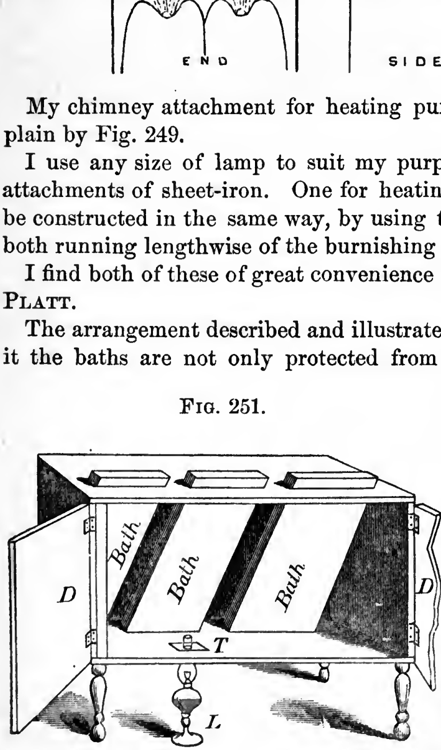
My chimney attachment for heating purposes, is also made plain by Fig. 249.

I use any size of lamp to suit my purposes, and make the attachments of sheet-iron. One for heating the burnisher can be constructed in the same way, by using two four-inch wicks, both running lengthwise of the burnishing tool.

I find both of these of great convenience and use to me at all times of the year.—S. L. Platt.

The arrangement described and illustrated below, will serve an excellent purpose. By it the baths are not only protected from accident, but a constant gentle warmth is secured at a very moderate outlay of trouble and coal oil. Developing and fixing solutions may be kept alike warm, so that no matter how cold the room, all things are in good working order, as far as temperature is concerned, as soon as the doors are opened in the morning. In the summer time, a dish of ice, instead of a lamp, will keep all cool.

Fig. 251.

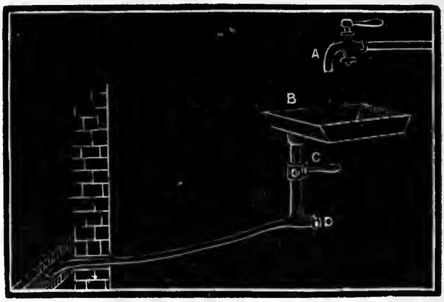


The apparatus may be cheaply and easily made, consisting only of a wooden box on feet, with folding doors, a support for the bath-holders, and a cover. *L* is a coal-oil lamp, placed under the box, the chimney running up through a piece of iron or tin, at *T*. *D D* are the doors. When the latter are closed, a very small flame will create an amount of heat quite sufficient for the desired purpose. The box should be made of light wood, and of a size to suit the requirements of the operant.—E. Long.

I have known photographers to keep their dark-rooms insufferably hot and close while their supply pipes in winter ran up from the ground outside.

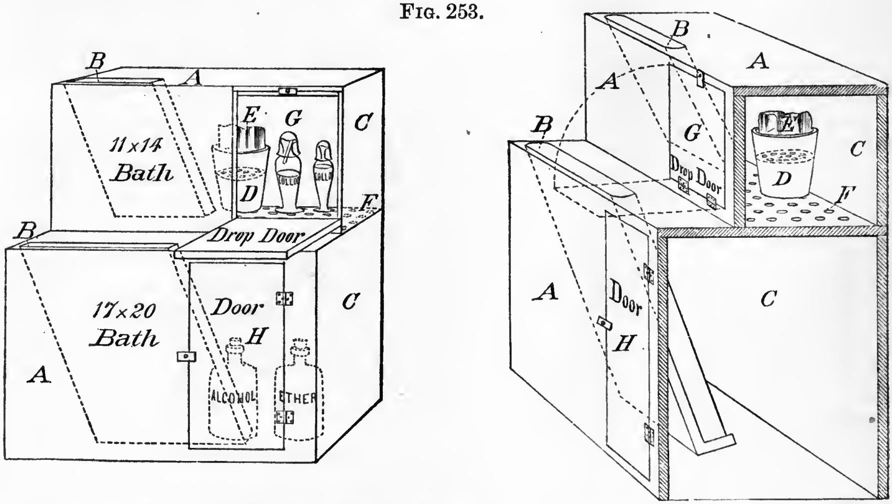
I send you a diagram of the way in which I have arranged my waste water pipe, as I have always been bothered in the winter season by having the pipes frozen up, but my plan now works to perfection, and is as follows: *A* is the tap over the sink; *B* the sink; *C* is a stop-cock which will hold the water in the sink until it is full; then I let it out at once and then turn the stop again; *D* is a nut which may be removed in case the pipe should get clogged up with dirt or lint; a long wire may be run through from *D* to push away any dirt. My waste is a three-quarter inch gas-pipe, and works to a charm.—T. M. Wells.

Fig. 252.



I gladly illustrate my method of keeping solutions cool in hot weather by a drawing. I have built permanently, in the proper place in the dark-room, a box in two sections, a small upper section, and a lower and larger section, substantially as shown in the drawing.

Fig. 253.



ing. The bottom of the upper section is completely perforated with holes an inch or more in diameter, through which the cold air from the upper section can pass down to the lower section; also, the warm air from the lower section rise to the upper section to become cooled by the ice (Fig. 253).

I have a pail made in two sections, the bottom of the upper section is pierced by

123. In some sections of our country "bad water" is the bane of the photographer, and he must distil all the pure water required in his work. In some establishments the still is running nearly all the time. The construction of a still is not difficult or expensive when the proper principles are followed.

The matter of supplying it with heat must also be considered. I have found an alcohol lamp—or rather one of the tiny, patent alcohol stoves sold everywhere, to do an immense amount of work, and it is always clean.

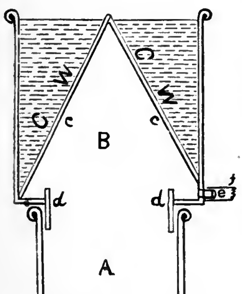
After distilled water is procured a convenient receptacle for supplying it is a comfort. Again we refer to the notes for help.

numerous holes, through which the water from the melted ice reaches the lower pail. I place in the upper pail from five to eight pounds of ice each morning, and place it in the upper section of the box. This will be sufficient to keep the two chambers at a temperature of about sixty degrees for twenty-four hours. The upper section contains the collodion and a small 11 x 14 bath; the lower section contains the large 17 x 20 bath, and the stock of alcohol and ether, and such other things as I wish to keep cool. In the drawing, *A A* is the box; *B B*, baths; *C C*, upper and lower chambers; *D*, pail in two sections; *E*, ice; *F*, perforated bottom of upper chamber; *G*, door to upper section, which, for convenience, I have hinged at the bottom, and drops forward in opening; *H*, door to lower section.

I have used this chamber for about eight years, with uniform success. If heat is required in winter, a gas-jet may be burned in lower section.—J. H. SCOTFORD.

123. I give you a sketch of an apparatus for distilling pure water. Some sixteen months ago a *man* told me about it, and I went right over to the tinman's, chalked out a drawing on his wall, and an hour afterward I had the whole affair "*biling*," and at a cost of only one dollar; here it is. It can be made of tin plate, or, better, tinned copper. It is so perfectly simple that really it requires no explanation. A is a round vessel, and the same height as its diameter, with a stout wire around the top edge; this vessel to contain the water to be distilled.—J. EDWARDS SMITH.

FIG. 254.



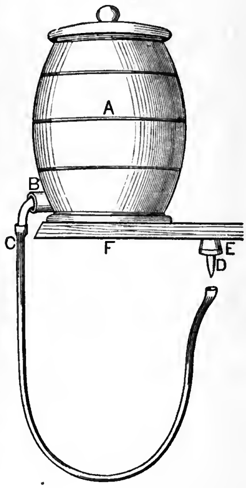
We all know the value of distilled water. The following will be found a good plan for getting it, as illustrated by Fig. 255.

A is an ordinary stone ice-cooler, sitting on the shelf F in any convenient place in the dark-room or elsewhere; overhead, for instance, out of the way. The outlet B is stopped up with a cork, with a piece of bent glass or metal tube through the centre. Over this tube one end of a piece of one-quarter inch rubber-hose C of the desired length is stretched, to carry the water wherever desired. The water is guided by holding the hose in the hand, and stopped by a pinch of the thumb and finger. When not in use, the lower end of the

124. Careful filtration is a necessity with many of the solutions used in photography, with varnish, emulsions and so on. The lighter ones are managed with paper filters. Others must be treated with apparatus contrived for the purpose. The contrivances are quite as numerous as their uses. Sometimes the apparatus used for filtering does not filter—at least not effectually. There should be no economy practiced in this direction. Get the best and save the most.

hose is stretched over the piece of glass-tube D, which has been heated, drawn to a point, and inserted in the second cork E, which is fastened under the shelf F, or at any other convenient place. Bore a hole in the shelf for the cork E to fit in.

FIG. 255.



It will be seen that when about to use the water, the hose should be pinched tight, withdrawn from the point D, and the end guided to the spot where the water is needed. The same arrangement may be used for other purposes also. To make the cork staunch in any such vessel, first fit it quite tight, and then dip it in hot paraffine; then heat the opening for the cork, and press it in, and when cool, it will be water-tight.—J. W. OSBORNE.

124. To make a plaited filter, take a rectangular piece of paper and fold it like a sheet of paper—that is, to bring two corners together, then (Fig. 256) fold 10 upon 2, and now always open the last fold after folding; then 10 upon 6, then 1—10 upon 1—8, then 2 upon 8, then 2 upon 6, 2 upon 4, and 10 upon 4. This will produce seven folds, all on one side of the paper. Make, now, folds between each of these, so as to raise ribs on the opposite side of the paper. Cut off the projecting corners, to give the whole a circular shape; open it, and form it into a cup (Fig. 257).—ALEXANDER SPICER.

FIG. 256.

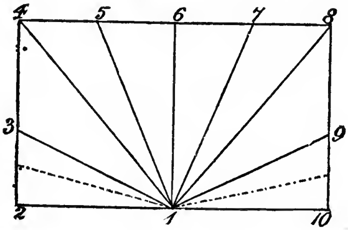
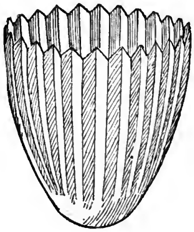


FIG. 257.



I take a common glass chimney, such as is used for coal-oil lamps, invert it in the top of a cyanide or other wide-mouthed bottle, cork up *both* ends of the chimney, cut a hole

When paper filterers are used see that they are clean and free from dust. They may be used over and over again for some purposes provided they are clean.

through the lower cork, and run a glass tube through it from the bottle to the chimney; now cut a few slits in the same cork, and then wind clean cotton-wool around it, and it is ready for use. The tube remains a fixture in the cork, but can be removed to clean, etc. Pour the collodion into the inverted chimney, and *cork* up the upper end, then you have as nice a filter as you can desire (Fig. 258).

FIG. 258.

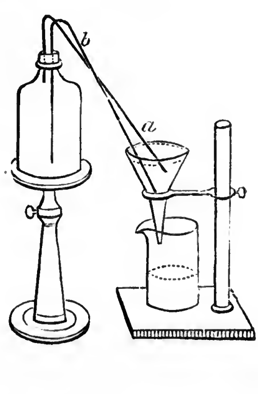
Perhaps you do not quite understand what I mean, so I will make a rough sketch, which will make it plainer to you.—C. ALFRED GARRETT.

As it is usually a matter of some importance in filtering a liquid that the filter should be kept full, and as it is very tedious to be continually attending and feeding during the operation, the following simple device will, I hope, be found of great service:

The bottle containing the liquid to be filtered is placed on a shelf or stand above the level of the filter. Through the cork (which must fit air-tight; it is better to put varnish around the top) pass two bent tubes; one end of *b* dips far enough down into the liquid to draw off just the amount you wish, the other descending deep into the filter. The tube *a*, at one end, reaches just below the mouth of the bottle, the other end being fixed at the height in the filter at which you wish to keep the solution.

Start the apparatus by sucking the liquid into the tube, *b*; it will flow steadily until it reaches and closes the lower end of the tube *a*, when by cutting off the ingress of air into the bottle, it stops any further flow till the liquid in the filter again sinks below the end of *a*. The minute *a* is clear, the flow will again commence, to be stopped as before, when *a* is covered. When the liquid in the bottle sinks below the end of *b*, the whole operation ceases (Fig. 259).

FIG. 259.



Determine beforehand how much of your solution you wish to filter, set *b* accordingly, start the thing working, and then leave it to itself, until you have need of the filtrate.—REV. CLARENCE A. WOODMAN.

I send you a cut of my Universal Filter (Figs. 260 and 261). I use it as follows:

For varnish or albumen I use an ordinary tin funnel; I first solder a tin band one inch wide on the top, then make the adjustable top of tin to fit in loosely; this consists of another band two inches deep. Spread a piece of cotton flannel over the narrow band on the top of the funnel, with

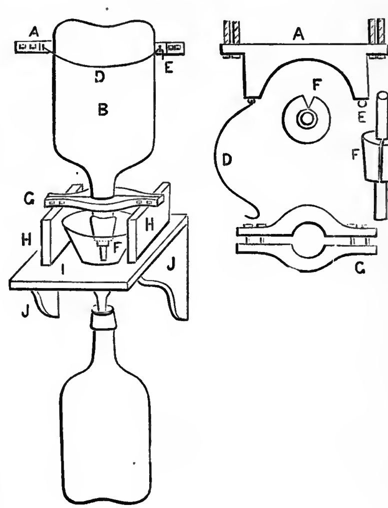
I have given so many hints from wise heads and wonderful dark-rooms that I am sure no one need use dirty solutions.

nap side up, then crowd in the wide band, which will draw the flannel snug. The filter is then ready. For varnish, wet the flannel with alcohol; for albumen, use a piece of muslin if the flannel does not filter fast enough.

Fig. 260.

Fig. 261.

Fig. 262.



I have used it for collodion, varnish, cream, milk, fat, paint, albumen, honey, and a host of other things I will not mention.—S. L. Platt.

I append drawings of my filtering apparatus, with full directions for its construction. Let *A* (Fig. 262) represent a piece of wood one inch thick, and a half disk sawed out, half the circumference of the demijohn, *B*. There is also a piece of soft wire, *D*, fastened at one end of the piece of wood, *A*; at the other end it is bent so as to hook into the screw eye, *E*, and thus keeps the inverted demijohn, *B*, in its place. This piece of wood is fastened at the proper height to any convenient wall of the apartment. The demijohn, *B*, capable of containing the entire solution of the bath, is provided with a cork, through which passes a glass tube about three or four inches long and a quarter of an inch in diameter; a portion of the cork is also cut out, as is represented in the drawing, *F*. Around the neck of the demijohn are two pieces of wood joined together, which enclose the neck, *G*. The demijohn being charged with the solution and corked, is inverted over a funnel containing the filter. The uprights, *H H*, support the piece *G*, and keep it from resting on the funnel. This funnel rests in a hole cut out of the shelf, *I*, which latter is supported by the brackets *J J*, which are, like the piece *A*, fastened to the

125. The subject of development is treated elsewhere, so that this department may be devoted entirely to the contrivances which make the dark-room

wall. The lip of the funnel either dips into another similar demijohn, or, if you prefer, into the bath-holder. You will observe that the instant the demijohn, A, is inverted, the solution commences running out, and the air-bubbles in, and the solution would eventually all run out, were it not for the fact that *the mouth of the demijohn dips below the top of the funnel;* consequently, as soon as the solution *reaches the cork* in the demijohn, the atmosphere is cut off from entering the hole in the cork, and thus matters come to a standstill *until* sufficient solution has run through the filter to again allow the air to enter the demijohn, when the solution runs out as before, etc. Should your bath consist of three or four gallons of solution, which would require many hours to filter, you have merely to start this simple piece of work at night when you go home, and in the morning the work is done.—W. KURTZ.

125. To protect pyro solution, use a layer of oil (I use good "headlight") about an inch thick. Same for ferrous sulphate or ferrous oxalate solution. The potassic oxalate solution has a disagreeable habit of crawling up the inside of the bottle and around the neck. A thin layer of oil is sufficient to prevent this.

FIG. 263

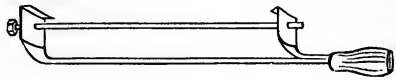
The method of operating is plain. Simply blow into the tube *A* (Fig. 263), and the pressure on the liquid will force it out of tube *B* as desired. Don't tip up the bottle towards the lower end of *B*, or it will be apt to act as a siphon. For the same reason the bent portion of *B* should not have the end lower than the level of the liquid in the bottle. If this bottle, in its simple form is not elaborate enough to suit, just attach a piece of rubber tubing to *A* with a rubber bulb (such as are fitted to the ordinary atomizers) at the end, and squeeze this in the hand. This will enable you to allow the bottle to stand on a shelf, which may be a gain when using large bottles.—H. SCHOONMAKER.

Various forms of holder have been proposed, for supporting the plate during its development and redevelopment, where this last is required, in order to save the hands from the silver stains, which are apt to be caused.

About a year ago, an idea occurred to me, which Mr. Zentmayer carried into execution for me, and which has proved, after very thorough trial, to be free from all objection. Fig. 264 will give a clear idea of it. A brass rod, just stout enough to have the necessary stiffness without being heavy, is inserted into a wooden handle, also another similar piece, much shorter. Each of these carries an arm about three inches long, the upper part of brass, but the lower half of solid silver. At the convenient and comfortable, and which serve to make the manipulator's lot a happy one. For those who wish not to soil their fingers, the caterers to the

bottom this silver piece is bent short at right angles. The two arms are connected by a rod passing through both. In one, it simply turns round, in the other hole there is a screw-thread cut, with a corresponding thread on the rod. This last has at its right-hand end, a mill-head. It is evident that, by turning this mill-head, the arms are made to approach or separate.

FIG. 264.



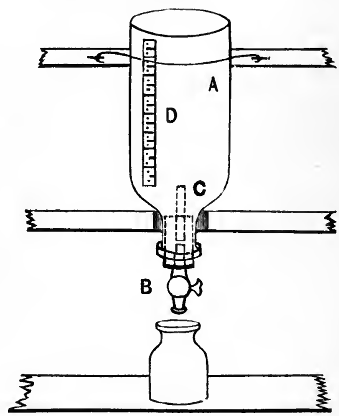
The space between the arms is such as to correspond with the size of the plate most frequently used. A holder can, however, be used for two sizes of plates, taking the larger size by its breadth, and the smaller by its length, as the construction admits of a certain degree of play. Thus, the writer's takes a 6½ by 8½ plate the long way, and an 8 by 10 the short way, there being but half an inch difference.

A firmer grip of the holder is obtained by partly squaring the round handle, which could not be very clearly shown in the figure.—M. CAREY LEA.

I desire to describe a very simple little piece of apparatus, which I have lately devised, for holding the developing solution, and which is in working use.

It consists of a two-pound acetic acid bottle *A* (Fig. 265), with its bottom removed, by the "alcohol string," or other of the well-known methods, sustained in an inverted position, as clearly shown in the sketch, against the wall of the dark room over the developing sink or tub, within easy reach. In the usual place is a good, tightly-fitted cork—sufficiently so to withstand the pressure of the bottle full of developer, into a hole in which a cork is placed from the outside a small faucet *B*, and to continue the connection to the interior of the bottle, a short glass tube *C*, which should be of such a length as to reach to about where the *straight* sides of the bottle begin. *D* is a scale constructed as follows: Paste upon the outside of the bottle in a perpendicular position, a strip of white paper one inch wide. Open the faucet *B*. Pour in water (through the top of the bottle) to fill up to the top of the tube *C*, where, of course, all excess will overflow. Make a mark upon the strip of paper where the water now stands; this is zero. Close the faucet. Now measure in your graduate sixteen ounces of water, and pour into the bottle; mark the level of the water now upon the paper strip, and then divide down to zero, with dividers, into sixteen spaces. These will represent ounces, and number them accordingly. This constructs the scale and makes the instrument self-measuring. Now empty out all the water by

FIG. 265.



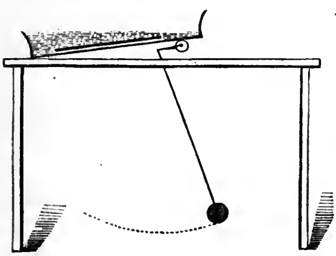
trade supply many little conveniences which I need not describe to you. Notes, however, of one or two things which may have been overlooked, come in place right here.

removing the holder from the bracket. Replace. Now fill up to zero with your common admixture of developer. Below this now it will never fall, and is considered to be empty.

Its manner of use is already anticipated by the reader. Faucet closed. From your stock-bottle of concentrated iron solution, pour two, three, or four ounces, as your formula or *judgment* dictates, which amount, remember, is being indicated upon your paper scale as you pour; then the water, acetic acid, alcohol, all of which is being measured and indicated in the same manner.—WILLIAM ROBERT BROOKS.

For a long time I have been using a very convenient device to give a continuous rocking motion to the dishes containing the negative and developer for dry plates. It consists simply of a pendulum, made from an iron rod, the upper portion of which is bent into an elbow, and furnished with a small wooden or copper wheel. The rod passes through the laboratory table, in which a hole has been made, and there is its point of suspension. The lower extremity of the rod, which reaches nearly to the floor, carries a weight of about nine pounds. When an oscillating motion is given to this weight, the elbow, which is elevated a little above the level of the table, rises and falls alternately, transmitting its vertical movement to the bottom of the dish resting on it. This dish has no backward or forward motion, as the small wheel turns in following the oscillatory motion. The weight having been set in motion will continue swinging about three minutes, slowly and regularly (Fig. 266).—E. COURTIER.

FIG. 266.



Mons. Gabert's novel developing apparatus is, I may say, an hydraulic engine, and has the advantage over all other oscillating apparatus, that it continually goes on working without any aid from the photographer.

In looking at Fig. 267, it can be seen that this apparatus resembles a large pair of scales. *D* is the beam, supported by two bearings, *G G*, firmly screwed into a strong table; on one end of the beam is a flat space to stand the developing tray, on the other end is attached the hydraulic box. When the tap *A*, is opened, the water from a reservoir fills up the box to the dotted line, *C;* this end of the scale has now become the heavier and falls, and shoots out all the water; the other end of the beam, bearing the tray, now falls down, the water continues to fill up, and causes the other end to go down, and so on every minute, or part of a minute, and so keeps the liquid in the developing tray in constant agitation. The springs at each end of the apparatus are to soften the shock, and by their elasticity aid the end to rise. In order

FIG. 267.

The "veteran" will smile at some of these niceties, but that is often because he will not employ them and does not realize how very useful and convenient they are.

I never show any disrespect to a manipulator who goes about with stained fingers and varnished thumbs, and yet in these days when photography is becoming more and more one of the refined arts it behooves us all to present it to the public as sweetly as can be.

A real careful worker may maintain a cleanly appearance of things without any of those "extra tools." I have the highest respect for such a worker.

In all these instances have *good* "tools." You have no right to expect good results unless you do.

to obtain the proper equilibrium, a weight is laid upon the beam, *D*, and shifted at will toward or from the fulcrum.—PROF. STEBBING.

Some developing dodges come in good right here. The first is a plate tongs (plattenzangen), a contrivance for handling the plate during development, and other operations wherein it is desirable to keep the fingers clean, or to preserve them from the action of the solutions.

FIG. 268.

FIG. 269.

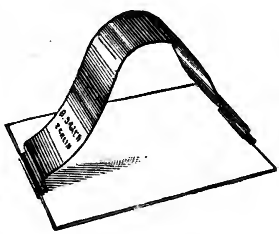
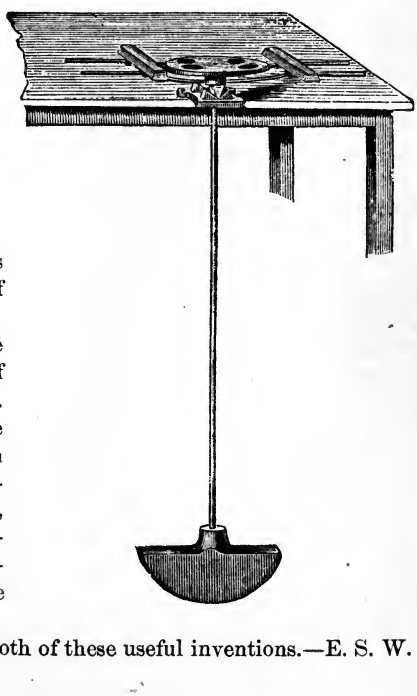


FIG. 270.



A band of silver is so bent as to answer the purpose, strong enough to secure the safety of the plate during the handling (Figs. 268, 269).

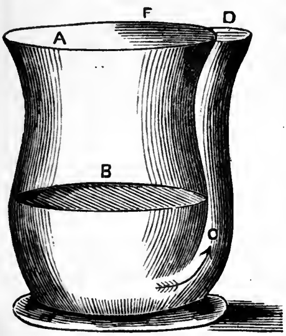
The other is a contrivance for rocking the plate during the development. Its construction is made very plain by the drawing. This machine (Schankelapparat) may be large or small, according to your requirements. The dish containing the plate is set upon the bed-plate, fastened in place, the pendulum started, and the operation goes on automatically (Fig. 270).

We are indebted to our German friends for both of these useful inventions.—E. S. W.

As the mechanic is known by the tools he works with, so too should the artist photographer use none but the best, and have them conveniently placed and in good order for immediate handling. Then, and only then, will he

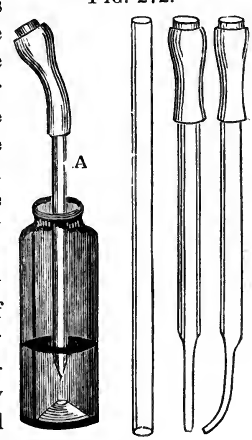
The following idea for a developing cup may be useful to those who use the gelatino-developer. *A* (Fig. 271), opening to pour in the developer, which, filtering through the perforated partition B, passes, when used, through opening of arrow, O, out of mouth, D. F is a covering to prevent the unfiltered solution from overflowing when tilted by the operator. It might be difficult and expensive to have them made of porcelain or glass. Could they not be made of gutta-percha? Of course, when the photographer has determined to use gelatine in the developer, he will have some ready filtered; but when some, after standing, is required speedily, a vessel like the above would surely prevent a plate from being injured.—DAVID DUNCAN.

FIG 271.



By using the little pipettes described below (Fig. 272), the photographer can take from any solution desired, drop by drop. They are five or six inches in length, and about three-eighths of an inch in diameter. The photographer can make them for himself, by procuring a glass tube ten or twelve inches long and of the proper size. Heat it in the middle by gradually lowering it into the flame of a spirit-lamp, keeping it constantly turning so as not to expand the glass unevenly, thereby causing it to break. When it has become very soft and pliable, it must be pulled suddenly apart, thus causing the separated parts to be drawn out into very fine points; break off one of these points, and you will have a tube with a very fine aperture. Procure a piece of elastic rubber tube two or three inches long, having an inside diameter a little smaller than the outside diameter of the glass tube; close one end with a cork, and slip the other end on to the glass tube, and your instrument is complete. If you want a larger hole in the end, you have only to break off more of the point.—D. EDSON SMITH.

FIG. 272.



I have found a great convenience in the employment of a new dropping-bottle, the description of which, I think, will be of service to our readers. It is easily constructed, and works very well, little or no evaporation taking place. To fit up the apparatus, fit cork *b* (Fig. 273) firmly into the neck of bottle *a*; now pull over the neck the lower part of the India-rubber pear, and fasten it on with a string, or with iron or brass wire. Now fit cork *c* into the top of the India-rubber pear, and fasten it tightly in the same manner. Take the curved glass tube, and push it down the centre holes of the two corks into the bottle; the apparatus will appear as in Fig. 274.

reap the benefit of seeing how easy it is to accomplish the mysteries of the dark-room.

To set it at work, press the India-rubber pear in, taking care that the thumb covers the small hole *e*; the air contained in the pear will rush through the small hole in cork *b*, and press upon the liquid in the bottle. The liquid will make its way up the glass tube, and make its exit either rapidly or in drops, according to the pressure of the hand upon the India-rubber pear.

FIG. 273.

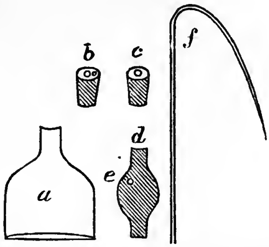
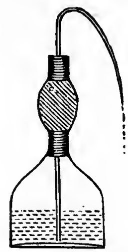


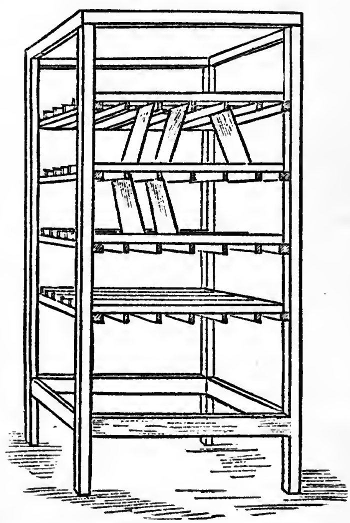
FIG. 274.



a, glass bottle with tubular neck. *b*, cork perforated by two holes. *c*, cork perforated by one hole. *d*, India-rubber hollow pear. *e*, small hole punched in India-rubber pear. *f*, a curved glass tube.

To fill the apparatus, draw out the glass tube, and put down a long, thin tube, with a glass funnel at the end. The liquid will easily make its way down, as the air will be expelled by the hole in the cork into the India-rubber pear, and thence through the thumb-hole *e* into the atmosphere.—PROF. E. STEBBING.

FIG. 275.



I find the four poster a very useful piece of apparatus for drying plates. I will give the size of mine; but, of course, other sizes may be more convenient (Fig. 275). The four posts are six feet long and one inch and a half square. The first operation is to place these posts in pairs, and mark upon them lines indicating the places where the supports for the shelves are to be screwed. The intervals between these supports must be according to the size of the plates which are to stand upon the finished structure. My shelves are placed at different distances, so as to accommodate different sized plates. The supports, two feet long, and made of stuff one inch by three-quarters of an inch thick, are now screwed into their places, when the pair of posts have the appearance of two ladders. The shelves must now be taken in hand, and are conveniently made before being put into position. They are made of laths, about one

126. The siphon is an article which should hang as conveniently as the fire-extinguisher, for in case your tanks become clogged and threaten an overflow,

inch by three-eighths of an inch, which can be bought by the dozen at any saw-mill. These can be carefully measured off with pencil-marks, the upper laths being spaced out according to the size of the plates which are to stand upon them, the lower ones being intended for the top edge of the leaning plates to rest upon. At each point of crossing, the junction must be made good by one French wire nail.

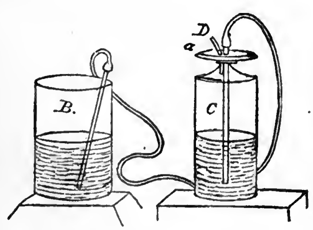
When the shelves are all in position, the general structure can be screwed together with tie-pieces, the back and sides filled in with black glazed calico, and a blind of the same material fitted to a roller in front. In my four-poster a closed gas-stove is fitted to the lower part; but this is not necessary for gelatine plates, which will soon dry if the room itself be not damp. The skeleton arrangement of the shelves permits a constant current of air to circulate round about the plates; but a better current can be insured by taking advantage of the rising property of warm air in the following manner.

It is well known that the admixture of certain salts with ordinary water raises the boiling-point of the liquid far above the stereotyped 212 degrees. Acetate of soda stands, I believe, at the head of the list in raising the boiling-point to 256 degrees.

My suggestion is, that at the bottom of the drying-box (which should be pierced with holes for the admission of air) should stand, on four short feet, a metallic vessel filled with a boiling solution of the soda. This hot box would cause a constant draught of warm air to rise to the plates standing in racks above it, and the retained heat would dry the thickest film in a few hours.

The four-poster is highly useful for other purposes than the mere drying of newly made plates. It can be used as a rack for glasses when they have received their final rinse under the tap after washing. It will serve the same purpose for negatives, which will quickly dry in such a position, particularly if the erection be brought close to a fire. At other times it will form a nest of useful shelves, where cardboard, paper, glass, and other things can be conveniently stored. It may be modified in various ways to suit individual wants. Thus it may be convenient to shorten the legs, so that the thing can stand on a vacant table; or the same kind of shelves can be fitted to an existing cupboard, in which case efficient light-tight ventilation must be strictly enforced.—T. C. HEPWORTH.

FIG. 276.



126. My siphon is supplied with a glass tube at one or both ends, so as to fit tightly through the disk *a* (Fig. 276). The disk is covered on the under side with rubber, so that by pressure it will make an air-tight connection with the mouths of bottles or other vessels, which you may wish to empty or fill. Now, as in the illustration, to empty the bath *B* into the bottle *C*, lower the bottle and press firmly on the padded disk (*a*), and with the mouth draw air from *C* through *D*. Or, if you wish to empty *C* into *B*, raise *C*, press on the disk as before, and blow through *D*, which will force the liquid out of *C* to *B*. In this way you can empty or fill any vessel that the disk (*a*) will cover,

it might save you as much damage as the other. Again, for emptying solutions of all kinds from one vessel into another quickly, the siphon is of great service.

without (as in the old way) getting any of the solution in your mouth.—J. Ezra Gause.

Buy of any druggist a rubber bulb with an opening at each end, about four feet of rubber tubing and a glass tube such as is used in babies' nursing-bottles. Have the hole in the bulb and tubing as near the same size as possible, and the glass should be large enough to fit into the rubber snugly, to prevent any air from getting in. Use two pieces of the glass, each about one and a half inches in length, and press each piece about half

Fig. 277.

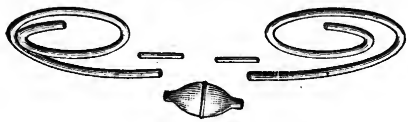
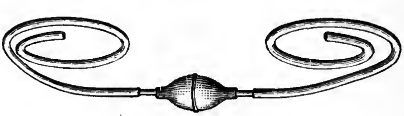


Fig. 278.



of its length into each end of the bulb; cut the rubber tubing in two at the centre, and press the end of each piece on the glass tubing, and the siphon is complete. It requires no cement to hold it together, and when one part becomes worn or injured a new one can be substituted without buying all new. These different parts will cost but from seventy-five cents to one dollar, and this siphon is worth more than one from a dealer which costs two or three times that amount, because there are no cemented parts to give out. When not in use it can be rolled up, put in a small box, and it is out of the way. It is used the same as any bulb siphon, by holding tightly the lower end of it while forcing the air out of the end in the solution to be drawn by pressing together the bulb (Figs. 277, 278).—W. D. Chandler.

Having used the following method of emptying large flat dishes containing silver solutions for some years past with perfect success, I thought a description of my method might not be unacceptable.

Every photographer knows how difficult it is to pour back the solution of nitrate of silver from a large flat dish into the stock-bottle again without spilling some portion of the liquid. By adopting the following method not a drop of solution need be wasted. Provide a cork that will fit into the neck of the stock-bottle, and with a cork-borer bore two holes in the cork, and fit each hole with a piece of glass tubing, a short piece and a long piece. To the short piece attach a piece of India-rubber tubing above the cork and to the other end of the India-rubber tubing attach another short piece of glass tubing. The long piece of glass tubing that passes through the cork must project above the cork some little distance, and should bend over slightly, so as to be able to apply the mouth easily to the end of it. Place the stock-bottle on a chair or box just below the bench on which the dish containing the solution stands; insert the cork provided with the two pieces of tubing into the mouth of the stock-bottle, and bring the piece of India-rubber tubing over the side of the flat dish, placing the piece of glass tubing at the end of it in the

I have added notes concerning a number of methods of using the siphon though in principle they are the same. A siphon needs to be pounded gently. If forced violently and it is caused to spurt, it will often do more damage than

liquid to be emptied. Then apply the mouth to the long piece of glass tubing, and exhaust the air from the stock-bottle, when the siphon formed by the India-rubber tube will at once begin to act, and continue running until nearly all the liquid has passed over into the stock-bottle. The dish should be tilted at one end. The small remaining quantity of solution may be easily poured out into the bottle.—THOMAS LATCHMORE.

How to Empty a Silver Bath.—Fig. 270 shows the position when the solution is passing from the bath-dish into the bottle. Fig. 280 shows the position when the solution is passing from the bottle into the bath-dish.

To make one of these siphons there is to be obtained a bottle large enough to hold all

FIG. 279.

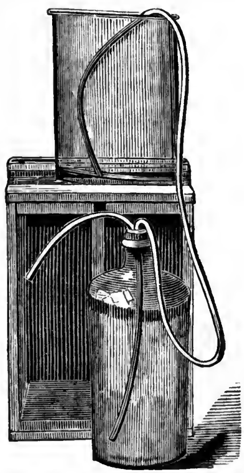
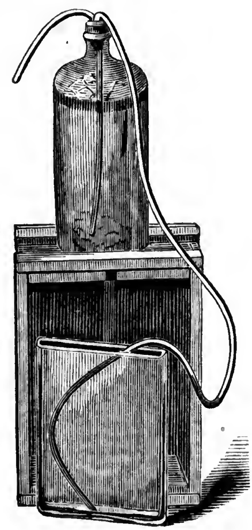


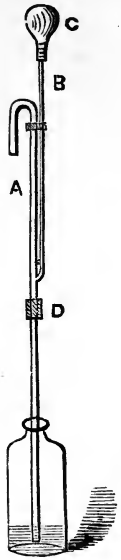
FIG. 280.



or the greater portion of the solution, and fit a cork air-tight in the neck of it. Now procure as much rubber-tubing as you may wish (size to suit taste) cut a short piece off, and pass it just through the cork. The long piece also passes through the cork down to very near the bottom of the bottle. These tubes should fit tight, to allow no air to escape in that direction. When all is ready set the bottle in position near the bath-dish, but *lower*, to allow the air to act upon the solution as it passes through the tube, for herein lies the secret of the siphon. Now place the loose end of the long tube into and extending to or near the bottom of the dish. Now take the loose end of the short tube in the mouth and draw upon it. When the solution begins to run into the bottle, your help, by way of "a sucker," is no longer needed, for it will "go alone" until all of the solution is you can cleanse out of sight for a long time. Give it thought, as you should all your manipulations.

out of the dish and into the bottle. If you wish to reverse this operation, set the bottle higher than the bath-dish, *and blow into the short tube* to start the solution.—I.B. WEBSTER.

FIG. 281.



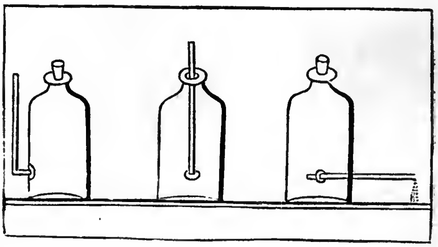
The accompanying drawing (Fig. 281) represents a siphon for removing silver solutions from trays, bottles, etc., without staining the fingers, spoiling or causing loss of solution.

In order to make the above siphon, procure glass tubing of a 7-16 bore, bend the end to a curve by means of a flame; at the lower part of the tube solder a 3-16 tube, and curve it upwards as in diagram. It is only now necessary to join to the top of *B* an India-rubber bottle. Another tube is joined to siphon *A* of sufficient length to permit it to touch the floor of the laboratory. A joint is made at *D* with gutta-percha, not India-rubber. To work the siphon, plunge the long end into the stock-bottle, which is placed on the ground, in which there has been purposely left a small quantity of the solution, put the short end of the siphon into the tray; it suffices simply to squeeze the bottle in order to expel the air. Open the hand, and immediately the siphon is at work. The small quantity of liquid left in the bottle performs the same office as if the end of the tube had been stopped with the finger. Should it be necessary to decant the solution from a deep bottle, join a piece of glass tubing upon the short stem by means of gutta-percha tubing.—PROF. E. STEBBING.

I am called upon to give a description of an easy method of decanting collodion, albumen, or, in fact, any other glutinous liquids. I offer for your appreciation a simple means which I have employed with success for the decantation of syrupy liquids.

Take a tubular bottle large enough to contain collodion sufficient for a day's work; into the lower hole put a cork, through which has been passed a small bent glass tube, which latter should be a little longer than the bottle is high (Figs. 282 and 283). The bottle being now filled with collodion is allowed to stand all night, so that all dirt and undissolved cotton may fall to the bottom, a cork being placed in the neck of the bottle, and one in the top of the glass tube, to prevent evaporation. (Vulcanized India-rubber corks, tubes, etc., should not be used for collodion, for the sulphur which is in them will be dissolved, and the silver bath will become contaminated.) The next morning the collodion, being fit for work, is extracted from the bottle by lowering the glass tube (Fig. 284), previously removing the corks from the bottle and tube. Air-bubbles may

FIG. 282. FIG. 283. FIG. 284.



127. The emulsion processes have almost driven the wet collodion process out of use, and yet, for the sake of those who practise it, and for "auld lang syne" a few remembrances of it are here recorded.

The dipper and the nitrate bath are to be had of all the dealers. A dipper of silver wire is cleanest and best, but it may be of wood or rubber.

Litmus paper is about the humblest member of the dark-room contrivances, but its office is an important one, and it should always be conveniently placed.

128. After the careful and neat photographer has occupied a carefully con-

be prevented by receiving the collodion on the side of the neck of the collodionizing bottle. The excess of collodion poured on to the plate should be received into another bottle and set apart until the evening, when, after adding ether and alcohol, of which it has been deprived by evaporation, and some new collodion to replace that used during the day, it is added to what remains in the decanting-bottle, and is fit for use again the next morning. This system has the advantage of suppressing the glass-tap, which often sticks in a disagreeable manner, or, what is perhaps worse, leaks.—LEON VIDAL.

127. When physicians and pharmaceutists buy litmus-paper, "they generally make the same mistake that the photographer does, and demand that it shall be deep in color. that the blue shall be very blue and the red very red. This is wrong in principle and practice, particularly when slight traces of alkalinity or acidity are often important, and the palest instead of the deepest paper should always be selected. What is sold as 'a sheet of litmus-paper' should never be less than four inches by twelve, or three by eighteen. Such a sheet cut lengthwise through the middle gives a strip which, when cut crosswise into strips a quarter or three-eighths of an inch wide, is of a convenient size and form for use. The sheets, one paler and one deeper of the same color, if desired, should be rolled up together in a tight roll, slipped into a test-tube and corked. In corked test-tubes they keep unchanged for an indefinite time, while the test-tubes when empty and corks are always worth their cost to those who use litmus-paper. In this form of sheets, however, the paper is not so convenient for the experimentalist as when cut into strips one to two inches long and a quarter of an inch wide; and the writer finds that about one hundred of such strips put up in a wide-mouth tube vial, corked and properly labelled, is a most convenient and popular form for general use. One such vial of each color put up together forms a pair which no one should be without; and most workers will buy them if they can get them. These convenient little strips may be shaken out of the vial as wanted for use, but as the fingers should never touch any other strip than the one taken, it is best to take them from the vial by a pair of forceps from the pocket case."—DR. EDWARD L. SQUIBB.

128. Every one who undertakes to photograph well, should possess a reasonably good balance. I do not speak here, of course, of delicate analytical balances turning with the hundredth of a grain, but of good, common balances turning on knife blades, and moving immediately with a quarter of a grain. And I may remark here that an easy way of testing this, by those who do not possess fractional weights, is by cutting up pieces of paper, or, better, of tin-foil. If a nearly square piece be weighed off, weighing *four*

structed and well accoutred dark-room, it should be his pleasure to send from it the best possible results. To this end, as has been enjoined previously, he should be exact in weighing and measuring his preparations.

grains, and the smooth, hard letter-paper or the tin foil be cut into sixteen equal parts, we have so many quarter-grain weights, well suited for testing a balance. And a balance that will not give an easy and decisive indication by the addition of such a quarter-grain fragment, when loaded with a drachm in each pan, is unfit for use.

Another important point, after having ascertained the sufficient delicacy of the balance, is to habitually be on guard against *sticking*. Neglect of this point has led to thousands of errors in weights, and vexatious and inexplicable failures in the operations connected with them. "Sticking arises from this: when the pans are not far from equally loaded, a very slight cause will deprive the beam of freedom of motion. It may not rest exactly square on its supports, or some grains of dust or other foreign body may have got on the socket under the knife-blade, or there may have been a slight tendency to rest. Any of these, and perhaps other causes, may preserve the beam from oscillating, meantime the needle points exactly vertical, and the weight seems to have been correctly taken, when, perhaps, it is wrong by enough to seriously affect the next steps to the operations.

The only sufficient safeguard against this dangerous mistake, is never to take a weight with the needle in this condition, never to depend upon the needle pointing directly to the centre of the index, but always to make the needle oscillate, and see that at each oscillation it moves to an equal distance on each side of the centre, as far to the right as it does to the left. With a needle moving freely, and passing to an equal distance on each side, anything like sticking is impossible, and the operator feels safe that his weight is correctly taken, *provided that his weights are correct.*—M. Carey Lea, M.D.

The danger of mistakes is far greater with measuring-glasses than in weighing, than most persons would find it easy to believe, but it may be proved in various ways. Any one desirous to verify his measurements, can make the following experiment: measure off at once 16 ounces of water in a 16-ounce graduate and pour it into a bottle; next take a 1-ounce graduate and measure off successive ounces from the portion thus placed in the bottle, until the whole is consumed, and compare the result.

The surface of water or of other liquid in a measuring-glass is not plane or level, but represents a parabolic curve. The liquid is drawn up the sides of the glass by capillary attraction, and the whole surface has a meniscus curvature. It is the central or lower portion of this curve that should correspond with the ruled line of divisions and not the upper.

If the operator, having made as accurate a measurement as he can, changes his position so as to alter the manner in which the light falls upon the glass, he will find that his measurement no longer appears correct, but seems to be more or less than right. What was, or appeared right when the light came from above, is no longer so when the light comes in level lines, or is thrown up from below. Of these, the best results are given by a level or horizontal light. A good burner on a level with the eye is very convenient for taking measurements. On the other hand, light from a gas-burner considerably above the observer's head, tends to very incorrect results.

These two operations though simple, are nevertheless the sources of many blunders to those who have not paid a certain amount of attention to the ordinary causes of error.

Another matter of considerable moment is the holding of the measuring-glass perfectly perpendicular. A very little error in this respect will quite vitiate the results. And the evil of this increases directly with the diameter of the upper surface of the liquid as it stands in the measuring-glass. For this and for other reasons, narrow, deep graduates are to be preferred to broader, lower ones.

Narrow, deep vessels of a cylindrical shape will give more accurate measurements than those that are conical, and are much used for exacter work. With *burettes* still more accurate work can be done, especially, as I have shown elsewhere, when a particular arrangement is used for making correct readings.

Specific Gravities.—The combined operation of weighing and measuring gives the *specific gravity* of a substance which represents the relation of weight to bulk. This determination may be made in two ways, viz., by ascertaining the weight of a given volume of the substance (specific gravity bottle), or by examining its buoyancy (hydrometer).

The last is the least troublesome, especially when a number of specific gravities of liquids are to be taken, but the first is by far the more accurate. Not only is the reading of the hydrometer less exact, but a great many of them are very carelessly and indifferently made.

It is hardly safe to use a hydrometer without first testing it with a specific gravity bottle. The latter is a small vial closed with a tube stopper; the tube has a capillary bore like that of a thermometer, the liquid being poured in nearly up to the top of the neck, the stopper is inserted, and the excess of liquid escapes through the tube-stopper and is wiped off. The bottle is of such a size, that when filled with distilled water it has a given weight at a fixed temperature, generally of 62° F., though sometimes 60° or 70°. A 200-grain bottle or a 10-gramme may be considered the best sizes. The only precautions necessary are to have the bottle thoroughly clean inside before pouring in the liquid to be tested, and to wipe the outside perfectly dry before taking the weight, handling it as little as possible, so as to avoid raising the temperature.

The specific gravity is indicated at once by the weight of the liquid. If when the 100-grain bottle is filled with nitric acid, the weight of the contents proves to be 145 grains, this, of course, indicates a specific gravity of 1.45. Having determined the specific gravity of any liquid, this may be used to test the accuracy of hydrometers by allowing them to swim in it, and noting the indications, and how far they are correct.

In using the hydrometer, care must be taken in two different ways: it must be lowered gently into the liquid; if allowed to slip quickly in it will sink too far and then rise again with the stem wetted above the line of the liquid. The hydrometer, having thus an extra weight to carry, will give an erroneous indication. Also, it must not be let to touch the side of the vessel, or it will be held there slightly and not move freely.

The degree should be read off by looking from below and using a level light. Managed in this way, results of tolerable correctness can be got, but not equal to those of the specific gravity bottle.—M. Carey Lea, M.D.

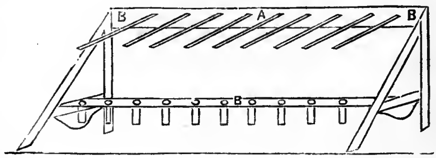
129. Not only are correct measuring and correct weighing a nicety in dark-room manipulation, but the strength of the solutions should be carefully main-

Those who are working *dry* processes know how difficult it is to get their plates properly dried, and at the same time to keep them from the light, and free from foreign substances tending to injure them.

The following diagram of a drying-stand for dry-plates, will overcome some trouble.

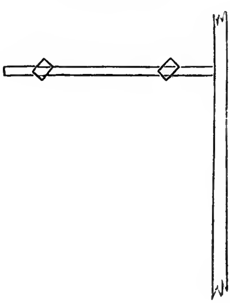
The upper connecting piece *A* has ($1\frac{3}{4}$ inches apart) round sticks the size of a lead-pencil, slightly inclined from a right angle, *glued* to it as shown in the figure. The lower piece, *B*, is furnished with short lengths of glass tubing, also $1\frac{3}{4}$ inches apart, about $\frac{1}{2}$ inch diameter, and $1\frac{1}{2}$ inches long, to receive the lower corner of the plate, and convey the drippings to a trough beneath, which is supported by a bent wire at each end. This stand may be fitted in a box, and, when the box is closed, the trough should be removed.

FIG. 285.



A slip or tube of glass runs from *B* to *B*, and, if perfect immunity from wood is desired, glass squares can be fixed on the projecting arm, thus (see Figs. 285 and 286):

FIG. 286.



Of course there are dozens of modifications possible.—ARTHUR GREEN.

129. It often happens in the practical everyday working of a gallery, that it becomes necessary to know the strength of the several solutions of nitrate of silver employed.

If too weak, unsatisfactory results are obtained, and if too strong, silver is uselessly wasted; in either case difficulties arise which are frequently attributed to other causes.

The instrument generally used to give this information is the actino-hydrometer, and although it is strictly correct in the testing of pure silver solutions, is very unreliable when these solutions have been for some time in use. It is noticed by those using it, that a bath working well when the hydrometer indicates forty grains to the ounce, will after a time not be in the same good condition until it marks forty-five grains or more. The reason of this is, that this instrument shows only density or specific gravity.

It is well known that different bodies of the same weight are of different sizes, and again, that bodies of the same size have different weights, as for instance, a pound of lead is smaller than a pound of wax, and a piece of lead weighs more than a piece of wax of the same size. When the weights of different bodies are compared to the weight of equal volumes of water we have what is called their specific gravity. The specific gravity of gold is 19.3—that is, 1 cubic inch or foot of gold weighs 19.3 times more than a like bulk of water, and when the specific gravity of an acid is given as 1.4 it means that a cubic inch, or a pint, or any other measure of it weighs 1.4 times more than an equal measure of water. We have in the hydrometer a quick means of finding specific gravities tained at the proper degree. Frequent tests should be made and no heedlessness whatever allowed.

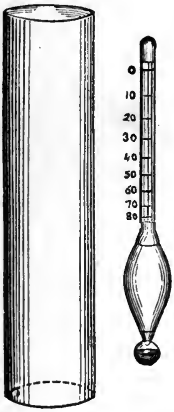
A great convenience in the dark-room is plenty of clear, pure water, and a proper arrangement of the tanks, with a means of saving such waste as is of value, and of getting rid of the rest without injury to the health.

There are some persons who guess even at the condition of their chemicals. I believe in "instinct," "feeling," "inspiration," and whatever you choose to term it, but above all things else I do lean on thoughtful care in doing all things well.

It is simply shocking to see the slovenliness of some manipulators, and yet, they are the very ones who have the most time to complain of their results and of that bugbear "Cheap John."

of liquids. If we float it in different densities, it will sink to different depths in them, but always so far until the weight of the volume of displaced liquid equals the weight of the whole instrument. As hydrometers are used for various purposes, the scales are divided differently, some to indicate specific gravity, others to give the different percentage of alcohol, or to give the strength of acid, etc. As the same liquid varies in density according to its temperature, it is necessary to have a standard, which is usually sixty degrees Fahrenheit, and all solutions should be made of the proper temperature before testing.

Fig. 287.



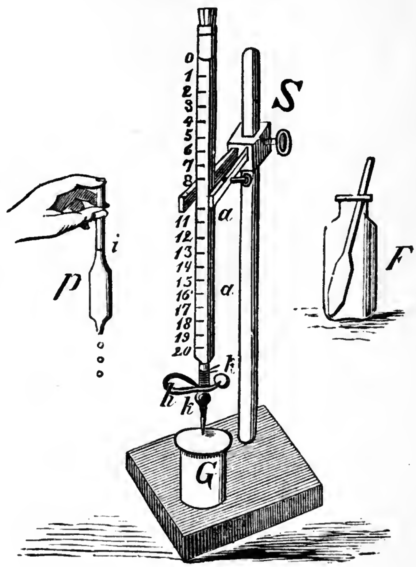
The scale of the actino-hydrometer is prepared in the following manner: It is first floated in pure water at sixty degrees Fahrenheit, and the point to which it sinks marked (this is the *zero* of the scale. Fig. 287.) It is then placed successively in solutions of the same temperature containing ten, twenty, thirty, etc., grains of nitrate of silver to the ounce, and the different points to which it sinks carefully marked. These points are, when the scale is to indicate one grain for each degree, the ten, twenty, and thirty degrees, etc., of the scale. The intermediate single degrees are put in by simply dividing off into ten equal spaces. This instrument thus prepared can be used to test any other pure solution of a soluble salt, but as these solutions vary very much in density when containing the same number of grains of the different salts dissolved in them (for example, a solution containing twenty grains of chloride of ammonium does not test the same as one containing twenty grains of hypo soda) a table of corrections is required. Such a table accompanies Tagliabue's actino-hydrometer. The instrument has no discriminating or selecting power, hence if the two solutions just named were mixed together, no table could be made which would give from the indication on the stem the number of grains in the one, and the number of grains of the other contained in each ounce of it.

When a silver bath is new, the reading of the hydrometer can be relied upon, but in

A man who is slouchy in his dark-room will exhibit the same talent under his skylight—in fact, in whatever he does. Do not be caught. Form correct

working, as every plate extracts silver by the formation of iodide and bromide of silver in the collodion film, and adds nitrates of potassa, cadmium, etc., according as iodide and bromide of potassa, cadmium, etc., have been used as excitants, we have an impure solution in which the above salts as they increase its density test by the hydrometer as so much silver, and we cannot tell from its indications how much nitrate of silver alone it contains. The older the bath, the more impure the solution, and the more unreliable this manner of testing becomes.

Fig. 288.



There are, however, methods by which we are able to ascertain the quantity of nitrate of silver in any solution, pure or impure, one of the most accurate of which is the one introduced by Dr. Vogel. His "silver tester" consists of a stand *S*, a burette *a*, two pipettes *p* and *F*, and a beaker glass *G*. A solution of iodide of potassium is prepared, containing 1023.4 cubic centimetres of water, exactly 10 grammes of pure dry iodide of potassium. 100 cubic centimetres of this solution precipitate 1 gramme of nitrate of silver, so that if 1 cubic centimetre of a silver solution is measured off and tested, every cubic centimetre of the test solution used gives 1 per cent. of nitrate of silver (1000 cubic centimetres = 2.11 pints and 1 gramme = 15.4 grains). This prepared solution is placed in the burette *a*, which is divided off into cubic centimetres, and furnished with a pinch-cock *k*. The pipette *p*, is then dipped in the silver solution to be tested, filled, by drawing with the mouth at the upper end, to the mark *i*, which is an exact cubic centimetre, and the solution allowed to run into the glass *G*. Into the same glass *G*, are placed 1 or 2 cubic centimetres of prepared nitric acid, using the pipette *F*. (This nitric acid contains 1 grain of protosulphate of iron to every 2 ounces of pure acid.) And finally 10 to 14 drops of a prepared starch solution are added. (This solution is made by rubbing up ⅛ oz. of starch to a thin paste with distilled water, pouring it into 12½ ounces of boiling distilled water, and stirring for several minutes; after settling for a few hours, the clear solution is poured off, and 2½ ounces of pure pulverized nitrate of potassa added, when it is ready for use, and will keep undecomposed for about six weeks.) The solution in the burette *a* is then allowed, by pressing open the pinch-cock, to run into the glass *G*, until the blue color which is produced does not disappear by shaking, but remains per-and exact habits when you first take up photography, and they will help you right through.

manent. With a little care at the close of the testing, a single drop will be found sufficient to produce this permanent blue color. A simple reading of the number of cubic centimetres of solution used, gives the per cent. of nitrate of silver. Thus, if it stands at 7$\frac{3}{5}$, the tested silver solution contains 7$\frac{3}{5}$ per cent., that is, 100 cubic centimetres of solution contain 7$\frac{3}{5}$ grammes nitrate of silver, which is equivalent to about 35 grains to the ounce.

Dr. W. H. Pile, of Philadelphia, manufactures a "volumetric silver test," which is much simpler than Dr. Vogel's, as it consists of but a single tube, and is almost as correct. In using it, it is only necessary to fill the tube (Fig. 289) to the point O with the silver solution to be tested. Then add the test solution (made by dissolving 140 grains of well-dried rock salt in one pint of distilled water at 60° F., and adding to the clear solution 2 grains of bichromate of potassa), freely at first, afterwards gradually, closing the tube with the thumb and shaking well after each addition, until, after allowing the precipitate to settle, no more cloudiness is produced by a drop of the test. The level at which the liquid in the tube stands gives the number of grains of nitrate of silver contained in each ounce of the solution.

FIG. 289.

There is an "easy method of testing," which is within the reach of every photographer, the only articles required being an 8 oz. narrow-mouthed bottle, a graduate glass, and some common table salt.

The test solution is made by dissolving 55 grains of well-dried salt in one pint of water. Measure into the 8 oz. bottle $\frac{1}{2}$ oz. of the silver solution, and add the test solution to it carefully from a clean graduate glass, shaking well after each addition, until no cloudiness is produced. If it takes 1 oz. of this solution, it contains 10 grs. of nitrate of silver to the ounce; if 2 oz., it contains 20 grs.; and so also of fractional parts; 3$\frac{1}{8}$ oz. show 31$\frac{1}{4}$ grs.; 3$\frac{1}{2}$ oz. 35 grs., etc. As every 1 oz. of solution used shows 10 grs. of nitrate of silver to the ounce, it is only necessary to multiply the number of ounces and parts of an ounce by 10 to give the required result. A 2 oz. graduate glass is the best size to use, as it is so graduated as to show $\frac{1}{8}$ oz. readily; and as every $\frac{1}{8}$ oz. of test solution equals 1$\frac{1}{4}$ grs. of nitrate of silver, this test is sufficiently accurate for all practical purposes. If about the number of grains in the solution is known, add at once nearly the required quantity of the test, and afterwards small quantities at a time. Supposing it to contain about 40 grs., add 3$\frac{1}{2}$ oz. of the salt solution, shake well, and towards the latter part of the process it requires hard shaking to get the chloride of silver to precipitate out and leave the liquid clear. Then add from an exact measured ounce about $\frac{1}{8}$ oz. at a time, until the precipitation is complete. Add the quantity used to the first 3$\frac{1}{2}$ oz., multiply by 10, and we have the number of grains of nitrate of silver. It frequently happens that, before sufficient of the salt solution has been used, that the precipitated chloride of silver is quite bulky, but when shaken up, after the addition of the last required quantity, it

130. And last of all comes a study in the question of economies. A great deal of unnecessary waste of the precious metals may occur if no care is exercised to prevent it.

becomes much denser and settles rapidly to the bottom; this is a good indication of enough solution having been used. One or two trials of this process will give all the experience required to enable any one to do it easily and quickly.

If the silver solution contains ammonia, an ammonio-nitrate solution, as it is termed, after measuring off a ½ oz. of it into the 8 oz. bottle, make acid with a little pure nitric acid, and then proceed in precisely the same way as above explained.

Dr. Vogel's, Dr. Pile's, and the "easy" methods cannot be used if the solutions contain salts of lead or mercury; but as these salts are not used by photographers, it is not necessary to give processes by which such solutions can be tested, requiring, as they do, some knowledge of chemical manipulation.—James F. Magee.

130. Now, if you will take a box of a suitable size, minus a top, and set your bath into it (see Fig. 290), and, just as soon as your plate is dipped, tip it (the bath) forward,

Fig. 290.

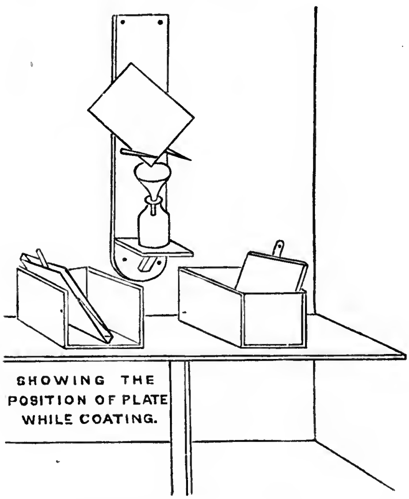
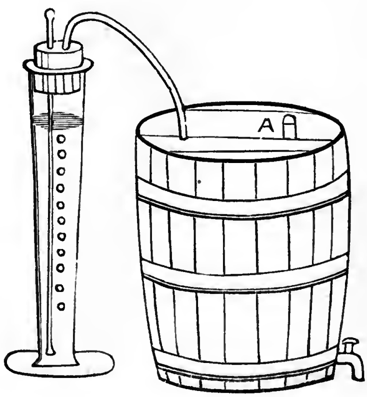


Fig. 291.



and let it remain in that position until you are ready to remove it to the plate-holder, you will be astonished to see how free from pinholes your negative will be, and it will save you an immense amount of filtering. I have been practising this plan for many years, and am surprised that so few operators have adopted it.—I. B. Webster.

"I have made a little apparatus which does away with the evaporating of the silver solutions in order to get rid of the accumulated alcohol. It consists of a tall bottle to hold the solutions to be decocted. The bottle is closed by a stopper perforated by two

Again, *time* may be economized by careful attention, *in time,* to all the matters pertaining to the work.

A good rule is to do first what *must* be done without anxious care as to what must follow. Then everything will be done on time, and, as a rule, well done.

Once more, do your best and leave the rest. Worry spoils more work than bad lighting, in some studios. Whatever else you do—after everything else is clean—don't worry.

I have given a good deal of care to this matter of dark-room contrivances. I have selected my notes from a large experience and from a large quantity of material, and have tried to suggest only what is of real help. There is much

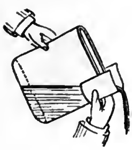
holes, through which one short and one long glass tube, reaching down to the bottom, pass. To the short tube an india-rubber tube is fastened, and the other end of it is connected with a barrel full of water. Now, as soon as the water is turned on, the air is drawn through the long tube and bubbles up through the silver solution, removing all the alcohol in a very short time. This sketch (Fig. 291) will help you to understand it I hope.

"A is a hole to insert the funnel for filling the barrel with water, now closed."—R. BENECKE.

A glass or any other kind of straight-edged bath-holder without a lip can be readily emptied without spilling a drop, in the following way:

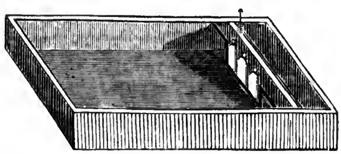
Take a strip of clean, white, tough letter-paper; bend it around one edge at the mouth of the bath, and above it; hold it very tight with one hand, while you manage the bath with the other, and pour. (See Fig. 292.) Try it. I use the same strip of paper over and over again.—B. W. KILBURN.

FIG. 292.



A new horizontal filtering tray for the negative bath was presented to our Society by Mons. Guinet. Under the ordinary covering was adjusted an upright ridge of glass to within an eighth of an inch of the top; this ridge was perforated with, say, four or five holes, of a bridge-like shape. A filter, which stopped up the holes, was placed on the back of this ridge. The silver solution is now put into the tray; the latter is then immediately brought from a horizontal to an upright position; the bath runs over the ridge, the ordinary covering for such trays acting as a reservoir, and keeping the liquid from running over. The tray is now placed in a horizontal position, the upright ridge preventing the silver solution from coming into the tray otherwise than by passing through the filter. In a few minutes the liquid will be found on this side of the ridge, and the bath is ready for use.—LEON VIDAL.

FIG. 293.

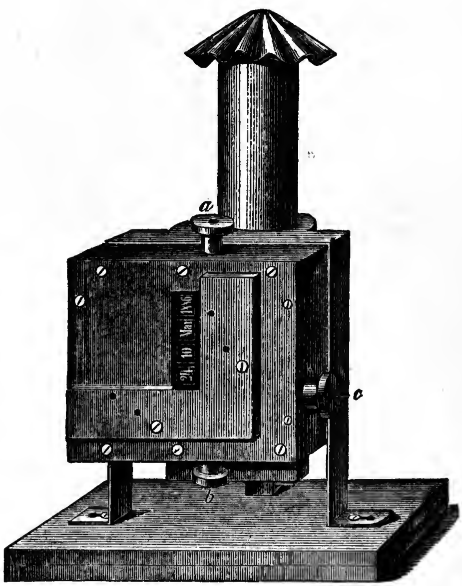


Mr. Kruse, of Berlin, has invented an ingenious negative numberer, which may be thus described: A small benzine light (or candle) is placed in a metal lantern, so constructed, help in having these conveniences, provided they are properly used, kept clean, and not allowed to serve merely as dust catchers. Now all such misfortune may be prevented if the habit of "squaring up" becomes a fixed principle and is daily followed with conscientious care. I am emphatic about this, for I know how much good results depend upon the careful use of clean dark-room contrivances.

As in any other work, so in the dark-room, the photographer should look well after his light supply. If the light is allowed to come into the dark-room from the side, it should be from a window sufficiently low and sufficiently forward to enable one to receive a good light underneath the plate when held for development. This window must be provided with shutters or covers, that more or less light may be shut out as desired. I need scarcely add that every particle of *white light* must be carefully excluded.

both with regard to the admission of light and the letting out of smoke, that no white light can escape. One side of this lantern is made light-tight by means of a wooden box attached to it, and this box contains the contrivance for numbering the negative. On the outside of this box, in the right-hand corner, there is a groove cut, into which the yet unnumbered negative can be inserted. Close to the edge of this negative—in the middle of the side of the wooden box—is a narrow slit parallel to the edge of the negative through which the light issuing from the lamp within the lantern can reach the negative. This slit is covered by three small hoops of thin copper sheathing placed together. Two of these hoops, or bands, have on them the numbers 00 up to 99, the third one has from 0 up to 9, and these numerals are cut as patterns, so that by a judicious turning of the bands, the numbers from 00000 up to 99999 can be seen in looking through the slit. The turning of both these bands, which, numbered from 00 to 99, form the last four figures, is caused by moving a button up or down, by which means the bands referred to are wound off from one small wooden cylinder on to another, whilst the band bearing the numbers 0 to 9, which indicates the 10-thousands of the number, is changed by every movement of

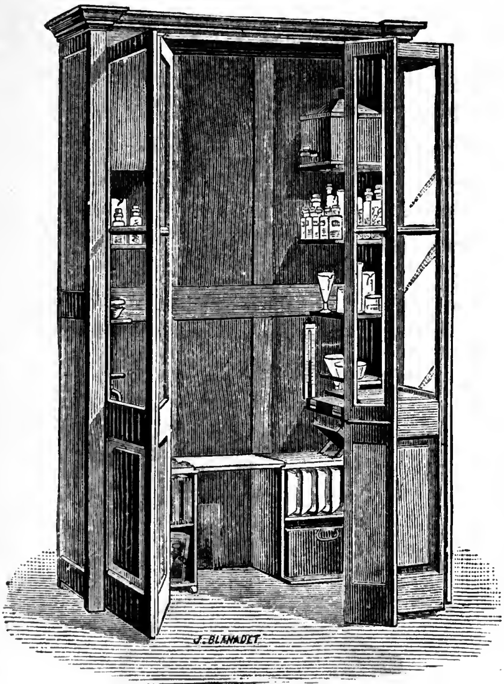
Fig. 294.



The dark-room being now in perfect order, with all its contrivances, we shall proceed to put it to practical use.

the hand from 10 to 10-thousand numbers. In using the instrument, the light is shut off by means of a red glass brought to view from within when looking for the controlling number; the negative is inserted in the slit before mentioned, and then by a sudden turn the red disk is drawn away. The exposure for the number is therewith at an end, and the latter appears in the development black upon a bright ground. Mr. Kruse has also arranged the apparatus so as to print his name and title upon the plates.—E. S. W.

Fig. 295.



Photographers sometimes lack the necessary room for fixing up a small laboratory. M. Enjalbert, of Montpellier, has forseen this case, and has remedied it by the construction of a closet in which all the operations belonging to negative photography can be performed. This closet, when shut, does not take up more room than an ordinary piece of furniture of this kind. We see that we have here everything that is necessary for making the divers manipulations, for holding the products, the dishes, recipients, etc. Evidently the space is rather limited, but it is sufficient for the photographic tourist, and the closet can be used in a bedroom or in an ordinary workroom. During the day, light may come from outside through the red glass, and at night, or if the closet is in a damp place, it may be lighted by a lantern. A water-tight tank for washings and the other liquid products that are to be rejected, is in one of the corners of the closet, and another reservoir full of clean water, placed on an elevation, is used for washing or the other operations requiring a flow of water.—Leon Vidal.

CHAPTER XIV.

NEGATIVE-MAKING—"WET."

A WONDERFUL revolution has taken place in negative-making during the past five years. The devout wishes of photographers for some new method that would enable them to discard the much slandered nitrate-bath have been met by emulsion photography, which now takes the lead.

Still the "wet" method has its uses and its votaries. There are some cases where this "old" method gives the best results, and there are some workers who still adhere to it exclusively. Concise directions for making and finishing negatives by the "wet" or collodion process will therefore follow.

132. The first step is to scrupulously clean the glass plate for the reception

132. I send photographs of a little affair I have got up for cutting off varnish from old negatives, also for soaking new glass. I think I have got just the thing for that purpose.

FIG. 296.

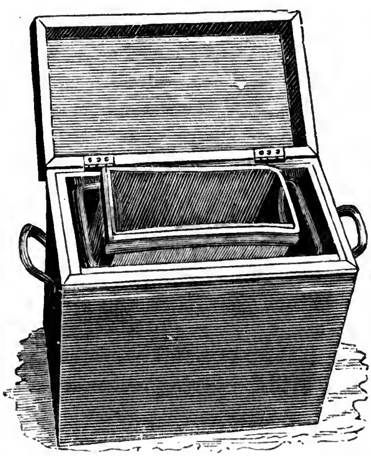
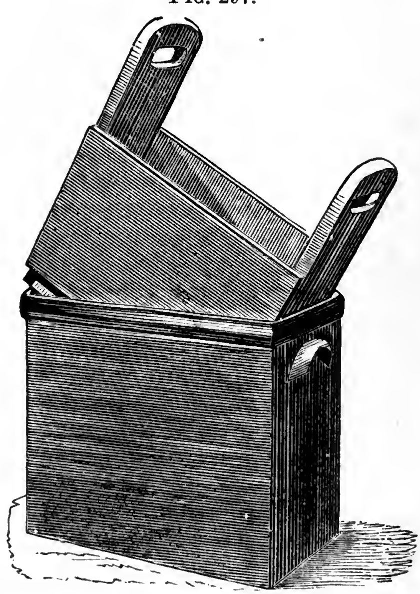


FIG. 297.



I have had two boxes made at the pottery, one fitting inside of the other, to put the glass in on the edge (Fig. 296). Draw up the inside box, let it rest on the two ends, as you of the collodion film. Taken from the boxes in which the glass arrives from the factory it is placed in a strong solution of concentrated lye. Afterwards it is washed, and then, while wet from the top, flowed with a very dilute solution

will see in Fig. 297, and by the time you have it in position the acid will all be out, having gone through the bottom, which is perforated with holes. Then you can get out the glass without any trouble; it will hold glass enough to run an ordinary gallery a week *these times*. This one takes in an 11 x 14 glass.

The one I use for lye has a wood box for inside; for acid I use the stone, as the wood would soon eat up. It is not necessary to case it, yet it costs but a little more, and shuts up tight; you get no smell of the acid.—S. ROOT.

On Albumenizing Glass.—When albumenizing the glass was first proposed, I found difficulties, but the following method has given me plates perfectly free from faults.

Prepare a stock solution of albumen as follows:

The whites of six eggs.

Strong ammonia, one drachm.

Shake well, with a few pieces of broken glass in the bottle.

In a stoppered bottle this keeps any length of time, indeed improves by age.

When about to use, take eight ounces of water, and add to it thirty drops of C. P. nitric acid; mix well, and add half an ounce of the above albumen. Shake well, and filter through paper.

Clean the plates by any method, flow with the dilute albumen, and dry as usual.

The plates keep indefinitely.—C. F. RICHARDSON.

To clean glass for collodion and silvering, rasp off the edges and corners with a wet sandstone (a scythe whetstone is just the thing), drawing it at an angle and diagonally from the face of the glass, to avoid chipping the surface. Whether new or old glass, varnished or unvarnished valueless negatives, wash thoroughly in clean hot water and immerse in a very strong solution of boiling potash, from three to five minutes, or longer if old hard varnished glasses. Scrub with a fine broom brush upon a padded board, covered with tightly drawn flannel, in clean hot water, rinsing thoroughly, and then rinse off in clean cold water, and coat before dripping with thinned albumen, two or three ounces to the pint of water, from newly laid eggs, with four or five drops of aqua ammonia. Dry and keep from dust, moisture, and light, chemically clean. Use at pleasure; time will not deteriorate.

Remarks: Glasses having upon their surfaces pure metals as silver, copper, gold, or any other metal, must have the same removed with the proper acid, or aqua regia, before using the potash: but all glasses prepared according to the foregoing recipe, can have no free pure metal in contact with their surfaces.

The albumen should be freshly made and very thin.

Stock solution: Whites of six eggs, water six ounces, aqua ammonia one ounce. Dilute for use.

A common sheet-iron bakepan will answer to boil the potash in, on an ordinary cookstove.

Scatter a layer of edge cuttings of various lengths from common glass, of the size of of pure albumen. When dried and freed from dust or adhering particles it is quite ready to receive the collodion film.

133. In the pages devoted to Theory and Chemistry the offices of collodion have been stated. In short, to obtain a combination with nitrate of silver in solution that is sensitive to light and will hold a developable image, certain salts must be introduced. Collodion serves as the vehicle which carries these

an oat straw, on the bottom of the pan, and between each layer of glass, to prevent contact of surfaces.

Keep the hands clear of any caustic by using wooden tongs, and a little skilful manipulation, and do not scratch the glass in the least.

Never pack glasses together flatwise, nor lift them so that one rests upon another, but let each support only itself.

My method of cleaning glass may not be all new, and may not be the best known. It is the best I know; the simplest, and always avoids dirty, foggy, or stained glasses, or peeling off of the film.—ALBERT S. SOUTHWORTH.

The Blanchard Brush.—This contrivance, which combines in an eminent degree simplicity and efficiency, is of very great value in applying various kinds of photographic solutions. It was originally employed in applying both silver solutions and developing solutions to enlargements on paper. Besides its general convenience in evenly spreading the solution, it was found of special value in the process of development, as it gave to the operator a kind of local power in controlling the action of the developer. Where a mass of shadow required great depth to give force to the picture, the energy of the development could be increased by a little manipulation, and a little nitrate of silver added with the brush. Its latest use has been in connection with the application of preliminary coating of dilute albumen to glass plates. All difficulty in spreading the albumen solution, usually a troublesome operation, vanishes when this brush is employed. One sweep of the brush, which may be made of any width, covers the plate evenly, without irregularity, bubbles, or any kind of drawback.

The brush is made as follows: A strip of plate glass, about three inches wide and five inches long, is provided. On one end is fastened a loop of swansdown calico—a cotton material, twilled on one side, and with a long plush-like nap on the other. It is to be obtained at any large draper's. The nap side must be outwards; two thicknesses will be found better than one; and the loop can be readily fastened to the end of the glass by a small elastic band.—VALENTINE BLANCHARD.

133. An excellent keeping collodion can be made as follows: Pure absolute alcohol, 35 fluidounces; concentrated ether, 35 fluidounces; iodide of ammonium, 150 grains; iodide of cadmium, 150 grains; bromide of potassium, 120 grains; pyroxyline, 300 grains, or more if necessary.

This should be set aside for a week before use, and will keep two or three months, and sometimes longer if the materials are pure. My many experiments have led me to the belief that the iodide of cadmium is the most stable of all the iodides at present manufactured, and the iodide of iron the least so. In fact, a collodion made in whole or part

19

salts to the proper place and retains them there during the after-processes necessary to complete a photograph.

Formulæ for making collodion are very numerous, but their results are practically the same—at least sufficiently so for our present purpose.

The collodion is poured from a vial or pourer, and by motion of the hand caused to flow evenly over the whole surface of the glass, the surplus being

of iodide of iron, becomes worthless for all practical purposes after twenty-four hours; yet it is the most extremely sensitive collodion I know of while in its best condition, which is only for an hour or two. The iodide of ammonium comes next, but will produce a more sensitive collodion in less time than any other, except the iron. Its keeping properties are small, though much greater than the iron compound. The bromide of all the bases gives better keeping qualities to collodion than the iodides of the same base. It follows, therefore, that no arbitrary rule can be laid down for the manufacture of collodion in all cases.

Dissolve the iodide and bromide in the alcohol, and the bromide of potassium in a few drops of water, and add to the rest: finally add the ether; after again shaking well, filter it through paper and set it aside. This is the stock solution and will keep a long time without detriment. When wanted for use, take of the iodizing solution sufficient to last for two or three days, and add pyroxyline until it is of the proper consistency, and filter clear for use. Some photographers use two to two and a half grains of potassium to the ounce of collodion; this is worse than useless, it is waste.—George H. Fennemore.

My experience has been that a collodion properly prepared with an eye to its keeping qualities, and bromo-iodized with the salts of cadmium, will increase its sensitiveness for at least nine months, and at the end of a year I found no diminution, although the color of the negative began to change somewhat to a grayer tone, yet, without any appreciable loss of actinic resistance. But I found I could increase its sensitiveness by the addition of one grain of iodide of ammonium to each ounce of collodion. I also tried if the iodide of cadmium would have the same effect, but it did not. The effect produced by the addition of a little iodide of ammonium to the already sensitized collodion, led me to considerably modify the preparation of collodion for keeping, and with the most successful result, as I shall explain presently, in my formula. But first, a word or two on the chemicals used in the manufacture of collodion. This is a subject of no small importance to those intending to make a collodion intended for long keeping. It is not sufficient to make it as you generally do, merely substituting the salts of cadmium for those of any other base, but a proper appreciation should be had of what constitutes the elements of destruction in each chemical used, and to apply the test before mixing them together.—George H. Fennemore.

Which side of the glass should be coated?

When plate-plass is used, the finest and most perfect side should, of course, be selected. But in the case of blown-glass, most of which is perceptibly bowed, the question arises: Should the convex or the concave side be coated? Some careless operators do not pay poured off from one corner into a separate vial. The film quickly dries. When it is barely "tacky" to the touch of the finger it is ready to be excited or sensitized by immersion in a solution of nitrate of silver, called the "bath."

This should be done in the dark-room.

134. The bath solution may be held in a horizontal dish or in a vertical vessel open at the top. Unless the plates are very large the last form is the better. When the collodion is set, the plate is placed upon a dipper and lowered into the exciting solution with one steady, continuous, but not sudden, motion. There it should remain, according to the temperature, until, on examination, all oily or irregular lines are removed. To facilitate, the plate should be easily "churned" up and down in the solution while the sensitizing process goes on.

When about to remove the plate from the solution, slowly lift the dipper and, seizing the plate in one hand, allow the superfluous solution to drip back into the bath-vessel.

Now place the excited plate in the holder of the camera, the film side next to the lens. Everything is then ready for the exposure—for catching the image.

135. Before further procedure, however, let us have a fair understanding as

any attention to the point at all, but coat the best-looking side, whether it be convex or concave. Generally, however, the concave side is selected, and for the reason that then the pressure of the spring in the frame tends to correct the curvature, whereas if the convex surface be collodionized, the pressure tends to exaggerate the curvature.

This method of proceeding is quite correct for portrait work, and for taking the fronts of buildings; in a word, for all cases where the centre of the object is nearer to the lens than are the sides of the object.

But in landscapes it most commonly happens that the central objects are more distant than those at the side. When this is the case, it is evident that if the plate has been coated on the concave side, then its curvature greatly increases the difficulty of getting the whole of the picture into focus together. Whereas, if the plate be coated on the *convex* side, then its centre is brought nearer to the lens, and the shorter focus of the distant objects is favored by the form of the film.

Consequently no general rule can be given as to which side of a bowed plate should receive the collodion; the concave side being best for one class of objects, the convex for another.—M. Carey Lea, M.D.

134. The sensitizing bath must be prepared from re-crystallized nitrate of silver, and should be rendered slightly acid in order to produce perfectly transparent shadows; too much acid exerts the same injurious effect upon the negative as too little. One part of silver dissolved in twelve parts of water, is a good proportion for making a bath; a saturated solution of iodide of potassium is prepared, and to every 400 grammes of silver

to what we are to expect to see in a first-class negative. The answer is just the same, no matter what method we adopt—"wet" or "dry."

A brilliant negative is the first thing needful in obtaining brilliant pictures. Every possessor of a portrait album must have remarked how comparatively few of the pictures in his collection have any pretension to brilliancy. Many photographs are sharp and full of detail, but at the same time dull and without vigor, or they are sharp and clear, but hard, and without either detail or half tone. But few specimens are plastic and brilliant, and have sufficient gradation of tone.

A process by which brilliant negatives are obtainable, includes, of course, many manipulations with which the experienced photographer is perfectly familiar; but, nevertheless, to the general reader, a recapitulation of the different conditions necessary to their production may not be without interest.

The great source of failure lies in the thickness of the film which forms the image upon the glass plate. The negatives of many excellent photographers possess a certain amount of thickness, nevertheless a really good negative should be thin and perfectly clear. A few points in the deepest shadows should display clear glass, and, in certain portions of the high lights, an almost perfect opaqueness of the film should be visible; and between these two extremes there should

solution is added one drop of the iodide and one drop of strong sulphuric acid, as follows: Nitrate of silver, 30 grammes; distilled water, 360 grammes; strong sulphuric acid, 1 drop; saturated solution of iodide of potassium, 1 drop.

If the water and chemicals used are perfectly pure, this bath will give beautifully clear negatives; but, should not this be the case, and there is formed upon the picture a gray deposit, capable of being removed by the finger, the bath is purified with a solution of caustic potash, 2 grammes; water, 100 grammes—which is added by drops to the silver solution (shaking the latter the while), until a slight turbidity is observed. The bath is then exposed to the sun for a few hours, or to open daylight for some time, when a black precipitate will be formed, which is filtered off. For every 100 grammes of bath is then added 1 drop of acidulated water made by mixing 10 grammes of sulphuric acid with 100 grammes of water. After standing for some hours, the following test should be made: Coat a plate with collodion, sensitize it, and let it drain well; develop it in the ordinary manner, without exposing, and wash and fix the plate as usual. After fixing, if the glass is not perfectly clear, but is still covered with a thin, light deposit which may be removed by the finger, a few more drops of acid must be added, and the experiment repeated; too much acid must never be added at any one time, and care must be taken that the plates used in the experiments are perfectly clean. As the deposit upon the plate may likewise be caused by the action of light, all chemical rays must be carefully excluded from the dark-room.—EDWARD L. WILSON.

Pure silver and distilled water will make a bath which will not require sunning or be as many gradations of tone as possible. If few half tones only are present in the negative, it is impossible to obtain a brilliant print from the same, as the result will either be weak or hard, according to the difference in the thickness of the film in the lights and shadows.

136. Let us suppose that a picture possesses twenty different gradations of tone; in order to be able to furnish a good print, the negative must then be composed of twenty different thicknesses of deposit, which are visible when the image is seen by transmitted light. A negative which begins with perfect transparency, presenting no hindrance whatever to the light in the production of the deepest tones, and which possesses the twenty gradations of tone, is capable of giving a perfectly brilliant result, although it may not appear very opaque in its highest lights. But if the deepest shadows are covered with a deposit equal to ten gradations, then the film in the highest lights must be of a thickness equal to thirty gradations of tone, in order to be capable of producing a good print; if the film in the highest lights is equal in thickness to twenty-five gradations of tone only, it will give less brilliant pictures than the negative first mentioned, although the film may, at first sight, appear of greater thickness.

Underexposed negatives generally give hard pictures with large masses of white and black, and without detail or half tones. Overexposure causes a gray

boiling. But as this water is not at hand often, good, soft spring water, or from a piece of ice, or river water, will do. Put one or two ounces of silver into a quantity of water sufficient to fill your bath-holder, with a little excess; place it in the sun for six or eight hours, or, what is just as well, place it over the fire in the evaporating-dish, and bring it to a boiling heat. Either method will throw down all impurities in the water. Filter and add silver, to make it up to 40 grains to the ounce of water by the testing-tube, which everyone should have. Not more than 40 grains strong, as much trouble often meets you at once when made stronger.

Coat a large glass plate on both sides with collodion, and let it remain in the bath over night. Filter the bath again, and try a plate; if it works clear and clean, add no acid; if a little foggy, add two drops of C. P. nitric acid to 50 ounces solution. Now, after using a few plates, it will work all right, and should not be altered for weeks, unless it be to add more of the same solution of which the bath was made.

If you work with care, with clean plates and clean fingers, the bath will not need filtering oftener than once a week, or once in two weeks, according to use. It is a positive evil to be filtering the bath every day. When by use the bath works oily by excess of alcohol and ether, but well otherwise, add a little alcohol to the developer, and use the bath as long as possible.—William Snell.

First of all, work the bath until the negatives show signs of pinholes; then remove it from the holder and filter half of it in the dark. Return to the holder (which, of course, precipitate to cover the picture, which fogs the shadows; a print produced from such a negative is too light in the shadows and too dark in the lights, for everything is lost in half-tone, and brilliant lights and deep shadows are wanting; in an overexposed negative a black coat becomes gray. In developing a plate which has been exposed too long, it is best not to allow the developer to go too far, but to wash the plate as soon as symptoms of overdevelopment are recognizable; in this manner many a picture may be saved.

The collodion to be used must not be too freshly mixed, and should be perfectly clear; its consistence should not be too thin, and it must be sufficiently iodized. Thick collodion should be diluted with equal parts of perfectly pure alcohol and ether.

Since so much is entailed, then, in securing a negative of the proper quality, it is incumbent upon the photographer to exercise the utmost care and attention in all details. To do so at first is better than to resort to after manipulations.

137. Understanding this we carry the ready plate out into the light for exposure. When we bring it back to the dark-room it will hold wondrous possibilities.

We have so carefully studied the subjects of lighting, posing, and exposing, in and out of doors, that for our present purpose not even an exposure upon paper is necessary. We will imagine that it has been made and properly made, and repair to the dark-room, full of curiosity to know what shall come forth from the mysterious image which has been impressed upon the still wet film.

has been well washed in the interim), and add to it an equal bulk of a plain forty-grain solution of nitrate of silver dissolved in sunned and filtered rain-water to which a little silver has been added. The bath is now ready for use, and will be found to give negatives far better than would be obtained from any new bath.

The remaining half of the old solution may be boiled down and crystallized. The crystals are washed and dried, and then can be used as ordinary crystals; for when obtained in this way they are quite free from iodide, acid, or organic matter.

Do not let it be supposed that I condemn sunning the bath, for this is not the case; but if a bath, either all or in part, which has been in use is taken into the light, an action is at once started, and unless that action be allowed to go on until completed it is hopeless to attempt taking good negatives. Therefore, if a bath is intended to be used again directly keep the light from it; but if time can be spared give it all the light possible.

About filtering a bath; let any photographer who uses paper for the purpose of cleansing the solution properly just try for once the stuffing of the funnel with cotton-wool (which should have a little alcohol and ether run through, and then washed with water), and see the difference between the bath filtered so and through paper.—W. T. Wilkinson.

138. So far we have only been mixing the clay. We now come to the moulding stage. We should, as we proceed, bear in mind all the points—the nature of our subject, the condition of the light, the temperature, the length of exposure, and the nature of the solutions employed in development. Not once should the thoughts wander from the work

138. Conditions of the action of the developer are: 1. The presence of a silver solution. 2. A certain proportion of alcohol and acetic acid, in order to facilitate the flow of the developer, and to enter into the film. Thin iodized collodion can stand but a small proportion of iron (two per cent.). Thick iodized collodion requires a strong developer. Strong developers give more details in the shadows (they work softer), while weak developers work hard. The latter are better suited for copying line drawings, etc.

Formulæ for portrait and landscape work: Five parts of sulphate of iron, or seven parts of sulphate of iron and ammonia; three to four parts of glacial acetic acid; one hundred parts of water;

Or, ten parts of sulphate of iron, or fourteen parts of sulphate of iron and ammonia; three to five parts of alcohol; two hundred parts of water; two drops of sulphuric acid.

For drawings: Five parts of sulphate of iron, or seven parts of sulphate of iron and ammonia; three to five parts of alcohol; two hundred parts of water; one drop of sulphuric acid.

The proportions of alcohol, as well as of acid, should be greater with a bath containing much alcohol than with one freshly made.

It is very convenient to keep in stock a saturated solution of sulphate of iron, or a solution of one part of iron to five parts of water. This may be diluted in due proportions, and the alcohol and glacial acetic acid added afterwards. Sulphuric acid may be added to the saturated solution at once.

Ordinary spring water is suitable for making the developer. (Water which is too hard requires a little more acetic acid.) Ordinary alcohol is sufficiently pure for developing purposes, but it should not contain too much fusel oil.—Dr. H. Vogel.

Compound Developer.—I have worked this with great success, finding it to be the most intensely working developer I have ever used: Water, 40 ounces; iron, 1½ ounce; sulphate of copper, ½ ounce; glacial acetic acid, 1½ ounce; or, about 11 ounces of acetic acid, No. 8; alcohol, 1½ ounce; ammonia, 50 drops.

It requires little or no redeveloping or strengthening, and has the great advantage of allowing you to keep it upon the plate a longer time without fogging.—R. J. Chute.

The addition of organic substances to the developer is extremely favorable to the production of brilliant negatives. The three following formulæ are recommended:

No. 1. Sulphate of iron, 25 grammes; loaf sugar, 40 grammes; glacial acetic acid, 15 grammes; water, 500 grammes; alcohol, 15 grammes.

No. 2. Sulphate of iron, 10 grammes; loaf sugar, 40 grammes; glacial acetic acid, 10 grammes; water, 400 grammes; alcohol, 1 gramme.

No. 3. Sulphate of iron and ammonia, 22 grammes; gelatine, 1 gramme; glacial acetic acid, 8 grammes; water, 300 grammes.

The plate is now taken into the hand from the plate-holder and held by one corner, over the sink. With quick and skilful hand the developing solution is poured upon the film, and with one motion caused to spread over the whole surface of the plate.

With regard to the latter, the gelatine is dissolved in the acetic acid and 50 grammes of water (this will take several hours), and the sulphate of iron dissolved in 250 grammes of water, and both solutions are then mixed. In general it will be found that weak developers produce opaque negatives, and strong developers, negatives of a harmonious character. No. 2 developer is suitable for summer work and for strongly-lighted pictures. The developer should be used sparingly, for the employment of too much solution impairs the brilliancy of the negative.—L. STERNBERG.

The developer must harmonize with the general use of the light. That is, the same proportions would not answer for an open skylight, or one where the light is subdued by passing through thin curtains, or a ground-glass, or one of a southern exposure. In each one of these the light is of a different value, therefore, the relative proportions of iron, acetic acid, and water must necessarily vary, that harmony may be secured. Iron deposits the silver, acetic acid simply retards. Therefore, it is very essential that these should be in that proportion that accommodates the best use of either of the above-mentioned skylights.

Taking a nitrate bath nearly free from alcohol, and an open light, 1 ounce of sulphate of iron to 24 ounces of water, and sufficient acid to cause it to flow quite freely. One ounce will do it. Let this proportion be the thermometer of the bath. When it refuses to flow, do not add more acid, but change the bath. *As the plate receives the first lighting under the skylight, so it receives the second under the developer.* That is, by the manner of manipulating, it can be made harsh, too intense, streaked and stained, fogged, flat, without detail, too soft, with too much detail; all these, and yet the same can be made just right, in every respect a good negative by the right handling. One cannot consistently be changed without the other, so the bath must be consigned to hotter regions to evaporate. In nine cases out of every ten it will be just at that time when also the excess of iodide needs removing.—G. F. E. PEARSALL.

A new developing process, requiring little or no intensifying, is as follows:

Protosulphate of iron, 2 drachms; sulphate of copper, 1 drachm; water, 10 ounces. When dissolved, add ordinary alcohol, 4 drachms; glacial acetic acid, 2 drachms; liquor ammonia, 20 drops. Shake well and filter.

If, instead of the protosulphate of iron, ammonio-sulphate of iron be used, then the liquor ammonia is not required.

If the sulphate of copper be found to dissolve too slowly, its solution will be accelerated by being placed in warm water.

Should it prove requisite to intensify the negative, the following may be used:

Distilled water, 1 ounce; pyrogallic acid, 4 grains; citric acid, 3 grains. To be mixed in equal portions with the following: Distilled water, 2 ounces; nitrate of silver, 10 grains; glacial acetic acid, 2 drops.—WILLIAM MACNICHOL.

If we attempt to stop development on a fully exposed plate, before it has reached its

Impatience is soon relieved. The whites, or such parts of the subject as have received the most light, first make their appearance, and are followed by the shadows and their details.

The result is the appearance of the latent image, which, however, is negative —*i. e.*, the parts which are light in nature are, by transmitted light, dark or dense in the film, and *vice versâ.*

full intensity, streaks and stains will be sure to form if we do not pour on an abundance of water, and keep the plate wholly covered until the oily appearance of the film has nearly disappeared, and there is no longer any difficulty in keeping the film covered with a small quantity of water.

In photographing landscapes, it is often of the first importance to carry as little weight of material as possible, and the necessary supply of water adds greatly to the load. The appearance of the plate spoken of is caused by the difficulty with which pure water mixes with a solution containing alcohol. The remedy is simple. If an equal amount of alcohol to that contained in the developer is added to the wash-water, one-quarter drachm per ounce or more, then with practice and care, one ounce can be made to go as far as a pint of ordinary water, for the purpose indicated. The "crawling" of the developer, or of the wash-water, will be *increased by adding too much alcohol.* Where the use of gelatine in acetic acid is indicated, as in copying drawings, the developer flows over the plate without a break, though no alcohol is added. In this case alcohol is not required in the wash-water.

I had devised this expedient for landscape photography before the publication of Robinson's method with golden syrup. There are some difficulties with the latter that make it well to combine the two methods. First, if the plate has had a full exposure, it is impossible to cover its whole surface at once with the preservative, and thus stop development on all parts alike, and stains result unless we dash it over the plate, and thus use more bulk of it than we would have to of the water and alcohol mixture, on account of the viscid nature of the syrup; even if it contains its proper proportion of alcohol. There is a second difficulty; many samples of commercial molasses, perhaps all, contain chlorides. In two samples this was so much the case, that a curdy precipitate of chloride of silver was formed when it was poured on the film, and this remained in part, firmly adherent, and became discolored by diffused light, and left numerous dark spots after fixing. The best plan, under the circumstances, seemed to be to first wash off the developer with the alcohol and water, then to flow on the syrup mixture, when no curds formed, since the silver had been washed off. Then "golden syrup" was useful to keep the plate moist until an abundance of water could be obtained for fixing, and but a small quantity of the syrup was required.—JOHN M. BLAKE.

The *development* of a negative requires both mechanical skill and a keen perception of the requirements of the occasion.

Lines may occur on the negative by the stoppage of the developer when poured over the exposed plate. The stoppage is generally the result of carelessness, or of the drying of the film after removal from the bath. In the latter case, more of the developer must

If success has rewarded us, our result is agreeable to the suggestions made in 135, 136, and 137. To hold it so, it must be cleansed of the superfluous chemicals still adhering to the film, and at the same time it will be "fixed." Thorough washing must take place between development and fixation.

139. Two ingredients are employed for fixing negatives, namely, cyanide of potassium and hyposulphite of soda. The former is very poisonous, and its use should be avoided.

be taken to enable the plate to be properly flooded. The free nitrate of silver having partially dried on the film, but little will be carried away by the developer over the edge of the plate. The defect may also arise from the repulsion of the free nitrate of silver on the film from the developer, either through excess, or the contrary, of alcohol.

Lines may also be caused by leaving a small quantity of water in the developing-cup. This will not readily mix with the alcoholic developer, and will cause development to be delayed on portions of the negative.

That the image is poor and flat may arise from washing off the free nitrate of silver from the plate by the developer; from the use of too strong a developer; or from the bath or collodion, as already explained.

In addition to negatives becoming hard from the collodion or bath, they may have the same defect from the use of a weak developer; from one with too much acid in it; or from underexposure. The first two causes may arise from the protosulphate of iron changing to persulphate.

When the developer refuses to flow evenly over the film, and seems to be repelled by it, either too much or too little alcohol has been added.

A scum on the developer, formed during development, may denote a want of acetic acid.—JOHN L. GIHON.

139. In fixing a picture, whether we use cyanide or hypo, much the safest, cleanest, and most economical plan is to have a dipping-bath. If cyanide be used, it has less chance of getting into any stray cuts or scratches we happen to have on our hands or fingers—sometimes very troublesome, perhaps dangerous—not to speak of the poisonous fumes inhaled when pouring it on, or when immersing the plate in an open dish. I think most photographers would give the preference to hyposulphite of soda for fixing if they were not afraid of having it near their baths. But if it be kept in another place—as it is not necessary to have either of the fixing agents in the dark-room—it has this good advantage over the cyanide, that it does not seem to thin down the negative nearly so much as the cyanide, being less energetic in its action, and I think it also leaves the negative of a better printing color. A point very often neglected, and which is very necessary to aid in securing clean pictures, sometimes saving a world of trouble, is to make it a habit, after developing or fixing a picture, to rinse the hands in clean water, and dry them carefully on a cloth kept for that purpose: it will help to keep our tempers sweeter, and leave us in a more amiable mood than if we discovered sundry smears and smudges under the collodion film, on coating or developing the next plate, which our now chemically-clean fingers had something to do with.—ANONYMOUS.

A saturated solution of hyposulphite of soda is best. The plate should remain therein until all appearance of yellowness disappears and the image looks clean and clear.

140. Thorough washing in changing water should follow fixation, after which the plate is placed in a rack or edged on a support and allowed to become absolutely dry.

Where running water is not obtainable, then the wash water should be entirely changed several times during the operation of washing.

The washing should be continuous also. If a negative becomes entirely dry, or partly dry, no further washing will do it any good. The hyposulphite should be *thoroughly* washed from the film if all risk of discoloration and loss is to be avoided.

As some have complained of the destruction of negatives fixed with hyposulphite of soda by time, a correspondent of the *News* brings forward a case in which a set of negatives, ten years old, fixed with hypo, were found in excellent order.

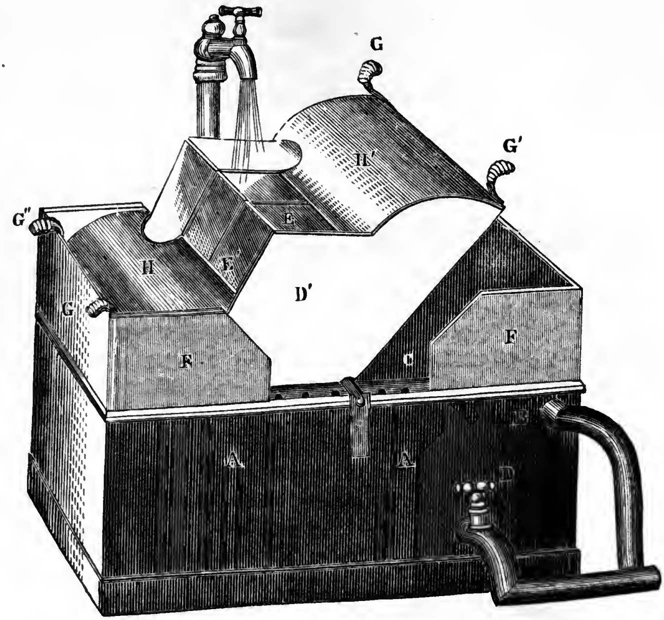
No possible danger can arise from fixing with hyposulphite, if it be perfectly washed, and this washing out will always require a certain time, no matter how rapid the current of water may be. When water is scarce, so that a stream cannot be kept up for the needful time (five to ten minutes, according to size), it is better to distribute the water into four or five pans, and let the negative lie five or ten minutes in each in succession. The last pan, or even two pans of one negative, might be used to begin the next with. Where a stream is used, of course particular care must be taken that a ripple forms on every part of the film, to make sure that the water is everywhere in active motion. Even with this precaution, however, time is needed, because the film is not like the blotting-paper, from which solutions can be "displaced," but it is like membrane, from which liquids must be removed by osmose, which is always far slower in its action than displacement.

140. The course of washing a negative is not often observed, but it is interesting to notice the action of the water when received upon a levelled plate. The current, from the spot where the water impinges on to the film to the edges, does not seem to act upon the whole of the liquid present; for, if a spot of dust or other floating particle be observed, it will be noticed that it does not instantly disappear from the plate in the current of moving water. We have watched such a floating mote upon a negative, and have seen it retain its place for a considerable time, till, if the plate were slightly tilted and the stream directed to one end of the plate, it immediately disappeared. To our mind the hand-washing is far the better plan, if there be convenience for having it so done; but, failing that, we should prefer a continuous stream sweeping along a levelled plate from end to end for a much longer time than is usually considered necessary.—*British Journal.*

141. To protect the still delicate film from abrasion during the process of printing, the plate must next be varnished. This operation should be performed in a room free from dust. The plate should be warmed, then the varnish poured upon it and sent over the whole surface the same as collodion.

Fig. 298 shows a "washing apparatus" of my own invention, which gives the most perfect satisfaction.

Fig. 298.



A varnished zinc dish, *A*, contains the pictures destined to be washed, after having been submitted to the hyposulphite's action and a salt-water washing. At ten centimetres from the bottom of the dish is placed a horizontal bored plane, on which are settled the pictures. The upper side, *D*, is composed of a double dish at balance. When the reservoir, *E*, which is located under the water-spout, is full, it will fall on the repair, *F*, and sooner tenders the other to receive the water. The motion that consequently follows will singularly help to despoil the pictures from hyposulphite.—A. Bettini.

141. My proportions for varnish are as follows: Bleached lac, 10 drachms; picked sandarac, 5 drachms; alcohol, 12 fluidounces.

Leaving out the sandarac, I let the lac dissolve as completely as it will, and then filter it through paper. Take rather a large filter, soak it thoroughly with clean alcohol before pouring in the varnish, or the fine stuff will at once choke the pores of the paper

The varnish should be hard and dry before the negative is handed to the printer.

Varnishes of excellent quality are sold by the supply merchants. Those who use but little will find its purchase more economical than manufacturing it.

and stop the filtration. Pour off quietly so as to keep the thicker parts for the last. Cover up the funnel with a glass plate. The last portions may be thinned with an ounce or two of alcohol to enable them to get through, and still leave sufficient body.

Next add the sandarac to the filtrate, and filter again. This second filtration is no trouble at all, as the varnish goes through like so much water (of course, a fresh filter is to be used).

To apply the varnish made according to the foregoing formula, the plate is to be slightly heated, for which a Bunsen's burner answers perfectly.

The bottom of the plate should be pleasantly warm when felt by the edge of the right hand (the lower part of the thumb and side of the hand), not hot. The varnish is poured on, tilting the plate first forward, then backward, alternately, till it is covered, so that the pool of varnish shall continually spread in all directions. If any smoke rises, the plate was much too hot. The plate is tilted, the varnish poured off into another bottle and held vertically for a minute till the varnish sets. Holding before a stove to dry is perfectly useless, and only increases the labor.—M. Carey Lea, M.D.

A cheap little article for keeping varnish clean can be readily understood by looking at the annexed cut (Fig. 299). *A* is a toy teapot, *C* is a small tin funnel, made to fit neatly in the top of the teapot, *B* is a strip of tin, covering about half of the top of the funnel. In using, pour from the spout, and drain the plate into the funnel in which some cotton has been placed.—O. I. C.

Fig. 299.

I feel that I must revert once more to the question of transparency. To my mind, the influence of varnish is always regrettable, and therefore the less that varnish changes a negative, the better. Few, I think, appreciate how much varnishes can differ in this respect. I have in my possession a commercial varnish much used here, which works with remarkable ease and smoothness, requires no heat, and leaves a surface the smoothness and polish of which cannot probably be equalled by any spirit-varnish (it appears to be made with benzole). But it reduces the image more than any varnish that I have compared it with.

One reason that photographers do not generally appreciate these differences, lies in the fact that it is difficult to measure in any given case what effect has been produced, in comparison with what would have been produced in the same case supposing a different varnish had been employed. But the comparison is easily and exactly made in the following simple manner:

I take the finest and thinnest French letter-paper, cut a number of pieces of a convenient size, pour out the varnish into a clean pan, plunge the paper completely under it for a half minute, and then dry it, either cold or hot as the case may require. This I

Thus far we have assumed that our operations have been successful. Cases will occur, however, where the negatives will need after-treatment, intensification or reduction, and sometimes more or less retouching. All these processes will receive attention further on.

142. The principal annoyances which beset the wet-plate maker arise from a disordered condition of the nitrate bath, from the collodion film, or from the two together.

The main troubles to be met with from the bath are fog, pin-holes, weakness, and markings upon the film.

repeat with each varnish to be tried. The difference in the opacity of the paper after this treatment gives an excellent indication as to the properties of the varnish. I inclose some specimens of paper so treated. Those marked *C* have been treated with the commercial varnish before spoken of, and those marked *L*, with that here recommended. The marked difference in the effect will be observed. Those that are dried with heat are so marked, and can be compared accordingly.—M. CAREY LEA, M.D.

Removing varnish from old negatives is very easy and speedily done. Make a wooden tray 14 x 18 inches square, 6 inches deep, watertight; then varnish the inside with shellac; varnish several times; let it get dry and hard; pour in three gallons of water, and add nine or ten pounds of common washing soda; when dissolved, add one quart of sawdust which has been made from cutting crossways of the stuff, as this is more solid; the sawdust prevents the glass from lying so close together, and does not scratch, and gives the solution a chance to get all through between them all the time. Twenty-four hours will loosen the varnish, and it will wash clean when under the tap; after they are cleanly washed place them carefully one by one in strong nitric or sulphuric acid; twelve hours after this wash under the tap with a good stream of water running, with a clean, soft sponge that has no grit in it; after rinsing the plate well, then draining a few seconds, it is ready for the albumen. The article represented by Fig. 300 is the best I have found amongst many ways of coating the plates. No bubbles or specks will bother you when properly used. There is a funnel on top, by which you filter each time you pour from your plate, and is of such a shape as not to spill out while pouring.

FIG. 300.

And for varnish it works like a charm. You filter all the dirt out through the cotton in the funnel; this is tin, 3½ inches diameter on bottom, 2½ inches on top, with a lid to which the funnel is fast. The height is five inches.—E. DOANE.

142. I was once in a terrible fog. Friends came to the rescue, and suggested many things, such as examination of dark slide, camera, and dark-room window for possible access of white light; the examination of the dark-room walls for alkaline emanations, fungoid growths, etc. Everything seemed in vain. I visited a friend's studio and tried a plate with his chemicals; all went well. I took a stock of collodion, bath, and developer home from my friend, and tried them in my own dark-room with the old result—

Sometimes the fog or veil which covers the film is so persistent that one may neutralize, sun, boil, acidify, dilute, strengthen, add permanganate of potash, and what not, to the solution, without removing it. One or the other of these treatments should correct the evil, but sometimes there are local causes which prevent.

When such trouble comes, sit down coolly and consult *Photographics*. It will probably show you a way to overcome the nuisance.

143. Fog to the photographer is as baneful as a sunless sky to the hay-

fog. Almost hopeless, I felt disposed to pull my dark-room to pieces. I proceeded to strip the paper off the walls, in doing which rather hastily underneath the sink, through feeling cramped, and not being at the time in the pleasantest mood, I damaged (fortunately for me) the gutta-percha waste-pipe from the sink; finding it to be very brittle through long use, I thought it would be much better to have a new one than to waste time in trying to mend it; so I got a chisel, and as soon as I had chipped the mortar away from round the pipe it appeared loose. I took hold of it, and drew it out. I could see at once there was not sufficient to reach through a double brick wall. I went to the outside and saw the pipe still in the wall; after cutting that out, I found in the centre a quantity of wet deposit. This had been confined in with mortar, inside and out, for goodness knows how long, and had been soaking in the wall, hence the fungoid growth upon it. This accumulation of hypo, iron, pyro, acetic acid, etc., would, I think, give off a quantity of sulphurous gas quite sufficient to fog any plate. At all events, whether so or not, I am most thankful to say, since I have removed that and put a new pipe, the wall is drying, and my plates have been clear from fog every day since. I now can get a very fair negative from my large bath, with which before every plate fogged fearfully. I feel that there is every hope now that the cause is removed.—G. W. Wallace.

143. It is a mistaken idea, *excess of iodide in a bath*. I claim it is not possible when it is kept up to the original or proper strength, and that pinholes from excess of iodide are only the surest indication of weakness.—S. M. Robinson.

"Why don't you add water first, and precipitate the iodide? That 's what most of the authorities recommend."

Can't do it Focus; never did it in my life, and don't believe in it. More operators have been led into difficulty by following such suggestions, and keeping their baths *insufficiently* iodized, than have ever been benefited by it. When I make up my bath, after boiling, to the proper strength and bulk, if there be any excess of iodide it will filter out and leave the bath with just the quantity it needs, saturation. And I believe it will receive no more, theories to the contrary notwithstanding; and if this strength be kept up, it will never show excess of iodide. There may be exceptions to this in warm weather, when the bath is at a high temperature and considerable evaporation takes place. In that case the bulk is reduced by evaporation, and the quantity of silver by use; but the relative strength remains the same, as well as the *original quantity of iodide*, which is in excess, not from any additions to it by use, but from the very reasonable fact that there are not so much silver and water as in the first place to hold it.—Roland van Weike.

maker. Even worse is it when his films present the appearance of a map of a sectional view of the Pleiades—are full of spots, which, in photographic parlance, are termed "pinholes." They result from various causes, and are met in a variety of forms. The chief cause is an over-iodized bath. Such a condition occurs after considerable use. The usual remedy is to filter the bath after precipitation. There are two or three opinions on this subject. Some manipulators find a day or two of exposure to the sunshine more efficacious than filtration. The evil need not occur in the hands of a careful and exacting manipulator.

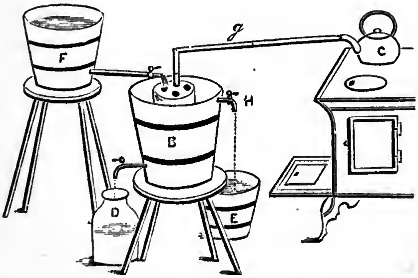
All these annoyances are the result of matter in the wrong place. The true remedy is to find out what, and where, is the matter.

There are two sides to most questions, and there are two to this; but I have yet to hear a reason given for taking iodide from the bath other than that of avoiding pinholes, which are merely nightmares that seldom appear, and are now being proved not to be caused by an excess of iodide; while even the advocates of the precipitation theory admit that the condition of the bath just before it begins to show pinholes is the most favorable for producing excellent work. This then is the important point, to keep it as near as possible to that excellent condition, which is that of saturation with iodide of silver, and the maintenance of its strength at as uniform a standard as it is possible to secure.—R. J. Chute.

I have found the following an excellent treatment for the negative bath overcharged with iodides and weakened by the quantity of alcohol and ether dissolved therein.

Having turned the bath into a glass jar, at least large enough to hold twice the volume of the bath, add to it distilled water until the bath is reduced to 15 or 20 grains to the ounce; it will assume a milky color, but will clear up by being allowed to stand a few hours, after which filter closely into an evaporating dish, evaporate slowly over a water-bath until it is only about one-eighth its original volume (120 to 130 grains to the ounce), remove, cool, and add distilled water until it is brought to the standard of strength desired. Let it stand one day in the sunlight, when, after filtering closely, it will work charmingly, and pictures will not easily fog.

Fig. 301.

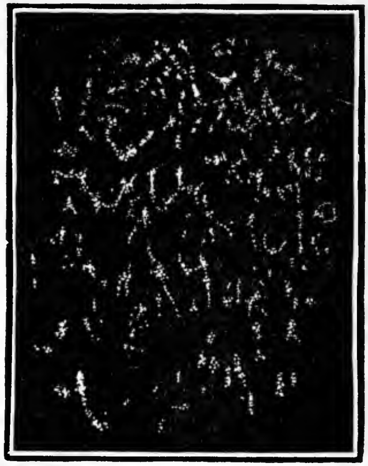


I send you a sketch of a contrivance for a still. *A* is the condenser perforated with water flues; *B*, the tank in which the condenser is immersed; *C*, the generator; *G*, the steam pipe; *D*, the receiver of distilled water, and *F*, the supply cistern of cold water, which should be so placed that the water will fall upon the top of the condenser; *E* is the hot water waste taken out at *H*.—F. W. Spencer.

144. Stains and "marble" marks upon the negative are a common disorder. Their causes are various—usually a scum on the surface of the bath solution which gathers there after use. A few drops of water in the collodion will often temporize a remedy. Careful attention to the solution will prevent the disease. "Comets," "oyster shells," "volcanoes," and "splurges" are, as a rule, the result of carelessness (Figs. 302, 303).

Fig. 302.

Fig. 303.



144. Dirty fingers are, I think, the most likely cause. My suspicion will appear to have some weight in it when we reflect how we handle the extremely sensitive glass-plate. First, many of us hold it by the corner to collodionize it; and, if one's thumb should be warm and at all tainted, away goes the evil into the bath, and must act in various ways to injure both the bath and plate. But the *next* operation is the most fertile source of these marblings. While the plate is in the bath we make use of the few minutes in wiping our slide, seeing that our developing glass is clean and so forth; then, often without washing our hands, we re-enter the tent, lift up the plate, and seizing one corner hold it until we think it is drained sufficiently for the slide. Well, now, in this act we place our thumb and finger upon a vertical moving surface, and should the finger be in the least tainted, what can be more natural than that the liquid next it should be affected and run its course down the plate, settling in various parts, according to the moisture of the plate, when touched? Besides, we often finger the other corners while adjusting the plate in the dark slide, and so cause further mischief.

Most of us have found that these stains appear and disappear when no change has been made in the chemicals, etc., and occur more frequently in hot weather, which facts favor my suspicions.

If dirty or new carriers are frequently the cause of these stains, then unclean fingers must be offenders also; but we can prevent this evil by washing our hands before handling the plate, and when lifting it from the bath *keep it on the dipper* for two minutes, at least, before touching it. I have often thought some plan might be found for suspending the dipper and plate during the draining, and should any one have hit upon one, The real fact is the careful, clearly and thoughtful photographer is rarely troubled with the annoyances described. And thoughtfulness is about as good a preventive as any.

it would be of great service to know it. Silver-wire dippers could be more easily managed than glass ones.—HENRY PIPER.

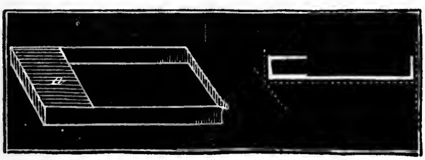
The bath should be always perfectly free from scum, and in hot weather the developer may usefully be reduced by mixing an equal quantity of water. But I am satisfied that each and all of these precautions will be found far less effective than that to which I have here called attention.

Before closing, it may be well to remark that few photographers are aware how easily and perfectly these stains may, for the most part, be removed.

This is best done before the negative is fixed. Keeping the plate very wet, take a very soft gilder's brush (it should be *very* soft, an ordinary camel's-hair pencil is wholly unsuitable), and wetting the brush also thoroughly, pass it over gently and steadily. The stain will at first resist, but presently comes away as a white powder. It will cease to be visible by transmitted light some time before it disappears by reflected, and it is best to stop as soon as the first of these results is effected. On one occasion I had a negative of which near one-third of the surface was covered by these stains; I did not wish to lose it, and, with a little care succeeded in getting rid of the whole of them. Without great care and gentleness, however, the film will give way; with good pyroxyline and careful manipulation, however, this need rarely happen. A piece of *extremely* soft paper, thoroughly wetted, answers even better than the gilder's brush, and is less apt to break the film. The paper must not be folded, but a single thickness tapering to a point must be well wetted, and the point be drawn gently over the stain.—M. CAREY LEA, M.D.

I use a flat well-bath formed of porcelain, the well at the end of the tray being of such capacity as to hold enough liquid to flood the plate thoroughly when placed on the bottom of the tray, and an inclined motion given to the latter. This will be better understood from the following diagram (Fig. 304), in which is represented the bath, the end *a* forming the well of which we have spoken. The open space of the bath represents the dimensions of the largest plate capable of being sensitized, and a ledge upon the bottom, which cannot be shown in the diagram, prevents the plate from slipping down into the well when the tray is tilted upwards in the manner and for the purpose now to be described.

FIG. 304.



The well-tray is fitted into a wooden case constructed in such a manner as to allow a plate to lie in a horizontal position. It stands on two end-pieces, one of which is inclined inwards at a considerable angle, the object of which is to allow of the bath being reared up on one end in a sloping direction. The diagram (Fig. 304) shows the configuration of the case in section. The solid line indicates the bath in outline, while the dotted line represents the case.

The use of the apparatus is as follows: The well having been nearly filled with nitrate

145. Of course, constant use will weaken the strength of the nitrate bath. Under such circumstances it becomes very human and acts very much as tired

of silver solution, and the bath having been previously placed so as to stand at a slope, the collodionized plate is laid upon the bottom, its lower end resting upon the shallow ledge of which we have spoken. An easily-fitting, although light-tight, wooden cover is now placed upon the case, and the bath is laid in a horizontal position, by which the silver solution flows over the plate in an unbroken sweep. All this may be done in a lighted room, owing to the exclusion of the light from the bath. After allowing the plate to remain immersed for any determined portion of time the bath is reared up on end, by which the liquid flows back into the well, leaving the plate in a sloping position to drain.

It has already been shown that the perfect drainage of the plate in a moist atmosphere is an effectual preventive of the formation of surface markings, and it will be seen that the bath now described provides the requisite conditions for effecting the necessary drainage. The interior of the case and of its cover is coated with paraffine, by which both remain unaffected by the moisture.—G. W. FOXLEE.

145. Let us consider what is the condition of a bath that has been used until purification becomes necessary, as compared with a freshly made solution in good working order. The old bath would be: (1) overloaded with ether and alcohol; (2) diminished in bulk and strength; and (3) it would contain a varying proportion of injurious substances called "organic matter" for want of a better expression, as well as an excess of iodide of silver. Plainly, then, any method of purification to be effective must be one that will remove the ether, alcohol, organic matter and iodides, and make up strength and bulk; and by far the best one in our estimation is to throw down the silver in the form of carbonate, and, after a thorough washing, to redissolve it with nitric acid. The fact of the silver being in the form of an insoluble precipitate, capable of being washed, insures a perfect removal of the ether and alcohol, and, although it may be possible that some of the iodides are taken up again by the nitric acid after being thrown down with the precipitate of carbonate of silver, still the solution will be found not to give any sign whatever of their presence, nor of the evils which follow. The organic matter, and probably a large proportion of the iodides remain behind in the form of a dirty, black, and insoluble mud, which may be easily filtered out, leaving a clear, neutral solution of pure nitrate of silver, which can be used at once after bringing it to the proper strength by the hydrometer and acidifying as usual. If the bulk be short, the proper amount of fresh crystallized silver and water may be added.

Boiling a bath is not by any means as efficient a manner of purification as it is generally believed to be. There is nothing in an old solution coagulable by heat alone, so that, unless the bath was thoroughly sunned after being neutralized, the organic matters would remain after the boiling. The bath should be diluted previously and thoroughly filtered *before the boiling*, if this plan must be followed. Adding fresh silver and water before boiling, and then filtering, is a most erroneous plan, and the fact of the solution working well after this messing has been gone through with, proves nothing one way or the other. It is absurd to put fresh silver into a solution already foul and awaiting humanity does when overworked. The remedy is obvious. But the disease has crept in slowly and therefore the cure must be effected gently.

purification. Neither can we understand what is meant by "acid being present in a passive condition." This is carrying things too far, for the solution must be either acid, alkaline, or neutral, and the question of what chemical function is performed by a substance not capable of responding to any known test may be very properly dismissed from an article of this kind, and, at all events, the infinitesimal quantity of a new compound formed by the neutralization of a bath (either with acid or alkali) might be disregarded. At the risk, then, of being somewhat tedious, let us repeat that if a bath is to be boiled, the operations should follow each other thus: (1) Neutralization, preferably with bicarbonate of soda; (2) dilution, thorough sunning and filtering; (3) boiling nearly to dryness; (4) making up to the proper strength; (5) filtering and acidifying.

The precipitation method is carried out as follows: Provide a large, strong bottle or jar capable of holding four or five times the bulk of the bath to be purified. Filter the bath into this jar and add a sufficient quantity of a filtered saturated solution of bicarbonate of soda to precipitate the silver. It will require quite a large quantity of soda to do this, and as there is violent effervescence, care must be taken not to add too much at one time, and to shake well between each addition. When the silver is all down, allow it to settle, and draw off the supernatant water with a siphon (a yard of India-rubber tubing, one end inserted into the bottle and the other sucked with the mouth till the fluid flows, answers very well). Fill up the bottle with water, shake, allow to subside, and draw off as before. Repeat this half a dozen times or more, and finally add nitric acid very cautiously until the precipitate is *not quite all dissolved.* At this stage of the process the solution will look black and muddy; throw it on a filter and test with litmus paper; it should be neutral. Then add water enough to make the strength right, and acidify.

A bath so treated is really a *new bath*, and will be found to work perfectly. It is best to conduct the whole process by yellow light, and it is presupposed that the water for the washing is pure and soft, or at least the same kind of which the bath is to be made. If the water is hard, the last three washes may be made with distilled water or melted clean ice. Each filtration must be done through a fresh piece of paper. Two thicknesses of the ordinary gray kind may be used.—EDWARD L. WILSON.

The stubborn bath would not yield until cyanide of potassium was resorted to. The addition of it brought about a better state of affairs. A little of a fresh solution was added, just sufficient to cause a permanent turbidity. The solution was then placed in the feeble light of a winter sun, which gleamed out fitfully at intervals during a week. A very short exposure blackened the particles of cyanide of silver in suspension, and finally the solution became perfectly bright and clear, having deposited a copious precipitate, which was removed by filtration.

The bath was then tried without any addition of acid, with one or two samples of good commercial bromo-iodized collodion, and the result was surprising. The film, on removal from the bath, presented a perfectly even creamy coating, free from marks of any kind. On applying the iron developer after exposure, the image came out with remarkable vigor, with dense lights and clean transparent shadows.—GEORGE W. WALLACE.

146. After all care, reasonable and sometimes unreasonable, the product of our manipulations will occasionally finish weak, flat, and insipid looking without the density required to produce first class prints. Overexposure, want of harmony between collodion and bath, a weak bath and too short time given to sensitizing the film are among the leading causes of weakness. The best way

146. The formula I give is for a portrait or landscape, and not for reproduction requiring considerable intensity:

No. 1. Bichloride of mercury, ½ ounce; water, 20 ounces. No. 2. Water, 20 ounces; iodide of potassium, 20 grains. No. 3. Water, 4 ounces; of No. 1, ½ ounce.

The negative is taken, washed and fixed, and washed well and *dried*. Then flow the negative with water, and flow it with No. 3 just long enough to discolor the film, and well wash and flow with No. 2, and as soon as the dark film becomes evenly tinted with the solution, wash and dry. It will be found that the mercury has not penetrated through the film, but only just acted on the surface to which it was applied. On looking at the back of the negative it will be seen as before the mercury was applied, but the surface will show the creamy effect of the iodide of silver. On looking through the negative, it will be found to be of a dirty greenish-yellow and transparent, and, if properly done, will be found to give a soft, brilliant print, and the negative will not change in the sun. I find many use a solution of bichloride of mercury and iodide of potassium mixed in one solution, but it is really a very bad intensifier for portrait negatives, and the negative will change in the light.—JEX BARDWELL.

There are certain difficulties connected with the use of the mercury treatment, as an intensifier after fixing, that are sometimes so annoying as to cause some photographers to abandon it entirely. When the sublimate solution is employed only till it blackens the negative, it will often act unequally. If the negative be left in until it whitens, with a view to subsequently treating it with iodine or with sulphide of potassium, it will sometimes happen that the picture becomes veiled. That which before immersing in the mercury was clear glass, may come out with a thin whitish deposit. If now the iodine or the sulphide be applied, this whitish deposit becomes black, and the negative suffers greatly.

To avoid these troubles, I proposed the following mode of action: Leave the plate in the sublimate solution until it is completely and evenly white. Wash it well off, and pour over it a solution of cyanide of potassium of one grain (or not exceeding two grains) to the ounce. This will rapidly blacken the negative strongly, at the same time clearing it up. It must be poured very evenly over the film, or used as a bath, and must be washed off as soon as the effect is produced, for if allowed to continue, it will whiten the film again.

It is evident that this process is particularly suitable to copying from engravings. It may also be applied where the picture, by mismanagement, has become slightly veiled during development, and is especially useful in cases where mercury has been applied, resulting in a deposit on the high lights, to know that the negative is not thereby spoiled, but can be saved by using cyanide as here described, instead of the ordinary treatment. —M. CAREY LEA, M.D.

to correct the evil is to make another negative. When that cannot be done resort must be had to strengthening or intensification. With an over dense negative but little can be done except to throw it away.

As a rule intensification is not recommended. More space is devoted to the subject in *Wilson's Photographics*—more methods of doing it—more reasons for not doing it. In case of emergency reference can be had thereto and thus more space left here for greater necessities.

Thus much for the "wet" method. We now join the caravan and turn to the "dry."

Perfect Negatives without Retouching.—I give the following formula, which, in my hands, produces negatives that need little or no retouching:

Plain collodion, 8 ounces; iodide of ammonium, 32 grains; iodide of sodium, 8 grains; bromide of potassium, 8 grains; bromide of cadmium, 16 grains; neutral bath, 40 grains to the ounce. Developer—Stock solution: Water, 64 ounces; sulph. iron, 3 ounces; Epsom salts, 2 ounces; acetic acid, about one-half ounce to 12 ounces of stock solution.—CHARLES EVANS.

CHAPTER XV.

NEGATIVE-MAKING—"DRY."

147. If this work was intended to serve as a history, many a long chapter could be filled with the details of the brave crusades made against the wet collodion negative process by the knights of the camera who have so generously fought for our mutual freedom. More than once, at the expense of much toil and experiment, a new ruler has been raised to the throne, only to become unpopular and to witness a return to the old rule, which continued to be the favorite.

Chloro-bromide emulsion, chloro-iodo-bromide, collodio-bromide, and collodio-albumen emulsion, were among those which promised most for a successful reign, but their time was short.

147. The following is the mode of preparation of my chloro-bromide emulsion:

Collodion.—Ether, 20 fluid ounces; alcohol, 12 fluid ounces; pyroxyline, 162 grains; bromide of cadmium, 320 grains; bromide of ammonium, 64 grains.

Add half the alcohol to all the ether, and shake up with the pyroxyline; throw the salts into a flask with the rest of the alcohol, and heat till dissolved; add to the other portion, shake up well, and place in a warm, light place for three weeks; it will be better still in two or three months.

This collodion will require 16 grains to the ounce of nitrate of silver to sensitize it. I always use fused nitrate.

Having measured out the quantity of collodion to be sensitized, weigh out 16 grains of very finely powdered nitrate of silver to each ounce, throw it into a test tube or flask, and pour over it alcohol of sp. gr. 0.820 in the proportion of 1 drachm to each 8 grains of nitrate; boil for a few minutes, and the nitrate will dissolve: pour it now in successive portions into the collodion, shaking up well after each; shake about five minutes after the last portion is added, and every few times thereafter.

In twenty-four hours after sensitizing, the mixture will be in condition to use. The filtering is best done by putting a piece of soft clean sponge in the neck of a funnel and cutting a small circular filter of close woven linen. Before filtering, the collodio-bromide mixture should rest quiet for two or three hours after its last shaking.

I use as a preservative the following: Cover a quarter of a pound of good litmus with hot water; set a basin or plate over the bowl and put in a warm place for a day; throw the paste upon a filter, and pour on hot water till the filtrate amounts to a quart (the

The bromo-gelatine process had been offered for some time, and, gradually gaining supporters, at last ascended the throne. It has apparently come to stay. A great many rebelled against it at first, but its more loyal subjects remained firm, until by comparing notes and giving of what they knew, they have won almost universal fealty to a process which, it is almost unanimously agreed, is a very satisfactory substitute for the old method.

The bath-holder and the dipper are hung upon the dark-room wall as trophies of past battles, with no less affection than the old-time Crusader felt when he hung up his sword and shield.

filtration is slow); add a drachm of carbolic acid and the litmus solution keeps good indefinitely: Litmus solution, 1 ounce; water, 6 ounces; gum arabic, 90 grains; sugar (fine white), 90 grains; acetic acid, No. 8, 25 minims.

The above quantity makes a convenient bath for a 6½ by 8½ plate. Throw the collodio-bromized plate into a pan of water until the greasy marks are gone, and then pass it into this bath, where it should remain, with occasional agitation, about ten minutes. The time is not important; five minutes will be sufficient.

The tannin preservative is as follows: Water, 7½ ounces; gum arabic, 90 grains; sugar, 90 grains; tannin, 15 grains. The washing of the plate is the same as above. The development may proceed by the strong alkaline development.—M. Carey Lea, M.D.

In my chlor-iodo bromide process we have silver iodide emulsified with bromide and chloride, and in some hands it works well. The collodion is made thus: Ether 0.730, 4 drachms; alcohol 0.805, 4 drachms; pyroxyline, 8 grains. To every ounce of collodion the following are added: Dried cadmium bromide, 9 grains; ammonium bromide, 2½ grains; ammonium iodide, 2 grains. Directly before emulsifying, add aqua regia, 2 drops.

The emulsion with an excess of silver is formed by adding 25 to 30 grains of silver nitrate, and, after an hour's interval, 2 grains of cupric chloride or cobaltic chloride; 2 drops of hydrochloric acid may be substituted for either of these or for the aqua regia.

The emulsion may at first appear flaky, but after the addition of the chloride it is only necessary to shake well and leave it for twelve hours. On again shaking, the emulsion will be found perfect. It may be used before drying or after drying. In the former case any of the preservatives ordinarily used may be employed.

If it has to be dried, it is poured out into a dish and left till it is in a leathery condition on the surface, after which a preservative is poured upon it. Any preservative will answer. I use water, 6 ounces; acetic acid, 3 drachms; solution of gum arabic with sugar, 4 drachms; prepared albumen, 1 ounce; gallic acid (60 grains to 1 ounce of alcohol), 4 drachms; tannin (60 grains in 1 ounce of water), 2 drachms.

The albumen is prepared by the addition of an equal bulk of water to the white of one egg, and clarifying with twelve drops of acetic acid.

The gum and sugar solution is made by mixing half a pound of gum arabic and two ounces of sugar in forty-four ounces of water and adding one and a half drachms of carbolic acid.

All plate rubbing, collodion flowing, sensitizing and so on, are done away with. The sensitized plates are received from the manufacturer ready for exposure in the camera. Or, if the manipulator prefers it, he may prepare an emulsion, coat his glass plates with it, and set them aside for use whenever it agrees with his inclination, be it weeks or months or years.

Moreover, he can expose them to-day and develop them a year hence, should it suit his convenience. Again, the greatest latitude in the matters of exposure and development are possible, and, when touring it there is freedom from great weight of apparatus and appliances.

The pellicular mass is then broken up, and it and the preservative are transferred to a large glass jar, and left there twenty minutes. The preservative is then poured off, and the washing takes place.

Instead of drying the emulsion, it may be poured direct into the preservative, taking care that the latter is more than four times the bulk of the former. The washing in this case takes place by decantation in the usual manner. This last method is stated to give the most soluble pellicle. The pellicle is then dried in the oven or water bath and is reëmulsified by taking for each three ounces of the original collodion: Ether, 1 ounce; alcohol, 1 ounce; plain collodion (4 grains of pyroxyline to the ounce), 2 ounces.

Shake well at intervals, and in a week it is ready for use. The plate is coated in the ordinary manner and dried. The exposure is about equal to that of a wet plate.—M. Carey Lea, M.D.

The collodio-albumen process is as follows. Preliminary coating: Albumen (the white of one egg), 30 c.c. (8 fl. drs.); water, 70 c.c. (19 fl. drs.); ammonia, 1 to 2 c.c. ($\frac{1}{4}$ to $\frac{1}{2}$ fl. drs.) Reduced to a state of froth, and after repose, filtered through paper.

After complete desiccation, the albumenized plates are placed in a grooved box, to be used when wanted.

The collodionizing of these albumenized plates is done preferably with old collodion, or with a mixture of two-thirds new collodion and one-third of old.

Sensitizing is done in the following silver bath: Water, 100 c.c. ($3\frac{1}{2}$ fl. ozs.); nitrate of silver, 8 grammes (123 grs.); acetate of lead, 1 gramme (15 grs.); crystallized acetic acid, a few drops.

It is very advantageous to expose the sensitizing bath to full light for some time, and to filter before using it; thus are avoided the fogs and reductions which may occur in the development, a very frequent cause of failure in sensitized dry plates.

After sensitizing, which requires about three minutes, wash, first in water slightly acidified with acetic acid; then cover the sensitized coating, 1, with a solution of phosphate of soda at three per cent.; 2, of gallic acid at one per cent., and without washing, with the following preserving varnish: Water, 100 c.c. ($3\frac{1}{3}$ fl. ozs.); pure dextrin, 9 grammes (139 grs.); gum arabic, 1 gramme (15 grs.). Made with the application of heat, and after the addition of a few drops of acetic acid filtered through paper.

The plates thus prepared are placed on the dryer, so as to obtain a regular and complete desiccation; they will preserve their quality for at least a fortnight.

148. While, as a rule, it will be found most certain, and certainly the most economical, for the photographer to purchase his sensitive emulsion plates ready made, he may not always wish to do so. Therefore, complete formulæ for making emulsions of various kinds will follow, with all the notes of practical worth which have been given as bearing upon the subject.

There are so many methods that manufacturers of plates make a choice, fancying that they see advantages in one which are not possessed by others. This causes uncertainty always as to the sensitiveness, and makes it necessary for the user to make a change in his exposure and development, as well as after-treatment, every time the brand of plates is changed.

Development of the Image.—The exposed plate is first plunged into very pure water, then into another dish containing tepid water; it is washed for the last time, and then exposed to the following reducer: Water, 250 c. c. (8½ fl. ozs.); gallic acid, 1 gramme (15 grs.); pyrogallic acid, 0.3 gr. (4½ grs.); acetic acid, 3 c. c. (¾ fl. drs.); alcohol, 3 c c. (¾ fl. drs.); in which are placed, at the moment of the immersion of the plate, a few drops of a solution of phosphate of soda at three per cent., and a few drops of acetate of lead of the same strength, to which has been added a little acetic acid. After a few minutes the plate is withdrawn, and a trace of solution of silver at three per cent. is added. The plate replaced in this energetic reducer soon shows all its details, and then additional nitrate of silver is added so as to obtain the necessary vigor.—ERNEST BOIVIN.

148. *The relative sensitiveness of dry plates, compared with the wet, is not constant, but varies with the amount of light—i. e.*, the stronger the light, the more sensitive the dry plate, compared with collodion, and the weaker the light and the longer the exposure required, the smaller is the relative sensitiveness of the former.

Take, for instance, a very sensitive dry plate, with which a good instantaneous view, under favorable conditions, can be made in from one-fortieth to one-fiftieth part of a second. To obtain an approximately equal result with a good collodion plate would require at least two or three seconds, so that in this case the dry plate would prove from one hundred to one hundred and fifty times as rapid as the wet. Now, with the very same plates, make a portrait under the skylight; here the dry plate will require say two seconds, while the wet, under the same conditions, will have to be exposed sixteen to eighteen seconds, so that the former will this time prove eight or nine times as quick. In a very dark wood, or for an interior, the difference of the two plates will be a still smaller one, and the dry plate will here only prove three or four times as rapid as the wet. How ought one to mark this very sensitive dry plate? One hundred, nine, or three times as rapid as a wet plate?

This also explains the contradictory results above mentioned. Some manufacturers test their plates for an out-door view, others under the skylight; some use very powerful, others less powerful, lenses; some use large, others small, diaphragms; and they will, therefore, in one place find their plates thirty times, in the other about eight or ten times as quick as collodion.

Of course, it would be too much to expect a uniform standard of plates. The best plan is to choose a brand from which you can produce the best results, and adhere to it. Another good idea is, when you desire a quantity of plates, to test samples made from certain batches of emulsion, find which suits best, and then have your stock order made from that emulsion.

Since a number is given by the dry-plate manufacturer to each emulsion he mixes, the plan suggested is not a difficult one.

149. The manufacture of emulsion must be conducted in the dark-room.

The reason why the sensitiveness of the dry plate increases with the amount of light, respectively with the shortness of exposure, one cannot tell with certainty.

Some readers will perhaps ask here: "How ought one to mark the dry plates, so that everyone can have an approximate idea of their sensitiveness, and guess close to the right time of exposure, even if he never worked the brand of plates before?"

The best means for testing and determining the relative sensitiveness of dry plates, up to the present time, is by a sensitometer, either Vogel's or Warnerke's; and I would advocate that every dry-plate maker should test his plates with one of these instruments, and mark the packages accordingly. I am well aware that these instruments have many pros and contras, which to discuss here would lead too far; but as long as we have no better means, they should most decidedly be used. But marking sensitometer degrees by the manufacturers alone will be of very little use if the customers are not acquainted with these instruments, and know what, for instance, "15 or 20 Warnerke" means. If not practically, they ought at least theoretically, be acquainted with the sensitometers. Our photographic journals will have to explain these instruments, and everyone ought to read these journals, and profit by them.—Dr. S. C. Passavant.

149. The following apparatus goes far to lighten the labors of those who make their own gelatine plates. It is my cooking-box, warming-box, etc. (Fig. 305.) 1, can for warm water; 2, lamp for heating.

Fig. 305.

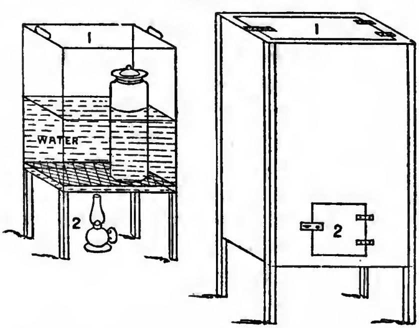
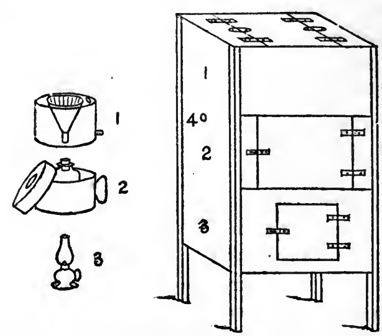


Fig. 306.



The heat from lamp passes all around the inside can containing water. Place a wire net in the bottom of the can to raise the jar about one inch; the heat will then be even.

The purest and best ingredients should be used, and cleanliness and exactitude cared for throughout.

I always prepare the emulsion the evening before using, and place to filter in my warming-box, made as design. (Fig. 306.) 1, warm-water shield for funnel containing filter.

"Pour the emulsion in, and allow it to drip in the bottle contained in warm-water can, No. 2. Place a small lamp in at No. 3, and keep it burning so that the heat is kept at 100° till after the flow is ended. This I do with my flowing apparatus, which connects with the emulsion bottle by means of a small rubber hose passing in the heating-box through the hole in the side at No. 4."—S. L. Platt.

For the preparation of gelatine emulsion a water-bath is indispensable. I make use of an ordinary tea-kettle when experimenting on a small scale. (Fig. 307.) *T* is the kettle filled with water and heated by the Bunsen burner *B*. *P* is a porcelain jar such as apothecaries use for medicines. *J* is a funnel having its neck stuffed with cotton, so that hot water (with which it is first filled) drops into the jar at the rate of three or four drops per second. *S* a glass rod for stirring, *t* a thermometer. I prefer porcelain jars rather than glass flasks or vessels as generally recommended, they are not so likely to break. For 7 ounces of emulsion then, let a jar holding 14 ounces be selected, and about twice as deep as it is broad. If gas is not to be had, a powerful Berzelius lamp petroleum cooking-stove, or charcoal fire with bellows and good draft may be substituted. It need scarcely be said that the apparatus must stand in the dark-room. For illumination a lamp with ruby-red chimney may be used. *During the addition of the silver, and, in fact, as long as there is an excess of bromide present, it is not necessary to be over-cautious about the light*, for the bromide keeps down the sensitiveness considerably; but when the perfectly washed, highly sensitive emulsion is to be handled, then care is necessary, and the direct light of the lamp should not be allowed access to it *longer than is absolutely necessary*. At the distance of three feet, a few minutes will do no harm. The ceiling of the room should be painted black in order to prevent reflection from the lamp (Fig. 308).

Fig. 307.

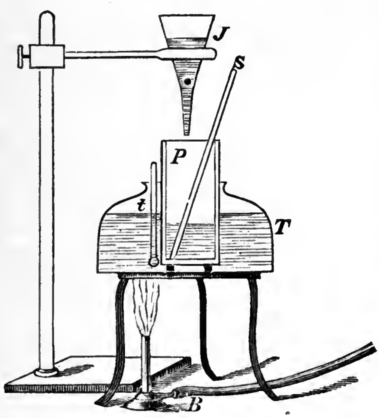


Fig. 308.

In this manner I have made as much as two quarts of emulsion. If larger quantities are to be prepared, I advise a hollow tin case to be adapted around the funnel and filled with the water; this will keep the solution warm. Of course, larger water-baths will be required.—Dr. H. W. Vogel.

It will be understood that the temperature at which the gelatine is cooked, rules the degree of sensitiveness of the resulting emulsion—the higher the tem-

To secure gradations of higher lights, in the tone, and relief in the shadows, I take three beaker glasses; in the first I put 370 grains bromide of potassium, 4 gr. iodide of potassium, 310 gr. best gelatine, 7 fluid oz. distilled water, and 3–4 minims glacial acetic acid, or 1½ gr. of citric acid. In the second glass I put 460 gr. crystallized nitrate of silver, in 3½ fl. oz. of distilled water. In the third glass I dissolve 310 gr. of the best gelatine (216 gr. hard and 94 gr. soft for warm weather, and 155 gr. of each in winter), in 8½ fl. oz. of distilled water.

While the chemicals are dissolving, and the gelatine swelling, I get ready the water-bath. When the bath is hot, I put in the contents of the first glass, which is subjected to successive degrees of heat until the gelatine is perfectly dissolved. The solution is then transferred to a black bottle, similar to those employed in transporting mineral waters, and stopped with a cork, cut in such a manner as to afford ventilation to the bottle. To the contents of this bottle 1¾ fl. oz. of distilled water are added, and well shaken; then the solution of silver nitrate (second bottle), in portions, ten in all, and the whole again well shaken after the addition of each portion. The bottle and its contents are again transferred to the bath, and suffered to digest for two hours at 150° to 160° F. After this digestion, the emulsion is quickly cooled down to 85° F. During this time, the gelatine is allowed to dissolve in the third glass, and the solution cooled down to a point at which it remains firm, but still in a fluid condition. About 2 drachms of pure ammonia are now added, the whole well shaken, and poured into the bromide of silver gelatine emulsion, which has been cooled down to 85° F., again shaken, and immediately filtered, without further digestion, through flannel into a porcelain dish, and left to set. After the setting, the gelatine is pressed through canvas, and washed for five or seven hours in running water, then remelted and refiltered. The emulsion is now in readiness to be poured upon the plates. It flows and dries easily, since it contains comparatively little water.

I prefer the oxalate of iron developer, without the preparatory alum bath, or addition of bromide of potassium, or hyposulphite of sodium

The plates are very sensitive, and give brilliant negatives, with rich shadows, free from all spots.—Franz Kniebel.

To render emulsion films insoluble take water 12 ounces, alcohol 6 ounces, chrome alum 12 grains.

After exposure I immerse the trial plates in this solution for two or three minutes, perhaps a little longer, and then soak them in a dish of water, using a camel's-hair brush to rid them of the bubbles formed by the alcohol in the film coming in contact with water, until the water flows smoothly over the plate. (It would also be well in *all* cases to use the brush in developing to insure the absence of bubbles.) I then develop them, and they come up clear and brilliant, perhaps a little more brilliant than when not using the alum; and wash them in water of about 100° (warmer than it is likely ever to be used in summer), fix as usual, and wash again in warm water as before, and dry spontaneously. Not a particle of frilling or reticulation. No alum was used except that men-perature the more sensitive the emulsion. Sensitiveness is also secured by the addition of ammonia to the bromide of silver.

tioned at first. A longer soaking would undoubtedly cause the plate to stand even drying by heat, which I did not attempt, as I don't consider it essential.—D. BACHRACH, Jr.

Slow Emulsion for Landscape Work.—I will give a formula, although I claim no particular merit for it, except that I have tried so to adjust the details that the process may be as simple as possible, and that the chance of failure may be reduced to the minimum: A. Nitrate of silver, 200 grains; distilled water, 3 ounces. B. Bromide of potassium, 160 grains; iodide of potassium, 10 grains; Nelson's No. 1 gelatine, 40 grains; muriatic acid, 2½ minims; water, 3 ounces. C. Hard gelatine, 150 grains. D. Hard gelatine, 150 grains.

The gelatine of B is allowed to soften. At the same time water may be poured over the lots of gelatine C and D (kept separate one from the other) to let them swell.

A and B are now heated to 120° F., and A is poured into B slowly, with vigorous stirring. The emulsion thus formed is allowed to stand for ten minutes with occasional stirring. Meantime, as much of the water is squeezed out of the gelatine C as is possible, by wrapping it in a towel, or similar piece of cloth, and wringing the cloth round.

After ten minutes the emulsion (having been allowed to remain without stirring for at least two minutes, to allow any granular bromide which may have been formed, to subside) is poured over C, heat being, if necessary, applied to melt the gelatine. When the gelatine and the emulsion are thoroughly incorporated, the jar containing them is set on one side to allow the whole to set into a stiff jelly. In cold weather there is no difficulty in getting the emulsion to set, but if the weather be warm it should be allowed to stand in a vessel containing water, with a lump or two of ice in it. Once thoroughly set, the emulsion is washed in any of the well-known ways, being either squeezed through canvas, or otherwise cut into small fragments. When it has been washed thoroughly and drained until no more water will run from it, D (having had as much water as possible wrung out of it) is added. The whole is melted up, and one-half ounce of pure alcohol is added, when it is ready for coating plates.

The quantity of emulsion that I have described should serve to coat a dozen 8 x 10 plates. A skilled coater could make it cover a dozen 10 x 12 plates without any part being too thin.—W. K. BURTON.

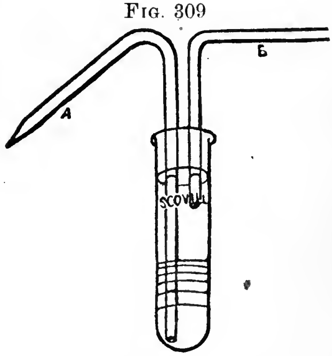
All the articles employed must be scrupulously clean and dry. Any contamination by dirt of any description, and particularly that to be found in a photographer's work-room, is almost sure to spoil the emulsion, or, at all events, its sensitiveness, and to cause endless evils. Hence *clean* paper should be used, and the chemicals should not be left on the benches or table in contact with the wood. The scales in which the weighing has to take place should be examined for dirt (chemical or otherwise) and a few circular filter papers on which to weigh the materials, should be at hand. Weighing should never be done without a filter paper of equal size and weight being placed in each pan of the scale. A saucepan of hot water should be ready in which to place the beakers, etc., in which the different materials have to be dissolved, and care should be taken that it is not too full. It need scarcely be said that all weighing can be done in ordinary light. To com-

Three methods will be given for the preparation of emulsion, therefore, including one, in the practice of which, the slow boiling of the gelatine is followed.

mence operations, the following may be weighed out separately and placed on clean paper after weighing, it being supposed that a dozen or a few more whole plates are required: 1. Potassium iodide, 10 grains; 2. Ammonium bromide, 140 grains; 3. Nelson's No. 1 photographic gelatine, 30 grains; 4. Silver nitrate, 200 grains; 5. Nelson's No. 1 photographic gelatine, 80 grains; 6. Simeon's Swiss gelatine, or Coignet's special gelatine, 80 grains. Nos. 3, 5, and 6 are rapidly covered with water, shaken or stirred in it a few seconds, and the water poured off as quickly as possible. This gets rid of any adherent dust on them. Nos. 1 and 2 are then dissolved in 1 drachm and 1½ ounces of water (ordinary tap water is good enough) respectively, and then No. 3 is added to No. 2 and allowed to swell in the liquid. It may require a little coaxing to get it beneath the surface of the water, but if a good-sized developing cup be used there will not be much difficulty. When swollen, the cup containing the salts and the gelatine is placed in boiling water for a few minutes, till the latter is dissolved (which it will readily do in a very short time), and raised to the temperature of about 150° F.; if the gelatine be alkaline, 1 drop of hydrochloric acid may be added. The silver, No. 4, meanwhile, is also dissolved in 1½ ounces of water, slightly warm.

This last may be placed in a spray apparatus, which is made as follows; Bend two thin glass tubes in a common fish-tail burner of the shapes *A* and *A* (Fig. 309). The tube *A* should first of all be drawn out so that the end is perfectly closed; this may be done by the heat of a Bunsen burner, by holding the straight tube over it at about an inch from the end in one hand, and at any convenient distance in the other, and when thoroughly softened by the heat at one point, by simply pulling the tube outwards the glass collapses, and the short bit is pulled off. A flat file is then applied to the point, and the glass filed away till a very small orifice is left. The two tubes are then inserted in a cork which is fitted into a test-tube, as shown. The silver nitrate is placed in the bottom of the tube, and a very fine spray of liquid can be forced through the orifice of *A*.

FIG. 309



The solution of gelatine and bromide should be placed in a glass beaker or a jam pot, and in the dark-room the spray is blown on to it, and the liquid stirred at the same time with a clean glass rod. When the silver nitrate has been added to the bromide, the iodide is dropped in with stirring, and the remainder of the silver solution subsequently added. This is a better plan than adding it to the bromide at first, and depends for its value on the fact that the iodine from the iodide will replace the bromine from the silver bromide, soluble bromide being reformed; grains of silver iodide thus formed, have the same size as the bromide originally formed. This gives a very fine emulsion indeed, and, if correctly carried out, a drop of it when poured on a strip of glass should show an

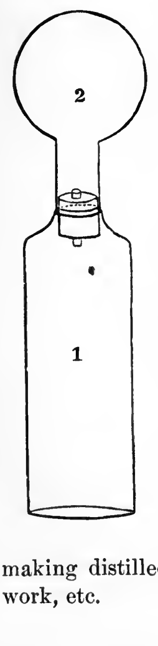
The preparation of the glass is substantially the same as that given for the "wet" process, cleanliness being the great desideratum.

orange-yellow color by transmitted daylight, or a deep ruby when a gas or candle-flame is examined through it. The possible sensitiveness of an emulsion depends almost entirely on the fineness of grain of the bromide when first formed. With a gray or blue tinted emulsion, extreme rapidity can never be hoped to be attained. The emulsion should be transferred to a 20-ounce bottle, and *well shaken* for a couple of minutes, after which it is ready for the next operation.—CAPT. ABNEY.

If two one-drachm measures be filled, one with the bromide solution and the other with the silver nitrate solution, and then be poured into a bottle together and well shaken, and this operation be repeated again and again till the two solutions are exhausted, you get a perfect emulsion without grain, and very smooth. It will be noticed that in this plan the silver and the bromide solutions are in equal quantities.—W. ENGLAND.

Another plan is to draw out two funnels to fine points and support them on funnel-holders over a jar. These are filled with the two solutions, which are allowed to run into the jar, a stirrer being used to aid emulsification; other workers use the scent diffuser, by which to secure fineness of grain. Any of these artifices may be employed. A later plan, which the writer has adopted, and which is very effective, is to shake the gelatine containing the bromide into a froth, and then to add the silver nitrate little by little. This makes a beautifully fine emulsion, and seems to be equivalent to immersing a delicate film of gelatine into a silver bath, when we know that splendid films are to be obtained, having the very finest grain.—L. WARNERKE.

FIG. 310.



Many of the difficulties of collodion emulsion-making may be overcome by the use of the contrivance I describe below. 1. A glass bottle of any capacity whatever, intended to contain the bromized collodion. 2. A glass balloon for the solution of silver nitrate. (Fig. 310.)

The two are joined together by means of a long cork. This cork is perforated, and a small glass tube fixed in the hole. Supposing that an emulsion is to be made, the bromized collodion is placed in the bottle and the cork introduced (as the cork is long, half of it stands out of the bottle); the nitrate solution is introduced into the balloon. The bottle is now turned upside down (as the glass tube is small, no liquid escapes if turned with care) and fitted into the neck of the balloon, which is immediately turned upwards. Now, if the apparatus be shaken with force, at every movement a few drops of the silver solution are precipitated into the collodion, and the bromide of silver is thus slowly formed in the collodion. The shaking is continued until all the nitrate solution has made its way into the collodion.—A. DAVANNE.

What I describe below is an apparatus for the making of emulsions. It can also be employed for every service required as a still, such as making distilled water, distilling alcohol and ether, precipitating cotton for emulsion work, etc.

I have heard it said that one need not be so careful in this matter, but I have seen many bad results from unclean plates.

Fig. 311 represents said apparatus as fitted up to distil water. *A* represents a copper boiler on which is firmly screwed by means of clamping screws, a dome made of the same metal. *BB′* two funnel-shaped holes in which are inserted two corks or India-rubber plugs. *C* is a smaller hole stopped with a cork, the use of which will be seen hereafter.

To set the apparatus at work, fill up the boiler with the exact quantity of water which the large bottle *D* can hold. Fit into plug *B* the condensing apparatus *E;* stop up the holes in the plugs *B′* and *C* with corks, and light the fire or gas under the boiler; by looking at the bottle *D*, it can easily be seen how much the water has diminished in the boiler, which can easily be refilled if required, by taking out the cork *C*, and putting a funnel in its place.

Fig. 311.

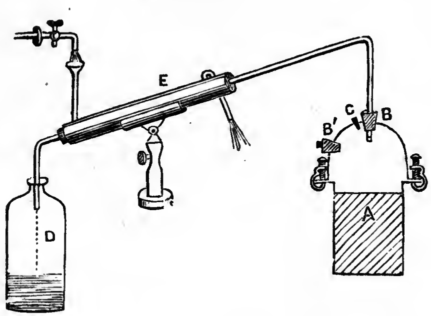
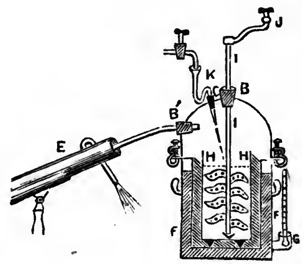


Fig. 312.



Water containing alcohol, the product obtained in precipitating emulsions or collodion, must be distilled in this manner also; but on no account must water containing a mixture of alcohol and ether be so distilled; we shall see how hereafter.

I will now give a description of the apparatus as arranged in order to precipitate collodion or emulsions.

As may be seen by Fig. 312, a slight addition is made to the apparatus. 1. *G* is a copper boiler, having handles on the sides, and near the bottom an opening in which to insert a cork bearing a thermometer, *G*. This boiler is filled about quarter full of water, and when the still is introduced it displaces the water and forces it to rise to the level indicated. A second addition is that of a porcelain pan or pail, *H*, which is placed in the middle of the still in such a manner that a certain quantity of water may separate it from the still. A centre point is fixed in the bottom of this pan, in which rotates the lower end of a shaft bearing a number of propellers or beaters, *I*, in wrought silver. On the top of the shaft is fixed a handle, *J*, or any other mechanical contrivance by which the beaters can be made to rotate. A funnel and glass tube "*tube du surete*," *K*, in a cork, is fixed into the hole, *C*, in the dome, to enable the collodion to be poured slowly

150. To prepare an emulsion with ammonio-nitrate of silver based on Dr. Eder's plan—proceed as follows: *A.* Bromide of potassium, 370 grains; gelatine, 518 to 694 grains; pure water, 10½ ounces. *B.* Nitrate of silver, 458 grains; pure water, 10½ ounces. *A.* should first be dissolved.

After soaking, say fifteen minutes, place the ingredients in a water-bath at a temperature of 95° to 120° F., till the gelatine has dissolved, and the solution is clear. Now ammonia is added drop by drop to *B.* until the precipitate first

into the apparatus *E*, as represented in Fig. 313, is this time passed through the lower plug *B′*.

In order to set the apparatus at work, the porcelain pan is nearly filled with distilled water, in fact to the level of the beaters, and is then fixed in the middle of the still, which is then firmly closed by means of the clamping screws.

The apparatus now being ready for work, is placed upon a gas or other stove, and as soon as the outside thermometer marks 150° Fahrenheit, which supposes the heat of the water in the interior of the pan sufficiently hot to evaporate ether, the fire is extinguished, and the collodion or prepared emulsion is gradually poured into the interior of the apparatus by means of the glass tube and funnel *K*. In coming into contact with the hot distilled water, a great dilatation takes place by the rapid evaporation of the ether; at the same moment the precipitated cotton is drawn violently down to the bottom of the water by the movement of the screw or beaters, and is there kept in constant agitation. The ether makes its way out of the still through the glass tube at *B′*, is condensed in the cooling apparatus, and is collected in a bottle about a quarter full of distilled water, and left there until a certain quantity is collected, and above all, to extricate any alcohol which has made its way out of the still in company with the ether. As for myself, after having shaken it up once or twice, in decanting it with care, I find it sufficiently pure to make normal collodion. Naturally, if a great purity be required, it must be washed several times, taking care to diminish the quantity of water each time; a tenth of the volume is sufficient for the last wash. The ether is then put into a bottle containing chloride of calcium, and left there for several hours, or even days, and then distilled, in the same apparatus as Fig. 313, but without the beaters.

Let us return to the precipitated cotton; in an hour the water is sufficiently cool to dip the hands into it, therefore the dome is detached, and the porcelain pan containing the precipitated cotton with the alcoholized water taken out; this is poured through a fine sieve which retains the cotton; the water is set aside to distil the alcohol from it, when sufficient is obtained to pay the expense. The product, pure cotton, or cotton containing bromide of silver, is then washed in several changes of water (and finally I give it a last wash in alcohol), and then it is set aside in enamelled iron trays, to dry spontaneously.

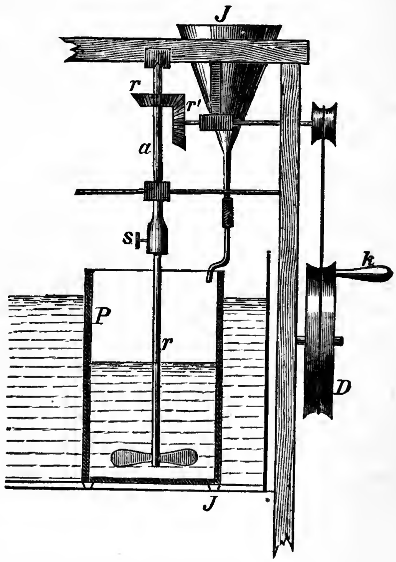
The dry product, whether it be precipitated cotton or sensitized cotton obtained by this process, has a honeycombed appearance, dissolves readily in the solvents, and gives a very pure solution.—Prof. E. Stebbing.

150. I have introduced a stirring apparatus for quantities of two quarts and upwards. It consists of a hard-rubber stirrer, *r*, dipping into the solution in the jar, *P*, and turning

formed is redissolved and the solution is clear. These operations can be carried on in daylight. Now, to the dark-room and in as weak a ruby light as possible, gradually add the silver solution to the gelatine. Shake well after the addition has been made, at intervals, and set aside to cool. Then replace the bottle in the water-bath, which should be at a temperature not exceeding 95°; let it remain for from half to one hour, allowing the water in the bath at the same time to cool down gradually to, say, 75°, not lower. The temperature should not be allowed to sink so low as that, there may be danger of

on a vertical axis supplied with a bevelled wheel, *r r′*. The axle of the latter is connected with a multiplying wheel and handle, *D k*. For preparing large quantities of emulsion I recommend steam-heating, but if the above apparatus be placed over a fire, it will be well to support the jar *P* on two iron supports, so that the hot water can circulate under the bottom; otherwise, the bromide of silver may cake fast to the bottom, owing to its being more heated than the sides.—DR. H. W. VOGEL.

FIG. 313.



For a rapid emulsion I use the following with much success: Nelson's No. 1 gelatine, 80 grains; Coignet's Swiss, or any good, hard gelatine, 280 grains; nitrate of silver, 232 grains; bromide of potassium, 164 grains; iodide of potassium, 20 grains; strong water of ammonia, 1 drachm.

The sensitiveness of the above depends upon its subsequent treatment.

If mixed in the usual manner—*i. e.*, the silver dissolved in water and added to the gelatine solution—a plate of ordinary rapidity will be the result; but if the silver is added to the gelatine *dry*, as described below, much greater sensitiveness will be obtained.

Proceed as follows: Dissolve the salts in five ounces of water and add the minimum of gelatine (eighty grains), and set in hot water. Weigh out the silver in large crystals. Put the same in a strong jug, or any suitable vessel. Heat both the jug and the bromized gelatine to about 140° or 150° Fahr. Carry them into the dark-room, and pour the gelatine solution as quickly as possible into the jug and upon the dry silver. Shake rapidly till dissolved, after which replace in the hot water and bring to boiling point. If boiled longer than thirty minutes, a drop or two of nitric acid should be added. In the meantime the remaining gelatine should be standing in sufficient water to cover well. After sufficient soaking (an hour, more or less), drain the water all away, and melt slowly, keeping the temperature down. After the boiled emulsion has cooled to about 90° add the gelatine setting; but the quantity of water should be sufficient to prevent the temperature falling lower than stated. In adding ammonia, which should be done before adding the silver to the gelatine, great care is needed, lest the temperature rise too high. The water-bath should be watched also, for too high a temperature will cause fog at development. The danger mark is 100° to 105°.

151. When the digestion is complete pour the emulsion into a porcelain dish and place it in cold water for the purpose of setting it quickly. When thoroughly set, it is pressed through coarse canvas, and then suspended in a bag and washed either in frequent changes of water, or, better still, in running water for from four to five hours. As the emulsion absorbs a good deal of water during the washing, the latter must be removed either by allowing it to drain for some time, or the excess may be expelled either by gentle pressure or by pouring alcohol over the emulsion. In the latter case only half the ordinary amount of alcohol should be added to the emulsion after filtering. The emul-

the remaining gelatine, and lastly the ammonia, after which proceed as usual with setting, washing, etc.—GEO. SPERING.

Great care is necessary all through. In order to succeed, it is necessary to have the arrangements of the dark-room such that the temperature of the emulsion and freshly coated plates can be absolutely under control. This can readily be attained with ice and hot water, handled with judgment and a little ingenuity. The simpler the arrangements are, however, the better, as there is then less danger of making mistakes, and the results will be more uniform. Any good operator who will take hold of the matter of making his own plates will very soon be able to produce much better ones, as regards both rapidity and quality, than any of the commercial brands in the market, for the reason that he will do his own work, throughout, and will do it in all of its points, with greater care and skill than the hired help that do the work in the dry-plate factories.—JAY DENSMORE.

151. The changes which gelatine undergoes by heating and putrefaction, so far as I have been able to determine, are as follows:

Gelatine during prolonged digestion splits up into two substances—semi-glutin ($C_{55}H_{85}N_{17}O_{22}$), insoluble in alcohol, and precipitated by platinic chloride, and hemi-colline ($C_{47}H_{70}N_{14}O_{19}$), which is soluble in alcohol and not affected by platinic chloride. Semi-glutin, by standing, reduces silver nitrate without precipitating it, while hemi-colline causes a flaky precipitate of the same. This splitting up of the gelatine is the reason why gelatine after long-continued boiling loses its setting power, without, however, any decomposition setting in. The latter is only apparent after several days' boiling, and renders the gelatine quite fluid; but boiling for a half, or even an hour, does not produce an injurious effect.

If gelatine be submitted for a long time to a temperature of 30° C. to 50° C., it loses sion may now be melted and filtered, or any sediment may be allowed to subside to the bottom. If the emulsion is to be preserved, an antiseptic should be added, consisting of one grain of salicylic acid, dissolved in alcohol, to every ounce of emulsion. The same weight of oil of thyme—or, best of all, carbolic acid—may be substituted. The alcohol serves a good purpose by accelerating the setting of the emulsion.

The proportions of potassium bromide to silver nitrate employed should not be less than 4 to 5. With less bromide, fog is apt to make its appearance. This is a nice point and requires extreme and careful attention. As Dr. Eder truly says:

equally its setting power; but at a later period than in the former cases. It is very difficult to decide the exact point when putrefaction, shown by the development of gas and formation of ammonia in combination, begins, and the separation above alluded to ends.

Boiling with even a slight addition of ammonia, or of acid, quickly deprives gelatine. of its setting powers, and the same splitting up appears to occur; at all events, the formation of hemi-colline is apparent. Gelatine warmed with water containing one or two per cent. of ammonia, at a temperature not exceeding 40° C., will, at the end of three hours, be found to have the temperature of the setting point lowered to 1° or 2°. A four per cent. solution of gelatine digested for five minutes with a two per cent. aqueous solution of ammonia at temperatures of 30° C. or 40° C., has its setting power reduced from 5° to 8° C., and after three hours' digestion, about 1° C. to 2° C. If a sample of gelatine is too soft, alum can be used to harden it.

The fixed alkalies have the effect of decomposing the gelatine when boiled with them; and acid potassium bromide—as might have been expected—deprives gelatine of its seting power more rapidly than a neutral sample.

This loss of setting power, caused by heating at 30° C. or 40° C. for a long time, is almost always the result of decomposition. Germs of putrefaction are always present in the atmosphere, so that no artificial ferment is necessary. Decomposition is very quickly set up by the addition of a small quantity of animal tissue—for instance, muscular tissue, or, still better, the substance of the pancreas, and digesting over heat. According to Weyl, the products of decomposition caused by water and pancreas are alike.

In their reaction there are formed from every 100 parts of gelatine, 9.48 parts of ammonia, 24.2 parts of volatile fatty acids, 12.2 parts glycol, 19.4 parts peptone, and 6.45 parts carbonic acid. The volatile fatty acids are acetic, butyric, and valerianic acid, the first of these being more abundantly present in proportion as the process of decomposition is prolonged. The gas given off does not consist of carbonic acid alone. The ammonia is combined with the fatty acids, and remains in solution.

Putrefaction occurs in a gelatine solution contained in a close vessel, although, under such circumstances, it takes about six times as long to develop as when the solution is in contact with the atmosphere. The organisms produced during the progress of decomposition are anaërobes, which are capable of spontaneous generation, and can exist apart from contact with the air.

152. "The difficulty of determining the proper proportions depends on the fact that if too much bromide be employed, the sensitiveness is reduced; if too little, there is a danger of fog. If an emulsion containing a very small excess of soluble bromide be prepared without ammonia, and digested for several days at a temperature of 110° or 120° F., the process of modification proceeds rapidly, and, owing to the low temperature employed, there is very little danger of decomposition. If, however, the operation is shortened by boiling or addition of ammonia, an excess of soluble bromide is very useful to counteract the natural tendency to fog. In case of long digestion, an excess of soluble bromide retards, but does not prevent the attainment of great sensitiveness."

The conversion of the insensitive into the sensitive modification takes place very rapidly if the directions given above be followed out. Even at a tem-

Gelatine which has been subject to decomposition produces fog in gelatino-bromide plates.—DR. J. M. EDER.

152. The amount of iodide of silver which has so far been employed in the preparation of gelatine plates is, in proportion to the amount of bromine, very small, but greatly varying in the different formulæ put forth. The amount could even be increased in the preparation of emulsion for ordinary use. The results of the two might be compared.

It would be urged that it is very difficult to prepare a gelatine emulsion containing iodide of silver which shall possess the same degree of fineness as one containing bromide of silver. It will be found to be much coarser in grain.

In the *British Journal* (June, 1884) there is a method given for the preparation of a very fine grained iodide-bromide of silver emulsion.

It is this: add to the concentrated gelatine solution first the silver solution, slightly acid; then follow the iodide solution, which it is most advisable to mix with a portion of the gelatine solution, and last of all the bromide.

By this plan the iodide of silver comes in contact with an excess of nitrate of silver, and is formed into a concentrated gelatine solution. This, as well as the strong dissolving power of the silver nitrate, acts upon the iodide of silver so that it is formed much slower and in a much finer state of division.

Another method, when no great amount of iodide of silver is required, is as follows:

The iodide of silver is precipitated in an aqueous solution, dissolved after washing in a concentrated silver solution, and added to the bromidized gelatine solution.

If a pure iodide of silver emulsion is to be made, the following plan is the best:

Suppose we wish 150 c. cm. of emulsion; weigh out 100 grains (6.2 grammes) of nitrate of silver, and dissolve it in 60 c. cm. of water, to which 50 grains (3.1 grammes) of gelatine, and 2 drops of nitric acid are added. Next dissolve 50 grains (3.1 grammes) of gelatine and 40 grains (2.5 grammes) of chloride of sodium in 60 c. cm. of water. The two solutions are mixed and stirred well together, and left to stand in a warm place for an hour to set. A chloride of silver emulsion is obtained in this way with such a fine grain that the film is almost transparent. To change this chloride into iodide of silver emulsion all that it perature of 77° F., the operation is generally complete in fifteen or twenty minutes. If a small portion of the emulsion, examined on a strip of glass, transmits blue light, the digestion may be stopped, and it will generally be found that prolonging the digestion over thirty minutes does not give material increase of sensitiveness, although, if the temperature be properly controlled, it may be continued for three hours without any decomposition.

If, when the emulsions are prepared, the solutions are too hot, or dissolved silver is insufficiently diluted, or the quantity of gelatine is not properly proportioned, a coarse-grained emulsion, without any corresponding increase of sensitiveness, will be the result. Such an emulsion would be useful in several of the heliographic processes.

153. As there is no danger of the emulsion losing its setting powers under

is necessary to do is to pour a solution consisting of 120 grains (7.5 grammes) of iodide of potassium in 60 c. cm. of water upon the set mass. In a few hours the decomposition of the chloride of silver is complete.

The precipitate possesses the same fineness as the chloride emulsion. It is now washed in the usual manner. The operation may be expedited, and the decomposition effected more readily, if the chloride of silver emulsion be finely divided after it is set, and in this condition treated to the iodide of potassium solution.

This iodide of silver emulsion may be used alone, or in union with bromide of silver emulsion.

Comparative experiments could be better conducted in this manner and more exact than when the iodo-bromide of silver emulsion is prepared together.—Dr. C. Sturenberg.

At first I used to add the iodide after the silver, but after some experimental work, I now dissolve the bromide and iodide together, and see no difference in results. A good plan to get a fine precipitate is to filter the silver into the iodo-bromized gelatine, with constant stirring. It is also well to wash the sheets of gelatine in several changes of water before cooking it. In this way we reduce the chance of spots. Keeping emulsion a full week before use is far better than using it up immediately after it is made. There is less chance of spots by this procedure. Immersing plates in alum before fixing is far better than afterward.

Common china or earthenware pots are very handy for coating, as they tend to hold back any froth or bubbles, which are the sorest nuisance in emulsion work. Don't use heat in drying plates after coating. Let them dry spontaneously in a cool and well-ventilated room. In the absence of such a room, get a large, light-tight box, or chest, and put the plates in, and several saucers of chloride of calcium, which will absorb the water from the plates; they will dry in about two days. Put in plenty of the chloride of calcium. You need not waste it, as it can be dried again over a kitchen stove and used again and again.—Ranald Douglas.

153. In choosing gelatine, note the following:

When ammonia is not to be used, the gelatine should have an acid reaction; when the low temperature employed, it is best to add all the gelatine at once. In emulsifying with ammonia, it is never advisable to add a second quantity of gelatine to the emulsion after digestion, owing to the renewed heating which is thus entailed. When the action of the ammonia is too prolonged, especially in summer time, frilling is very apt to ensue.

The washing of the emulsion should be conducted with the greatest care, as it is absolutely impossible to attain full sensitiveness in the presence of a considerable excess of soluble bromide; and if any trace of ammonia be left behind, it exercises a caustic action, and combines with any salicylic acid which may afterward be added, so as to reduce its antiseptic properties. Never forget that an unwashed emulsion, prepared without ammonia, will keep fresh for a long time without requiring the addition of an antiseptic.

In proportioning the amount of gelatine to the sensitive salts, it has been stated, that if a hard gelatine, possessed of great power of resistance, be em-

ammonia is used, it is a matter of indifference. The opinion has been repeatedly expressed in English journals, that the clear descriptions of gelatine are invariably acid. This is only in a certain way. All alkaline gelatines that I have come across were cloudy; but all acid samples were not clear and transparent.

A test of the emulsion at a temperature of 40° C. can be made by means of silver bromide and ammonia.

Ammonia as recommended below should not be added before but after digestion, and just before the washing stage. A plate may be coated with the unwashed emulsion, and, after being allowed to set, may be soaked in water for twelve hours. When dry it should be treated with a normal developer, and give clear glass. If any fogginess is apparent we may conclude that the gelatine employed contains injurious by-products, and it should be rejected.

Ordinary collotype gelatine may be taken, but that sort is to be preferred which gives the clearest and hardest jelly, and absorbs little water.

The gelatine must be free from fat, otherwise there will be depressions in the film, and bright spots with blurred outlines in the negative. A gelatine of this kind, is however, often employed when the emulsion is prepared with the addition of ammonia. In this case the fatty matter is probably saponified, and the spots will disappear.

A four per cent. solution of gelatine sets thoroughly at a temperature of about 20° C. Since this corresponds to a melting point of about 28° C. or 30° C., it is now an easy matter to determine roughly the melting points of various sorts of gelatine, and to infer that the setting points will be some 8° C. or 10° C. lower. The higher the melting and setting points are, the better is the gelatine, so long as it dissolves thoroughly in water at a temperature of 40° C. or 50° C.—Dr. J. M. Eder.

One fact must also be recollected, that frequent reheating of gelatine speedily detracts from its setting powers, and that if too little water be added to it in mixing, the film has a great tendency to become leathery, more particularly if a little chrome alum has been ployed, less is required than when a softer sample is made use of. A small proportion of gelatine is to be recommended, for the following reasons: The emulsion, when broken up into small pieces, does not absorb so much water during washing. When the emulsion is rich in bromide of silver, there is no necessity for using thick films, which, besides being liable to frill, take a much longer time to dry than thin ones. If, on the other hand, the proportion of gelatine be too small, the bromide of silver is coarse in the grain, and sinks to the bottom of the emulsion. In preparing a hard, quick-acting emulsion, employ a large proportion of potassium bromide, a given quantity of gelatine, and one and a half times its weight of silver nitrate. Dr. Van Monckhoven rightly remarks that a large proportion of gelatine gives a soft image; a small proportion a denser but harder picture.

154. When preparing an emulsion by boiling, and subsequent digestion with ammonia, the following hints must be regarded.

added to it to prevent frilling. A judicious mixture of alcohol to a gelatine solution increases permeability and should not be neglected. The use of a sufficient quantity of water is, however, the great desideratum, and should be carefully attended to, the quantity, of course, depending on the temperature at which the plates have to be prepared; thus in winter more water should be used than in summer. A very horny, glassy film is objectionable in many ways, and a matt surface for the plates should be aimed at. This depends almost entirely on the gelatine that is used, unless it be modified by additions such as glycerine, to which we may at once say we object, on account of its affinity for water.—CAPT. ABNEY.

154. The sensitiveness of a gelatine emulsion is increased not only by long-continued heating, by which the gelatine is partially decomposed, but also by boiling for not more than a quarter of an hour, when no alteration of the gelatine can be observed. Still more powerful is the fact that an emulsion of gum-arabic will also be made more sensitive both by long-continued digestion at a moderate temperature, as well as by boiling a short time. Now, gum-arabic does not alter in burning; we may conclude, therefore, that, in all these cases, the increased sensitiveness is due to a change in the physical condition of the silver bromide. Many samples of gelatine contain substances of unknown composition, which, in the presence of ammonia, reduce bromide of silver, and give rise to a foggy emulsion. Such samples of gelatine should be avoided.

Another factor in the attainment of increased sensitiveness may possibly be, as pointed out by Dr. Lohse, the degree of porosity of the gelatine film. Substances which, like alum, have a tanning action, make the film leathery and impervious, and a less sensitive plate is the consequence. Under ordinary circumstances, however, I do not think this difference is sufficiently great to be observable in practice. At any rate, I have not remarked any considerable difference in this respect between a hard collotype gelatine and a soft and fine sample, though comparative toughness of the two was just as marked after they had been treated in the usual way with ammonia.—DR. J. M. EDER.

This method gives more sensitive plates, but requires greater care, than the preceding. It depends on the fact that the sensitive modification of bromide of silver forms very rapidly at temperatures between 140° to 212° F., and that the sensitiveness of such an emulsion, in itself very great, can be still further increased by subsequent treatment with ammonia at a low temperature.

The proportions of the ingredients are the same as those previously given: 370 grains of potassium bromide, which should not be alkaline, are dissolved in 10½ ounces of water, in a strong glass bottle, and 518 to 694 grains of gelatine introduced. The whole, after soaking for some time, is dissolved in hot water, at a temperature of 95° to 120° F. The remaining operations must be conducted in the dark room. To the warm solution of bromized gelatine add 458 grains of nitrate of silver previously dissolved in 10½ ounces of water. The latter may also be warmed over the water bath. There is no absolute necessity for this proceeding. Now wrap the bottle in a thick cloth, and shake well, taking care that the cork is not blown out by the steam. The remainder of the silver may be rinsed out with about two ounces of water. Finally, 1 to 2 grammes of potassium iodide, dissolved in a little water, are added to produce a clearer film. During the boiling which follows, the cork must not be pushed in too tightly, otherwise the pressure of steam might break the bottle. A roll of linen will prevent the bottle coming in contact with the heated surface of the bottom of the saucepan. The best way is to replace the cork during boiling by another in which a small groove has been cut for the escape of the steam. The bottle containing the emulsion is put into a saucepan, covered by a tightly fitting lid, and the spirit lamp or gas jet light below, care being taken that not even the reflected light from the flame falls upon the emulsion. The water bath, which should contain hot water, can soon be brought to boiling point, at which temperature the emulsion should remain for twenty or thirty minutes, after which it may be allowed to cool down. When

Boiling the Emulsion.—A saucepan of sufficient size to hold the bottle must be procured and filled with water to a convenient height, and a flame, such as a gas-burner, placed beneath it. To prevent bumping and breaking the bottle, place half a dozen folds of blotting paper at the bottom of the saucepan. After the water has been brought to a boiling point the emulsion is kept boiling for twenty minutes to half an honr, it being shaken at intervals (say once every ten minutes) for half a minute or so. A thick cloth tied around the hand prevents any scalding. The boiling, by the by, should take place without the cork being left in the bottle, for if it remain in it would be blown out by the force of the steam. A cork with a slot cut in it is, however, not open to objection.—CAPT. ABNEY.

large quantities of emulsion are being prepared, the boiling should be continued longer. The necessary time of boiling must be reckoned from the moment that the emulsion reaches a temperature of 50° C. If the emulsion is very acid, such as occurs when ammonium bromide is employed, the boiling may be continued for an hour without damage, and with a resulting increase of sensitiveness. But as gelatine boiled in the presence of an acid is apt to decompose, only a small portion of the gelatine should be used, and the bulk added afterward.

155. The emulsion at this stage will be found extremely sensitive, and *can be used as it is;* but by further treatment with ammonia, it is possible to increase the sensitiveness considerably.

155. *Cooling and Washing the Emulsion.*—After the proper time of boiling the saucepan is removed. The gelatines Nos. 5 and 6 should in the interval be rapidly rinsed in several changes of water to get rid of any adherent dust. They should then be placed in a pot with two ounces of cold water and allowed to swell. After this they are melted at a temperature of about 100° F., by immersing the pot or flask in hot water, and added to the solution in the bottle. *Both the emulsion and also the dissolved gelatine* should be cooled to about 70° to 80° F. by allowing water from the tap to run over the jar before the addition is made.

After a good mixing, by shaking, the froth is left to subside and the emulsion is poured out into a flat porcelain dish and allowed to rest. The time which it will take will vary according to the temperature of the surrounding air, but a couple of hours are generally amply sufficient, and often a much less time will suffice. In very hot weather, if the dish be stood in iced water, no difficulty in setting will be found. After a proper consistency is obtained (such consistency being that the gelatine should not tear with a moderate pressure of the finger) the emulsion is carefully scraped off the bottom of the dish with a strip of *clean* glass and transferred to a piece of very coarse canvas which has been previously boiled in water to get rid of any grease or dirt. The emulsion is then twisted up in this and by a gentle pressure squeezed through the interstices, the ball of emulsion being absolutely below the surface of the water into which it is forced. The water causes the threads of gelatine to remain tolerably separate, and, as it passes through the liquid, most of the soluble salts are at once extracted.

When all is squeezed through, the particles of gelatine may again be transferred to the canvas, and, after stretching it loosely over the mouth of the jar (emptied of water), may be doused with water from the tap or from a water jug. After a couple of gallons have been thus passed over it, the emulsion should again be squeezed through the canvas, and the same operation repeated, thus exposing fresh surfaces of gelatine to the action of the water. After another sluicing with water the emulsion may be considered as washed, though, to make assurance doubly sure, the gelatine may be left at the bottom of the jar, and the water changed two or three times. To show the importance of thorough washing, the following experiment may be noted. An emulsion was made as above, and, after once squeezing through the canvas, a part was immediately used for making plates.

When the temperature has fallen to about 40° F., two drachms of strong ammonia (sp. gr. 0.910) are added, and the emulsion is digested for half an hour or an hour at a temperature of 95° to 100° F. Then the emulsion is ready for washing, which may be carried out in the same manner as already described.

Dr. Eder claims that an emulsion prepared in this way is, perhaps, one-fifth more sensitive than one prepared according to the preceding. It gives well-graded harmonious pictures, free from tendency to hardness. The picture appears readily under the developer. The details in the shadows should be fully developed before the high lights are too dense. Emulsions produced by this method are specially suitable for portraiture, although they do not give such absolutely clear glass in the shadows as can be obtained by the first method. By this method extreme care should be exercised in the choice of materials.

A second part of the same was washed under the tap for five minutes; a third part was squeezed and washed a second time; and a fourth part was allowed to soak, and squeezed a third time. The relative sensitiveness of the four parts was as follows: 1—1½—2½—2½.

The first washing increased the sensitiveness to one and a half, and the second squeezing to two and a half, while the third squeezing and washing had no perceptible effect.

I consider this method of washing superior to those which follow. Two squeezes, it is believed, are equal to twenty-four hours' such washing. Gelatine is hard to permeate, and, being a colloidal body, the crystalline salt has hard work to get through when the emulsion is not finely broken up.—CAPT. ABNEY.

Draining the Emulsion.—When the emulsion is considered to be properly washed, it is then drained. This I generally do over the canvas, though some recommend a hair sieve, but it does not appear that there is much advantage to be derived from its use. The great point in either case is to drain long enough. A couple of hours is sufficient time, and then the emulsion is ready for melting.

It will sometimes happen that no amount of draining over a hair sieve or canvas will render the emulsion sufficiently free from water to set well when dissolved up. I have found that by pouring a couple of ounces of alcohol through the emulsion when draining, that the excess of water is taken up and it becomes firm. It should be noticed that before redissolving the gelatine it should be firm and free from all sloppiness (if such an expression may be used); one dose of alcohol generally effects this, and if not one, two will. The alcohol may be saved if required. In case this artifice be resorted to, only half the quantity of alcohol should be added to the emulsion when it is redissolved for filtering and coating the plates. Emulsion that is cut up into shreds is much more easily drained than that which is squeezed through the canvas. It is not that the gelatine takes up more water, but that the water clings mechanically to the small particles forming it. I recommend that the canvas be as coarse as possible, having a mesh not less than one-eighth of an inch, if such can be procured.

Dissolving the Emulsion.—After draining, the emulsion should be transferred to a clean

The gelatine and bromide should not be alkaline, otherwise there is danger of fog during the boiling. If a difficulty is experienced in procuring neutral, or slightly acid, materials, the warm solution of potassium bromide and gelatine may be cautiously acidified with dilute acetic acid. The condition of the mixture must be only very slightly acid, otherwise the setting power of the gelatine will be impaired. Warming the bromide gelatine as recommended, before the introduction of the nitrate of silver, hastens the operations considerably. Half an hour is the most suitable period for the boiling, a quarter of an hour being hardly sufficient; while, if the operation is prolonged to three-quarters of an hour, fog sometimes ensues. Some samples of gelatine will admit of longer boiling than others. Generally speaking, the emulsion may be boiled so long as it remains clear, and the longer it is boiled the more sensitive it will be.

156. In digesting an emulsion with ammonia, special care must be taken as to the temperature indicated. Generally speaking, half an hour's digestion

jar or jam pot, and then placed in boiling water until all the gelatine is thoroughly dissolved. A temperature of 120° F. or more may be given it with advantage. The emulsion, when all additions are made, will be about six and a half ounces. The addition of one-half grain of chrome alum is to be recommended. This should be dissolved in one drachm of water and added with stirring; six drachms of absolute alcohol are next to be added in the same way, and the emulsion is then ready for filtering. This operation may be carried out in various ways. I now use wet chamois leather, or swansdown calico which has previously been well boiled and washed. This is allowed to rest loosely in a funnel, and the emulsion filters slowly through it, all coarse particles being left behind. A small plug of washed wool is used by many, and answers well. It is preferable to filter into a Florence flask, as it will bear heat, though an ordinary medicine bottle will answer if the flask be not at hand. The bottle or flask is again placed in water at a temperature of 129° F., and the next operation is to coat the plates.

156. The effect of the temperature at which the plates are dried on the modification of their sensitiveness should not be overlooked. From experiments made on this subject in the case of very rapid emulsions, the bromide of silver exists under a form in which its sensitiveness is easily modified by pressure, or some other influence. The sensitiveness may be impaired to a visible degree, simply by the temperature at which the plates have been dried. Even between the ordinary limits—that is to say, between 10° and 22°C. (50° to 71° F.)—variations of sensitiveness have been found in the ratio of 2 to 3 for 1.

The plates dried at a low temperature develop more rapidly than those developed at a high temperature. From these experiments, the lower the drying temperature, the better. It has been observed, however, that up to 16° C. (60° F.) there is no falling off of the sensitiveness.—ANONYMOUS.

will be sufficient, but the operation can be continued for an hour, and even two hours, without danger, and there is more certainty that the desired sensitiveness will be attained. Besides this, the subsequent treatment with ammonia compensates for any defect in the boiling during the first part of the process. The same precautions recommended under the first method, in regard to the addition of ammonia, are applicable in this case. In both methods it is directed that all the gelatine should be added at the outset. With some samples of gelatine easily acted upon, it may be found necessary only to add part of the gelatine at first, and the remainder after the digestion is completed. Gelatine being the most obstreperous ingredient in use, a modification of treatment may be required by every lot used.

157. For the preparation of an emulsion by digestion at low temperature proceed as follows:

Although the methods given above are reliable, yet, owing to the extreme care required in the manipulations, and the danger of fog from the use of unsuitable materials, it is thought best to give another formula which may be absolutely relied upon even in unskilled hands.

After what has already been said on the subject, I may give the formula in a few words: 370 grains of bromide of potassium and 617 grains of gelatine are dissolved by heat in 10½ ounces of water, and, as soon as the solution is complete, the temperature of the mixture is raised to 120° F., and a solution of 463 grains of nitrate of silver in 10½ ounces of water is introduced. The emulsion is placed in a water bath at a low temperature, viz., 90° F., and digested at this temperature. It is well to keep back half the gelatine till after digestion.

If an emulsion is required about as sensitive, or twice as sensitive, as wet

157. *Frilling.*—Gelatine films on glass have occasionally a very awkward way of expanding, and forming frills and blisters when heated with water, especially when the water contains salts in solution. Frilling and expansion of the film are also promoted—1, by coating the plates thickly; 2, when the gelatine absorbs a good deal of water; 3, when the emulsion has been digested a long time over heat; 4, when the gelatine contains gum-arabic.

The first of these faults can be cured by coating the plates more thinly; the second by addition of alum or chrome alum, or by soaking the plate before development in a cold saturated solution of alum. The latter is generally efficacious, if the plate be developed immediately after coming out of the alum bath. If this fails the plate may be rinsed and dried, and then developed. By this means the absorptive power of gelatine is a good deal diminished.—Dr. J. M. Eder.

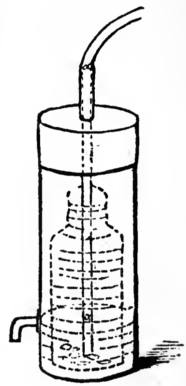
collodion, it may be used after six to twelve hours' digestion. Such an emulsion is very well adapted for landscapes or interiors.

If a more sensitive preparation is required, the digestion may be continued for three days at a temperature of 90° F. The resulting emulsion will be very sensitive, and well adapted for portraiture, as it gives soft, harmonious negatives. It may be looked on as one of normal sensitiveness.

158. Dr. Eder says: "No doubt the best method of washing emulsion is to

158. There are several modes of extracting the soluble salts from the emulsion. Putting on one side dialysis as introduced by Mr. King, owing to its tediousness, we pass on to the most ordinary method. The emulsion, when prepared, is poured out into a flat dish in a very thin layer, say about one-eighth of an inch thick. When set, it is scraped off the dish with a piece of glass, and transferred to a jar or bottle in strips. Mr. England first scores it over with the prongs of a silver fork, so breaking it up into fine strips. Cold water is then poured on to it, and a stream of running water kept flowing over it for twelve hours, more or less.

Fig. 314.



I have converted a tin canister into an effective washing apparatus, as shown in the figure. In the lid of a common canister a hole is perforated so as just to admit of the insertion of a glass tube, *a*, *a*; a piece of India-rubber tubing connects this with the water tap, and covers any small chink between the glass and the lid, as shown. A bottle containing the emulsion to be washed is placed in the canister, the tube being inserted in it. The water flows over the top of the bottle and rises in the canister to the level of the spout, where it trickles over into the sink; the heavy water containing the soluble nitrate is thus perpetually stirred up, and caused to flow over the neck of the bottle. This answers admirably, and can be used in the daylight if necessary, but is more applicable to emulsion that has been cut into strips than to that which has been squeezed twice, as the small particles are apt to be carried over the top of the bottle and choke the exit tube.

After the emulsion has been allowed to rest for two or three hours, two ounces of alcohol to each ounce of water are poured into the bottle containing it, and well shaken up. The gelatine rapidly assumes a pasty appearance, and subsides to the bottom. The bottle is then inverted, and the fluid, which contains the soluble nitrates and excess of water, is poured off, and may be preserved for distillation. The explanation of the efficacy of this method is, that the alcohol has a greater affinity for water than has the gelatine, and that in extracting the water the soluble salts are extracted with it. Methylated spirit not containing gum may be used, and the lower the specific gravity the more effectual it is.—Wratten and Wainwright.

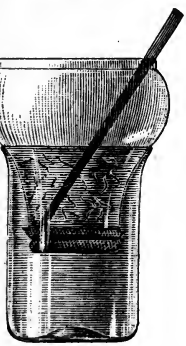
After the emulsion is settled, drain off the water into another vessel so as to catch any stray particles that would otherwise be lost. A second change of water is now poured first break it up into small pieces; but as, in this state, it absorbs a large quantity of water, I give a method recommended by Heid. The emulsion is poured

on the emulsion and well stirred up with the glass rod, the whole again allowed to settle, and this is repeated six times. Finally it is treated with distilled water twice, and tested for free soluble bromide by adding a few drops of a ten per cent. solution of nitrate of silver to the last drainings from the emulsion. If a decided milkiness is seen after a few minutes' standing, the washing must be continued (with distilled water) until it no longer appears.

I have succeeded in this way with quantities measuring more than two quarts. Attempts have been made to simplify the process by washing-machines, but these have disadvantages.

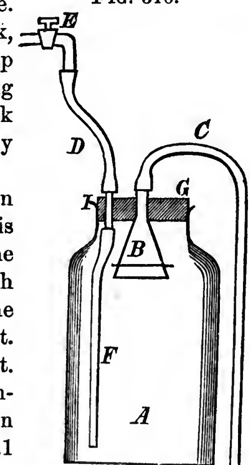
The divided emulsion is best put into a large bag made of coarse silk, and hung over a cross-stick in a small tub or capacious glass vessel. If the tub is very roomy, two hours' washing with two changes of water and an occasional shaking up of the bag will be enough. With smaller vessels four changes may be given. Schuman's apparatus (Eder) is also very practical (Fig. 315). A pear-shaped bell-glass is covered at its narrower end with stout muslin to support the emulsion, and the whole set in a roomy beaker, as seen in the figure. To change the water, it is only necessary to lift the bell-glass, when, by slightly agitating it, the water drains off through the muslin. The beaker is then emptied and refilled with fresh water.

FIG. 315.



Costly and complicated affairs for washing in running water have also been made, but they are not necessary. For operations on the small scale, a large china or porcelain teapot (not metallic) does good service. The cover is replaced by the layer of silk, and a rubber tube carried from the tap to the spout; the water, after circulating through the pot, escaping through the silk fold. The emulsion is kept constantly moving, and is washed very quickly.

FIG. 316.



Turnbull's washing apparatus, or one on the same principle, may be made of any size; its construction is easily understood from Fig. 316. The water is conducted to the bottom of the vessel by the tube *D F*, flowing off again through the funnel *B*, closed with silk, so as to prevent the escape of the small particles of emulsion, the tube *c* serving as the outlet. Eder holds that an emulsion which still contains 0.1 per cent. of soluble bromide has been sufficiently washed. He recommends this test for the washed emulsion: Prepare a solution of exactly $61\frac{3}{5}$ grains (4 grammes) of nitrate of silver in 2.1 pints (1 litre) of distilled water. 385 grains of the emulsion in the liquid state are weighed out, diluted with 4 or 5 volumes of distilled water, and after cooling treated with yellow chromate of potash until a distinct yellow tint is obtained.

out, after digestion, into a tall, square glass bottle, which should not be more than a quarter full at the most. The bottle is then laid on its side, and the emulsion allowed to set. When it has set, the bottle is filled completely with water, tightly corked, and laid on its side so that the part covered with emulsion is uppermost. The water should be changed repeatedly during twenty-four hours, after which the emulsion is ready for coating; about an ounce of alcohol should be added previously, and, if the emulsion is to be kept, an antiseptic may be added."

159. Armed now with a stock of clean plates, slightly warmed, and a quan-

2 drachms 50 minims (10 c.cm.) of the silver solution are then added, which change the color to clear reddish-yellow or deep red if the emulsion has been sufficiently washed. Very well washed emulsions strike the red color with 85 minims of the silver solution, and then contain less than 0.05–0.06 per cent. of soluble bromide. But if 340 minims of the silver solution strike no red color, or even no change of color at all, it is proof of insufficient washing.

This test can only be used with neutral aqueous emulsions. Those containing acetic acid must first have it removed or neutralized.

The whole analysis may be made by daylight, though candle- or gaslight will also enable the change of color to be distinctly seen.

A trouble with all forms of washing apparatus is that the pores of the muslin used for straining soon get stopped up. The pressing canvas should be thrown into hot distilled water immediately after use, well kneaded about, and then rinsed three times in hot water until there is no further milkiness. This is best done in the dark, for the light soon turns the stuff brown, and it can only be bleached again with weak acid (1 part nitric acid, 100 parts water). All the cloths used for filtering are cleaned in the same way.—Dr. H. W. Vogel.

Fig. 317.

All foreign matter should be removed by filtering through thick cotton cloth or washed cotton fitted into a funnel. But the funnel must be kept warm so as not to allow the gelatine to set. Special arrangements for this purpose, such as a metal case carrying hot water and applied around the funnel, are very convenient. The emulsion will soon choke the filter; this must be helped out by occasionally working the cloth gently to and fro.

Braun's pneumatic filters have lately come much into favor. They consist of a glass balloon tied over with chamois-skin below, and fitted above with a valve and rubber pumping ball. The opening in the neck having been uncovered, and the emulsion poured into the previously warmed balloon, the filtration goes on by pressing the ball (the cap fitting on the opening, of course, being replaced. Fig. 317).—Dr. H. W. Vogel.

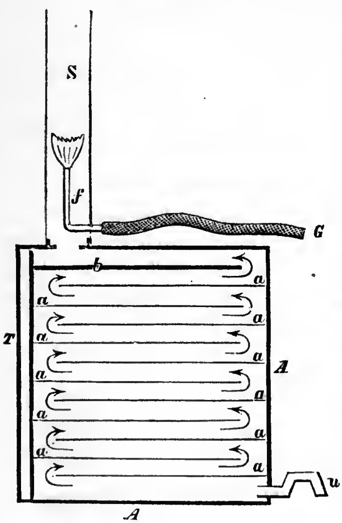
159. Spontaneous drying will answer in a clear, dark room, the time required being regulated by the changing dampness of the air. In damp winter weather the drying will

tity of emulsion from which we may expect *everything*, we proceed to the dark room to unite them. The emulsion is poured upon the plate in the same manner as the collodion, from a warmed measure. A glass rod is used to insure an even coating, and the superfluous emulsion is persuaded from one

often occupy three days, and there is risk of those spots remaining wet the longest becoming decomposed. In such cases efforts must be made to hasten the drying. This may be done on the small scale by immersing the (set) plate in alcohol for five minutes; this removes the greater part of the water, so that the plates will often dry in one or two hours. But this is too costly to be practised extensively. An artificial draft is generally used in such cases.

For small batches of plates, my form of drying-box may be used. It has proved very serviceable, and may be constructed at a moderate cost. It is made of tin, and is shown in the figure in section. *T* is the door opening at two corners, and shutting light-tight, with overhanging edges; *a a* are shelves of tin soldered fast to the sides. They are so arranged that the air circulates in the direction shown by the arrows. On these shelves the plates are laid after being firmly set. The air gains access through the tube *u* under the lowest shelf, and in order to create the necessary draft, a chimney, *S*, which consists of two riveted parts fitting by a joint, and thirty-nine inches high, is fitted at the top of the box. A gas-flame, *f*, burns inside the chimney as seen in the figure, *g* being the supply-pipe. As soon as the flame is lighted, a strong draft is formed in the chimney which sucks air through the box, and causes the plates to dry as quickly as they would in a well-ventilated room. If the weather is damp, and it is wished to hasten the drying, a pan of fused chloride of calcium is set at the bottom of the box. It is well to arrange a piece of tin under the flame to serve as a cut-off for the light, and prevent its entering the box. The piece *b* also is painted with dead-black varnish, as well as the lower surface of the upper wall of the box. Of course, the door *T* must fit tightly to the edges *a a*, otherwise the air would rise perpendicularly, and not circulate over the plates. A layer of felt is fitted to the door so as to effect this. In a box of this kind, constructed for 7 x 9 inch plates, the author dried eight dozen plates.

FIG. 318.



Large wooden drying-boxes have been made on the same plan. The higher the chimney and the larger the flame, the more powerful the draft. For such boxes several air-openings will be necessary, but care must be taken that the air admitted is free from dust.

The manufacturers have drying-rooms, well protected from light, and with a current of air from a ventilating machine driven by steam-power or gas.

corner into a bottle. The plate is then placed on a level shelf, and there left to set. From this it is removed to a drying cupboard, and still levelled, there retained at an even temperature until quite dry. This operation should not be hastened. Alcohol may be used in an emergency to facilitate drying.

Warm air is frequently admitted to the drying-box. The chimney *S*, for instance, may be surrounded with a metal case, and the heated air generated in the space between them conducted to the opening *u* by means of a tube; care must be taken, however, not to let the temperature rise above 76° F. I prefer air at ordinary temperatures. It is important that the drying proceed evenly, for at every point of the film where a check in the evaporation occurs, a streak is sure to form.—Dr. H. W. Vogel.

Mons. Harrison, Jr., presented the French Photographic Society with the model of a drying chamber for drying carbon tissue, gelatine emulsion and dry plates.

Fig. 319 presents a side view of the apparatus. No. 1 is a sheet-iron bottom heated by a spirit or gas lamp; the cold air enters by No. 2, and passing over the hot plate, is heated, and follows the direction of the arrow until it makes its exit by the chimney at No. 3.

Fig. 319.

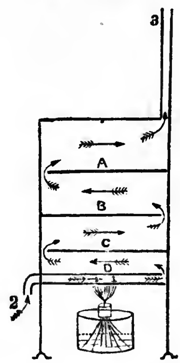


Fig. 320.

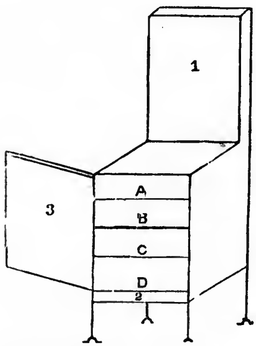
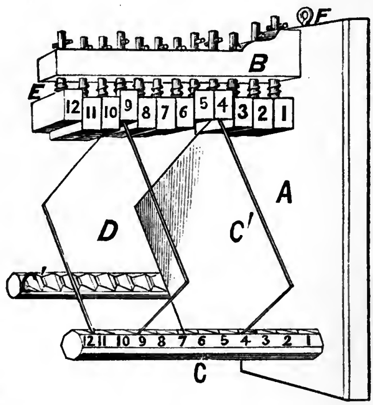


Fig. 321.



In Fig. 320 the front of the apparatus is seen A, B, C. D, are the shelves upon which the objects to be dried are laid. The door No. 3 is closed; this door pressing against the shelf B, closes the communication, and compels the air to take the direction of the arrows, as seen in Fig. 319. The value of this apparatus needs no further comment.

I draw your attention to a new stand, or plate-holder, which has for its object the rapid drying of gelatin plates. Some operators propose ovens and others drying apparatus, either by heat or a current of air; others prefer spontaneous desiccation. I find the latter preferable with a slight modification. As soon as I have covered my plate I lay it on a perfectly levelled sheet of patent glass, which is kept cold by a stream of cold water running under it. As soon as the gelatine emulsion has set I take it up, and insert it into the rack shown by Fig. 321. This rack or plate-stand is easily made. *A* is a

160. The exposure of emulsion plates, owing to their increased sensitiveness, should be made with careful study of all the attendant circumstances. The almost morbid desire for instantaneity, now existing to a far too great degree, causes many failures. There is no advantage in quick exposures for general subjects. In fact, there is oftentimes decided disadvantage. Take into consideration everything and use "lightning plates" only when their power is absolutely required. For ordinary work go slower, and take your compensation in better results. When you are a master in precision, then you may use the hair-trigger and expect to hit the glass ball almost every time. Until exposure becomes an inspiration with you, think carefully every time. Of course there are times when one must take the risk and throw rules aside. Accidental pictures are sometimes very fine. The remarks on exposure in another chapter should be regarded.

161. The development of a gelatine plate is no less beautiful than the

piece of wood into which is glued the support, *B*, and the two legs, *C C′*. The support, *B*, holds one dozen pegs, which slide up and down with ease. A spring, *E*, is put on each peg, in order to keep it down. On the two legs, *C C′*, are twelve notches corresponding to the twelve pegs. The apparatus is hung up against the wall of the drying-room by means of the hook, *F*. As soon as the film of gelatine has set, the plate is taken, and one of its corners is inserted into a hole at the bottom of peg No. 1; a little force is used to push up the spring, and the plate is then put into the notches; this spring now pushes down the peg, and the plate is firmly held. The same movement is repeated for the twelve plates, and the rack is hung up for them to dry, which is easy, as there is the space of an inch between each plate.—PROF. E. STEBBING.

160. *Local Strengthening during Development.*—This is the method adopted for the development of interiors, or, when it is necessary, to bring out the thick shadows of trees, especially in the case of under-exposure. In an alkaline bath the developer is allowed to act; a solution of ammonia, rather stronger than that for the development, is used for touching the undeveloped parts of the plate, care being taken to keep the brush in motion, and dipping it from time to time in the ammonia. By this means it is possible to bring out details which, under ordinary circumstances, are lost. The same process may be applied to an over-exposed plate, by using pyrogallic acid instead of ammonia.—J. H. F. ELLERBECK.

161. It is a mistake to judge of dry-plate negatives as you would wet plates; they are totally different, and it is those negatives which are most like a wet plate in appearance which disappoint you in the printing. This it is which makes it so difficult for a photographer, using both processes, to make even work, and it also tends to confirm him in the opinion that he cannot produce such good work with the dry process as he can by the wet, because he judges his dry negatives by a wet standard, and tries to get them as near a wet plate in appearance as possible, and the nearer he succeeds in this the more disappointed he will be with the resulting prints.

moulding of the clay into form by the sculptor. With the knowledge how to mix his potent chemicals, and with a mind that directs carefully, the pho-

All the negatives which produce the best prints here are quite unlike a wet plate—in fact, judging from his standard, the wet plate operator would doubtless pronounce them overexposed and flat. The shadows are not so clear as they must be in a wet plate to produce a brilliant print, and the highest lights are anything but opaque, but they produce a print which is at the same time soft and brilliant, full of gradation, and yet with a snap that is seldom seen in a wet plate which has no such soft delicate demitints.

I think that every dry-plate maker gives in his formula for development the fullest amount his plate will stand of the accelerator, and I find it best to give exposure enough to enable me to use less of the accelerator than the formula given with the plates. I am quite sure that I get better results than by a shorter exposure and full strength of normal developer given by the platemaker; of course, there are subjects which must be made as rapidly as possible, such as street views and drop-shutter exposures. The way I treat a plate which has had an exposure of a fraction of a second, or any underexposed plate, is this: when I find that under the normal development it is coming up slowly and the highest lights are gaining too much intensity while the shadows remain unseen, I put in a large amount of water, sometimes as much as four times the amount the development was commenced with; for instance, I develop a 10 x 12 plate with four ounces of water, to which have been added two drachms each of pyro and potash solutions (normal developer). On finding that the plate has not received enough exposure, I put in four, eight, or twelve ounces of water, and increase the accelerator till I have had as much as twelve drachms of accelerator to two drachms of pyro in sixteen ounces of water. To prevent frilling I use chrome alum. The progress of development is slow, but sure.—GEO. HANMER CROUGHTON.

The whys and wherefores of failure are not so far to seek but that they can be found on the same day. Some of the developers are chemical curiosities, or would be, if any man could ever get the mess to stay in solution. The solutions of "pyro" are, indeed, fearfully and wonderfully made, but with a pertinacity worthy of emulation, it refuses to amalgamate, dissolve, stay so, and if the "immature" commences all right, and does not guess at his exposure, he gets a fair negative or two, and in a week or so after he "drops" on some view and goes home to behold a charming example of a thin negative, never dreaming that his pyro compound solution, *minus* bromide of brains, is as uncertain as a saturated solution of anything made up from two different lots of chemicals. Having made his exposure, and supposed it is normal, he proceeds to mix a "normal developer" see circular. The image commences to come "too fast; he slaps in plenty of bromide, and it calls a halt, and he gets an uncertain amount of density, a marvellous lack of detail, and a most beautiful and conspicuously charming lack of harmony or gradation. The developer is then poured down the spout and a new one made up for the other plate. Having profited by his experience(?) he now commences with less pyro and alkali, and all comes up pretty well. But somehow it now commences to drag, and when it has come to a certain point it refuses to get denser, or to give out the detail. More pyro, and it gets worse; more soda, and it looks better; and finally it goes through tographer has power at hand which, with the exercise of the art and science in him, may produce wondrous results. The number of changes he may cause is

the alum and hypo, and comes out a ghost—past all patching, and our "immature" worker then goes for the platemaker more vigorously than politely.

We have solutions which contain quite too much alkali, and sometimes, if we follow the exact formula, we find a superabundance of material which lies harmlessly in the bottom of the bottle, undissolved and useless. Some of the pyro solutions are charming instances of chemical ignorance, if not comical in their effects, and many of our platemakers seem to ignore the fact that pyro *cannot* be kept in any solution, so far as is yet known, and retain its power to develop; and if it could do so, bromide of any kind should not be added to pyro solution. If the most perfect results are desired or expected, and if the positively best results are desired, then no bromide of any kind should be put in the developer in any form. But it is so exceedingly difficult to give exactly the correct exposure that some bromide is necessary; and a better way is to dilute your developer slightly, and make use of a little more time in development, gaining density not at the expense of detail or harmony.—THOS. PRAY, JR.

Go Slow: The demand for extra rapid plates that will develop without the use of a restrainer is so great that a really good plate is often condemned because it does not give the results it would have given had a restrainer been used. To me it is the same as to try to use the protosulphate of iron developer without using acetic acid; for both plates negatives have been obtained without its use, and with very short exposures, but they had very little printing qualities. In a prominent gallery here I saw a favorite plate developed, and the user praised it highly. No bromide or citric (pyro, sulphite, and soda was the developer). The negative seemed perfection. Calling at the same place at another time, saw plates developed (pyro, bromide, and ammonia developer). "Is this the plate you used when I was here before!" "Oh, no; this is an English, Birmingham, England, plate." "Why, I thought you liked the other plate so well?" "So I did; but they do not always come the same—thin, no body. Now, these Birmingham ones are so round and full of detail." I firmly believe that had the pyro, sulphite, and soda been used with a restrainer, and a trifle more time given, that the favorite plate would have been as round and full of detail as the foreign plate.

I have been led to these remarks, as I have devoted time and money to endeavor to make emulsions of uniform quality and developable with any published formula that photographers are more conversant with, but very seldom with the developer without a restrainer, and I judge that the prominent manufacturers of the country will coincide with me, viz., that all plates can be developed with ferrous oxalate, bromide, and citric acid restrainer, but not always with pyro, no matter what alkali be used unrestrained.—WM. BELL.

A preliminary bath (Vorbad).—Mr. Jastrzembsky recently published an interesting expedient for increasing the sensitiveness of a gelatine plate. He immerses the plate a minute or two in a solution of carbonate of sodium 1 : 100, and dries. I tried the method, and found it to work admirably. He remarks quite truly, that the treatment with a solution of sodium carbonate increases the tendency to frilling, and that, therefore, a substratum becomes necessary.—DR. H. W. VOGEL.

infinite. A turning of the wrist, a thoughtless movement of the hand, a few drops in excess, or stinting the solution here and there, may alter the form and

Accelerator for Development.—For some time past the preliminary bath (Vorbad) has been playing a rather practically important part in photography. In development it has come into service. It is well known that underexposed plates give very strong contrasts in light and shade, the high lights becoming very intense before the shadows show any detail, the more delicate parts being lost. These defects may be avoided by immersing the plate, before development, in a bath of 1 part hypo to 5000 parts water, then using the ferrous oxalate as a developer. The image quickly appears, the high lights are not so intense and the time of development is reduced one-third. The same effect is not had with the pyro developer. Recently besides hypo other bodies have been used which accomplish the same result. To these belong especially Lohse's preliminary bath, recommended by Dr. Messerschmidt, consisting of a solution of nitrate of chrysaniline 1 : 20,000. According to the experiments, this bath worked very energetically, even more so than the hypo, without the disadvantage which the latter sometimes occasions, the formation of a fog. Mr. Quidde has also used the chrysaniline with excellent results. He is also convinced that the action is more energetic than the hypo. He employed, at first, a solution of 1 part in 3000 of water, later making the dilution 1 : 20,000, but no apparent difference in the action of the two baths could be perceived. One thing was sure, there was no appearance of any fog, but he did observe in all his experiments numerous small specks on the plate; on examination he found that the chrysaniline had not been thoroughly dissolved, hence the small, undissolved particles were the cause of the specks on the plate. After filtering the solution, the specks entirely disappeared.—DR. H. W. VOGEL.

Handling the Developer.—I never pour developer on a dry plate, but prefer placing the plate in the solution, and using very little motion of the solution while developing. And that gives me time to do other things; while if I wish to step out of the dark-room, I place a board over the developing dish. I have no difficulty or trouble. I never intensify or reduce, as either, in my opinion, spoils the negative in a few months.

Don't expect the development to be too rapid; one second exposure on a child is enough. Though the negative looks thin, it will print much stronger than you had the least idea of. Keep your hand off the back of the plate at all times. Brush every plate off well before placing in the holder. Save and filter all your old developer, to prepare your negatives for final development with new. Don't add all your iron to the developer at once, as you can add the balance if needed, but can't take it out if too much. Usually half the quantity of iron will do, if using oxalate developer. Place your plate carefully in the holder, and pull out the slide easily, without any jar (having covered the instrument and holder with your common cloth); put in the slide square, and not one corner first; and let simple sense follow "simple thing," and you must succeed.—O. PIERRE HAVENS.

What developer shall we use? The ammonia is the nearest in point of time and action to the wet process, but it is such uncertain working, no two days alike. To-day we can work, say, three minims to the ounce of developer with fair results; perhaps to-morrow it may demand five; then look out for foggy times. Then we take the carbonate of nature of the image as much as the careless pressure and unskilled turning of the clay by the sculptor may ruin the loveliness of the statue.

Two methods of development with their modifications find about equal use

soda, which appears to have the least amount of latitude of variation of exposure. If you sin on either side, what is the outcome? If it is on the good old side of time enough and to spare, then you must add the restrainer, and get the blessing of the printer on your devoted head; or if you make sure to keep under the limits, you feel disgusted with yourself. But here comes a compromise which, with a watchful eye, will relieve us of some of our trouble:

A. Water, 12 ounces; citric acid, 60 grains; pyro, 1 ounce; sulphite of soda, 2 ounces.

B. Water, 12 ounces; carbonate of potash, 1½ ounces; sulphite of soda, 3 ounces.

Now here we have a stock solution that contains all that can be desired for a great variety of work.

For rapid exposures take of the pyro solution, 1 drachm; water, 2 ounces; carbonate of soda, 1 drachm. But if you find the image coming too rapidly, add a few drops of bromide solution, being careful to keep the plate gently in motion. If it is left to stand quietly for any time it will produce a mottling of the plates.

Now, after you have developed the first plate you see the action, and if it is too rapid use less of the carbonate solution; if you wish more density, increase the quantity of pyro solution, or if the same class of negatives with less density add more water.

I find this to be the best in use, as there is no need of fogging any plate from development. It has helped me many times in developing plates exposed by others. When I have no knowledge of the sensitiveness of any brand of dry plates my plan is to make a solution about one-fourth the usual strength, then the action is so slow that it will give one time to calculate the strength of the developer required.

If it should come up with an overtimed appearance, then use in the regular developer a few drops of the bromide and less of the carbonate. If the shadows show evidence of being undertimed, the regular developer comes in play.

After fixing most photographers immerse the negative in an alum solution, which is good, as it hardens the film and, in many cases, gives the negative a pleasant (to an old wet worker) gray tone. Should this not give you the color you desire try after taking from the fixing bath, a flow or two of the regular wet-plate developer. It will save you a few hours in these short days in printing.—Geo. Ennis.

Pyro and Carbonate of Potassa Developer. A modification of Dr. Stolze's and Dr. Eder's Formula. Stock solution No. 1: Citric acid, 60 grains; pulverize and dissolve in distilled or ice water, 8 ounces; granular sulphite of soda, 1½ ounce; pyrogallic acid, 1 ounce. Stock solution No. 2: Pure ice or distilled water, 8 ounces; carbonate of potassa, pure, 3 ounces.

The sulphite of soda, carbonate of potassa, and both stock solutions should be kept in well-stoppered bottles, glass stoppers are preferable for the carbonate of potassa. The latter should be completely soluble in the given quantity of water, if sufficiently pure.

Developer: Stock solution No. 1, ½ ounce; Stock solution No. 2, ½ ounce; water, 12 ounces.

among photographers. The first method is the alkaline, in which pyrogallic acid, bromide, and ammonia are the chief features; and the other is the ferrous oxalate combination. A few advocate the use of two solutions.

The developer should be used within a couple of hours after mixing, as it will work slower and produce yellow negatives when old.

This developer is very powerful, and can be worked with one-half the exposure required by many other developers in use.

If the plate was overexposed, the detail in the shadows will appear too soon, and will be all developed before the lights have gained sufficient intensity, the resulting negative being flat and without sufficient contrast. As soon as you notice in developing that the plate has been over-exposed, add immediately to each four ounces of developer, one drachm of bromide solution (one ounce of bromide of ammonium, twenty ounces of water), *which will produce more intensity* and will save the negative.

If the plate was underexposed, the detail in the shadows will not appear in time and the negative, if fully developed, will be too strong in the lights and deficient in detail in the shadows. In this case the negative may be improved by adding to the developer in the dish three times its bulk of cold water; move the dish to insure a good mixing, cover it and allow to stand quietly, giving plenty of time for the development of the detail, which will come provided the exposure has not been entirely too short.—G. CRAMER.

This is my latest method:

No. 1. Pyro-solution: Distilled or ice water, 10 oz.; sulphite of soda crystals, 4 oz., dissolve and add slowly; sulphuric acid, 1 drachm; pyrogallic acid, Schering's, 1 oz.; and water to make 16 ounces fluid.

No. 2. Alkaline solution: Water, 10 oz.; granulated carbonate of potash, 2 oz.; granulated carbonate of soda, 2 oz.; dissolve, add water to make measure 16 ounces.

Bromide solution: Bromide potass. 1 part; water, 9 parts.

To develop. For portraits on "special instantaneous," to 4 ounces of water add 3 drachms No. 1 and 2 drachms No. 2, and if the plate has had proper exposure, the above developer will be found to yield a soft and rich printing negative. More of No. 2 to be added if under-exposed, and more of No. 1 with a few drops of bromide solution if over-exposed.

For landscapes and interiors on "specials," where the exposure may be uncertain, lay the exposed plate in the pyro solution for a minute or two, then into the developing glass put half the quantity of No. 2 as has been taken of No. 1, and pour the pyro solution into it, and back on to the plate; by proceeding in this manner, adding more of No. 2 to bring out the image, or a few drops of a 10 per cent. solution of bromide to restrain, as may be required, much better results may be looked for than if a full quantity of No. 1 and No. 2 were mixed at once. For instantaneous views, or very dark interiors, I recommend the following procedure: To 4 ounces water add 1 drachm No. 2, soak plate in this while preparing the following: water, 3 ounces; of Nos. 1 and 2 each 3 drachms; 5 drops bromide solution; pour off the dilute alkali, and flow this strong developer over the plate; be careful to expose the plate as little as possible to the light used to develop by, no matter how safe it may be considered for ordinary development. Do not hurry

Those who use commercial dry plates should develop them as instructed by their manufacturer. The modifications offered by practical workers would fill a volume.

by adding more No. 2; cover up the pan and give the developer time to act, when more of No. 1 or No. 2 may may be added as may be required. For instantaneous marine views, it will be best to treat the plate the same as for landscapes, by soaking the plate in the pyro solution first.

For landscapes, machinery, architecture, etc., on B plates use ½ drachm each Nos. 1 and 2 to each ounce water, adding more of each as may be required, No. 1 giving density, No. 2 giving detail and hastening development. After washing off developer, immerse in following hardening and clearing solution: Water, 36 oz.; chrome alum, ½ oz.; citric acid, ¼ oz., 3 to 5 minutes; then wash and place in the fixing solution: hyposulphite of soda, 8 oz.; water, 40 oz. Let remain a few minutes in the hypo solution after all bromide of silver appears to be dissolved out, then wash in running water for not less than one hour, swab off the film with a tuft of cotton, while water runs over it, then place away to dry spontaneously.

Temperature of development has a great influence on the result. It should be kept if possible within a change of ten degrees; between 60° and 70° F. is a good temperature to secure uniform results. Cold retards development, heat accelerates, and causes flatness, therefore in summer time less No. 2 solution should be used, and in winter equal parts of Nos. 1 and 2 will be found about right.

Over-exposure, if known or suspected, commence development as directed under the head of landscapes and interiors.

Under-exposure can be remedied in a certain degree, but not entirely, by first soaking plate in water to which has been added 1 drachm No. 2 to 4 oz. water, then use developer composed of half drachm each Nos. 1 and 2 to 1 oz. water, and continue development slowly; but the best remedy, when possible to adopt it, is to expose another plate, giving longer exposure.

In very hot weather, I recommend the use of the alum bath *before* fixing, and *always* afterwards.

Intensification. With correct exposure and development, intensification need never be resorted to. The following formula is, however, very effective:

No. 1. Bichloride of mercury, 240 grains; chloride of ammonium, 240 grains; distilled water, 20 ounces.

No. 2. Chloride of ammonium, 480 grains; water, 20 ounces.

No. 3. Cyanide potass. (refined), 120 grains; water, 16 ounces; nitrate of silver, 100 grains; water, 4 ounces.

Add the solution of silver to the solution of cyanide, until a slight precipitate remains undissolved.

Let the plate to be intensified wash for at least half an hour, then lay in alum solution for 10 minutes, and again wash thoroughly; this is to insure the perfect elimination of the hypo. The least trace of yellowness after intensifying shows that the washing was not sufficient.

This fact seems to throw a deep veil of difficulty over photographic manipulation—to exasperate even sometimes, but there is no reason for being dismayed. Choose a line of practice and then adhere to it. I never yet saw the man fail in our art who was really desirous of success.

Flow sufficient of No. 1 over the negative to cover it, and allow to either partially or entirely whiten; *the longer it is allowed to act the more intense* will be the result; pour off into the sink, then flow over No. 2, and allow to act one minute; wash off, and pour over or immerse in No. 3 until changed entirely to a dark brown or black. No. 3 can be returned to its bottle, but Nos. 1 and 2 had better be thrown away. Wash thoroughly and dry.

Reduction. In cases of error in development the negative is too intense, the high lights may be safely reduced by the method of Mr. Howard Farmer, viz.: Ferricyanide of potassium (red prussiate of potash) 1 oz., water 16 oz., hyposulphite of soda 1 oz., water 16 oz.; immerse the negative in sufficient hypo solution to cover it, to which have been added a few drops to each ounce of the above ferricyanide solution; *the speed of reduction depends on the quantity of ferricyanide present.* When sufficiently reduced wash thoroughly. To reduce locally, apply the mixed solution to the wet negative with a camel's hair brush to the parts requiring reducing.—John Carbutt.

Alkaline Pyro Developer all in One Solution.—This is simple, economical, and durable, and the resulting negatives are extremely fine in color and printing quality. My formula is as follows:

Stock solution: Sulphite of soda (crystals), 3 ounces troy weight; bromide of ammonium, ½ ounce troy weight; bromide of potassium, 1½ ounces troy weight; pyrogallic acid, 2 ounces troy weight; dissolve thoroughly in pure rain, distilled, or ice water, 32 fluidounces; add sulphuric acid (C. P.), 120 minims; finally strongest aqua ammonia, 3 fluidounces. Add water to make up the bulk to 40 ounces.

Be careful to measure the sulphuric acid and the aqua ammonia very exactly, and keep the latter in a cool place, well stoppered, so that it will retain its full strength.

(Instead of 3 ounces of crystals, 2 ounces of granular sulphite of soda may be substituted to produce the same effect.)

The solution assumes a bright ruby color, and will keep a long time in a bottle with tight-fitting India-rubber stopper.

Dilute sufficient for one day's use as follows:

For ordinary purposes, 1 part to 11 parts of water.

For very short exposures, use 1 part with 3 to 6 parts of water.

For overexposed plates, or in all cases where great intensity and contrast are desirable, 1 part to 20 of water.

Always develop until the shadows have sufficient detail.

Wash well before fixing and prepare the fixing bath as follows: First dissolve a half pound of powdered alum in one-third of a gallon of water; then dissolve one pound of hypo in two-thirds of a gallon of water. After both are dissolved, pour the alum solution in the hypo.—G. Cramer.

Par Excellence.—I will now give you a formula for a pyro developer that is excelled

For the notes below I have, from varied sources, selected what seem to cover all that has been made known on this vital topic. And yet I am aware

by none; is simple and keeps in stock any length of time; it develops beautifully, and I consider it far superior to the oxalate:

Stock, pyrogallic. To 7½ ounces of common alcohol add ½ ounce of pyrogallic acid, and 60 grains of bromide of ammonium previously dissolved in a little water.

Stock, bromide solution. To 14 ounces of soft water add 340 grains of bromide of ammonium and 1½ ounces of concentrated ammonia. Keep both of these solutions in well-corked bottles.

Now, to develop, take 1 drachm each of pyro solution and bromide solution, and add 2 ounces of soft water. This is sufficient for small plates up to 5 x 8, and will develop several; it makes a very cheap developer, and after once using you will take no other.—E. P. LIBBY.

In Three Solutions.—Well, let's see; we will take the old method of making the pyro developer in three different solutions: No. 1, pyro; No. 2, bromide; No, 3, ammonia. Take four drops of No. 1, three drops of No. 2, and five to ten drops of No. 3.

I claim that the most skilful worker cannot make his negatives of a uniform character by this method, and with the careless operator it would be simply impossible; he might have his exposure right and developer wrong. Next plate he would change his exposure, and perhaps his solution, too, and be as far out of the way as ever.

In the above case I will give the palm to oxalate. Now we have a later and simpler form of the alkaline developer: stock-pyro in alcohol; No. 1, pyro and water; No. 2, ammonia, bromide, and water. To develop, take two ounces of No. 1, and five to ten drops of No. 2. Here, again, is a chance for variation; this drop business is not right; one is apt to get too many or too few of them, and with variable results. With the above method, as compared with the first, the chances are as two to three in regard to proportion. But by the latter method plates can be developed *much more* rapidly and just as certainly as by the oxalate, and for one-fourth the cost.—G. H. MONROE.

The Edwards Formulæ.—Now I come to my hobby, the Edwards formulæ *without* the glycerine:

Stock, No. 1: Pyrogallic acid, 1 ounce; alcohol, 6 ounces. Stock, No. 2: Bromide of ammonium, 50 grains; ammonia, concentrated, 1 ounce; water, 6 ounces.

For the day's use we have two other bottles to hold sixteen ounces each. Take one ounce of No. 1, fifteen ounces of water; label bottle D. (developer). Take one ounce of No. 2, fifteen ounces of water; label bottle A. (accelerator). To develop (exposure proper), take equal parts of D. and A. What can be more simple? The development is complete in less than two minutes at the most, and the results are *very* even, according to the duration of development.

Now, if this is not a saving in time, bring on the rival method. If a plate is over-exposed (5 x 8 plate and tray), take two ounces of D. and one ounce of A.; if under-exposed, one ounce of D., two ounces of A.; very simple and definite. Number of drops of this and drops of that are oftener put in with a squirt than carefully counted. By omitting the glycerine, the annoying bubbles are done away with.—G. H. MONROE.

that in less than a month there may be a hundred more offerings equally as useful. This is as it should be. In an art so beautiful as ours, the more

To Keep Pyro in Solution.—I have kept a three-grain solution of pyrogallic acid in water over a month in perfect condition, by the use of salicylic acid. It does not retard the development in the least. The proportions used are as follows: Pyrogallic acid, 60 grains; water, 20 ounces; to which add 15 grains of salicylic acid dissolved in 2 drachms of alcohol. This solution is always ready for use in equal quantity with the solution of bromide and ammonia, for making the developer for dry plates. The decomposition of pyrogallic acid in aqueous solution is very similar to that of other organic substances, and is prevented in the same way.—D BACHRACH, JR.

Carbonate of Soda Developer.—My process consists simply in using separately the pyrogallic acid bath and the alkaline bath. The mother solution of pyrogallic acid prepare as follows: Sulphite of soda, 25 parts; distilled water, 100 parts; sulphuric acid, 3 or 4 drops; pyrogallic acid, 10 drops.

I take from 10 to 15 parts (according to the results that I wish to obtain), to which I add 100 parts of water, and immerse my exposed plate in this bath. I allow it to remain at least one minute or more—even from 10 to 15 minutes would cause no injury. The image commences to appear in this bath on account of the presence of the sulphite; but it is quite useless, although without danger, to await this result. In the meanwhile, I prepare in another dish the following alkaline bath: Solution at 25 per cent. of sulphite of soda, 10 parts; saturated solution of carbonate of soda, 3 parts; ordinary water, 100 parts.

The proportion of 3 per cent. of the solution of carbonate of soda is a minimum which it would be well to increase twofold, and even threefold if the strength of the gelatine film can bear it.

I now withdraw the plate from the pyrogallic acid bath, and after having allowed it to drain two or three seconds, I at once plunge it into the alkaline bath. The development is made with very great rapidity and with a clearness explained by the very small quantity of pyrogallic acid in the alkaline bath. In fact, the gelatine film has absorbed in a manner the quantity of pyrogallic acid necessary for its development, and nothing more; from which it results that the alkaline bath is not sensibly colored, neither is the sensitive film.

When the exposure has been normal, the development is ended in one or two minutes, at the most; but it may be prolonged if it is observed that the intensity increases with the duration of the immersion. It is very rare that anything else is necessary than to wait in order to obtain a perfect negative. In case the exposure has been much too short, it may be necessary to add to this last bath in succession a little pyrogallic acid, then a little carbonate of soda, in order to force the tardy details to appear; but I repeat, this should only be done in exceptional cases, when very quick drops have been used. With exposures in the full summer sun of from one-twenty-fifth to one-fiftieth of a second, I have obtained excellent negatives, using a little patience, without having recourse to any addition of pyrogallic acid or of carbonate.—E. ANDRE.

One more thing and I am done. Commence the use of dry pyro if a lot of plates are generous rivalry there is, the more enthusiasm, and the more enthusiasm the more growth. And development is growth of the most fascinating description. It affords as much varied pleasure too as anything in art.

to be developed; a solution of two or three grains per drachm can be made—or of any multiple desired—and then, with little trouble, any amount needed can be used quickly, cleanly, and *surely*.

As it may not have been remembered, or of ready reference, I give the formula just as Prof. Newton gave it:

No. 1. Water, 32 ounces; yellow prussiate of potash, 3 ounces; carbonate of soda, 3 ounces; carbonate of potash, 3 ounces. Mix and filter.

No. 2. Water, 32 ounces; sulphite of soda, 3 ounces. Mix.

In both solutions the troy ounce of 480 grains is meant—*not* the avoirdupois ounce of 437½ grains.

Normal Developer: No. 1. 2 drachms or ¼ ounce. No. 2. 14 drachms or 1¾ ounces. Which makes up two ounces or sixteen drachms, or No. 1 one part; No. 2 seven parts. Now, when No. 1 and No. 2 are mixed, add two grains of dry pyro for each *one* ounce of mixed developer.

This is normal developer for somewhere near *normal* exposures; if you have a lot of guesswork plates to develop, make up your pyro in No. 2 and flow it over the plate, and then add the No. 1, or alkali (?), in small quantities until sufficient detail and harmony shall come out.

Overexposure can be cured by use of bromide of *soda* solution previously mentioned, or by dilution of developer, to an extent that will reduce it to a proportionate strength with exposure, but on no account use either bromide of ammonium or potash with this developer; you will be "left" if you do.

Underexposure, so far as it can be cured, can be handled by increase of amount of No. 1 to several times normal.

This developer will not bring out the object if a plate has been exposed $\frac{1}{1000}$ the proper time; nor will it make so harmonious a negative in a plate that has had one thousand times normal exposure.

Lastly, bromide of brains is one of the most valuable, least used, of all the essential requisites for an "immature" photographer.—THOMAS PRAY, JR.

I have been experimenting for two years to obtain developers to take the place of ammonia, that pernicious agent engendering bronchitis, deafness, etc. Here is the formula with which I successfully work:

No. 1. Pyro, 1 part; sulphurous acid, 1 part; distilled water, 8 parts.

No. 2. Saturated solution of carbonate of soda, 6 parts; sulphurous acid, 1½ parts; bichromate of potash solution, at 5 per cent., ¼, ½, or ¾ part; water, 18 parts.

To develop a half plate use 4 c. c. No. 1, and 75 c. c. No. 2.

In case of overexposure, bromide may be used. The development is slower than with ammonia, and there is a greater tendency to frill. Nevertheless this last may be obviated by passing the plate through a solution of sulphate of iron (8 : 80), to which is added one part of tartaric acid to preserve the solution. The sulphurous acid is only useful to

That is, if I dare apply the word art to anything chemical or physical. If I dare not, then I shall claim that development is more beautiful than art.

modify the color of the developed image. I should advises always to use the iron bath for fixing, if it is desired to obtain a more rapid development, in omitting the sulphurous acid.

The plate should be well washed, before and after immersion, in the iron bath. It should remain there from two to five minutes, according to the required time. The longer it remains, the more intense will be the tone. The action of the bichromate is curious: it accelerates the development, and, doubtless, hardens the gelatine, as when it is present there is less tendency to frill.—W. HANSON.

A Quick Method.—For a half plate, with an exposure of one second, instead of six on a cloudy day, use a sensitizer composed of 150 c. c. of rain water. one drop of a concentrated solution of hyposulphite of soda, and five drops of a solution of bichromate of mercury at one per cent. The plate is allowed to remain in this bath for half a minute, washed with care, and developed with the ordinary oxalate of iron. If the print be an instantaneous one, taken indoors, the immersion should be prolonged for about a minute. If the print should come too rapidly, retard the action of the bath by a drop of a concentrated solution of citric acid, or by making use of a developer to which 25 per cent. of water has been added. It is necessary to renew the solution when it has been used for three or four plates.—HERR VERRES.

Universally Useful.—In my hands this will do any reasonable thing:

No. 1. Pyrogallic acid, 1 ounce; water, 4 ounces; bromide of potassium, 600 grains; pure nitric acid, 20 drops.

No. 2. Concentrated liquid ammonia, 2 ounces; water, 2 ounces.

Use four drops of each to every ounce of water required to make up developer. If too rapid, add two drops of pyro; if too slow, add two drops of ammonia.

This, of course, is very concentrated and will require careful use, as a few drops either way will make a vast difference. Again, be sure you get good, pure ammonia, else you will be all at sea. Don't buy from a druggist, but from some reliable stockdealer or chemist. In all methods of development this fact is quite established, viz., that a slow development gives a finer grained negative than a rapid one, which makes a coarse deposit and lacks detail in the deep shadows. In using the sal soda developer, citrate of soda will be found a most powerful restrainer; in fact, a drop or two too much is able entirely to stop the development. Use it carefully, and measure how much is needed for the particular brand of plates you are using. Thus many an overexposed plate can be saved by its use. Bromide of potassium is the restrainer accepted by the majority of operators, it being more active than bromide of ammonium. Should a slow plate be used, then weaken the developer one-half, otherwise very strong negatives will result from the use of full, strong solutions. Wash the pyro well off before placing in the hypo, to prevent the peculiar pink stain often seen on dry plates.—G. HANMER CROUGHTON.

A New Method.—It has for a long time been my opinion, both from theory and some experiments that I made, that the present method of mixing both the pyro and alkaline

Every plate I develop is a new pleasure to me. I see something in it—and something come out upon it which I never saw before

solutions when developing, was neither the best nor most economical method, if, as I think, we can now mix up an aqueous solution of pyro that is stable and will not change. Those who understand the chemical action involved, are aware that pyro occupies almost precisely the place of free nitrate of silver on a collodion plate, and the sal soda or ammonia the place of the sulphate of iron or pyro, whichever was used. Acting on this theory I developed a few plates by first immersing them in a strong pyro solution for a minute (which I then drained off again into the bottle), and then developing them with the sal soda solution, using the same quantity of water as if the solution had been mixed in the usual way. The result was as good as the best developed plates by the other methods. It will be seen that several advantages are gained: First, the immersion in strong pyro causes a uniform absorption of it all over the plate. Second, at least two-thirds pyro is saved.

For plates, say up to 11 x 14 inches have a dipping-bath (your old silver bath-holder will do, rubber as well as glass), in which permanently keep the following solution in quantity sufficient to cover the plate. An occasional filtering is all that is necessary to keep this in order indefinitely.

Water, sixteen ounces; sulphite of soda, four ounces; dissolve, and add enough sulphuric acid to turn litmus paper decidedly red. Then add one ounce of pyrogallic acid, one-quarter ounce of bromide of potassium, and one ounce of sulphate of magnesium. When a plate is to be developed, dip it in this bath not over a minute, then take out and drain it, and develop with the alkali.

Developer, Stock Solution.—Crystallized sal soda, ½ pound; water, 1 quart; sulphite of soda, ¼ pound; bromide of potassium, ½ ounce.

Of this take one-half of an ounce to two and one-half ounces of water, and develop the plate as usual

It will be noticed that I put the sulphite of soda in the second solution as well as in the first, because so little of the latter is used that the desirable color given by the sulphite to the plate would *otherwise be absent.* The sulphate of magnesium is added to the first solution to prevent the softening of the gelatine which is likely to occur when the solution is either warm or tepid.—D. BACHRACH, JR.

This formula for a potash developer is well adapted for instantaneous plates.

No. 1. *Pyro Solution.*—Warm distilled or melted ice water, 2 ounces; chemically pure sulphite of soda (437 grains to ounce), 2 ounces; when cool add: sulphurous acid, 2 ounces; and finally add: pyrogallol (Schering's), ½ ounce or 218 grains; which is done by pouring the sulphite solution into the pyro bath, repeating the pouring until the pyro is dissolved. The solution, which will now measure five fluidounces, should be filtered, and will contain forty-four grains of pyro to each ounce.

No. 2. *Potash Solution* is prepared by making two separate solutions as follows: *a.* Water, 4 ounces; chemically pure carbonate of potash (437 grains to the ounce), 3 ounces. *b.* Warm water, 3 ounces; chemically pure sulphite of soda (437 grains to the ounce), 2 ounces; *a* and *b* are next combined in one concentrated solution, a small

And besides all this, there is always a mystifying apprehension about it which adds to its charm and works wonders in bringing about one's best results.

quantity of which when mixed with the pyro will be sufficient to develop three or four plates. The strength of the solution will be uniform, and it will measure between eight and nine fluidounces.

Supposing a plate to have been greatly overexposed, or properly timed, or the length of the exposure is unknown, to develop a 5 x 8 plate take 2 ounces of water and add thereto 3 drachms of No. 1, and from ½ to 1 drachm of No. 2, of the potash solution. Then pour the solution upon the plate; after a minute's interval, should no part of the image appear, add a second drachm of No. 2, putting it into the graduate first, and then pouring the developer from the tray into the graduate. The solution is again flowed over the plate, and if after a minute's interval no image appears, repeat by adding a drachm of No. 2 at a time, until development commences. In this way the picture will be brought out very gradually, the development will be under perfect control, and can be prolonged until all details appear, without the slightest danger of fogging the plate. The principle involved is to add sufficient pyro at first to give proper density, and then add minute quantities of the alkali at stated intervals until the right strength is reached to commence the development.

In place of the No. 1, or the pyro in solution, dry pyro may be used with good effect, 6 to 8 grains being sufficient for 2 ounces of water.

If a plate has had what is termed a drop-shutter exposure, or, in other words, an instantaneous exposure, to 2 ounces of water add 3½ drachms of No. 1 and 3 drachms of No. 2, increasing it a drachm at a time, in case the shadows fail to come out, up to 5 drachms.

The sky will appear rapidly, but the dark portions will develop gradually.

Brilliant, clear, bluish-gray quick-printing negatives are produced with this developer on almost any brand of plate, the necessity of using clearing solutions is avoided, and all chance of stain to the negative disappears. The developing solution remains clear, and from four to eight plates may be developed successively in it at one time. Should the negatives be too dense, the amount of No. 1 may be decreased a third to a half.

Among the advantages claimed for the developer are simplicity, certainty of uniform action, and production of clear negatives. The solutions being in concentrated form may be kept in small bottles, convenient for handling.—F. C. BEACH.

Newton's Method.—For a developer well adapted to bring out fully the details in a plate which has had a very short exposure, I use the following:

No. 1. Water, 1 ounce; carbonate of soda, 15 grains; yellow prussiate of potash, 15 grains; sulphite of soda, 5 grains.

No. 2. Water, 1 ounce; chloride of ammonium, 7 grains; pyro (dry), 6 grains.

Nos. 1 and 2 are mixed, and the whole poured over the plate. Development commences within a minute, and is usually finished at the end of three or four minutes. The proportions named above are correct for an ordinary drop-shutter exposure, but they are not arbitrary; they may be varied to suit different cases, as, for example, should the plate have been greatly underexposed, equal parts of Nos. 1 and 2 (with the pyro left

The student must not be alarmed at this variety, for even in nature it is rare to find either fruit or flower developed and brought to perfection twice alike.

out of the latter) may be added, a little at a time, to from three to four times the strength stated, until all the details in the shadows are brought out, without danger of producing green fog, which frequently appears from the excessive amount of ammonia sometimes used in the ordinary ammonia and pyro developer. In case of overexposure, half a grain to the ounce of developer of bromide of sodium is added, and the solution diluted with water.

Nos. 1 and 2 solutions may be kept in a more concentrated form, and diluted for use. The following are the right proportions for 10 per cent. solutions:

No. 1. Water, 9½ ounces; carbonate of soda, 480 grains; yellow prussiate of potash, 480 grains; sulphite of soda, 160 grains.

No. 2. Water, 9 ounces; chloride of ammonium, 510 grains; solution of one drop of sulphuric acid in one ounce of water, 1 drop; pyro (one commercial ounce) 437 grains.

If No. 2 does not change from a purple color to a clear yellow color within an hour after mixing, one or two drops more of the sulphuric acid solution may be added.

To prepare a developer of the proper strength with the above solutions for the development of a 5 x 8 plate which has had a drop-shutter exposure, take: Water, 5⅓ drachms; No. 1 solution, 2⅔ drachms. Also: Water, 7 drachms; No. 2 solution, 1 drachm. Mix the two, and develop in the usual way.—H. J. Newton.

Mr. Bachrach's Plan.—Without going into the reasons and the theory involved, I will simply give the formula as I now use it. In our establishment we only use it for plates of less than 11 x 14 inches measurement, preferring the usual formulæ for larger plates. The solution No. 1, of pyrogallic acid, etc., is to be used in a regular dipping bath, into which the plates are to be dipped before development in the alkaline solution. No. 2 is the developing solution into which the plates are removed after dipping in the bath.

No. 1. Pyrogallic acid, 2 ounces; water, 16 ounces; sulphate (not sulphite) of soda, ½ ounce; bromide of potassium, ¼ ounce.

Dissolve, and add to this solution 4 ounces of sulphite of soda, dissolved in 15 ounces of hot water, made slightly acid after dissolving with sulphuric acid to C. P. Then add 30 grains of salicylic acid dissolved in 1 ounce of glycerine and ½ ounce of alcohol. This solution keeps indefinitely, and will also answer as well for developing the usual way.

No. 2. Sal soda, 1 pound; sulphite of soda, 1½ pounds; water, 1 gallon.

When ready for developing, make up the developer by using 1 part of No. 2 solution to two parts of water; make plenty of it, as it works better in large quantities and is cheap. Dip the plate from ten seconds to half a minute in No. 1 solution, and then remove to a dish containing the developer prepared as above. They will develop regularly, and you may leave the plates in until *fully* developed. If the time of dipping in the pyro has been carefully noted, by using one brand of plates, accuracy can soon be acquired. No fear need be had of too much density, as the plate has absorbed only a certain quantity of pyro, and consequently the high lights cannot, as in the ordinary method, be "piled up" by continued development. The latter only occurs with this method when dipped too long in the pyro, and when this is noted by the way the plate

A few words on the *rationale* of development should come in right here for the help of the novice, before we proceed any further.

develops, it is only necessary to add water to the developing solution, and it can be remedied. When the plate has been overexposed, or is suspected of having been, dip it a longer time in the bath; if underexposed, a shorter time. Want of contrast can be cured, if taken in time, by adding pyro solution to the developer; but this is only liable to occur with overexposure or too short immersion in the pyro. Different brands of plates require variations in time of dipping.

The advantages of this method of developing are greater uniformity of results, a closer resemblance to wet-plate effects, and a great saving of pyro. In summer it is necessary to keep No. 1 solution cool.—D. BACHRACH, JR.

My Developer.—I have tried nearly every formula published, and have found that the Cooper developer is the simplest and the best that I have used. It is prepared as follows.

No. 1. Sulphite of soda, ½ pound; pure water, 2 quarts; pyrogallic acid, 2 ounces.

No. 2. Carbonate of soda, pure, crystals, ½ pound; water, 2 quarts.

To develop, take No. 1, 2 ounces; No. 2, 2 ounces; water, 2 ounces.

The developer can be used until it turns a dark color.

For fixing, I use the following: Put three pounds of hypo soda in a gallon bottle, nearly fill with water; after the hypo is dissolved add four ounces of chrome alum solution. After it settles it can be used.

The chrome alum solution is prepared as follows: Chrome alum, 1 pound; water, 5 pints.

The chrome alum will impart a greenish color to the fixing bath. When this color disappears, the bath should be renewed.

With the above developer and fixing bath I have no trouble with fog or frilling.—WILLIAM MCCOMB.

Worth notice, also, is the communication of Stolze, according to which the bromide of silver gelatine can be mixed with pyrogallic acid and sulphite of soda. When dried and exposed, these plates will develop in a simple soda solution. The possibility is therefore determined that the manufacturer of the emulsion can add at once the necessary quantity of pyrogallic acid; this being a great convenience and a saving of much time for travelling photographers. Meydenbauer asserts that the sensitiveness of the plates is increased by this addition. About the durability of such emulsions no observations have been made, except one of six weeks.

I introduced with success in April, 1885, the sulphate of ammonia in the pyro developer; and on May 5, 1885, he communicated to the Vienna Photographic Society his discovery of the property of hydrazine (particularly the phenilhydrazine as sent to him by Dr. Walter, of Basle) acting in alkaline solutions as a developer for transparent pictures upon bromide and chloride of silver.—DR. J. M. EDER.

Developer proposed by M. de la Motte: A. Water, 100 c. c. (3 fl. ozs. 3 fl. drs.); carbonate of ammonium, 25 grs. (386 grains); bromide of potassium, 1.2 grs. (18 grains). A. Water, 100 c. c. (3 fl. ozs. 3 fl. drs.); carbonate of ammonium, 25 grs. (386 grains). Or, After the sensitive plate has been exposed in the camera, it holds what is termed a latent image. Exposed to the light in that condition the obscuration

B. Water, 100 c. c. (3 fl. ozs. 3 fl. drs.); carbonate of soda, 25 grs. (386 grains); bromide of ammonium, 1 gr. (15 grains). B. Water, 100 c. c. (3 fl. ozs. 3 fl. drs.); carbonate of soda, 25 grs. (386 grains)

The plate having been washed in water for five or six minutes, is plunged into a dish containing (for a plate 18 x 24 centimetres) (7¼ x 9½ inches) 125 c. c. (3 fluid ounces 10 drachms) of a solution of pyrogallic acid at 1 per cent., well mixed with from 12 to 15 c. c. (3 to 4 fluid-drachms) of good beer, and is allowed to remain in this liquid for about one minute.

The plate is then removed; 4 or 5 c.c. (1 to 1¼ drachms) of the solution A or the solution B are added to the bath, and the plate is again plunged for 30 or 40 seconds; the image will not yet show itself. 3 c. c. (49 minims) of A, and 2 c. c. (32 minims) of A, or 3 c. c. (49 minims) of B, and 2 c. c. (32 minims) of B are added, and the plate is again immersed for about half a minute; the image will now appear. The development may be continued if it is necessary, by adding more or less of A and A, or of B and B, as may be required.

If a solution of sodium is used for the development of gelatino-bromide negatives, corresponding with colors that are strongly non-actinic, too great a degree of intensity may be obtained, and it is better to remedy it by underexposure.

After an ammoniacal development, it is possible to obtain all degrees of intensity, and if this were insufficient, the image must be strengthened by a mixture of pyrogallic and acetic acid, containing about ten per cent. of beer.—LEON VIDAL.

Dr. Monckhoven's plan: I herewith give Dr. Monckhoven's developer as I am now using it: Place upon the stove and boil a teakettle full of water.

No. 1. Boiling water, about 24 ounces; sulphate of iron, 6 ounces; oxalic acid, 3 ounces. No. 2. Boiling water, 24 ounces; neutral oxalate of potash, 8 ounces.

To make the developer—1st. In a small granite-ware or porcelain-lined kettle put the six ounces of iron, and pour about the above amount of boiling water upon it, stirring it with a rod; in about one or two minutes it will be dissolved. Then add the crystals of oxalic acid, and stir for a moment, when the iron will be converted into a yellow precipitate of oxalate of iron, which in two or three minutes will settle to the bottom of the dish, after which the water should be carefully decanted off, leaving the iron in the bottom of dish; about the same amount of fresh hot water should be added and well stirred, and again allowed to settle and be decanted. This operation should be performed four or five times, or until the acid used is completely washed out of the iron.

2d. In the meantime the oxalate of potash is to be dissolved in about twenty-four ounces of boiling water, and after the last washing has been decanted from the iron, the potash solution is turned upon it, and it is placed over the stove and stirred for about five minutes, when the iron will all be taken up by the potash. When cooled to 85° F., it is ready to use. This makes a saturated solution of ferrous oxalate, and if used of this strength will develop a fully exposed plate in about ten seconds. In practice this is too energetic to permit a proper examination of the work; therefore I divide the soluof the film would ensue and prevent all chance of the latent image ever becoming apparent, by whatever means applied. But if it is protected from the

tion into two parts, one of which I weaken with water until it will consume one to three minutes in the development. The advantages of this developer are that, by the simple addition of water, you can adapt it equally to the most delicate draperies and lightings, or hardness and strength, that are attainable by the old wet process. An underexposed negative can nearly always be brought up to good printing qualities with the strongest developer, and it is possible to make exposures of an eighth of a second or less in the studio, with good results, by its use.—J. H. SCOTFORD.

Ferrous Oxalate Developer in Concentrated Solution.—By following the indications given by Dr. Eder, I have made the following concentrated solution: Boiling water, 500 grammes; neutral oxalate of potash, 300 grammes.

This solution made, to the same liquid at 95° C. (203° F.) we have added sulphate of iron, 100 grammes; when all was dissolved, we filtered this liquid into well-stoppered bottles. In use, this is what we observed: An exposed plate plunged into this developer gives but faint traces of the image to be developed, but the intensity increases when water is added to the concentrated liquid. By adding an equal volume and even double the volume of the solution, we have obtained very complete development. When developing plates that have had a normal exposure, we can at once use three times the volume of the concentrated solution. If, on the contrary, overexposure is feared, the water should be added gradually. A prolonged stay in concentrated solution retards the coming of the image, instead of rendering it more intense. A plate immersed in water, before being treated with the concentrated developer, does not develop any better in it, unless at least the proportion of the additional water be increased twofold. To resume, this concentrated solution offers the advantage of reducing to a *minimum* a solution of ferrous oxalate ready for use; by the addition of more or less ordinary water, it is possible better to conduct the development of overexposed negatives.—LEON VIDAL.

Try my developer: A. Hot soft water, 7 ounces; sulphite of soda, 2 ounces; when cold, add pyrogallic acid, 1 ounce; salicylic acid, 6 grains, dissolved in half gallon alcohol. For use, add 7½ ounces of water to ½ ounce of solution A. B. Hot water, 57 ounces; sulphite of soda, 2 ounces; carbonate of potassium, 2 ounces.

To develop a 5 x 7 plate, use 1 ounce of A with 1 ounce of B. To secure more intensity, use more of A, or if too much intensity, I use less of A and more of B. I do not know as this is new, but I have not seen it put up in this form.—CHARLES KNOWLTON.

A New Sulphite of Ammonia Developer.—I have fully recognized the value of a potash developer for rapid plates and short exposures; but, notwithstanding this, I recommend a new developer, containing ammonia and ammoniacal sulphite, which is excellent for almost all commercial plates: A. Dissolve 10 parts of pyrogallic acid and from 25 to 30 parts of ammoniacal sulphite in 100 parts of water. B. Dissolve 5 parts of ammoniacal bromide in 150 parts of water, and add 50 parts of liquor ammonia.

To make the developer, take 100 c. c. of water, 4 c. c. of the pyrogallic solution A, and 4 c. c. of the alkaline solution B.

The development is very quickly made, and if slower action is required, add 50 c. c.

light, and developing solutions applied immediately a real image begins to form. A building-up process commences. The particles of reduced silver

of water, which gives softer images. On the other hand, if we wish to obtain stronger images, add a few drops of a ten per cent. solution of ammoniacal bromide.

The ammoniacal sulphite developer gives well-modelled and brilliant negatives, in which the high lights are well rendered and the deep blacks well defined; the negatives have a very agreeable dark brown tone. The ammoniacal sulphite renders the pyrogallic solution more permanent than does the sodic sulphite, and with this developer there is not much danger of fogging.—DR. J. M. EDER.

Formula for Development with Hydrokinone.—I have been trying hydrokinone ($\frac{2}{3}$ gr. hydrokinone to the ounce) for ordinary Wratten & Wainwright plates. Exposed fifteen seconds to the north sky (clear), with stop (f–42); ordinary negatives; working positives on the $3\frac{1}{4}$ plate. Manner and results as follows: Soaked one minute in water, and one minute in $\frac{2}{3}$ gr. hydrokinone to ounce, then added $\frac{1}{6}$ dr. ammonia to ounce. In 6 minutes faint image appears, in 10 minutes (from last note) I recognize picture, in 14 minutes detail out very faint, and in 21 minutes intense enough for transparency. Fixed and yellowish-red green fog, not removable by Edwards' modification of Cowell's clearing solution (1 oz. alum, 1 oz. citric acid, and 3 ozs. iron to 20 ozs. water), nor by bleaching with ferric oxalate, or re-development by ferrous oxalate developer. The same exposure with same plates develops beautifully with $\frac{1}{2}$ dr. ammonia, $\frac{1}{4}$ gr. bromide of potassium, and 1 gr. pyro to oz., with perfectly clear shadows. Using the sulpho pyrogallol of the Platinotype Company, it took five minutes before they showed the faintest image; in fact, development very slow.—DR. H. L. VERCOE.

The solution of hydroquinone in alkaline sulphites, on the contrary, remains perfectly white for a certain length of time, and it is with it that I propose to operate. In 100 parts of a solution of soda at 10 for 100, I dissolve 1 part of hydroquinone; I steep my impressioned plate two or three minutes in the bath, and, without draining it, I plunge it into an ordinary ammoniacal pyrogallic developer without sulphite. The image appears with all its details, and the bath does not acquire a dark color. If the negative is a little gray, I add a few drops of an aqueous solution of hydroquinone at 1 for 100; that I make at the time, and in very small quantity. In this manner I obtain negatives that are perfectly clear, of a beautiful red-brown color, eminently favorable for printing. The sulphite bath may be used until exhausted. The pyrogallic bath may serve several times, and, moreover, the addition of a few drops of the hydroquinone solution of 1 for 100 increases but very little the cost. I have not tried hydroquinone with the alkaline carbonate developers, but I believe that it would render great service in intensifying the negatives, after the appearance of the details in the pyrogallic bath, especially in the process recently recommended by M. Balagny.—M. E. JOLY.

Any one accustomed to the various processes to which a photograph may be subjected is convinced that a slow or gradual development has many advantages over a rapid development.

Although a strong developer will compensate more for a shorter exposure than a run, spring, leap, climb, pile up, fall into their places just as the sand of the simoom and the snow of the mountain do and form the elevations and depres-

weak developer, yet even in the wet process, with the exception of some peculiar cases, a weak developer is to be preferred.

Above all, a weak developer works more clearly and uniformly than a stronger one, and requires less skill in manipulation. This is especially apparent in the production of large photographic landscapes, without which it is almost impossible to represent an atmospheric effect with success.

The image produced by a weak developer is more harmonious in its general character; and in the photographing of interiors it gives that uniformity in gradation of tones which is so desirable.

The dark portions, which are a constant factor in interiors, have more chance to develop and bring out the detail. Moreover, there is no danger of making the high lights too intense, which would occur if a strong developer was employed.

Cases not infrequently occur in which a peculiar constitution of the developer is demanded, as, for instance, in the reproduction of engravings or line drawings, more acid must be added to it than is used in the development of portraits or in landscape photography.

A weaker developer, in consequence of the slowness of the deposition of the silver, gives a far more delicate and pleasing image than can ever be hoped for with a strong developer.

Transparent positives are more pleasing in every respect when slowly developed.

The same remarks seem applicable to the modern dry-plate development.

It is said that the oxalate development gives negatives which have greater resemblance to those produced by the wet-plate process, but we can assert with positiveness that the artistic effect produced by pyro development far transcends the effect to be obtained by the use of oxalate.—Dr. H. Sturenberg.

A Plea for Over-timing.—One thing experience has taught me—that is, whenever it is possible to overtime a picture do it, and when you come to develop you won't regret it.

Make the following solutions:

No. 1. Pyro, 1 ounce; sulphite of soda, 2 ounces; bromide of potassium, 40 grains; citric acid, 40 grains; water, 12 ounces.

No. 2. Carbonate of potassa, 3 ounces; sulphate of soda, 2 ounces; water, 12 ounces.

Take one drachm of No. 1 to one ounce of water, and add ten drops of (ten grammes to ounce) solution of bromide of potassium. Let the plate be in it for a minute, then pour off its solution, and cautiously add No. 2, beginning with one-quarter of a drachm to every ounce of the solution; wait two minutes before you get frightened at the non-appearance of the image; be assured if you have overtimed there is plenty of what the philosophers call potential energy to work out its own salvation. After the two minutes are up, you may add another one-quarter of a drachm of No. 2, and keep right on developing not too rapidly. If, in adding the first one-quarter, the image comes up in less than a half minute, lift the plate immediately from the solution, and lay it in a bath of bromide of potassium, one drachm to the ounce (ten grain solution), and keep it sions we see. A sectional view of a developed image is a miniature in drawing of what a sectional view of the earth snow covered, sand scattered would be.

there a couple of minutes; then, without washing, put it back in the solution, and it will work out slowly and beautifully.

Always begin with the weak developer; keep a stock on hand for the purpose. Another thing which I have learned—don't be stingy or saving with weak developer; you may have to pay for it in the loss of a negative. Overtimed negatives are beautiful and soft if managed in this way. I have used the most rapid plates, and given them ten times too much exposure, and yet by this method obtained the best finished negatives I have; but, sometimes, you cannot overtime. Well, then, this is the way I manage: I take the plate from the holder, lay it in plain water for two minutes, covering it up, of course; I then wash it by pouring water over it, place it in solution composed of one ounce of water, one drachm of No. 1 or No. 2 and go on with the development. In nine cases out of ten it will come up like a full-timed negative. It is strange, but it is a fact, that the washing after removal from the plain water facilitates the development. If the plate should still lack details in the shadows, I lift it out and transfer it to a dish containing one ounce of water to one drachm of No. 2, and let it lie a half minute, then return it to the mixed developer. I prefer this to adding the accelerator directly to the developer.

Be sure to let the plate lie in the developer till it has density enough, but be careful not to get it too dense.

It is a good plan to develop one plate, and fix it, and see how far you have gone in intensification; then, with that experience, go back and develop the rest.

My parting advice is, use the quickest plates for all subjects, and overtime them, and you will be happy.—EUGENE ALBERT.

A Method of Treating Plates whose Time of Exposure is Unknown.—On developing my American plates I worked upon the supposition that I did not accurately know the times of exposure. I could not definitely say whether a certain plate had been over- or underexposed.

I therefore proceeded as follows: The plates were first of all laid in a solution of 150 c. cm. of neutral oxalate of potassa (1 to 3), and only 5 c. cm. of iron (1 to 3), and the appearance of the image watched for.

If the outlines of the image began to appear in about a minute and a half the exposure was considered right.

They were then left in the bath, while a second bath was prepared: 150 of oxalate of potassa, 10 of iron. Number one was placed in this, whilst a second plate was put in the first bath.

In bath No. 2 the second plate was allowed to develop further.

When it was found that no further detail could be got from the second bath it was put in a third: 150 oxalate of potassa, 20 of iron. This was sufficient generally to develop the plate fully.

Now as regards the treatment of underexposed plates:

Two, or even three, minutes was often not enough to bring out even the high lights in

I am sure you understand. No small number of the particles of silver go adrift and find no place in building up the image. Some of these are driven

No. 1. They were placed respectively in Nos. 2, 3, and 4, and allowed to finish in the latter.

If the plates came up very rapidly in No. 1, they were immediately transferred to a bath of the same strength, to which from five to den drops of bromide of potassium were added. The development was in this way retarded, and a plate of sufficient intensity produced.

The baths were always strengthened after three or four plates had been developed therein, or a new bath made.

In this manner the plates were developed slowly and regularly; sometimes a half hour elapsed before a plate left the final developer. They were usually intense enough, and rarely needed any strengthening. Some, however, did need a little doctoring. I remember some of the plates which I had taken in the high plains of Arizona and New Mexico. I had given them an average exposure of seven seconds with smallest stop, an exposure which had been shown to be correct for some negatives taken upon the Northern Pacific Railroad, but at this elevation the exposure was too long, and the plates, as a matter of course, were overexposed.

It is, therefore, true, as Bunsen has shown, that the actinic force is greater in high altitudes than upon the sea level, but I had no idea the difference is so great.

Over-developed plates I subjected to this process of reduction with iodine already mentioned. I cannot, however, recommend the cyanide of potassium. The reduction is more under control with the former. The plates are laid in a solution of iodine and iodide of potassium, recommended above for the removal of green fog; they are then put in the fixing hypo, by which the iodide of silver formed is dissolved. If they are not clear enough, repeat the process.

Finally, you will perceive that the negatives give perfectly clear shadows. If they look thin, strengthen them with bichloride of mercury and ammonia.

The atelier photographer may laugh over the amount of pains to save a badly exposed plate, but he forgets that he does not have to travel miles and miles to secure his object. The amount of labor expended upon anything increases its intrinsic value, if not its exchangeability. The portraitist, when he has made a bad negative, need only turn smilingly back to his subject and say, "You have slightly moved; I think I can improve it by another exposure."

And we try, conscientiously, all in our power, to get what we can from our plates.

A skilful amateur, present during my development, was astonished that I should devote so much time. But patience is a virtue of our race.—Dr. H. W. Vogel.

If photographers in general would use a little more judgment in the development of dry plates, there would be fewer complaints, fewer failures—more profit and greater satisfaction to all, from the plate-maker to the customer who gets the photographs. It will never do to condemn a plate because it does not happen to give satisfactory results by the same development and treatment that another one gives all that can be desired by. A plate which is inclined to give hardness must have a very different treatment away by the wash-water, and the most persistent ones are "cleared" off by the fixing process. The entire operation is fascinating.

from the one that tends to weakness and flatness of image. The former should be developed with a very weak solution of pyro—not more than from one to two grains to the ounce; this will necessarily require a longer exposure than one which is to be treated by the opposite. A plate giving a thin, flat image with the developer at this strength of pyro will, if nothing else be the matter, give all that can possibly be desired by using from four to five grains to the ounce of solution of ammonia, potash, soda, or whatever may be used as accelerator, being varied accordingly. Compare two negatives, after the most has been done for both, according to their requirements. The former will be found to be highly satisfactory before the comparison is made, and will yield points to please a certain class of photographers, and also *their* customers. It might be said, Where, then, is the use of changing? The use of changing would be to make photographs representing nature more perfectly and raise the standard of photography *in comparison.* The latter negative will be found to possess a depth of richness in white drapery, and the blackest velvet be full of half-tone, when both are taken together on the one negative, thus representing nature to perfection, so far as light and shade can do, and leaving the best results of the wet plate a thing of the past. I am well aware that such results are not got every day, but I am as well aware they have been and ought to be, and with *nothing* short of this should photographers rest content.

I have changed from one developer to another until at present I am most in love with the one published by Mr. Cooper as recommended for the Eastman plate.

I prefer to make it up dilute enough at once to use equal parts without having to go to the trouble and time of measuring it out to add to so much water.

No. 1. Pyro, 1 ounce; sulphite of soda, 4 ounces; hot water, 48 ounces.

No. 2. Washing soda, 4 ounces; hot water, 48 ounces.

Use equal parts to develop with, and to gain more density add a drop or two of a fifty grain solution of bromide of ammonium. Very little of the bromide solution will make a great difference in the action of this developer. A little longer exposure will be required when any bromide is used. If a plate should show any trace of fog, lengthen the exposure and use less of the soda and a little more of the bromide; and it will be a very bad plate, and one that should never have been coated, if this will not give clear negatives. I would recommend keeping the developer at from 80° to 90° in the winter. No fear of frill or softening of the film.—James Inglis.

Overdeveloped Negatives.—Almost the very last thing that a photographer learns, is the exact point at which to stop development. It is easy to give a criterion to fix the point; the difficulty lies in acting up to it. To get the most perfect combination of brilliancy and softness, one should develop just as long as transparency remains in those denser portions of the image, which are to constitute the high lights, so that the very central spot, as it were, of the highest light, shall print white. But then this must be a mere point, smaller than a pin's head. Just so soon as this point widens out a little, we get that repulsive chalkiness that leads the careful photographer to consider the negative as worthless. (See note by Eugene Albert, page 358.)

162. One of the great obstacles in the way of successful emulsion work is frilling. It will be treated of presently. One method of preventing it is to

The difficulty in hitting the right point lies, not merely in the needful experience of what the negative should be, but in judging it under difficulties. The light in the operating-room is often insufficient; but even if abundant, its color is unfavorable, and the negative itself is to some extent blocked up by the undissolved iodide and bromide. Besides, the fixing-bath varies in strength, and acts differently upon different films, so that at times more, and at others less, reduction of strength occurs in the fixing

Experience and close observation remove these difficulties to a large extent, but not altogether, so that, after a succession of good results, there will be, from time to time, a negative got in which too much attempt at brilliancy has been made, and which, when viewed after fixing and by ordinary light, gives evidence of something like blockiness in the high lights. In work done at home, it will generally be best to try again. But even then, the discovery may come too late, and, in views exposed at a distance, we have not this remedy, and in either case, must see what can be done with the negative.

I take it that a careful photographer, when such mistakes do occur, will find them out before he varnishes the negative. Not, perhaps, in trying new methods, or in working new sorts of dry plates, in which often the actinic transparency and opacity are very deceptive, but, in any regular work habitually pursued, the exercised eye will always detect this defect before varnishing. If not, then very troublesome operations of darkening parts of the back may need to be tried. Varnish, colored yellow with alcohol, solution of annatto, of dragon's blood, or of gamboge, may be tried, perhaps, with advantage, though the writer has never had much satisfaction out of this sort of operation.—M. Carey Lea, M.D.

162. To prevent the loosening of the gelatine film in the fixing bath, which happens very easily during the warm weather of summer time, and to harden the film, 1 part of hypo solution (1 to 4) is mixed with $\frac{1}{2}$ to 2 parts of saturated aqueous alum solution. The mixture will pretty soon become muddy by separation of sulphur and sulphurous acid, but for all that it acts satisfactorily.

The negatives easily become milky, which is no hindrance in their printing qualities; but it does not look very well, and is the reason for using the mixed hypo and alum baths only in exceptional cases. The first negatives are washed, dried, varnished, and according to requirement strengthened or reduced.—Dr. J. M. Eder.

The proper use of the alum bath in connection with the dry plate is this: When the plate is fully developed wash it under the tap, or souse it in a dish of water; wash it well, then plunge it into an alum bath for half a minute. Why? If the developer goes over into the hypo a little on each plate the hypo gets stained, and in the dark-room you can't see it, and then the film on the plate gets stained; the washing will get off most of the developer, and the alum is a scavenger, and it readily picks up the pyro and the alkali, and cleans off what you cannot see, but what will show in the bottom of the alum bath, very prominently, after six or eight plates have been through; then wash again, and chuck into the hypo; now your plate will not "cockle, frill," or run off the hypo; when through with it, it can be washed off best by a *soak* of five minutes in still water, immerse the plate in a suturated solution of alum for five minutes previous to fixing it. The negative should be well rinsed before and after this operation.

163. Hyposulphite of soda is the very best material for fixing. The strength should be, say, four ounces of hyposulphite to a quart of water.

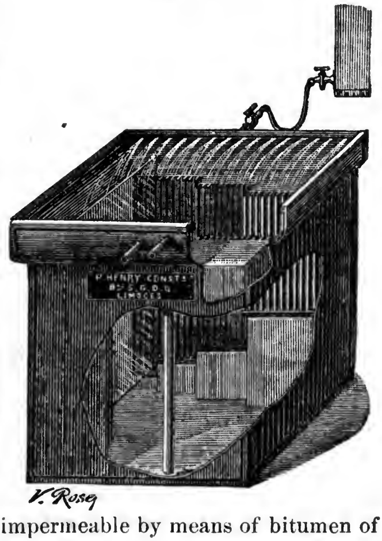
and then back into the alum bath, where it can lie five minutes or half an hour, and then let it go to the wash for three to five hours. Don't mix the developer into the alum; don't mix alum and hypo; don't mix hypo and alum; don't carry a plate from one bath into any other *without well washing* each one every time.—THOMAS PRAY, JR.

I have recently made some experiments with solution of sal-ammoniac as a medium for the fixing of bromide of silver gelatine plates. Plates which had been exposed, when subjected to the action of the bath for several hours, lost completely the bromide of silver which they contained, in the film, and merely the pure gelatine layer appeared. The effect was more rapid when the plates were first treated with ammonia. Plates which had been developed with pyrogallic acid were slower in fixing under the influence of the sal-ammoniac solution than unexposed plates, but with a longer time the fixing was effectual. Plates containing iodide of silver in the film in connection with the bromide of silver exhibited a trace of fogginess, probably from the unaffected iodide of silver which did not injure them in the least, and which entirely disappeared with longer treatment with the fixing bath, but the bromide of silver plates fix perfectly clear. I have not perceived in our experience any injurious influence of the sal-ammoniac solution upon the film with the employment of plates prepared by the newer method with chrome alum. True, the plates assume in the bath a strong relief, and sometimes worm-shaped elevations appear, which, however, shrink up on drying, and do not interfere with copying or in making transparencies. The tone of the picture is an agreeable brownish-black.—DR. E. LIESEGANG.

163. Mr. Henry, of Limoges, describes a washer (Fig. 322) for gelatine plates for which the following advantages are claimed:

Any thickness of glass can enter the grooves which are in such a way that they do not abrade the gelatine film. The water is divided over the whole surface of the box, and is maintained always at the same level by means of a siphon. When the pressure of water is very variable, and when the siphon does not suffice, a device is used to avoid an overflow. Finally, the plates may be removed with the greatest care.

FIG. 322.

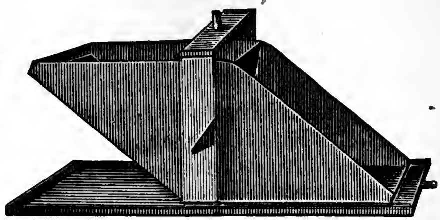


Another automatic washer, invented by Captain Gorcoix (Fig. 323), is formed of a waterproof box in which is suspended a metal recipient rendered impermeable by means of bitumen of Judea. This recipient is formed of two triangular or prismatic troughs joined by one

Most thorough washing should follow the fixing in order to eliminate every particle of hyposulphite from the film.

of their sides. The water introduced from the top accumulates in one of the troughs When it reaches a certain level, its weight brings it down and lifts up its companion. This water runs into the dish loaded with the salts to be diluted, and during this time the other trough is being filled in its turn to obtain the inverse motion. There can be no question that the water loaded with deleterious substances is entirely thrown out and renewed at each rise and fall. The time of contact is made greater or less by regulating the flow of water.

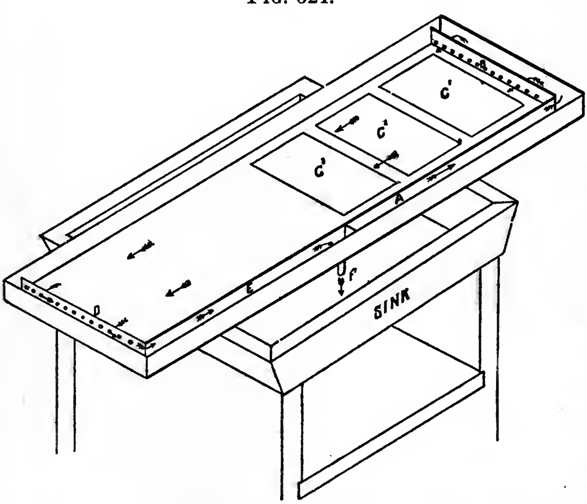
Fig. 323.



The staining of the film has been the cause why so many have given up the pyro developer, valuable as it is in many points, and have turned to the oxalate. But the advantages of the pyro cannot be had by using any other developer; therefore the attempts are many which have been made to prevent or remove the discoloration. I have found the following excellent:

A saturated solution of alum, 500 c. cm; citric acid, 4 grammes; or, instead of citric acid, muriatic acid may be used. Alum, 500 c. cm.; muriatic acid, 30 c. cm. Wash the negative well after fixing before subjecting it to the clearing solution.

Fig. 324.



Another good clearer is: Alum, 30 grammes; citric acid, 30 grammes; sulphate of indigo, 90 grammes; water, 600gra mmes.

The plates need only be slightly washed after fixing, and allowed to lie in the solution till they attain a beautiful brown color.—R. G. Weiss.

The pan shown (Fig. 324) is intended to set on the top of an ordinary sink. The water runs from the tap into the open space *A*, thence it flows in the direction of the arrows and enters the pan through small holes in the bottom of the partition *B*, flows over the negative *C* to the partition *D*, when it flows out through small holes in the top of the partition in the channel *E*, and running out of the pan at *F* into the sink.

To determine certainly when this is effected a test may be made of a portion of the wash water as directed for the printing department.

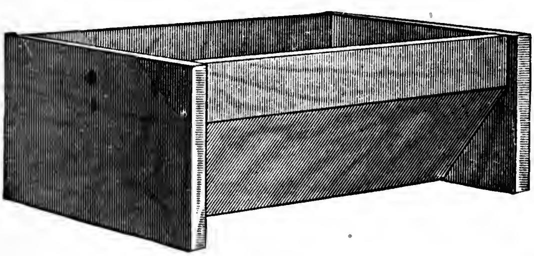
The water flows in one sheet, without eddies, from *B* to *D*. This can be easily tested by dropping into the channel *A* some soluble aniline color. Plates fresh from the hypo are put near the end *D*, and when the pan is full, negative C^1 will be washed enough and can be removed and the other plates shoved up to make room for the next plate to be developed. If desired, alum can be put in a little ridge across the pan between C^3 and C^3; it will be gradually dissolved and act on the negative toward *D*, but those on the other side will not be affected; or the alum can be put in the channel *A*.

I will give the actual dimensions of my pan, and from that others can judge what size will best suit their wants. I use plates 8 x 10, 6½ x 8½, and 4¼ x 6½. The pan I have is nine inches wide where the plates lay and thirty-six inches long. The sides are one and a half inches high; the partition walls *B* and *D* are one and a quarter inches high. Partition *B* has sixteen holes one-eighth inch diameter, and as close to the bottom as possible. Partition *D* has the same number and size of holes seven-eighths of an inch from the bottom. The channels *A* and *E* are one inch wide. The outlet *F* is one-half inch diameter. The pan is made of copper, with a very heavy wire around the edge. There are four ridges running the whole length of the bottom, $\frac{1}{32}$ inch high, to keep the plates up a little. The outlet *F* is brought close to the inlet *A* so that it can be placed in any direction on a common sink. The holes in partition *B* are placed close to the bottom to prevent eddies.—O. W. Hunt.

I made a fixing tray which I like so well that I think some of your readers may like to get one of the same kind.

The tray is 8½ x 10½ inches inside, and 3¼ inches deep, made of ½-inch boards. The bottom is only 2½ inches wide, but spreads out until 8½ inches apart about 2½ inches from the lowest part of the bottom, and then the sides go straight up (Fig. 325).

Fig. 325.



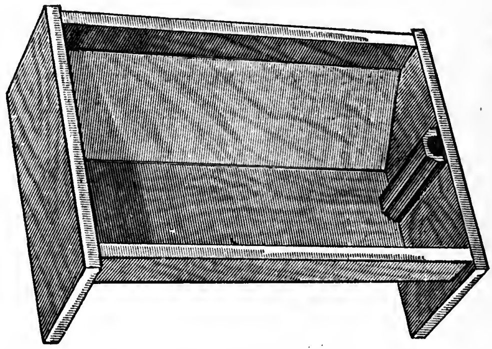
The negatives are fixed with the film side down, and they come out clean, even if the bath is very old and discolored, and besides many negatives can be fixed at the same time.

I use a tray of the same shape for washing negatives, and to this I have added a practical siphon (Fig. 326). This is made out of a piece of wood 1½ inch wide, ¾ inch thick, and ½ inch shorter than the tray is deep; from this is cut out a piece lengthways, so that it will leave a hole about ½ inch in diameter, when the piece is nailed to the inside of the end of the tray, and there is left an opening of about ½ an inch at the bottom to let the water in. At the top there is bored a hole through the tray to let the water out, but so high up that it will leave three inches of water in the tray.

If after-treatment is needed, when the plates are perfectly dried, they may be varnished, as directed for the wet.

The negatives are washed with the film side down, and may be left in the water many days without any injury. As the plates only rest on two ends, many plates may be washed at the same time without one touching the other, and I think the washing goes on quicker than when the negatives are left with the film up.

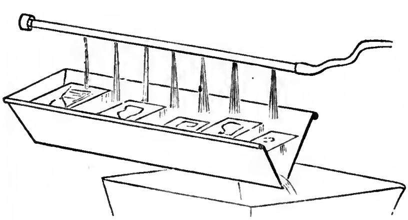
FIG. 326.



I make the end pieces square, so that the trays will have a good base to stand on. The same kind of siphon can very successfully be used on washing tray for paper prints. I paint the trays with asphaltum varnish.—J. J. ESKIL.

A negative-washer that you can make yourself. Take a piece of zinc and bend it in shape of an old-fashioned pig trough any length you want it, stop up one end and put the other in the sink; take a piece of lead-pipe a little shorter, and make holes about one inch apart, and hang over it, and connect the water with a rubber hose; you thus have the best washer that can be made. Lay the plates across the trough, and, of course, the smaller ones will go nearer the bottom, and the larger ones near the top, or you can wash two or three layers of plates at one time if necessary. Fig. 327.—C. H. SCOFIELD.

FIG 327.



When is the hypo out of gelatine negatives? I have for guide, viz., plates that develop and fix quick, hypo washes out of quickly. Plates slow in developing, and very slow in fixing, will be very slow in having the hypo washed out—in fact, with such plates one is *never sure* that the hypo is ever got rid of. Such plates give up the hypo better by soaking than being washed directly under the tap. Hypo in gelatine negatives is not so destructive as in collodion, but finally, will destroy them. I have negatives, gelatine, five years old, that have hypo in them, and yet are used to produce good prints from them. The test whether hypo is out of any gelatine negative, take a plate that has been given the supposed washing to rid it of hypo, put it on a levelling stand, cover it with water, let it remain there some twenty minutes, now pour this water into a weak solution of bichloride of mercury; if a precipitate is produced the plate has not been sufficiently washed; if the mercury solution remains clear, one can be reasonably sure that the *hypo is out.*—WM. BELL.

164. When the manufacture of bromo-gelatine emulsion plates was taken up in earnest, a great many stumbling blocks were found in the way. Some of the difficulties seemed insurmountable. Those who partially overcame them,

I believe that by placing the plates in a bath of weak javelle water, say a tablespoonful in a quart of water, it is possible to eliminate the last trace of hyposulphite. Care must be taken not to use too much of the javelle water, as in this case the negative might be injured; many operators only use a teaspoonful in a quart of water. If the plate has been well washed, twenty drops will suffice. There exists a solution of Labarraque for washing, containing dry chloride of lime, which acts in the same manner as the solution of javelle water; its effect is almost instantaneous. Here is the way of making this solution:

Preparation of the Solution of Javelle Water.—Dissolve four ounces of dry chloride of lime in a quart of water; close well the bottle and shake from time to time. In another vessel dissolve four ounces of dry common potash in a quart of water; allow these two solutions to rest from six to ten hours, then slowly pour the potash solution into that of the chloride of lime, agitating the vessel evenly. Allow the mixture to repose for a half-hour, then filter through paper; the product obtained is a pure javelle water, which, in a well-stoppered bottle, and kept in a cool place, will not deteriorate. In using, before taking the prints from the hyposulphite baths, pour in three quarts of water, as many times five and a half fluiddrachms of the solution as there are prints in the fixing bath. The prints taken from the hyposulphite baths are carefully drained and gently placed in the javelle water, in which they are allowed to remain three minutes, keeping them constantly in motion; after which the bath is again renewed for three minutes. The prints, well rinsed, are now ready to be mounted.—Leon Vidal.

164. *The Wilson-Paget Prize Emulsion.*—Proceed as follows: To make a pint of emulsion: Select a 20-ounce narrow mouth stoppered bottle, with a well-fitting stopper and thin bottom. Make it perfectly clean. Make a stock solution of hydrochloric acid (pure), 1 fluiddrachm; distilled water, 12½ ounces. Put into the 20-ounce bottle 20 minims of the above dilute acid; 3 fluidounces distilled water; 210 grains dry ammonium bromide; 80 grains Nelson's No. 1 photo. gelatine. Leave the gelatine to swell for (say) fifteen minutes or longer.

The addition of a trace of hydrochloric acid to the soluble bromide and gelatine is recommended in the formula given for the following reasons: If the soluble bromide be absolutely neutral, and the gelatine a suitable sample, the hydrochloric acid is *not necessary*, and better omitted. If, however, the gelatine be ever so little alkaline, or even apparently neutral, but yet does not give a clear solution, acid is required. Its use is not to produce silver chloride, but to insure a fine precipitate of silver bromide. A fine precipitate is easily obtained, however rapidly the solutions be mixed, if two conditions exist, viz., if the bromized gelatine solution contain a trace of hydrochloric acid, and the *silver* solution be not stronger than 110 grains per ounce. If it be 50 to 60 grains per ounce, it may be all poured in at once; or if a little weak solution be first poured in, the stronger may follow (as per formula). A good test for the suitability of a gelatine is to see if a fine precipitate can be obtained without having to add hydrochloric acid. Too much although they owed the most of what they knew to the industry of others, withheld their own "finds" rather ungenerously.

hydrochloric acid retards or prevents the conversion of the silver bromide into the sensitive form in cooking; a large excess destroys the gelatine.

The addition of hydrochloric acid must be made *intelligently*, according to the other materials accessible.

Ammonium bromide should be as nearly as possible *neutral.* It is usually more or less acid, even though otherwise pure, and frequently becomes strongly acid by keeping. It is then unfit for use, and will not give good results unless almost neutral.

On the whole, it is better to use bromide of potassium. The latter is often alkaline, but may, without much difficulty, be obtained neutral, and is free from any tendency to alter.

Silver nitrate is usually, if good, slightly acid with excess of nitric acid. It may be so used; but better results are obtained if the silver solution be neutralized with carbonate of soda. A slight excess does no harm, as the resulting trace of carbonate of silver is converted into bromide; indeed, an emulsion *may* be made by mixing washed carbonate of silver with a soluble bromide.

The uses of neutralizing the silver are twofold. One is, that as the amount of acidity of silver nitrate varies with different samples, it insures the same conditions in all cases; the other is, that the presence of nitric acid in an emulsion produces a tendency to green and pink discoloration in the finished negative.

In another clean glass vessel (beaker, measure, or flask) dissolve 330 grains of nitrate of silver (recrystallized) in three ounces distilled water.

Pour out about two drachms of this silver solution into another small vessel (say a test tube), and dilute it to half strength with an equal quantity of distilled water.

Take the 20-ounce bottle and the two lots of silver solution into the dark room. The writer prefers to use a large paraffine lamp protected by one thickness of ruby and one of dark orange glass, to two thicknesses of dark orange paper without any ruby.

In the dark-room have a gas boiling stove, and on it a tin pot or saucepan deep enough to contain the bottle when the lid is on. It should have a perforated tin false bottom, to prevent the bottle resting immediately on the true bottom; or a piece of wire gauze will answer. Let the pot contain some three or four inches in depth of *boiling* water.

Turn out the gas of the stove if alight, and plunge the bottle into the water two or three times, so as to avoid cracking it by too sudden heating; then leave it for a few minutes, until the gelatine is completely dissolved. Do *not* leave it in longer than necessary for complete solution. Take it out, shake up, remove the stopper, and set bottle down on table near your lamp, so that you can see what you are doing.

Pour in, *all at once*, the four drachms of *dilute* silver solution. Put in the stopper and shake up thoroughly, but not too violently, for about half a minute. Now pour in the strong silver solution in quantities of about half an ounce at a time, shaking as before after each addition, and, when all is added give a final thorough shaking for (say) a couple of minutes.

This induced Mr. Paget to offer a prize for the best workable emulsion method given free to the public. The prize was won by Mr. W. Wilson, of London, and his process is given below entire.

If the instructions have been so far accurately followed, there will be no coarse precipitate or grit in the finished emulsion.

Now put the bottle into the pot of hot water, see that the stopper is not jammed in, and put on the lid. Light the gas, and boil up as quickly as possible. If the water was previously boiling, and the gas only turned out for the mixing operation, it should boil up in less than five minutes; then keep boiling for *fifty-five minutes*. At the end of this time turn out the gas, take off the lid, take out the bottle, and remove the stopper *at once*, or you will not get it out afterward. The bottle must now be cooled down as quickly as is consistent with safety to the glass. In very cold weather it may stand on the table for ten minutes or so, and then be cooled with water; or, in any weather, place it in a pan of nearly boiling water, and cool gradually by allowing cold water to trickle slowly in, shaking the bottle occasionally. Whatever method is adopted, it should be down to 90° F., or lower, in fifteen or twenty minutes at most. It cannot easily be made *too* cold, as the gelatine has lost its power of setting.

In a glass beaker (about 12 or 14 ounce size) put one ounce of Nelson's No. 1 photo. or "X opaque" gelatine, and pour over it 10 ounces of clean ordinary water. Leave it to soak until the gelatine has absorbed 4 ounces of water, pour off the surplus 6 ounces, melt the swelled gelatine by immersing the beaker in hot water, and pour it into the 20-ounce bottle containing the cooled emulsion. Shake up well, and pour all back into the beaker, draining out the bottle thoroughly. Leave it to settle in a cool place for twenty-four hours. It must next be washed.

The addition of the gelatine after boiling should be made when the boiled emulsion and dissolved gelatine are *both* at as low a temperature as possible, and between the time of this addition and that of washing the emulsion it should be kept as cold as possible. The reason of this appears to be that the excess of alkaline bromide has a most destructive effect on the new gelatine, and therefore the lower the temperature and shorter the time during which the two are in contact the better.

There is a curious effect depending on the temperature at which the emulsion and fresh gelatine are mixed, viz., that if quite cold the resulting plate will have a matt surface, and the higher the temperature, the more glossy it will be.

A plain solution of gelatine in pure water is very little injured by prolonged boiling; but if an alkaline bromide (or chloride) be added, it is speedily deçomposed. Probably the alkaline nitrate, which is present in the emulsion in large quantity, may be even more effective.

For the washing, clean ordinary water at a temperature *not over* 50° should be used. Water cooled down to below 40°, by melting ice in it, gives uniform results.

In a glazed earthenware pan or other suitable vessel put about 3 pints of cold water, and add 3 ounces of saturated solution of bichromate of potash (made by saturating clean ordinary water with recrystallized bichromate).

Before squeezing the set emulsion through the canvas, it should be cooled down so as

165. Still there were drawbacks, one of the greatest being the impossibility of securing a satisfactory degree of sensitiveness without weak, insipid results.

to be as firm as possible. If so, the water into which it is squeezed remains almost clear, or but slightly milky. If the *emulsion be soft*, even though the *water* be ice cold, the water will be more milky, and the emulsion take up too much. Too much excess of said bromide, too high a temperature at the time of adding the gelatine, or keeping at too high a temperature between adding and washing, will produce the same result.

The emulsion may, of course, be washed by precipitating with alcohol, squeezing the clot, breaking it up, and soaking in water; but the writer prefers washing with water and bichromate, as described, on account of the clear and brilliant shadows so obtained.

Having cooled the beaker of set emulsion down to 40° F., run a bone spatula or paper knife round, and turn out the emulsion, or cut it out in lumps. If cold, it will come out almost or quite clean from the glass. Place it on a piece of coarse "straining cloth," or canvas, and squeeze through the meshes into the water, the operation being performed under the surface of the water. Leave it for an hour. Lay the straining cloth over the mouth of another pan or large jar, and pour the mixture of emulsion threads and liquids on to it, so as to let the latter run through. Squeeze the emulsion a second time through the cloth into clean cold water, and immediately repeat the operation a third time, leaving the emulsion in the last water for half an hour. When strained for the last time place cloth and all in a large beaker, and put the latter into hot water until the emulsion is completely melted and warmed to about 115° F.—*i. e.*, not warmer than is pleasant to the hand. With *clean* hands take out the cloth and squeeze it; very little will be lost. The emulsion should now measure about 16 or 17 ounces. Add two ounces of alcohol, and mix thoroughly. The alcohol may be either pure methylic alcohol, sp. gr. about 0.830, or *good colorless* methylated. The writer prefers the former. If the emulsion now measures less than 20 ounces, make it up to that by adding clean water.

A good deal depends on the temperature to which this is done, and by careful management much may be effected. If the emulsion is sufficiently rapid, and free from pink and green disease, it is best melted and coated at a low temperature. If it be slow and has a tendency to color, it will be improved by heating to 140° F. Some emulsions have became *more than three* times as rapid by this treatment; but it is a somewhat more dangerous one, as too high a temperature or prolonged heating may result in hopeless gray fog, which is more apparent during the development than after fixing.

The emulsion is now ready for use. It should be filtered into the coating cup through cotton wool to free from bubbles, and plates coated in the usual way, dried and used as usual for rapid gelatine plates, using about an ounce of emulsion for a dozen quarter plates.

In drying arrangements avoid the contact of gas or of the products of the combustion of gas with the moist plates. Both are very injurious.—W. WILSON.

165. *Obernetter's New Emulsion Method.*—To make 1 quart (1 litre) of emulsion put 2 drs. 34 grs. (10 grammes) of crystallized soda and 2 drs. 3.5 grs. (8 grammes) of citric acid with 3 oz. 1 dr. 43 minims (100 grammes) of distilled water into a two litre ($\frac{1}{2}$ gallon) flask; heat gently until the salts are dissolved and effervescence ceases (five minutes),

Mr. J. B. Obernetter, of Munich, claimed to have overcome this trial, and announced his readiness to sell his secrets to the public, provided a certain sum

and add 1 oz. 4 drs. 52.5 grs. (50 grammes) of gelatine with 1 pint (500 grammes) distilled water. Let the gelatine soak for half an hour and place the flask in hot water until the gelatine is dissolved (fifteen minutes). Meanwhile dissolve 3 oz. 1 dr. 48 grs. (100 grammes) of nitrate of silver in 6 oz. 3 drs. 23 minims (200 grammes) of distilled water, add it to the warm solution of gelatine, and also 1 oz. 4 drs. 5 minims (50 grammes) distilled water with which the vessel containing the silver solution has been washed. The mixture will become *milky*. After being shaken well, it is filtered still warm through moistened flannel into a flat dish of glass or porcelain, or into several china plates, on which the liquid should not stand higher than 0.8–1.2 inches (2–3 centimetres). Cover the vessels and keep them guarded against direct light in a cool place, between 43° to 68° F. In 2 to 6 hours, or, still better, in 12 hours, the solution will have become a gelatinous mass. Cut this with a horn-spatula into slices of two-fifths to four-fifths inches in diameter, any desirable length, and throw them into a beaker of 3 quarts (3 litres) capacity. Place it immediately into the washing apparatus in a dark-room, and pour upon it a solution of 5 drs. 8 grs. (30 grammes) of crystallized soda and 3 oz. 1 dr. 43 grs. (100 grammes) of bromide of ammonium dissolved in 1 pint (500 grammes) of distilled water. The mixture should be stirred well together with the glass tube of the washing apparatus, which stirring ought to be repeated every half hour during the first two hours. The longer the gelatinous mass is exposed to the action of this solution, the greater will be the sensitiveness of the emulsion. The silver salt will be converted during this time into bromide of silver, and it is easy to become aware of the progress of this conversion by cutting a small piece of the gelatine in daylight.

Six hours are sufficient, although I continue the contact over night, twelve to eighteen hours; greater sensitiveness is superfluous, if not injurious. In order to interrupt the operation, let the water run through the washing apparatus, for which twelve hours suffice; but I wash with frequent stirring for twenty-four hours, large quantities even forty-eight to sixty hours—rather wash too much than not enough. After the washing, let the water run, for the emulsion is done. For immediate use, melt the slices at 122° F., add for each 100 parts of emulsion 5 parts of alcohol and 2–5 parts of albumen, and filter through moistened flannel; otherwise the emulsion slices are preserved in alcohol of 80 per cent. Tralles.

The *sensitiveness* is increased with the increase of the proportion of *soda*, which ought not to exceed, however, double the weight of the *citric acid*.

The *hardness* is increased by the decrease of the soda in the bromine solution; it should not be less than one-fifth of the proportion proposed.

The emulsion will *work softer* either by greater sensitiveness or by attenuation of the bromide solution with water, in which case not more than double the quantity prescribed should be used.

So many questions have arisen concerning the method employed in the preparation of my emulsion, that I deem it advisable to sum up the complaints made, to determine the causes of failures and furnish the means of preventing them, in this paper.

was subscribed for him. An effort to obtain subscribers here, resulted in the method being presented to the public by the late John A. Scholten, Esq., of St. Louis.

Fogging of the Plate.—Here the camera or the plate-holder is solely to blame; there may be an imperceptible leak, or the dark-room may not be light-tight. The operation up to bromizing may be carried on in broad daylight; with the remainder a low-turned-down lamp must be used.

I must specially caution the operator when flowing the plate, on thorough setting. Then the plate is ready for exposure.

When the developer has completely covered the plate, the operation may be carried on very comfortably with the ordinary yellow light.

The emulsion works so clearly that ferrotype plates prepared therewith, after fixing and washing for two minutes in the mercury preparation recommended by me, gave direct positives not inferior in merit to collodion pictures of this kind. Their durability is, however, doubtful.

The Negative is Too Thin.—This fault has several causes:

(*a*) The plates have been too thinly coated; one cubic centimetre of emulsion to fifteen centimetres of glass is proper.

(*b*) Using stale albumen. The albumen is designed to thicken the emulsion, in order to hold the bromide of silver easier in suspension. It also has a beneficial action upon the beauty of the plate.

(*c*) In the earlier preparations, I made use of a variety of Simeon's gelatine, which was totally useless for the purpose, giving almost no image. But, to do justice to this gentleman, I must add that the samples of gelatine he has recently sent me are excellent for my purpose. I, however, prefer for general use Heinrich's gelatine, regarding it as the surest.

(*d*) There are varieties of oxalate of potassa which are cheap, but impure and acid; such a salt gives pictures having only one shade. If, however, the salt be used only in quantities absolutely necessary to dissolve the precipitate of ferro-oxalate (two volumes), one volume of iron solution, vigorous negatives will result.

It is asserted from one quarter that my emulsion washed with soft water gives flat negatives, but with hard water those of the proper strength. I dispute this assertion, but shall make it a subject of investigation. Should such be the case, all that is necessary is to harden the soft water by a piece of gypsum.

The Emulsion Lacks Sensitiveness.—The sensitiveness of my emulsion in comparison with Dr. Von Monckhoven's is as 18 to 14; in comparison with English emulsions, it is more sensitive. If with proper illumination the lights and shadows are not clearly indicated, the failure may be traced to No. 2. Or the cause may be that the place was too cold wherein the bromizing, washing, and development took place. To the question whether my method furnishes emulsions which have the same sensitiveness as English plates, I leave the method of preparation serve as an answer, which rests upon known effects, but which renders possible any degree of sensitiveness.

I make use of, for this purpose, an emulsion which has soaked for some days in alcohol

Both of the methods named were published in the *Philadelphia Photographer* at the time of their being made public.

—that is, one from which much of the water has been extracted. I wash it with common water to take away the alcohol upon the surface, put it in a suitable vessel, and melt the emulsion by means of a water-bath at about 70° R. When the emulsion has attained this temperature, I add to every one hundred grammes of emulsion four grammes of bromide of potassium and a quarter of a gramme of iodide of potassium, dissolved in a little water, and after frequent agitation suffer it to stand for fifteen or thirty minutes.

A trial plate may be flowed and examined through a light till the degree of sensitiveness desired is attained, but the experiment should go no further when the light transmitted is of gray color; twenty minutes are sufficient. The bulb containing the emulsion is then transferred to a vessel of cold water, and cooled down to a temperature bearable to the hand. To every one hundred grammes of emulsion two-thirds of a cubic centimetre of spirits of ammonia are added, the whole well shaken together, and then poured out upon a flat dish to set, which takes place in one or two hours; it is then cut in strips and washed in the apparatus for six or twelve hours.

The emulsion is sensitive to the highest degree. A mixture of this highly sensitive emulsion with a normal emulsion is recommended; it is preserved under alcohol as readily as the other.

My experiments upon the subject I will make known, and I desire further communications of the results of others in the matter.

Some Remarks Concerning the Preparation of Emulsion.—Two properties of the bromide of silver emulsion increase its value to photographers: First, the unsurpassable beauty of the negative combined with purity. Second, its high sensitiveness to the influence of light.

I have tried to combine both these properties in a method at once simple and effective, furnishing, above all, negatives entirely free from fog. The sensitiveness of this preparation is such that in good light, although the sun be not shining, an instantaneous exposure is sufficient to insure the best results. Nevertheless, I have the means of increasing this sensitiveness twofold, but the labor and difficulties attending are necessarily increased fourfold, the light employed in the preparation being reduced to a minimum.

The limit of proper time of exposure is difficult to determine; complete success in this respect is only attained by practice.

I have found it highly advantageous to combine emulsions prepared by different methods, those which are highly sensitive and easy-working, and those which are less sensitive and which do not work so easily.

The following formula gives an emulsion which is characterized by precision in mode of operating—that is, it can be employed equally well in reproducing an engraving by Dürer as well as an oil painting or portrait. It furnishes perfect negatives with ease of manipulation. I subjoin some remarks concerning the preparation, the apparatus employed, and the mode of operation.

Albumen.—By albumen, I mean pure albumen obtained by beating the whites of hen's eggs, fresh and free from all yolk, to a stiff froth and allowing it to subside.

The Obernetter method is also added here, as it first appeared. Scarcely any one is ever content to work a process in its entirety. All have useful practical hints from which the intelligent worker can draw to suit his inclination.

Filtering.—Strictly speaking, filtering is unnecessary, the passage through wet flannel being sufficient to prevent impurities and air bubbles.

Gelatine.—Nearly every kind of gelatine may be employed. In summer and in hot climates the harder variety is to be preferred, in winter the softer kinds. Emulsion with soft gelatines always gives finer negatives than do hard gelatines. A test of the applicability of the gelatine may be made as follows:

The silver gelatine made according to my formula ought to be so far set in four hours at a temperature of 12° R., in a quantity of one litre, that on movement of the vessel containing it the mass should not run, nor should it be colored brown even after twenty-four hours. There are three firms in Germany whose gelatine I recommend—Ch. Heinrich's, in Hochst-on-the-Main; F. F. Crenz, in Miehelstadt, in Hesse; and Simeon's gelatine.

For our climate, winter as well as summer, Heinrich's, of Hochst-on-the-Main, furnishes, under the name emulsion-gelatine, an article which gives excellent results. I work with this gelatine only. In summer, when it is excessively hot, I add a portion of Simeon's hard gelatine, which variety I also recommend for warm climates or hot weather.

Durability of the Emulsion.—If the emulsion, after washing, is immersed in alcohol so that it is completely covered, from day to day more and more water is extracted from it, so that finally it presents a leathery consistency, in which condition it remains for unlimited time. I have emulsions which are three years old, which work as effectively as on the first day. It is otherwise with emulsions in a thin state mixed with albumen. In winter it may be kept for a month or so, and may even be warmed so as to flow upon the plates; but in summer it is often spoiled in a few days, sometimes it may be kept for three weeks. All additions of antiseptics are unnecessary.

Nitrate of Silver.—This salt, so much used in photography, should contain no free nitric acid in the preparation of the emulsion. It should be dissolved in distilled water, and the solution should not redden litmus paper. The fused salt (lunar caustic) may be used.

Temperature plays an important part in the preparation of the emulsion, and in the development of plates. For the setting of the mass a temperature of from 8°–12° R. is the most suitable; on the contrary, for the maceration of the same, the temperature ought not to be under 12° R. Nor should all preparations for development, fixing, etc., be under 15° R.

Water.—All kinds of water suitable for drinking may be employed for emulsifying, as well for the preparation as for the washing. Only for the solution of the silver nitrate is distilled water demanded.

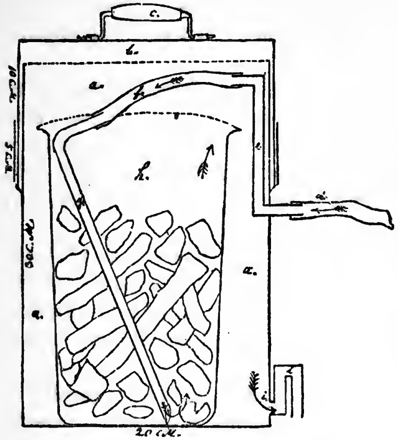
Washing.—For the purpose of washing, I make use of an apparatus of strong, sheet zinc, of suitable dimensions for two kilogrammes of emulsion. (Fig. 328.) *a.* Interior

A multiplicity of methods is given here in order that the manipulator may have a fair understanding of all the means at his disposal.

If he is wise he will choose from the assortment whatever gives him the

space of wash apparatus; *b*, the cover; *c*, handle of cover; *d*, gum tube for ingress of water; *e*, stationary brass tube; *f*, gum tube; *g*, bent tube of glass; *h*, beaker glass containing the emulsion; *i*, tube for exit of water.

FIG. 328.



Method of Using the Gelatine Emulsion.—If it be desired to employ the emulsion immediately after preparation it should have the proper degree of consistency for pouring upon the plates. In the cooler months, from October to May, the emulsion maintains for a long time the thinness necessary for this purpose. In the warm months, from May to September, its durability is doubtful, decomposition frequently taking place in a week. If it is desired to keep in stock the emulsion, during the summer season, or for the purpose of transportation, the emulsion should immediately after washing be transferred to strong alcohol, in which state it may be kept for a year in a leathery state by extraction of the water.

To make use of this emulsion again, it is cut in small pieces, put in a glass bulb or beaker glass, sufficient water poured on it, and left stand for two to five hours; the water is then poured off and the vessel transferred to another containing hot water, 40° to 50° R., till the emulsion is completely melted. If it is still too thick, it is thinned to the right consistency with distilled water. To every 100 grammes of this emulsion 2 to 5 grammes of pure albumen are added (beaten up to a froth and suffered to settle); the mixture is well shaken and filtered through damp flannel. The emulsion is then ready for pouring.

The emulsion should be put either in a beaker glass or a vessel with a wide neck, and placed in a vessel of warm water, 30° to 40° R., before pouring it upon the plate; all bubbles upon the surface should be broken. All this, of course, is to be done in the dark-room.

The plate is to be brushed over either with a blender, or soft brush, dipped in a solution of soluble glass (1 gramme of soluble glass to 200 or 300 grammes of water), then dried with filtering paper, polished, and dusted.

The flowing of the plate is done in the same manner as a collodion plate, the emulsion spreading as readily; if the room is cold it may, however, be necessary to slightly warm the plate before flowing. The emulsion is flowed to one corner, and the excess poured in the bottle. When the emulsion becomes too thick it is returned to the vessel of hot water. The emulsion may be poured to the last drop without affecting the purity of the plate.

It is to be observed that the emulsion should not be poured too thin upon the plate, best results, and then adhere to the same, only modifying as emergencies may arise. And I confess that emergencies never cease—they are always arising.

otherwise the resulting negative will be weak. The thickness of the film should be about that of a strongly iodized collodion plate.

The plate when coated should be laid upon a perfectly level plate of glass (cold), stone, or metal, not above 12° R. After two to five minutes the emulsion will have set, and the plate may be put in a perpendicular position, protected perfectly from dust and light; but the plates should not be too closely packed in the drying case, they are best if left to dry spontaneously. The next day after preparation the plates are ready for use. They keep a long time after exposure.

The development may be effected with any of the known developers. I prefer Dr. Eder's oxalate of iron.

The following preparation should be kept on hand:

A saturated solution of neutral oxalate of potassa in water. One part of neutral oxalate dissolved in three parts of water.

Solution of protosulphate of iron. One part of sulphate dissolved in three parts of water, and to every litre of this solution five drops of sulphuric acid.

Bromide of potassium solution. One part of bromide in ten parts of water.

To develop a plate, three volumes of the oxalate solution are put in one vessel and in another glass one volume of the iron solution. About a third of the iron solution is then poured into the oxalate solution, and the mixture flowed over the plate which is put in a shallow dish or tray. If the image comes up too quickly, it is a sign that the exposure has been too long; but it may be saved by adding more water to weaken the solution, and by the addition of a few drops of bromide of potassium. If the image is too harsh, the iron solution is added till it is all used up.

The negative may be judged by the transparency in from three to four minutes after the operation is finished. The plate is then taken out of the solution, washed under the hydrant, and transferred to the fixing-bath of hyposulphite of soda. After the fixing the plate is washed in water. The time of washing is not longer than that demanded by a wet plate—about five minutes. If it is desired to dry the plate quickly, it is dipped in alcohol; in ten minutes after this treat to spirits it is dry. Heat cannot be used.

If the negative has not sufficient intensity, which may be caused by too long exposure or by too thin coating of the plate, I recommend the following intensifier. After the fixing and complete washing from the soda, the plate is flowed over with the following:

Bromide of potassium, 20 grammes; bichloride of mercury, 20 grammes; water, 500 grammes; alcohol, 50 grammes.

Dissolved hot, and after cooling filtered. The time (one to five minutes) is regulated by the degree of intensity desired. It is then washed with water and flowed over with a solution as follows: 20 grammes of cyanide of potassium in 500 grammes of water, and 25 grammes of nitrate of silver in 500 grammes of water. These solutions are shaken together until a permanent precipitate is formed; the mixture is then filtered, and poured over the plate until no white spot is visible on the back side of the plate (one minute).

But they do not always require a modification of the chemicals. The whole secret is oftener in the thoughtful manipulation than in the means.

If the intensifying has been carried too far, all that is necessary is to transfer the plate to the hypo bath, where it is weakened. It is not necessary to add that it must be re-washed after removal from the fixing bath.

These operations are performed upon my plates quicker and more effectively than with other plates, owing to the thinness of the film, its adherence to the glass, and the ease with which the chemicals penetrate.

Aids to the Perfect Working of the Obernetter Emulsion Process.—It is not a strange occurrence in the history of a new process like the present to meet with such contradictory results in its practical working. On the one hand, brilliant success and perfect satisfaction; on the other, total failure and dissatisfaction. My endeavor was, naturally, first of all to prevent these failures, and only recently have I succeeded in discovering the principal causes producing them.

Their prevention was no easy task; but now, since I have struck at the root of the evil, it is possible to furnish a remedy, simple and efficacious. The principal cause of failure lies in the quality of the wash-water. Water containing a high percentage of carbonic acid or carbonates—that is, hard water—gave satisfactory results; but where soft water was employed the failures were soon manifest.

According to my opinion, soft water does not sufficiently penetrate the emulsion strips, especially if the strips are of any thickness, where the inner portions are poor in silver but rich in the other salts. Those salts not sufficiently washed out remain in the emulsion, and are the cause of the lack of sensitiveness and flatness.

The case is different when hard water is used. The chalk combines with the acids of the mass forming an insoluble compound, liberating free carbonic acid, which renders the mass porous, and facilitates the expulsion of the soluble salts.

The means are simple and the end easily attained, if the mass be cut up into the thinnest possible shreds. The silvered gelatine mass should not be thicker than a half centimetre, the strips about three or five millimetres in thickness. This labor is not great, since the gelatine when properly set easily divides, and besides the whole operation may be done in broad daylight. This seeming trifle is of such importance that I am convinced that most of the failures may be attributed to the neglect of the quality of the water employed.

I have found that the following particulars have not been sufficiently regarded, I therefore recommend them again to a serious consideration:

The silver solution must be poured into the hot gelatine solution not below 30° R., nor over 50° R.: only at this temperature is the fluid milky. When it is milky it is readily cooled and easily filtered.

The bromide fluid operates directly after the mixture as a refrigerating mixture, and indicates a temperature of 0°. When so employed it gives monotonous, unsensitive plates. The temperature ought not to be under 12° R.; it is better at 15° or 18° R.

The flannel for filtering the emulsion can only be used once—a piece ten centimetres square. If the flannel is used the second time, black specks will appear.

166. With all that has been provided, still the great desire of the manufacturers has been to produce, and the operators to have, a grade of plate in the highest degree sensitive, with which results equal to slower ones could be had. Up to the present this wish has not been satisfied.

An advantage gained in this direction has been ever opposed by some per-

The emulsion must be kept under alcohol before it is melted. It must be freed from the alcohol, which is best effected by washing in the apparatus for three hours. After the melting it must be thinned with water till it flows easily on pouring.

The drying of the plate must be completed in, at least, twenty-four hours, and must be done in an airy and perfectly dark room.—J. B. OBERNETTER.

166. *Development of Instantaneous Negatives with Carbonate of Soda.*—To develop an instantaneous negative 13 x 18 centimetres ($5\frac{1}{4}$ x $7\frac{1}{4}$ in.), I place in a glass 60 grammes (2 oz.) of water, and add immediately, and without taking the trouble to measure, from 5 to 10 c.c. ($1\frac{1}{2}$ to 3 drachms) of a 20 per cent. solution of sulphate of soda; I also add to this about 20 c. c. (6 drachms) of a solution in water of crystals of ordinary carbonate of soda (but free from sulphate of soda), this solution should be at least 20 per cent., even 30 per cent. would not be injurious. The alkaline mixture thus made in the glass I throw over the plate, allowing it to remain two minutes in order that the gelatine film should become completely saturated. After two or three minutes I place at the bottom of my glass, which is now empty, 10 centigrammes (3 drachms) at least of a solution of pyrogallic acid in alcohol: Alcohol at 40°, 23 grains; pyrogallic acid, 3 drachms.

To mix immediately I pour into my glass, over the acid that is there, the alkaline solution which is in the dish, and I cast anew the whole over the negative. In a very short time, even with the shortest exposures, the high lights appear, and after which the details; by agitating continually the dish, the negative covers itself by degrees in all its parts. Be careful especially not to look at it too soon by withdrawing it from the bath which is in its *first action*. In this state the reducing action goes on with much more energy than if you were to stop this action by withdrawing your negative from the bath to look at it by transparency, to again take it up by replunging the negative into a dish. A time will come when you will see that the action is stationary, then look by transparency; if the whites are wanting in detail, add to the bottom of the glass some carbonate without bromide, mix by pouring on this carbonate the liquid which is in the dish, and throw the whole over the negative. The details are made to appear by the successive additions of the carbonate. When all the details have appeared, it is *always* necessary to intensify your negative, which, in coming from the hyposulphite, would be too weak. For this you put in your glass from 5 to 10 c. c. ($1\frac{1}{2}$ to 3 drachms) of pyrogallic acid, mix with the liquid of the dish and throw over the negative. In an interval of about two minutes you again put in the glass from 5 to 10 c. c. ($1\frac{1}{2}$ to 3 drachms) of the carbonate solution; you again mix with the remainder of the bath and throw over the negative. By these two successive additions the negative is progressively intensified; with a little patience, if the intensity does not appear to be sufficient, you can increase it by alternating the solutions of pyrogallic acid and carbonate of soda. I generally finish verse drawback. Some manufacturers have become so exasperated as to assert that quick plates are "sour grapes" after all, and for some purposes "long exposures" are deemed best. Mons. Balagny, a persistent Parisian photographer, has taken issue with this opinion, and after much patient experiment, offers a means of development which, he claims, will produce from the most sensitive plates, the best results with the greatest ease. I add his method as sent

with the carbonate. Now wash in two waters, pass into the alum bath, and fix. Do not fear to make use of the sulphite, as it is this substance that gives the beautiful tones of the negative; if you have the least coloration, it is because there was not enough sulphite. You must use enough, but not too much, as it is said that it retards the development.

In the above formulæ the persons who are accustomed to using carbonate of potash can use carbonate of soda instead. With preparations of gelatino-bromide of great rapidity, it is possible, with the above development, to give to an instantaneous negative the same brilliancy and the same intensity as one that is not instantaneous.

In experimenting, I was led to plunge the flexible plates in developing baths of great energy. It is especially well in photography to know how *to dare*. I sought for an accident, and I found an excellent developer. As it is the carbonates that most frequently produce blisters, I plunged the flexible plates in pure carbonate at twenty-five per cent., or at saturation, before the development. The plates used had been exposed one or two seconds, at the furthest. As soon as I afterward added pyrogallic acid, even in very small quantity, the image appeared with such rapidity and such intensity that I understood that I had before me a process which would give me instantaneousness without the least trouble.

I make a solution of carbonate of soda at 25 per cent.; I also make a solution of sulphite of soda at 25 per cent., say 250 grammes (8 ounces Troy) of one or the other of these two salts, for a quart of water. I allow it to settle, and decant for use. To develop, place in a glass from 25 to 30 c. c. (7 fluidrachms to 1 fluidounce) of carbonate of soda, and from 15 to 20 c. c. (4 fluidrachms to 5½ fluidrachms) of sulphite of soda, the two solutions being mixed together. The flexible plate is placed in a moulded glass dish, so as to be able to follow the development by transparency. (I use moulded glass because the developer is so strong that it entirely dissolves the marine glue with which are made the wood-and-glass receptables for the bath.) The liquid is thrown on the pellicle, which is well wet, and allowed to remain in this state for about two minutes.

During this time of waiting, place in the glass, which is now empty, from 10 to 15 c. c. (4 fluidrachms) of pyrogallic acid dissolved in alcohol in the proportion of 10 grammes (3 drachms) to 150 c. c. (5 fluidounces) of alcohol. A large pinch of pyrogallic acid in powder may also be put at the bottom of the glass. Whether the acid is used in powder or in an alcoholic solution, the mode of operating is the same, and the result will be identical. All the alkaline liquid which is in the dish is poured on the acid and the most intimate mixture is obtained. The whole is again poured on the flexible plate which has remained adhering to the bottom of the dish. After agitation, and in a very from France, separated from the notes on developers, that it may be more fairly understood. The two papers were presented about three months apart.

167. The annoyances which beset the dry-plate maker and worker are numerous. Gelatine is a far less manageable substance than collodion—as sen-

short time, the image appears, but at first with a rather grayish tint; then it is the blacks alone that come up without intermission, until it is deemed that the action is insufficient. During all the time of development the whites are very well preserved; I may say that I did not miss one, and always without bromide. But a little bromide may be added with advantage when the slow stop has been used. In this case add, at the start, to the mixture of carbonate and sulphite, from 5 to 10 drops of a solution of bromide of ammonium in water in the proportion of 10 per cent.

When the development is ended wash well, especially if pyrogallic acid dissolved in alcohol has been used. When the greasy streaks have entirely disappeared, give an alum bath—60 grammes (2 fluidounces) for 1000 grammes (34 fluidounces) of water—and after remaining two minutes in this bath, fix with hyposulphite. The rest of the operation for drying the flexible plates has been already described.—M. BALAGNY.

167. I have often found it necessary to intensify parts of negatives. This has been done with an intensifier known as Edwards'. It is made by mixing a saturated solution of bichloride of mercury with a saturated solution of iodide of potassium, till there is a slight red precipitate, which is dissolved by adding a small crystal of hyposulphite of soda. It can be applied with a brush to any part which it is wanted to intensify. This will be found a very valuable dodge.

Another dodge is just reversing the above, and is used for local reduction or for reducing the intensity of the whole negative where it is too intense. The negative is flowed with a strong solution of red prussiate of potash, washed, and put into the hypo bath, and this can be repeated till the negative is thin enough, or parts can be reduced by applying the prussiate of potash solution with a brush to those parts only, followed by the hypo.

Dodge third: I have been troubled during the hot weather with the rapid discoloration of the developing solutions and consequent coloring of the negatives, which has not been taken out by the alum bath, but in all cases the most obstinate stain has given way to an application of Mr. Carbutt's clearing solution (1½ ounce of powdered alum, 20 ounces of water, and ½ ounce of sulphuric acid).—GEO. HANMER CROUGHTON.

I give my two methods:

Iron Intensifier.—The following stock solution, which keeps very well, is prepared: *G.* 5 parts of good white gelatine, dissolved in 50 parts of glacial acetic acid, diluted with 100 parts of water, and filtered.

For use, dissolve—*E.* 4 parts of sulphate of iron in 120 parts of water; filter, and add 10 parts of solution *G.* This solution keeps for some time.

S. 3 parts of nitrate of silver in 100 parts of water, to which are added 4 parts of glacial acetic acid. Also keeps well.

After the plate has been washed thoroughly, it is placed for some minutes in a saturated solution of alum; in order to prevent the risk of frilling the film, in the following acid bath: After the alum, the plate is rinsed, and placed for about five minutes in a sitive as a neuralgic person to every atmospheric change—most exacting in the treatment it requires at the hands of the manipulator.

three per cent. glacial acetic acid bath. In the meantime, pour (for a 5 x 8 plate) about 5 c. cm. of silver solution (*S*) into a glass, and place that and the bottle with the solution *E* within easy reach. The plate is then removed from the acid bath, rinsed, and the solution *E* at once poured over it, taking care that the plate is well covered; if necessary, aid with the finger. Care must be taken to have an abundance of solution on the plate. The solution is now poured off the plate into the glass containing the solution *S*, and then at once pour back again over the plate. The intensification goes on evenly. If red patches form, it becomes necessary to rinse forthwith, and then to pour on a two per cent. solution of cyanide of potassium. But, if care is taken, nothing of the sort will appear.

Sublimate Intensifier.—I strengthen first somewhat with the iron-silver intensifier, although I can use it also without the latter. Here is the formula: 4 per cent. solution of sublimate and a 2 per cent. solution of cyanide of potassium. Both keep a good while.

The manipulation is quite simple—after the sublimate has acted thoroughly, and the plate has been rinsed well, the cyanide solution is poured over it. A warm brown tone appears at once, and the shades remain quite clear; when ammonia is used, this is seldom the case. Also, no danger of turning yellow is to be feared. Of course, thorough washing is strictly necessary.—M. Wight.

It is useless to attempt the intensification of a fogged negative. An overexposed and fogged plate may be considered past doing anything with, and, on the other hand, little or nothing can be done with an underexposed or underdeveloped plate, where no detail has been brought out. But it sometimes happens that a plate comes out of the fixing bath clear in the shadows and full of the proper details throughout the rest, but wanting in sufficient intensity to make a good print. These are the cases in which intensification comes so well into play.

The process is extremely simple, but at the same time one requiring a certain amount of care and cleanliness, for the principal agent used is the bichloride of mercury, a potent chemical, tending to inequality in its action, unstable, and highly poisonous. Of the different formulæ given, I have found that of mercury, in conjunction with cyanide of silver (which will be found in the directions accompanying Carbutt's plates), the most reliable and satisfactory—not only for dry but also for wet plates, and although a negative may be very satisfactorily intensified after it has been dried, I think the most perfect and certain results are to be obtained immediately after the final washing (the plate having, of course, been submitted to the alum bath) and before drying, and in the case of negatives that have already been dried, they should be thoroughly moistened again in clean water before treating, and in both cases the superfluous water should be drained and carefully blotted from the surface. When this has been done, pour a sufficient quantity of the mercury solution into one of your glass or porcelain developing pans to cover the bottom to the depth of a quarter of an inch or so, set the negative perpendicularly into this and lower it on the solution, face down, with an even motion and without

The morbid desire for "lightning" plates often results in weak negatives, so that the demand for a safe and effective means of intensification has had a great deal of careful consideration. The best way is to use such plates as will give the proper density without after treatment, but since this cannot always be, we must turn to the intensifier.

pausing; in this way the solution will flow equally across, air bubbles will be forced out, and streaks and lines will be avoided. A scrap of glass or rod should be used to keep the face of the plate from touching the bottom of the dish, and it will, by serving to raise the plate out of the solution, save the fingers, the mercury being very destructive to the skin. When the image has become equally and thoroughly whitened, the plate should be removed and well washed and drained. The next solution, the cyanide, is best applied by having an abundance in a pan, so as to be sure of thoroughly covering the plate, and dropping the latter in, face up, as in developing, and keeping the pan in motion so that the solution will flow back and forth from end to end. In a few moments the whitened image of the negative will be turned to a clear deep brown, and when the change has taken place equally and completely, the plate may be removed and well washed and dried. The whole process may, of course, be conducted in open daylight. Always return the solutions immediately to their respective bottles, and wash thoroughly the pans; cleanliness is essential to the success of the process, and also important on account of the poisonous nature of the solutions used.

Negatives that have been successfully intensified and which it is desired to preserve for any considerable length of time, should be varnished. Intensified wet plates are particularly liable to change, returning unequally to the bleached condition, and my experience has been that varnishing effectually prevents any change; and although I have not as yet noticed instability with the dry plates, yet from the nature of the chemicals used, good negatives (intensified), which I wish to preserve, I varnish as a matter of thorough precaution.—XANTHUS SMITH.

Gelatine plates have many virtues, but associated with these virtues are a few failings, one of which is that they will sometimes, in spite of all the care spent upon them in developing, yield thin and ghostly images. This tendency is greater in proportion to the rapidity of the sensitive surface, as it is difficult to intensify the weak productions without clogging the shadows and destroying the half tones.

I have had very little success with the use of mercury as an intensifier, and the use of the pyrogallate of silver and the ferricyanide of potassium and uranium are out of the question. I prefer the use of the old method of intensifying with dilute hydrosulphate of ammonia or solution of sulphide of potassium. These are not the most delectable compounds in the world, nevertheless the photographer should not abandon them on that account.

By the use of either of these chemicals there will be no danger of destroying the nice gradations of tone on the negative, a danger frequently encountered with the use of the well-known intensifiers.

The solution must not be too strong, and it does not make any difference whether the plate has been developed by pyro or oxalate. Neither is there any necessity of so thor-

168. Again, from lack of knowledge as to the exposure, or from careless haste, the negative is too strongly developed, and as a result, is harsh and hard and too dense.

ough a washing of the plate as is demanded when we make use of mercury for intensifying.—L. REGNAULT.

168. *To Reduce a Negative.*—Dr. Eder has recently published some valuable notices concerning the reduction of too strongly developed plates with chloride of iron and oxalate of potassa. Dr. Eder employs the mixture as follows: *A.* 1 part chloride of iron, dissolved in 8 parts water. *B.* 2 parts neutral oxalate of potassa in 8 parts water.

Both solutions keep a long time without deteriorating. Immediately before using equal parts of *A* and *B* are mixed, forming a bright green solution, which keeps well for several days iu the dark, but decomposes in one day in the light. Of this mixture a little is added to a fresh and strong solution of hypo. In difficult cases 1 part hypo and ¼ to ½ of iron solution are employed. The plate to be reduced is placed in this solution. The image weakens quickly and uniformly. The plate is taken out and washed just before the desired reduction is reached, because the action continues during the washing, gradually diminishing under the stream from the tap. This reducer acts on plates developed either with pyro or oxalate, and does not destroy the details in the shadows, like cyanide. There is also less tendency to frill than with the cyanide bath. The reducing process of Mr. Lenhad for weakening certain portions of the negative is most excellent. A pad of linen is dipped in alcohol, and rubbed over the dry film until the dark parts brighten up. This is effected without any loss of detail, and without the slightest injury to the film. The finer parts may be rubbed with a flexible piece of wood dipped in alcohol. I saw, at the establishment of the Court photographer, Herr Burger, difficult retouching effected in this manner.—DR. H. W. VOGEL.

Managing an Overdeveloped Plate.—After pouring the developer on my plate, I had the satisfaction of seeing what would have been a very nice negative come up. But just at this time I was urgently called away and compelled to remain a couple of hours. On returning to my dark-room, I found the plate in my dish so intense I could not see through it. After fixing about three hours I set it aside as "no good," and left it about a week. One cloudy day, rummaging for a negative which had been misplaced, I ran across this plate—I cannot say negative. Thinking I would experiment a little, I put it in the washing tray and let soak a short while, after which I put it in the citric acid bath, which seemed to have not the least effect on it. Remembering the way in which I had reduced a number of negatives, I thought it would probably work on this, but was not prepared for the result which followed.

I prepared my chemicals as follows: Make a saturated solution of iodine in alcohol (98 per cent.), and a saturated solution of cyanide of potassium in water. I proceeded to flow my negative with pure alcohol, after all the greasy lines had disappeared from the film. I then applied the saturated solution of iodine to the plate, and distributed it evenly but quickly over the surface with a tuft of cotton.

I then immediately flowed the cyanide (weakened about one-half with water) off and on, until it dissolved the precipitate formed by the iodine, which is of a whitish-green

In such cases the careful application of a reducing agent must be made. A difficulty always occurs to decide the degree of reduction allowable. Some-

tint (I believe it is iodide of silver). And, presto! changed from absolute darkness; there appeared an image in full detail, everything is as clear as can be, such as a sand-box to the right of the principal figure, with the grain of the wood, and every row of brick, from the immediate foreground to the walls of a house in the distance.

After again applying the iodine and cyanide, I washed it thoroughly (the film must be washed under the tap, and rubbed until the greasy effect of the alcohol is done away with) and had a nice, brilliant printing negative; of course, a trifle slower than if rightly timed and developed.—DENSITY.

Among the many methods recommended, I have found the following to be the most effectual in abating excessive energy, especially when the density is the result of over-exposure:

It consists of a mixture of ferricyanide of potassium (red prussiate of potash) and hyposulphite of soda; both solutions are of equal strength, and are used in equal quantities. About one ounce of ferricyanide to sixteen ounces of water, and the same strength of solution of hyposulphite of soda. The reduction is gradual and entirely under control.

Now another advantage of this mixture is that it can be used as a local reducer. All that is necessary is to paint over with a brush the dense portions, and then immerse the negative, after a little while, in the hypo wash, and dry. If the reduction is not sufficient, repeat the process until you are satisfied. The beauty of this method is that it may be applied to the reduction of over-printed paper pictures. Use it in the same way. The tone of the paper photograph is not hurt in the least, and the whole picture much improved.—PRACTIQUE.

First diagnose the case and find out the cause of density before applying the nostrum. Sometimes I have found that the density is due to over-exposure. When this is the case, I make use of a recipe which I found in one of the German photographic journals.

I place the negative in a bath of chloride of copper, to bleach. After washing, redevelop with a concentrated solution of ferrous oxalate. Do not fail to make the ferrous oxalate strong; if you do not, you will defeat your object, and only make your negative stronger and more dense. Sometimes the negative is too intense in the high lights, but still has graduated half tones. Now I put such a negative in the chloride of copper until the image seen from the back appears white. Develop again slowly with the oxalate, and carefully watch, through transmitted light, the back of the plate. It will be found that detail in the shadows is first reduced and appears black on the back of the plate, then the half tones, and finally the high lights alone still appear white. The plate is now carefully washed and put in the hypo solution until the white portions are dissolved. In this manner the high lights alone are reduced, and the whole negative made more harmonious.

Another excellent method for reduction of intensity I have found to be a mixture of ferricyanide of potassium (red prussiate of potash) and hyposulphite of soda. I think it was first recommended by Farmer, of England.

Both solutions are of equal strength. About one ounce of ferricyanide to sixteen times no amount of coaxing and cajoling will "save" a plate, and it must be discarded.

ounces of water, and the same strength of solution for hypo. The reduction is effected gradually and entirely under control. It has also the advantage of being employed as a local reducer; for this purpose all that is necessary is to pour over the portion requiring reduction with the ferricyanide and then subject it to the hypo bath. I have also read in the *Philadelphia Photographer*, of the same solution being used for reducing over-printed paper photographs with great success, without affecting the tone of the print in the least. I found it to be true.

Although I recommend this latter recipe, I still hold up for the virtues of the chloride of copper mentioned above.

If chloride of copper cannot be procured at the chemist's shop, it may be easily made by simply mixing common salt with a solution of blue vitriol or sulphate of copper. It may also be used locally as the ferricyanide, and will be found to work admirably. The chloride of copper yields a portion of its chlorine to the metallic silver of the negative, forming a thin layer of chloride of silver, which is easily dissolved in the fixing bath.—H. K. Seybold.

My friend Rothe, of Cassel, was the first to call attention to the circumstance that the green crystals sometimes formed in the ferrous oxalate developer, if dissolved in hyposulphite, form an excellent reducing agent for too densely developed (not intensified), negatives. I tried his formula and confirm his statements; nevertheless I persisted in the old method of chloride of copper, because I was used to it, and, moreover, I may add, I had spoiled some negatives with the iron salt. But later, on obtaining more of the green crystals in the process of restoration of the oxalate developer, I did not throw them away, but tried the experiment again, and this time with considerably more vim, and now I am so satisfied and confident, from a practical as well as a theoretical point of view, that I am resolved to make the facts known for the good of the profession. I therefore recommend it to my professional brethren as the most excellent, absolutely safe method with which I am acquainted.

Let us proceed to the practical method for obtaining the green sesquioxalate of potassa (kalium ferridoxalate) from the old developer.

To every litre of old developer, sixteen grammes of dried crystallized oxalic acid are added; and the flask with the reddish-brown precipitate, which is allowed to remain with the necessary precautions, put in hot water. After repeated shaking, and when the oxalic acid is all dissolved, it will be perceived that the greater part of the red deposit has been dissolved on longer heating in the flask, or on pouring out into a porcelain dish the residue is finally dissolved. The last remnant will disappear on adding a few grammes of oxalate of potassa and heating. It is now filtered, while still hot, into a clean dish and exposed in a cool but not too light place; the air supplies the little oxygen which is still needed.

After twelve or twenty-four hours, the greater part of the kalium ferridoxalate is converted into the beautiful emerald-green crystals spoken of. The mother liquid is poured off, and the crystals dried on several thicknesses of blotting-paper in a room not too bright.

Let it be remembered, once for all, if anything is expected from a defective emulsion plate, it must be earned by patience, care, and skill.

From one litre there will result about eighty or ninety grammes of this salt. The salt is preserved in a glass flask in the dark, for it is somewhat sensitive to light; it keeps well if thoroughly dry. If allowed to remain in the light, it throws down a yellow precipitate of ferridoxalate. It is but sparingly soluble in water, but dissolves in a solution of hyposulphite of soda, forming a beautiful green color. It is this solution of hyposulphite which is to be used as the reducing agent of dense negatives. Ten grammes of the salt in one hundred cubic centimetres of fresh hyposulphite solution, give an actively working solution, but I would recommend the use of only one-half this strength (five to one hundred). The solution can be applied during daylight, by pouring it in a dish; the negative as it comes out of the hypo need not be washed, but simply laid in it, and from time to time lifted out, and the transparency tried till the desired result is obtained, for the action is continued somewhat in the water, especially if the solution has been strong.

This solution will keep for a considerable time, all that is necessary is to filter it from the deposit formed; when it becomes weak, strengthen it a little with the green salt. Parts of the negatives may be brushed over with a pencil dipped in the solution, when other portions do not need reduction; but observe to wash the negative thoroughly.—H. K. SEYBOLD.

I may here remark that while it is among salts that photographers look for their sensitive medium, it is among reducing agents that they look for their aids to rapidity, developers, and accelerators, and to the class of acids for their restrainers.

The first step in the production of a modern negative is the formation of a nicely balanced insoluble salt, and the suspension thereof in a vehicle capable of supporting it, mechanically only. The next is irregularly to alter the tendency of the sensitive salt to undergo decomposition or reduction. This may be done in a variety of ways. The film containing the particles of salt may be compressed unequally by physical force; minute metallic substances gently and simply be laid upon the surface; or it may be unequally heated; or it may be exposed over the mouth of a bottle containing ammonia; in all of which cases a visible trace of the direction of the action of the force applied in the dark may be developed. Another method of obtaining the same result is to expose the sensitive salt to light, when again a visible image of the direction and strength of the force employed may be developed. Development being merely the carefully regulated production of metal from salt, we see that the reduction of density is the production of salt from metal, and removal in place of deposition. . . . . .

Mr. John Spiller, F.C.S., who seems to have experimented with most of the density reducers familiar to myself, gives (page 68, *Year Book of Photography*, 1884) a formula which I have found to answer admirably. He summarises its action thus: "The chemical action is practically the attack of metallic silver with cupric chloride to form a double argentic and cuprous chloride, which is soluble in salt brine." Here, as in density reduction by ferric chloride, which seems at present to be the popular favorite, and by ferric oxalate, to which my attention was but lately attracted, the principle is the same.

169. "Fog," or veiling of the film is one of the most exasperating bugbears of "dry" work, and comes without any premonition. In the early days of

There are one or two points, however, insisted upon by advocates of ferric-hyposulphite. Only a slight rinsing after fixing is recommended, and a slight rinsing after each immersion in hypo. Why not no rinsing at all to save time or a good thorough but rapid wash to insure regularity of action? Where I have attempted at the reduction of negatives only slightly over-dense, I have found the most disastrous results follow a slight rinsing, where otherwise I could calculate the amount of work done to a nicety. On the other hand, I have seen that with an abnormally opaque negative a great deal of time could be saved at first, by avoiding all washing, and simply popping the negative momentarily into the hypo, for it does not take long to dissolve chloride of silver either by ferric hyposulphite or by sodiom hyposulphite and back into the ferric salt. Again, with ferric chloride (or oxalate) where strong and rapid in its action, a comparatively thorough washing, though by no means habitually insisted on, may save the picture a shock which will take all the pluck out of it, and leave it weak for life.—HUGH BREBNER.

Local reduction is done by chemicals, and these being liquids, it is very difficult to keep them from overrunning—overflowing the parts to be reduced and very often more mischief than benefit is the result.

I have often tried, and with good effect, simply grinding the too dense parts, after drying the plate, with some soft grinding powder; such for instance as is used to "matt" varnished negatives for retouching purposes. With some patience the most obdurate parts may be subdued into good printing condition. Wipe away the grinding powder when it has become dark and use fresh.

Some negatives when developed in a too often used developer will show a dark deposit after drying. This is certainly a fault, but one which can be turned to advantage. The local reduction in these cases will clear and clean the two intense spots by means of an often renewed tuft of cotton—dry, of course, as all these suggestions are.—KARL KLAUSER.

169. *General Fog.*—By general fog we mean the fog produced during development, and is caused by the partial reduction of the silver salt all over the film. This is probably due to the decomposition of the gelatine by long cooking, the products of which in the presence of a developer are apt to react on the silver salt and produce a partial reduction in it. The production of this kind of fog and electrical disturbance in the atmosphere are apt to go together. In unfavorable weather a few drops of a saturated solution of salicylic acid should be added to the gelatine during boiling or prolonged emulsification; this will generally check or entirely prevent the decomposition. An excess of silver is likewise very likely to produce the evil, but the presence of iodide in the emulsion will almost certainly cure it. Another fruitful source of fog is the light admitted to the plates during preparation or development. The light should be tested by putting a plate in the dark slide, and drawing up half the front and exposing the half plate to the light for ten minutes. If the fog be due to this cause, the plate on development is sure to show it by an increased reduction of metallic silver in the part so exposed.

bromo-gelatine, this disease almost drove the most optimistic advocates of the process from the contest. A careful investigation of the causes was followed

Whatever may be the cause of fog—whether the emulsion itself be in fault, or whether the plates have seen light—we have found that, as in the collodio-bromide process, there is one certain, sure cure. If the emulsion be at fault, squeeze it into water containing ten grains of potassium bichromate to each ounce, and allow it to rest for an hour, and then wash again for a couple of hours more. If all the bichromate be not taken out by this washing, it is not of much consequence; since, when dry, it is inactive. The sensitiveness after this treatment is not much diminished, and the negatives taken with it are beautifully bright. Plates may be treated in precisely the same manner, and give unveiled pictures. There is a *slight* diminution of sensitiveness if the bichromate be not all washed out, but nothing to hurt, except where very great rapidity is required.

Another cure is the addition of a few grains of cupric chloride. This diminishes the sensitiveness slightly, but is most effectual, the negatives yielding bright and brilliant images. A remarkable fact about the addition of the cupric chloride is that the gray form of bromide is converted into the red form if much of the copper salt be employed. The addition of a few grains of ferricyanide of potassium with a little bromide of potassium is also a perfect cure, but this slows the emulsion.

Red Fog.—I know very little about this disaster, but it is found to occur if the silver nitrate is in excess of the salts with which it should combine. Cyanide will sometimes eliminate it from a film, but this remedy must be used with caution.

Green Fog.—This fog is due to decomposed gelatine and oxidized pyrogallic acid. Green by reflected light, it is pink by transmitted light, being dichroic. This at once points to the fact that the fog is somewhat of the nature of a dye, and every oxidizing agent ought to destroy it. In some cases we have immersed the film in a strong solution of bichromate of potash, and, on afterwards washing, the fog has disappeared; but whether it is a certain cure, we hesitate to say—it is, at any rate, worth trying.—CAPT. ABNEY.

Pink, red, and green fog are much the same thing, only in different stages, and may easily be caused by forced or prolonged development. The unhealthy look of these negatives is all that condemns them; prints from such have more sparkle and richness of shadow than from negatives quite clear. A great deal has been written on green fog, but no satisfactory solution is to the fore as yet. A plate showing strongly of green fog can be cleared by allowing it to stay a long time in the hypo; but the remedy is worse than the disease, as it turns the plate to a sickly brown color. Surface fog or veiling may be put down to the emulsion. Either it has had a touch of light, or been heated too long in the manufacture, or has been prepared with an excess of silver. At times the coating on the plates is so thin as to lead one to think the shadows were veiling during development. Plates so coated need scientific development to produce good results.—JAMES BALMAN.

A Method to Remove the Fog of Oxalate of Lime from the Surface of Plates.—For the baths and washings, use ordinary water; then, after fixing, plunge the plate in a bath of ordinary water, 100 parts; ferrous sulphate, 20 parts; alum, 8 parts; tartaric acid, 2 by the subversion of the trouble in usual cases. But fog still comes to all, and must be met heroically.

170. Another one of the common annoyances is "frilling." Its equivalent in animal nature is the kicking of the mule, and the effect upon the human system is about the same. You may use the utmost care in every particular until you come to the fixing of the plate even, when, for some cause you cannot

parts. The fog rapidly disappears, and then wash in ordinary water. This process will be especially useful for plates to be used for making projections.—M. C. SIMON.

170. It is only in summer that the trouble comes to me. I have traced the cause to this origin, and have come to this conclusion: that they are solely due to excessive temperature of the weather, or the atmosphere of the coating-room, or the emulsion being too hot while coating.

Also, if the second portion of gelatine (which should not be more than necessary for its dissolution) be too hot when the boiled portion is mixed with it, frilling is almost certain to result. We will suppose you use good gelatine only. I use Swiss, and find it very reliable. In summer I would advise that the coatings be done early in the morning, before sunrise. The glass must be slightly warm; or, perhaps better, to be exact, the temperature of the emulsion, say 100° F., or as near that as possible.

Now suppose frilling occurs, some advise alum as a remedy. I have found alum a very poor help at best. I have lately had a valuable negative frill after fixing, and for a while the total destruction of the negative was threatened. Alum would not save it. I was in a quandary for a few minutes, when a bright idea occurred to me. I flowed over the plate several times with strong alcohol, and dried it rapidly. The blistering settled firm, and allowed the plate to be afterward washed and strengthened. I have since experimented with the batch, to find out the best remedy in case the plates would frill. The best way I have yet found is this:

Before developing, run a stick of paraffine round the edges. This keeps water from getting under the film. After developing, rinse a little, and immerse in the alum bath for a few minutes, say five or ten, then rinse again and allow it to dry; or, better, hasten its drying by alcohol. After it is once dry it can be again washed, fixed, and intensified without the blisters or frill reappearing.

I have made a good many plates for my own use, and when the above precautions in making the plates are adhered to, frilling never occurs.—RANALD DOUGLAS.

Frilling.—What is meant by frilling is the gelatine film leaving the glass plates in folds or wrinkles, and a greater nuisance than this cannot be met with. It is generally met with when fixing the plate, though we have sometimes met with it during the development, especially in hot weather. We will endeavor to state the causes of frilling as they are known. Frilling is often caused by the use of unsuitable gelatine, possessing but little tenacity. The more the qualities of gelatine are like glue, the less chance there is of meeting with this vexatious evil. If gelatine, however, were like glue in respect to hardness, the difficulty of developing a plate would be very great, since it is too hard. To meet this objection, a certain proportion of a less tenacious gelatine is mixed with the harder kind, a very good index of the tenacity being the temperature at imagine, the film will begin to corrugate and swell and rise in ridges from the glass, and you are surprised and baffled. There seems to be no universal preventive, for sometimes the cause cannot even be guessed at. There is some knowledge on the subject, however, and it has been gathered together for the notes.

which it melts after swelling. The addition of chrome alum to an emulsion also prevents it to a great extent. The objections to chrome alum are that it increases the tenacity of the gelatine and prevents easy development, hence it should be used sparingly.

Gelatine that has been cooked for a long time has a special tendency to frill, and unless fresh gelatine be added to the emulsion, in some cases the frilling is inevitable. Long cooking, in warm weather particularly, means decomposition of the gelatine, and decomposed gelatine is very detrimental in preparing a dry plate. Boiling for a short time has much the same effect on the gelatine as cooking at a lower temperature, hence to avoid frilling it is better on the whole not to boil the emulsion with the full amount of gelatine.

Another source of frilling is the plate being improperly cleaned. If water will not flow in a uniform sheet from a plate, it may be well understood that there will be but little adhesion between it and an aqueous solution of gelatine. This we believe to be one fruitful source of the evil.

Another source of frilling is unequal drying. Thus, if plates be dried in an unventilated box, it will usually be found that a central patch refuses to dry till long after the outsides are completely desiccated. At the junction of this central patch with the neighboring gelatine, frilling is to be looked for. It will spread to the parts which have been longest in drying. This is due to a false tension set up in the film, and can only be conquered by drying the plate by means of alcohol or by using a proper drying cupboard.

Again, when plates are coated in hot weather, unless precautions are taken, they take long to set. The emulsion remains liquid on the plate for sufficient time to allow the heavier particles of silver bromide to settle down on the surface of the glass. This, of course, diminishes the surface to which adhesion can take place. We believe that most of the frilling which takes place in plates prepared in hot weather may be traced to this cause. When washing after fixing, frilling is often caused by allowing a stream of water from the tap to impinge on the plate. This should never be allowed if the film is at all delicate.

Chrome alum is recommended to prevent frilling when soft gelatine is used in hot weather. Plates which frill or blister will not show any signs of so doing if kept for a few months.

A general remedy for frilling is to coat the plate with normal collodion containing about six grains of tough pyroxyline to the ounce of solvents. The formula would be thus: Tough pyroxyline, 6 grains; alcohol (0.820), ½ ounce; ether (0.725), ½ ounce.

This may be applied to the film immediately before developing the plate; the solvents are washed away in a dish of clean water first, and when all repellant action is gone,

171. Yellow stains; silver stains; developer stains; stains which come before, during, and after the manipulations, have had a great deal of attention. Some of the causes are known and remedies are found. Some are as much a mystery as ever. Frequently yellow spots appear, large and small, after

the developing solution is applied. If the film has been allowed to dry, a solution of one part of ether to three of alcohol will render it pervious to the developing solutions. In some batches of plates frilling is so obstinate that, although collodion is applied, the film has a tendency to curl off from the edges of the plate. It is advisable, where such is suspected, to run a brush with an India-rubber solution round the edges, to prevent the water having access to that part of the film. When fixing such plates, it not unfrequently happens that blisters appear, and if they are allowed to remain as they were, they will spoil the negative. To avoid this, wash the plate under the tap until all the blisters join. By a prick at one corner then let the liquid free, and continue washing.—Capt. Abney.

171. The question has often been asked, "How can the yellow stains in negatives, sometimes caused by intensifying them with mercury, be removed?" And up to this time I am not aware that it has been satisfactorily answered.

It has been recommended to change all the silver in the negative into the chloride, and redevelop. My attempts to remedy the trouble by this method have not been successful. The yellow stain persists in coming back, after all. This, it seems to me. might be expected. For what is the substance of the stain? Probably, sulphide of mercury, and, perhaps, sulphide of silver from the decomposition of the hyposulphites of silver and sodium remaining in the gelatine. It is not easy to convert either of these sulphides into chlorides in the film. I will not say it is impossible, but I have not succeeded in removing the stain in this way.

I shall now describe an experiment of mine, which is given for what it is worth, for I have not had an opportunity to repeat it.

A large pan, sitting at one side in an out-of-the-way place, contained an old hypo solution in which hundreds of 8 by 10 wet-plate negatives had been fixed, having been replenished often by the addition of the hot baths used for fixing prints, as well as those which had served out their time for dry plates. Not having been used for some time, the solution had partially evaporated and changed into a mass of crystals. Of what these crystals are composed, it would be interesting to know precisely. How much hyposulphite, trithionate, tetrathionate, double hyposulphite of silver and sodium, etc., they contain, would be a nice question to be solved by analysis. It is sufficient at present to say that some of the clear crystals were taken out and dissolved, and the solution proved to be a first-rate fixing bath for negatives.

This was not all. Among a number of negatives made one day last week, one was found next morning to need intensifying. After applying the mercury and following with ammonia (on the wrong presumption that the washing had been sufficient), one of the worst-stained specimens ever likely to be seen was brought forth. I reckoned my negative to be beyond the reach of human skill. It was a goner, sure. To see what further would happen, I slipped it into the said fixing bath, and left it to its fate from drying. It is believed that during fixation the hyposulphite creeps in through punctures in the film and cannot be removed by any amount of washing—it cannot be reached unless the film is removed and both sides washed. Enough water follows to diffuse this even small amount of hypo between film and glass

Saturday until Monday. I had been surprised when it came from the ammonia stained, streaked, and blotched, but on taking it from the above solution I could hardly believe, what was nevertheless true, that every blotch and stain had entirely disappeared and the negative was as clean and clear as ever.

What does this fable teach?

First, the crystals from an old hypo solution may be utilized for fixing negatives. Probably a large part of the silver remains in the mother-liquor as sediment. And, second, if the solution obtained as above described continues to perform as in the case related, it will be found to be the easiest and best way for removing the yellow stains caused by mercurial intensification.

The stains were not superficial, as may be surmised. The plate was thoroughly rubbed with the hand under the tap.—W. H. Sherman.

To remove silver stains from a gelatine negative, then, having caught a stained negative, proceed as follows: Remove varnish thoroughly, and then wash all the spirits out of the film, and having prepared the following solution, immediately before use pour over the negative, and keep your eye upon it, moving backward and forward until stains disappear, which will take from five till fifteen minutes, according as the stains have been longer or shorter in the film:

A. Sulphocyanide of ammonia, ½ drachm; water, 1 ounce.

B. Nitric acid, ½ drachm; water, 1 ounce.

The crystals of sulphocyanide should be used, and a fresh solution made for every negative, as when it is made up in solution it loses its strength. A and B must be made up separately, and added the one to the other. On no account must the nitric acid be added to the ammonia without the admixture of water, or hydrocyanic acid fumes will be given off, which are exceedingly poisonous; but with the addition of water the action is much slower, and no inconvenience is felt on this score.

The stains having been removed, have ready a saturated solution of chrome alum, and after taking the negative out of the stain remover, place it in the alum to harden the film and prevent blistering, after which wash, dry, varnish, and print as usual. The solution acts on nothing but the spots, and there need be no fear of its reducing the negative, the only change being to turn a yellow negative to a bluish tint.—Daniel Robertson.

No spots I have seen are so aggravating as the opaque kind. To think of and compose a picture to one's satisfaction (if ever it is done), and then find the negative pitted with these spots, often causes one to lose their moral tone for the time being. I know of no certain remedy for such, unless it be a slight rubbing by the finger, which may remove them before drying.

The spots I have called pits are not met with so frequently now as formerly. Makers are bringing their plates to such a pitch of rapidity by increased heat applied to the emulsion, or otherwise, that it tends to dispel them.

and cause the yellowness so fatal to good negatives. There seems to be no hope for a negative thus afflicted. There are red spots, too, which make the heart sick.

Clear spots that are not caused by abrasion of the film, are mostly due to impure chemicals. Very often the alcohol is at fault; they show more in plates made by any of the ammonia nitrate processes, but sometimes the appearance of large patches, irregular in form, and transparent, would lead one to suppose that the particular patch was insensitive. I can give no plausible solution as to the why and wherefore.

But by far the most troublesome of plague spots is the opaque spot; it seldom can be eradicated, whilst the clear spot may in a measure be remedied, with time and care, by delicate spotting.

Stains very often can be traced to the glass, and if examined closely, the explanation will probably be found in the thumb- and finger-marks underneath the film. I do not mean to imply that all stains arise from handling the glass with dirty fingers; a bad quality of glass may be used that has impurities in itself, and makers cannot be too careful in their selection of good, clean, and even glass. Dry plates are made at so low a figure nowadays that it is imperative that cheap glass should be used, bringing with it the usual amount of blisters, bells, scratches, etc.

Stains also arise from the wrapping papers, and by the careless manipulation of the plate during development and subsequent treatment, which only show upon the drying of the plate. But this, being entirely under the control of the operator, can hardly be called a defect in the plate.—JAMES BALMAN.

Our experience with gelatine negatives, especially when they have been strengthened, is that they may look beautiful and clear when looked through, but when printed copies are made from them there appear ominous spots upon the paper, which necessitate a good deal of touching up to make them presentable. This consuming valuable time, is a great drawback to the photographer, especially when a great number of copies is needed.

Now, if such a negative is carefully examined we shall perceive weak spots of a yellow color corresponding to the white spots upon the printed copies. No doubt, as some have remarked, these spots are to be traced to the insufficient washing of the negatives, which make their appearance on intensifying, the hypo not being thoroughly eliminated from the film. Or it may arise from imperfect fixing, or in not sufficiently moving the intensifying fluid during the process of strengthening, causing, in addition to these spots, cloudiness.

Sufficient care, of course, will prevent the occurrence of such phenomena, but in practice it is not always convenient to work undisturbed upon any one subject, and when the spots do come it is well to be able to know how to attack them. Moreover, when the originals from which the negatives are taken are weak, it is often necessary to subject the negative to a sort of inquisition—to torture it until it becomes better and has the requisite strength. Now, these processes frequently give the negatives a color and tone so very bad for copying purposes, that any means to improve them will be thankfully received.

172. Spots on gelatine negatives are also caused by "tear-drops," the result of unequal drying. If the manipulator will form the habit of watching whether such a nuisance is liable to occur or not, before the negative is dry

Now, let me here say, in treating such spotty negatives the process of changing them to a chloride of silver is of the highest value, inasmuch as the spots will entirely disappear. Proceed in the following manner: The intensified or not intensified negative is laid dry in a dish and covered with the following solution: Five per cent. alum solution, 1 litre; bichromate of potassa, 10 grains; chemically pure hydrochloric acid, 20 grains. These chemicals may be dissolved in pure water instead of the alum solution, but then there is danger of producing frills from the acid.

Allow the negative to remain in this solution until it becomes thoroughly yellow, which usually occurs in a few minutes. Wash next thoroughly under a cock until it becomes colorless and when looked through appears gray. Next carry the negative into the light room, or, best of all, in the sun, and let it be exposed a few minutes. If now the chloro-silver image is laid in the oxalate developer it will become black in a few minutes, because it is reduced to the metallic state, and all the green spots will disappear. The subsequent washing is effected in a quarter of an hour.

The chloride of silver solution gradually weakens, and, in consequence, works slower and slower, or not at all, in time; but it may be freshened up by the addition of bichromate of potassa and muriatic acid.

Although the transformation of a silver image into a chloride of silver image is not exactly new, I have not found it to be a process generally employed, but I think such remarks will not be found superfluous.—L. Belitski.

172. In making some washed emulsion, I found my plates "afflicted" by a species of tear drops which formed near the lower edges, as shown by Fig. 329.

Fig. 329.

An idea came into my mind that it might be caused by the cold produced by the evaporation of the ether. Under this inspiration I prepared two plates under the same conditions—that is to say, the weather was very bad, the painted walls of the house, as it were, running with water. In a quarter of an hour I visited my plates; water was running down the front as well as the back of the glass; the ether preventing its passage, compelled it to take a zigzag form on the collodionized surface; this is what caused the ramifications. In fact, my advice is, never to prepare washed emulsion plates excepting in a very dry place. I firmly believe that much failure attending washed emulsion plates is due to this not unknown but unobserved cause. Any one can make an experiment of this by covering a glass plate with ordinary collodion, and placing it against a wall in a damp place to dry; in two or three minutes the phenomenon will have made its appearance. Now that the cause is found, the cure is easy.—Leon Vidal.

after washing, it may be prevented entirely by a second slight treatment under the tap. Some brands of plates are apt to dry unequally, and with such the tear-drops are most liable to make their appearance. Bad washing and want

Tear-drops on gelatine negatives may be prevented by wiping off the surplus water from the face of the negative before setting it aside to dry, either with a squeegee or a tuft of cotton, or any other convenient thing.

Should a negative get spotted from uneven drying, put it again in water, and be careful to wipe the water off this time before setting it aside to dry, and it will be entirely free from any previous marking; tear-drops have a tendency to form upon some plates, but with this precaution observed they will never occur.

Brown-yellow stains coming upon negatives after they have been used a short time are, if *in* the film, and not on it, from lack of fixing. If a speck in a negative should seem to hang back, and not fix like the rest of the plate, unless special precaution be taken with this plate a stain is almost sure to appear on this spot, sooner or later. In such a case wash the plate for five minutes or so after it seems to be fixed, then place it back again for a few minutes into the fixing solution, or, better still, pour over it an almost saturated solution of new hypo. This will invariably clear off the most stubborn case. The spots that are slow to fix are from too thickly coated parts of the plate, and when they remain in the soda for a long time the pores of the film become close and impermeable to the fixing solution, but are immediately opened again when put into water, and will fix as readily as at first, when put back into the soda.—James Inglis.

It sometimes happens that gelatino-bromide negatives after a certain time are covered with a white powder produced by two causes: first, bad washing; and, secondly, deterioration of the varnish. I prefer, instead of varnishing the negatives, to keep them for a half hour in an alum bath after the last washing, after which I again wash them and give them an alcohol bath. If the white dust forms on our negatives, here is the remedy which we have always found successful:

1st. Expose the negatives to the sun, and carefully remove with a chamois the dry dust that covers the film.

2d. Wash the negatives in ordinary alcohol for a quarter of an hour. and allow them to dry.

The best means of avoiding these accidents is to greatly prolong the washings, which are *almost always insufficient.* After the last washing, plunge the plate into alcohol for a half hour and allow it to dry. If the washing in water has not been sufficient, the washing in alcohol removes the last traces of hyposulphite, and makes the negatives remarkably pure and clean. Use the same process for strengthened negatives. Washing in alcohol has also the advantage of accelerating the desiccation, a very important thing in winter especially. The gelatine negatives should always be kept in a perfectly dry place, and, instead of keeping them in grooved boxes, they should be piled up, having a thin sheet of white paper between them. In this condition, being removed from atmospheric influence, they are much less apt to spoil. It sometimes happens that in taking the picture of a monument there is a want of contrast, either because the sun is hidden, or from some other cause. In this case the insufficiency may be supplied by stopping of washing bring many a trouble which might as well have been avoided, and frequently cause a grievous deterioration of quality in the negative.

173. And with all these the chapter on hitches is not ended. No one has

the development when all the details have shown themselves, and strengthening with bichloride. The strengthening gives rather a hard tone, but this is an advantage when the contrasts are wanting and the negatives are flat.—CHEVALIER O'MADDEN.

173. In working with gelatine emulsion there is always a danger of chemical or light fog, due in the first case to faults in the preparation or development of the emulsion, and in the second to admission of light during some portions of the process.

In the following category I have enumerated most of the possible causes of failure under the several processes, commencing from the coating of the plates down to the varnishing of the finished negative.

The Emulsion becomes Fluid in the Bottle.—This defect is often due to the want of an antiseptic, such as salicylic acid, carbolic acid, thymol, etc., in the emulsion. The emulsion under the circumstances refuses to set. The setting powers can be restored by the addition of fresh gelatine; but the presence of any decomposed matter is apt to give very foggy plates.

The Emulsion is Thin, and Permits some of the Bromide of Silver to Separate to the Bottom of the Flask.—This may arise from too small a proportion of gelatine having been employed, the consistency of the solution being insufficient to retain the bromide of silver in suspension; or it may be due to a tendency to decomposition. The remedy in either case will be to stir in thoroughly fresh gelatine in the proportion of 2 grammes to every 100 c. c. of emulsion.

The Emulsion Turns Brown and Gray.—This often occurs when the emulsion has been exposed for some time to white light, but the change will probably only affect the surface of the emulsion, and the interior will still be sensitive and fit for use.

The Emulsion Flows Irregularly over the Plate.—This will probably be due to the want of a substratum. A weak solution of water glass (1–200) may be used, or a syrup of sugar and water, or albumen. Gelatine emulsion will not flow well over a collodion substratum unless a small quantity of glycerine (about 2 per cent.) is previously added.

Waves and irregular marks occur during coating, principally in winter-time, when the plates are too cold, or the emulsion not sufficiently fluid. The marks do not show after fixing. If the plates, on the other hand, are too hot, streaks are formed, which show in the finished negative. The plates should be slightly warmed, and the emulsion kept in water at a temperature of about 50° or 60° C.

Air-bubbles which form on the surface of the film during coating can easily be avoided by pouring back the excess of emulsion into a separate vessel. The best form of vessel to employ is an earthenware teapot wrapped up in a thick cloth.

The emulsion refuses to set when poured on to the plate.

a. The temperature of the coating-room may be too high; if so, the plates should be laid after coating on a metal plate or a stone slab, when they will set in a few minutes, and the film will not melt again so readily as it otherwise would.

b. The proportion of gelatine in the emulsion may be deficient. This may be remedied confessed as yet that the bromo-gelatine process, wonderful as its capabilities and results are, is the "process of the future," or all that the earnest photographer believes to be possible for his craft to accomplish. There are great

by the addition of 2 or 3 grammes of fresh gelatine to every 10 c. c. of emulsion, and, after standing for a few hours, the latter should be heated to insure complete solution.

c. The want of setting power is more often caused by a decomposition of the emulsion, consequent on too long a boiling, too high a temperature, injudicious use of ammonia, or frequent melting and setting of the emulsion, which is especially injurious to a gelatine of inferior quality. This want of setting power often gives rise to frilling and blisters, which may be avoided by the addition of a small quantity of the alum and glycerine solution.

Spots and small rings, which are very apparent in the finished negative, are due principally to irregular drying of the plates. The drying may have been prolonged too long owing to variations in the state of the atmosphere or temperature, or the same defect may arise from having the drying-cupboard too hot, and opening the door frequently while the plates are drying.

Gelatine films which have been dried by soaking in alcohol, frequently crack, owing to the contraction of the gelatine being too rapid. At other times faint marks make their appearance, which are visible in the finished negative.

Mildew occurs when the plates have been kept in a damp place. An emulsion to which an antiseptic has been added is not liable to this defect.

The plates are very slow in developing, or develop irregularly, when they have been kept for a long time in a very dry place. In developing such plates, they should be previously soaked for some time in water. The emulsion may contain too much alum or chrome alum, in which case the addition of a few drops of glycerine will improve its absorptive power. Such an emulsion is best treated with the pyrogallic developer, and before the addition of the pyrogallic acid a dilute solution of ammonia may be allowed to act on the plate for a few minutes. If the films are very hard, they may be soaked for a few minutes in water at a temperature of 30° C.

If the plate, on fixing, appears fogged, the mistake may have been caused by overexposure, careless development, employment of a faulty emulsion, or admission of white light at some stage of the operations.

a. The part of the plate protected by the rebate of the frame should be examined; and if this be free from fog, the fault has been due to overexposure.

b. If, however, the whole plate fogs over during development, we may suspect that light has been admitted. The camera and dark slides should be carefully examined, as well as the connection of the flange of the objective with the front of the camera. To test the quality of the ruby glass employed in the window or lantern, half a gelatine plate should be carefully covered over, and the remaining half exposed for three to five minutes to the light passing through the ruby glass. When treated with a fresh developer, both portions should fix out quite clear. If the exposed half fogs over, while the unexposed portion remains clear, the glass may be considered unsafe.

c. Fog may be due to decomposition of the gelatine, caused either by cooking the attainments before us. They are unveiling every day. We must be patient with what is and hope to do better with what comes.

emulsion too long, use of too high a temperature, addition of too much ammonia, or the employment, under certain circumstances, of materials having an alkaline reaction. The remedy for this so-called chemical fog consists in the addition of a few drops of tincture of iodine, or treatment of the emulsion, after it has been pressed through canvas, with a mixture of 1 part potassium bichromate, 3 parts hydrochloric acid, and 100 to 150 parts of water. After ten or fifteen minutes, the emulsion is thoroughly washed in plenty of water. The sensitiveness is slightly diminished by such treatment, but may be increased again by the addition of a few drops of ammonia.

d. Fog is apt to ensue when plates take longer than from three to six days to dry. The upper part of the film remains clear, but a large round spot on the under side of the film shows the part which has been the last to dry. As a remedy against very slow drying, Haack recommends sprinkling the drying-room with carbolic acid. Plates which have been already coated and give fog are more difficult to restore than the solid emulsion. They may be laid in the above bichromate mixture, and then thoroughly washed and dried. Another good plan is to immerse for ten minutes in a solution of 10 parts ferricyanide of potassium, 10 parts bromide of potassium, and 100 parts water, and to wash afterward for some hours.

e. If the plates have been dried at too high a temperature, they are apt to fog during development.

f. Plates which have been kept for a long time in a damp place are inclined to fog and lose their sensitiveness.

g. Lastly, wrapping plates up in unsuitable material, such as paper containing printed matter, various kinds of colored paper, tin-foil, etc., induces fog, and gives rise to marks, causing an abnormal reduction of silver under the action of the developer.

Red fog occurs when an emulsion contains an excess of silver, but this defect is rarely met with in commercial plates. According to Chardon, this phenomenon occurs when an emulsion is prepared with excess of soluble bromide by pouring the bromized gelatine into the silver nitrate instead of *vice versâ.* An emulsion formed in this way, however, does not give red fog, according to Abney, when developed with ferrous oxalate.

Yellow fog occurs during development with alkaline pyrogallic. It is due to the employment either of inferior pyrogallic acid, too concentrated a solution, or the excessive addition of ammonia. An old, discolored developer will also give the same defect. A negative which has been discolored in this way may be treated, after fixing, with a saturated solution of alum containing hydrochloric acid $\frac{1}{2}$ per cent. to 1 per cent., or with a weak solution of potassium cyanide. The acid should be washed off as quickly as possible, otherwise the film is likely to blister. If ferrous oxalate be used as a developer, and not thoroughly washed off before fixing, it turns the fixing solution yellow, and the negative becomes discolored.

Green fog may be due to various causes. Abney mentions a kind of green fog, which is di-chroic, being green by reflected light, and pink by transmitted light. This kind of discoloration may sometimes be removed by soaking the film in a solution of potassium bichromate, but hydrogen peroxide will be found more effectual.

The novice is oftentimes appalled at the number of drawbacks possible in the practice of photography. An impression seems to have been sent broad-

A white opalescent veil often occurs in developing with ferrous oxalate. This makes its appearance when plates are washed in water containing lime. The deposit can be removed with weak hydrochloric acid, but it is of no consequence, as it is quite transparent, and cannot be detected after the negative is varnished.

The Plates, when Developed with Ferrous Oxalate, become Covered with a Yellow Deposit.—This defect occurs when too large a proportion of ferrous sulphate is used in working with the mixed developers. If the acid potassium salt be employed, or if the neutral salt has been rendered acid, the deposit is thrown down in large quantities.

Clear, undefined spots and marks, visible after fixing, show that the gelatine employed contains grease. They do not make their appearance when the emulsion has been treated with ammonia, and subsequently washed.

Small pinholes are caused by particles of dust adhering to the plate, which prevent the light, as well as the developer, from acting. Plates should be dusted over with a broad camel's-hair brush before exposure.

White marks or round spots with a sharp outline, which have a glossy appearance after fixing, are caused by air-bubbles adhering to the plate during development. They may be avoided by rinsing the plate in water previous to development, or by keeping the developer in gentle motion.

Opaque spots of a more or less irregular outline are due to a reduction of silver caused by specks of dust dropping on the plate during coating or drying. Gelatine plates which have been soaked in alcohol to accelerate the drying frequently show these opaque spots.

Irregular zig-zag lines are caused when stoppages have occurred in the flow of the developer. Soaking the plates for a short time in water assists the flow of the developer.

The Image is Foggy.—This is generally due to overexposure, or to the development having been forced by addition of ammonia, without a corresponding amount of potassium bromide.

The picture is harmonious, but wanting in density, when too weak a developer has been employed. An increase in the strength of the developer will always be found a remedy when the emulsion itself is in fault. This defect is more apparent when the emulsion contains iodide of silver, nitric acid, or potassium cyanide, than when bromide of silver alone is present. It may often be due to the films being too thin, or the emulsion being too poor in silver.

The Picture is Hard, and Wanting in Detail.—This is generally due to underexposure, to want of sufficient ammonia in the developer, or to the employment of too much bromide of potassium. Underexposure is difficult to remedy in the case of ferrous oxalate development, unless the reserve developer be resorted to. The defect may lie in the emulsion itself being insensitive, or it may contain too much soluble bromide, and have been very indifferently washed. Such an emulsion requires a powerful alkaline developer, as ferrous oxalate is of very little use under the circumstances.

The Negative is Full of Detail, but too Dense.—When the developer has been allowed to cast that our art is "easy"—that "anyone can make good photographs." Therefore when failures and faults lift themselves up in the way, a good deal

act on the plate too long, the density may be reduced by soaking the plate, after fixing, in a weak solution of perchloride of iron (1–50 to 1–100). When the density is sufficiently reduced, the plate should be placed in the fixing solution, and, if necessary, the operation can be repeated. The 1 per cent. or 2 per cent. solution of potassium cyanide is effective, but is apt to attack the half-tones, and increase the contrast. Burgess recommends soaking the negative, after fixing, in a (1–60) solution of chloride of gold, and, after the yellow color which it gives to the negative has reached through to the back of the plate, the latter should be again placed in the fixing solution to dissolve off the chloride of silver formed on the film.

The Negative Exhibits a Coarse Grain.—This is due to defects in preparing the emulsion. The solution of silver has been too concentrated, the emulsion has been cooked too long, too much ammonia has been added, or the proportion of silver in the emulsion has been too large. It is impossible to remedy this defect.

The High Lights are surrounded by a Halo.—This is sometimes due to a defect in the lens, but it generally occurs from reflection of light from the back of the plate. This defect is not apparent when the films are thick, or when the plates are backed. The proposal to color the emulsion itself is impracticable, as such a process is found to reduce the sensitiveness of the emulsion. There is a reflection from the film itself, too, which often causes this halo round the high lights. Plates which have a matt surface, or which contain iodide, are not liable to this defect.

The Negative becomes Reversed during Development.—This phenomenon or (so-called) solarization occurs principally when the exposure has been abnormally long. Plates liable to this defect should be developed for as short a time as possible, and with a weak developer. Sometimes this effect of solarization is apparent when only an ordinary exposure has been given. If this is so, probably actinic light has reached the plate before exposure. Too much hyposulphite in the developer also reverses the image.

Frilling and expansion of the film, etc., generally attend the use of too soft a sample of gelatine. It may also be due to incipient decomposition of the gelatine, owing to too long cooking, or other causes, or the use of too thick films. The emulsion may also contain gum-arabic, or the plates may have dried irregularly, the part that takes longest to dry being the first to frill.

b. The same thing occurs sometimes during development with pyrogallic acid when too much alkali has been employed.

c. When the developer or the wash-water is too warm.

d. When too strong a solution of hyposulphite of soda has been used.

e. When plates have been treated with dilute acid solutions.

It is often useful to coat the plates with a substratum of water-glass (1 : 200), or else give an edging with a solution of rubber. The best cure, however, is undoubtedly to soak the plates either before or else after development in a 3 or 5 per cent. solution of alum or chrome alum for a few minutes. Williams recommends a mixture of: Tannin, 18 parts; alum, 18; glycerine, 48; and water, 380.

of surprise and disappointment follows. This should not be so, because it is not reasonable to expect photography to run any smoother than other pursuits

Chardon recommends soaking the plates in alcohol before development, and in a 50 per cent. solution of alum between development and fixing. It is often advisable, in developing plates which have a tendency to frill, to use double the ordinary proportion of pyrogallic acid, and make up the solution half with water and half with alcohol.

Chrome alum may also be added to the developer in the proportion of ½ to 1½ grammes to every 500 c. c., or the addition of 1 to 3 per cent. alum to the fixing solution may also be recommended.

Abney advises that plates liable to frill should be coated before development with plain collodion, and then be washed until the greasy lines disappear, and the water flows off the plates evenly. The development may then be proceeded with without any fear of frilling.

The Negative takes a Long Time to Fix.—This occurs equally when the solution is too dilute or too concentrated. The strength of the fixing solution should be regulated to about 1 to 5.

Intensification with Silver Nitrate.—Red fog is very apt to make its appearance during the process if the intensifier is not kept continually in motion, if it contains too little acid as a restrainer, or when the last trace of hyposulphite of soda has not been removed from the film. Red fog can often be got rid of by treating the plates with a 1 or 2 per cent. solution of hydrochloric acid, or by soaking in a strong solution of common salt. If citric acid be used in excess, it has a solvent action on the film.

Failures during Mercury Intensification.—The hyposulphite of soda should be thoroughly washed off in all forms of mercury intensification with the exception of Edwards's method, otherwise the treatment with mercury will give a brown stain.

b. The same thing occurs if the bichloride of mercury is not thoroughly washed off before the ammonium sulphide or hyposulphite of soda is flowed over the film.

Failures in Intensifying with Uranium.—If the fixing solution is not thoroughly washed off, the film turns brownish-red on the application of solutions of uranium salts. Any traces of ferrous oxalate left in the film gives rise to a bluish color.

The Negative becomes Darker after Fixing—This defect may generally be traced to intensification. It occurs when plates have been intensified with mercury or with silver, and in the latter case, especially if the precaution has been omitted of removing all free silver by replacing the negatives in the fixing solution. The only recourse left is to remove the varnish and attempt to clear the plate.

c. Negatives which have been printed from before varnishing, often turn red, owing to the silver in the paper combining with the gelatine to form red stains. The stains can be removed with dilute potassium cyanide.

Negatives have an opalescent appearance when they have not been thoroughly dry before varnishing.

The Plates Fade after Varnishing.—This is due to intensification, and is often met with in plates which have been intensified with England's or Edwards's methods. The only remedy is to remove the varnish, and try some other method of intensification.—Dr. J. M. Eder.

and recreations do. And I do not feel sure that our art would hold the fascination which it does for such myriads. Now, if it was all "smooth sail-

Flatness of Image is usually due to overexposure and development with the alkaline developer; the use of ferrous oxalate mitigates the evil; while, if iodide be in the film, we have never found any great lack of density to arise. Feebleness of the image is also often caused by too thin a coating of emulsion. In our own experience a thick film is a desideratum, giving all the necessary density to the image with facility. Remember that, when a vigorous image is required, it is most readily obtained by using a *freshly prepared* and strong ferrous oxalate solution.

Too great Density of Image is sometimes met with, and can be remedied by applying ferric chloride to the film, and then subsequently immersing in the hyposulphite of soda fixing bath.

The formula recommended is; Ferric chloride, one drachm; water, four ounces. This is flowed over the plate a short time, and then, after washing, the plate is immersed in the fixing bath. The solution acts very vigorously, and should be diluted if only a small reduction is required. Local reduction may be effected by using a paint brush charged with this solution on the moistened film. This practice is not, however, much to be commended, as it is rather working in the dark.

Density may also be diminished by the use of a strong solution of cyanide. Local reduction may be given by moistening the parts required to be reduced with water by a paint brush and then applying the cyanide in the same manner. The reduction can be seen progressing.

There are a variety of formulæ for reducing negatives. Perhaps the best is eau de javelle, which can be obtained of all chemists, but which is made as follows: Dry chloride of lime, 2 ounces; carbonate of potash, 4 ounces; water, 40 ounces. The lime is mixed with 30 ounces of the water and the carbonate dissolved in the other 10 ounces. The solutions are mixed, boiled, and filtered. The filtered solution should be diluted, and the plate immersed in it till reduction takes place. The plate should be fixed and again washed.

Yellow Stains.—Usually a yellowish veil appears to dim the brightness of the shadows when the development has been effected by the alkaline developer. This may be removed, if thought requisite, by the application of one or two drops of hydrochloric acid to an ounce of water and floating it over the surface of the plate. The film must be washed almost immediately, as the acid is apt to cause frilling.

Another formula, due to Mr. J. Cowell, is to immerse the plate in alum, 2 ounces; citric acid, 1 ounce; water, 10 ounces.

Another formula is: Saturated solution of alum, 20 ounces; hydrochloric acid, ½ ounce. The negative should be well washed in all cases after the application of either of them.

Too Granular an Emulsion is usually due to bad mixing of the soluble bromide and the silver nitrate, but it may also be caused by overboiling, and also by too small a quantity of gelatine in the boiling operation. Digesting too long with ammonia, as in Van Monckhoven's process, has the same effect. There is no cure for this evil.

Opaque Spots on a plate are almost invariably due to dust settling on the film when drying; they also may be due to imperfect filtering of the emulsion.

ing," we should then lose our feeling in it—our respect for it if it was "easy." One of the chief attractions attending it consists in the knowledge that one may fail awfully with it if one is not carefully and constantly on the alert.

Semi-transparent Spots on the plate before development are generally due to (1) excrescences on the glass plate, or (2) to the use of gelatine containing grease.

Certain gelatines are apt to contain grease, and that so intimately that soaking in ether or washing with ammonia will not eliminate it. A specific is as follows: We will suppose that 80 grains of Coignet's gelatine are required: 90 grains are weighed out, soaked in water, drained, and melted. The liquid is then very slowly poured, almost drop by drop, into methylated spirit, free from resin, where it is precipitated in shreds of a white pasty character; after it is all precipitated, the spirit is poured off and a slight rinse with fresh spirit given, and then it is covered with water, in which it should remain till the whiteness disappears. The water should then be changed and the gelatine drained and redissolved; about 10 grains out of the 90 seem to be dissolved in the mixture of alcohol and water. Emulsions made with this gelatine will be markedly free from grease spots. The same method may be adopted for large quantities of gelatine, omitting the final wash with water and leaving it to dry spontaneously. This is best done on glazed dishes. The gelatine can be broken up, weighed, and used in the usual manner.

Dull Spots on the Negative are also due to the use of gelatine which contains greasy matter.

Want of Density in a negative may be caused by over-exposure, but it more often arises from the emulsion itself. A rapid emulsion will always give a feebler image than a slow emulsion, although to form the image the same amount of silver may be reduced. This shows that the silver is in such a state of aggregation that it does not possess what may be called covering powers. We have found that the addition of a chloride emulsion materially aids the production of density. If one-fifth of an emulsion be added to an emulsion lacking in density giving qualities, it will be secured without detriment to the sensitiveness. The range of sensitiveness will be slightly altered. A hard gelatine is also conducive to feeble images. If prepared plates give feeble images, resort must be had to intensifying.—CAPT. ABNEY.

The round and matt spots, which are already visible on the plate before development (they form small wells or depressions) give darker spots in the negative that has been developed and fixed. Unfortunately, these defects are often met with, and more frequently when pure gelatine has been used, instead of soft gelatine, which sets more slowly. These spots arise in most cases from a want of proportion between the bromide of silver, the gelatine, and the water. The greater the proportion of gelatine, compared to that of the bromide of silver, the less often they are found; and, on the other hand, they are more easily produced when the emulsion contains a greater quantity of water. It is difficult to remedy this defect; the best thing to do is to add to the emulsion a solution of gelatine (one to six). Dust, and the small filaments which fall into the emulsion which has not entirely set, give rise to spots which present some analogy to those mentioned above, but they are not entirely round. Seen through the microscope, they show the nucleus of the spot formed by the grain of dust.

The navigator of the broad and turbulent Mississippi finds a peculiar charm in piloting his way along it, because he knows that, although snags and

The black spots, coming from contact with the fingers, are due to the plate having been touched, before or after development, by fingers to which has adhered a trace of hypo-sulphite.

Waves, striæ, and the clouds (Fig. 330) are, for the manufacturer of emulsion, a veritable calamity. They may arise from different causes. For example, if the emulsion is spread over plates with a cold glass rod, or by means of a brush upon which there remains a portion of half congealed emulsion (this is rarely the case with hand-made plates), or when some portions of the emulsion are badly mixed or badly spread. (Fig. 331.)

Fig. 330.

Fig. 331.

When there is a great difference of temperature between the plates and the emulsion, these waves are very likely to be produced; as is the case, also, if hard gelatine has been used, which sets very rapidly; whilst, with soft gelatine, they form with greater difficulty. The emulsion prepared by ebullition is less subject to this defect than the emulsion containing ammoniacal oxide of silver. But almost always the cause is due to a defective proportion between the bromide of silver, the gelatine, and the water. When the gelatine and the bromide are in equal proportions, and there is but little water, these waves are almost always produced; it is the contrary, when the proportion of gelatine is twice as great, and there is a sufficient quantity of water, and especially when a definite proportion of gelatine has been added. The proportion indicated by the author is the right one. Moreover, the precaution may be taken of heating the emulsion for ten minutes before using it, so as to obtain a perfect mixture.

Cloudy spots are produced if, when the ammonia is poured into the pyro developer, care has not been taken to make the mixture in a separate dish. Wherever the ammonia has been allowed to touch bright spots are produced in reflected light, which are but slightly visible in transmitted light.

Fig. 332.

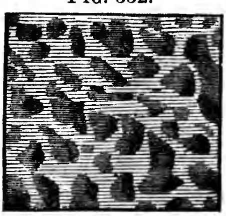
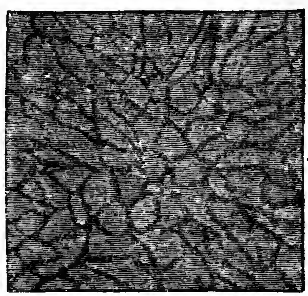


Fig. 333.



The plate presents the appearance of a honey comb, even before development (Figs. 332, 333). This comes from the emulsion containing too much alcohol, or from too much alcohol having been added, or from the emulsion having been kept too long under the alcohol.

sawyers abound, he possesses the skill to dodge them, and that he is going to do it almost every time. A kindred pleasure awaits the patient and loving

Failures in using Mercury Salts.—In all these strengthening processes, with the exception of that of Edwards's here are the causes of these failures:

a. Traces of sodic hyposulphite, which give a brown color to the salts of mercury (precipitation of the sulphuret of mercury). The plates have a strong veil. *Remedy:* Complete elimination of the hyposulphite by washing, before and after the mercury treatment. It is difficult to remove spots on the negative. According to Kuntzmüller, success is more easily obtained by using a solution of chloride of gold.

b. If the last traces of the solution of mercury are not completely removed by washing before treating the negative with ammonia or hyposulphite, a very dark and intense veil is formed.

c. A gray veil is almost always formed when the negative was already veiled before strengthening.

d. When the washing has been insufficient after the chloride of mercury bath, and before treating with ammonia or cyanide, spots are met with of the shape shown in Fig. 333.—LEON VIDAL.

Things to "Don't."—People who expect to use cheap lenses and the sham built cheap outfits, and expect to make beautiful negatives don't succeed. Reason why: Cheap lenses are one of the curses of amateurs. They wont penetrate, define, and yet give a flat field. May be good in one or two, but *never* in the three absolute requisites. And the cheap "boxes" have no swing back or lifting front, and when you must tilt the box to get in a bit, you upset all the rest.

Changing plates once a week and developers semi-occasionally is good practice, but it is bad for the success. Use one plate, and either expose the plate with a given lens and light so as to produce a fine negative with a given strength of developer, and when you have learned it, then change time of exposure, and modify your developer, but don't undertake to do it all at once if you expect fine prints

Don't use anybody's concentrated developers; under certain circumstances they may do fair work, but under all the varying lights and times of exposure to which the amateur tramp is subject, the concentrated developer don't give fine results.

Don't use anybody's double guaranteed developer that has bromide of everything except *brains* in it. Whether you believe it or not, bromide actually calls for the use of more pyro and we are all using more than *too much* pyro now. And while we are on the subject of bromides, allow me to say that bromide of soda is worth all the other bromides when soda or potash is in the developer, and bromide of ammonium is positively not allowable in some of the combinations of soda and potash. Citrate of soda is an elegant retarder, but all hands use too much, as a rule. Don't underexpose; you can hold in a plate, but you can't force one any more than get blood out of a brick. When you find the image coming too fast don't pour in bromide to increase density, but put in a lot of water—filtered water; reduce the strength of the developer; keep the pan moving and you will see when the retardation shows plainly, then keep watch, bring it up to density, and don't lean on bromide so much; you will get a far cleaner negative, finer gradations, and a degree of harmony that bromide will not give.

photographer. The long list of obstacles given in these pages is not intended to frighten, but only to forewarn that you may be forearmed.

Don't use anybody's solution of pyro. Careful experiment has demonstrated the fact that pyro decreases in energy very rapidly after a *very few* weeks. Many a negative is spoiled by the use of old pyro solution—two months old and older, and the inveterate use of bromide. Both of them are to the photographer what poor paper is to the artistic printer.

Don't be careless or slouchy about your work. When the light is let upon a plate it ought to give a beautiful result; if you have been careless in focussing, don't curse the plate maker.

Don't use alum or chrome alum in your hypo; keep the two solutions separate. The alum does the scavenger's work on the plate *after development*, and then after washing. The hypo does its work clean, clear, quickly, and much better than it could or would if the alum was discharging the filth into the hypo.

Don't use an old, yellow, or filthy solution of hypo; when the solution becomes discolored, throw it away. Never mind if some slouch has said he did use it; some people like to eat their food from soiled table covers, *we* don't.

Don't imagine you are so much smarter than the other fellow, and can do what he couldn't. You may sit down hard, only to find out there is another fool in town (look in the glass).

In using quick plates remember that more cleanliness is necessary; more care in filtering, more accuracy in weighing and measuring, more care in the light, and plate-holders, pans, washing, etc., for they are *so much* more sensitive that it requires more sensible, careful manipulation.

Don't imagine that you are to get to the top of the ladder in four weeks, photographically.

Don't believe all you hear, but do as the old goose did when he stood on one leg to see how long he could do so—"try it and see.

Don't change plate or formula everv time you hear a big story; shut one eye and think it over, sleep on it, and then don't

Don't be economical; get the best, and then learn how to use it; keep cool; read all you can get hold of, and then sift it, and if you get burnt semi-occasionally, you will learn a lot, and what you know be sure of.

Don't expect to get rich the first year.

Don't swear at ill luck; sit down and think it all over. You may not see the rascal, but you know him.

Don't believe any of this if you don't want to.

Don't believe that any developer is the best and only scientific developer, unless you want to; keep on spoiling good plates, and swearing. When you get sensible, get a formula; prepare it; use it with care; mix in a little brains; and you will have one of the best things I've found in four years. And lastly, dear reader, don't write me lots of letters asking why and wherefore and forget that postage stamps cost me cash, while courtesy is valued highly.—Thos. Pray, Jr.

174. Once a satisfactory negative has been obtained, every precaution will be taken to protect it—from the heartless, unsympathetic handling of the

174. If anyone will varnish a gelatine negative simply with the usual negative varnishes—upon which retouching can be done without grinding the surface—he can make all his retouching useless by simply allowing a few drops of water to fall on the surface, or by allowing his hand to rest on it while perspiring or moist. The effect is at once seen in semi-opaque spots, which show badly in printing, and can only be got rid of by revarnishing, thus making the labor in vain. Retouching direct on the surface of the gelatine, and then varnishing, would obviate this, but most retouchers do not find it a desirable surface by itself.

But there is another aspect to this case. A surface so easily affected by moisture is not safe against other deleterious causes. The reason for this is obvious. The varnish mostly used is composed of gum sandarac, alcohol, and sufficient gum turpentine to give it a soft, yielding surface, causing the pencil to take it readily. From considerable experience with varnishes, I find this one of the best for retouching purposes, and the one most generally in use. The weak spot in it for gelatine plates is the gum turpentine. It may be asked, Why not use shellac entirely? True, this varnish does not allow moisture to penetrate direct, if thick enough, but it is the poorest of all varnishes for practical use, because the surface is so hard as to require grinding—a most pernicious practice, making collodion plates hard and slow enough in printing, but still worse for a gelatine negative of good strength. A further objection is that from its filmy, contractile nature, should the negative ever be exposed to a continued damp atmosphere, such as in basements or cellars, it would cause them to peel off, as in stripping plates. I have often witnessed this effect on collodion plates; and I have also noticed that negative films varnished with shellac are the soonest eaten off in the acid dish, while those varnished with sandarac hold on much longer. In fact, shellac and mastic varnishes have the least stability of any.

Now to the remedy, and a perfect safeguard for gelatine negatives. I have found that the original method of first coating the plate with plain collodion, and then varnishing, to be a perfect and reliable protection. We use a collodion containing six grains to the ounce of gun cotton, and about thirty drops of castor-oil to the pound. Our varnish is composed of two ounces of sandarac, half ounce of the lightest orange lac to one pint of alcohol; to which one drachm of castor-oil is added, instead of using gum turpentine, to give a tooth to the pencil. Bleached lac may be used, but it does not come regular in quality, and if very old is insoluble. The color given by the amount of orange lac used is not objectionable, but those who object could use sandarac alone, though it does not dry as nicely or with as little heat as when a little lac is used with it. It will be seen that we here have a varnish on a film of collodion covering the gelatine; and I have found it to stand immersion in water a long time without moisture being absorbed by it. I would warn others, however, that no amount of protection can make a plate that has been treated with mercurial salts safe against deterioration; the most of such will go. I have found several negatives made in 1881, developed with oxalate and thoroughly washed free from hypo, that have become much weaker. They were not intensified, printer. Varnish is the best preservative, and the method of application is very similar to what has been offered for the "wet" negative.

175. By far the most learned treatise published on bromo-gelatine work is

were protected with varnish, and kept in a dry place. The later ones have apparently not been affected as yet, and it is also somewhat premature to decide as to the permanence of gelatine negatives.—D. BACHRACH, JR.

175. PRACTICAL NOTES. *The precipitation of an unwashed emulsion by alcohol* has been recommended by Wratten and Wainright, as well as by Obernetter, on the ground that while the gelatine itself is insoluble in alcohol, the bi-products enter into solution. The process is, no doubt, much more rapid than that of long-continued washing; but it must be borne in mind that potassium bromide and potassium nitrate are both very soluble in water, and only slightly so in alcohol. The ammonium salts are far more soluble. There is another inconvenience attaching to the process, in the fact that gelatine which has been precipitated with alcohol takes a long time to dissolve in water.

Drying of Gelatine Plates.—There is danger of fog if plates take too long a time to dry. From twelve to eighteen hours is about the correct time; if this period is exceeded, a few drops of carbolic acid may be sprinkled over the floor of the drying-room. The easiest and the best way to dry plates is to stand them on racks in an ordinary light-tight room. If there is such moisture in the air, calcium chloride or sulphuric acid may be employed to absorb it. If a drying-cupboard is used, the temperature should be about 27° C. to 30° C.

Drying Plates by means of Alcohol.—It has often been recommended, as a means of hastening the drying, to soak the plates in alcohol for a few minutes, after which, if stood on edge, they will dry in an hour or two. This method is good enough for drying test-plates; but it is not suitable for general employment. The alcohol soon loses its power of absorbing water, and plates which have been dried in this manner are liable to spots.

Alcoholic Solutions of Gelatine or Gelatine Emulsion.—In May, 1880, I observed that gelatine warmed with nitric acid was highly soluble in strong alcohol; but, as it also becomes soluble in water, it is of no use for preparing plates. According to Herschel, alcohol to which two per cent. of aqua regia has been added will dissolve under the action of moderate heat any quantity of gelatine. The film is insoluble in water, and takes about twice as long to dry as a collodion emulsion. Ether and chloroform have the same solvent action. The use of aqua regia lowers the sensitiveness of the emulsion considerably. According to Vogel, gelatine dissolves in organic acids without precipitating. If a few drops of acetic acid be added to an ordinary gelatine emulsion, the latter will be found to melt more readily, and to set with greater difficulty. The addition of a small quantity of acetic acid tends to prevent the recurrence of small pits in the film, to which a gelatine that sets too rapidly is liable. His new emulsion consists of a dry gelatine emulsion and pyroxyline dissolved in alcohol and acetic acid. An emulsion prepared in this way retains its normal power of setting, and a 10 per cent. aqueous solution of either oxalic, boracic, or succinic acid will readily dissolve under heat half its weight of gelatine, and the solutions admit of dilution with three times their volume of alcohol. An emulsion dissolved in double its bulk of acidulated water, to which three

Modern Dry Plates or Emulsion Photography, by Dr. J. M. Eder, my distinguished colleague of Vienna, and translated by a lamented friend, H. Baden

volumes of absolute alcohol are added, can be poured over plates like collodion, and dries in an hour, giving the same sensitiveness and brilliancy as an emulsion dissolved in water.

Konarzewski prepares a collodio-gelatine emulsion by dissolving 1 gramme of pyroxylin in 50 c. c. alcohol at 36°, and 50 c. c. acetic acid, and adding 10 grammes of dry gelatino-bromide emulsion; the whole being dissolved in the water bath. Such an emulsion can be poured over the plate like collodion, and dries much more rapidly than an ordinary aqueous emulsion. If the plates exhibit any tendency to frill during development, a substratum may be used previous to coating. Schlicht prepares an alcoholic solution of gelatine in the following way: He precipitates an aqueous gelatine emulsion with alcohol, and, when dry, he adds 1 part of the emulsion to 1 part acetic acid, allows it to stand for an hour, and then warms it over the water bath, when solution ensues in about five minutes. One part of a normal collodion and acetic acid (1 to 4) is added gradually with constant stirring, the bottle being kept warm during the addition. The emulsion may then be diluted with $\frac{3}{4}$ part of a mixture of alcohol and acetic acid (4 to 1) and filtered. It is a curious fact that such alcoholic gelatine emulsions are not so easily spoilt by an excess of silver nitrate as aqueous solutions. Such an emulsion may be prepared with excess of silver without exhibiting any signs of red fog if the excess of silver is removed by means of sodium chloride.

Wilde informs me that gelatine swelled in water is soluble in alcohol to which two or three times its bulk of acetic acid, neutralized with ammonia, is added. Such an emulsion, thinned with alcohol, gives a clear picture, and retains its power of setting for a considerable time.

On the Keeping Qualities of Gelatine Plates.—Camps had a good opportunity of testing this during the sea voyages that he undertook. He found that they remained unaffected by the severest changes. The preparation of gelatine emulsion is extremely difficult during the summer months, and many firms discontinue supplying plates during the summer time in consequence.

The Illumination of the Dark-room.—Opinions on this subject are very conflicting. Some photographers contend that a deep ruby light is necessary; others are in the habit of using orange glass only. There is no danger in the latter if the plates are protected from its direct action previous to development. Ferrous oxalate, owing to its deep red color, is very non-actinic, and a plate covered with a good body of solution can be brought out into white light during development. Whaite suggests the idea of coloring the pyrogallic developer with cochineal for the same purpose.

Hyposulphite of Soda in the Developer.—A trace of hyposulphite of soda during development of wet collodion plates is very injurious. In the case of dry gelatine plates and pyrogallic development a small quantity of hyposulphite of soda has no effect; with ferrous oxalate the case is very different. Abney observed that the addition of a few drops of a solution of this substance to ferrous oxalate brought out the detail rapidly, and he considers that its use admits of the exposure being reduced to one-third. If the plates

Pritchard. It is published by Messrs. E. & H. T. Anthony & Co., New York. I cannot close this section of my work more aptly than by adding from Dr. Eder's work his carefully collated practical notes.

consist of pure bromide, or contain chloride, there is a chance of a reversal of the image. I may mention that in this process the time the solution should be allowed to act after the addition of the hyposulphite of soda depends on the acidity of the developer. According to Abney, it is best to add the hyposulphite of soda as soon as the developer has impregnated the film. We have succeeded very well with plates consisting of bromide of silver alone, and find that the best proportions are from 2 to 10 drops of a 1:100 solution to every 2 ounces of developer. Larger quantities are liable to give reversed images.

Restoration of Old Ferrous Oxalate Solution.—The solution containing the green ferric crystals should be warmed in an earthenware basin, and potassic carbonate added until no further precipitate is given after filtration. A small quantity of the solution may be tested now and then for the purpose. The filtrate contains only a trace of iron, and consists for the most part of pure potassic oxalate containing an excess of potassic carbonate. The solution may be neutralized with oxalic acid, and a further addition of potassium oxalate made if necessary. If there is much potassium bromide present, it can be removed by the addition to every 100 c. c. of solution of 2 or 3 c. c. of an old 1:10 sensitizing bath. The solution may be used in the ordinary way after having been filtered for development. Kohnkes' suggestion of precipitating the iron with soda, instead of potash, is not advisable, as the solvent action of sodium carbonate on ferrous oxalate is much less than that of the potassium or ammonium salts.

Transparencies with Gelatine Plates.—These can readily be produced by exposing gelatine plates under a negative to a gas flame, and developing either with alkaline pyrogallic or ferrous oxalate. The former gives a brown, and the latter a black tone, which is to be preferred for this class of work. Transparencies can be employed for the reproduction of negatives, but such negatives are never equal in delicacy to the original. A method was given in the *Photographic News* of producing very beautiful transparencies from emulsion films on opal glass, which can be afterwards improved, if necessary, by retouching with a pencil or crayon.

Paper coated with gelatine emulsion was suggested in 1874 by Mawdsley, and can be prepared in much the same way as Warnerke's sensitive tissue. No doubt, it would be useful for landscape photography, but the films will, of course, require stripping after fixing. Ferran and Paul recommend the following method: A good stout description of paper is moistened and stretched on a board. To render it non-absorbent, the paper is varnished on both sides with a solution of 2 grammes of asphaltum in 100 c. c. anhydrous benzine, and exposed to sunshine for an hour to make it insoluble. Either one of the following solutions is then laid on: 50 c. c. ether, 100 c. c. alcohol at 42°, 1 or 2 grammes wax, stearine, or paraffin; or 50 c. c. ether, 2 grammes wax, and 20 grammes vaseline. After the ether and alcohol have evaporated, the emulsion is laid on with the addition of a small quantity of glycerine in order to prevent it from becoming brittle when dry. The negative, after being developed and fixed, is coated with a solution containing 12 per cent. gelatine and 3 per cent. glycerine, and when dry the film can easily be detached.

And yet, with all these things before us, who shall say that the end of the list of photographic possibilities has come? One of the greatest conquests has

Paper sensitized with gelatine emulsion has been suggested by Swan. Such paper is now being manufactured by a number of parties, and admits of a large number of prints being made in a very short time. The paper is exposed to gaslight under a negative, and developed with ferrous oxalate; the resulting tone being a cold gray, somewhat similar to platinotype.

Employment of Gelatine Emulsion for Reproduction of Drawings.—Gelatine emulsion is quite as well adapted for this class of work, as it is for landscapes or portraiture. The plates should be well exposed, and developed with ferrous oxalate containing a good deal of potassium bromide as a restrainer. If treated in this way they rarely require any after-intensification, but in case such a proceeding is necessary, mercury is the best agent for the purpose. Ammonia emulsion is most suitable.

Reversed negatives for collotype work can be produced by exposing with the film side inwards, the necessary correction for the thickness of the glass being made after focussing. In developing such plates, special care must be taken about the cleanliness of the solutions employed, otherwise the surface of the film may be fogged over before the picture which is on the inner side is sufficiently developed. But the better plan is to use "stripping plates." They are produced by J. Carbutt, of Philadelphia, and are used by most of the photo-mechanical printers in America.

Direct Positives in the Camera.—Negatives on collodion emulsion may be turned into positives, after development, by soaking in concentrated nitric acid, the reduced silver being thus dissolved away; and the picture then consists of undissolved bromide of silver. The plate should then be briefly exposed to light, and redeveloped, or treated with ammonium sulphide, when a positive image will result. It is impossible to treat gelatine plates with nitric acid, as the latter attacks the film; but we found that it was possible to employ mercuric nitrate for the purpose, without danger to the film. If a well-developed gelatine plate be treated with a strong solution of mercuric nitrate, a positive image quickly appears. The plate is then washed, and flooded with ammonium sulphide. The mercury solution should not be too concentrated, otherwise the film shrinks, and gets hard. Brooks gives a method for the production of direct positives in the camera. A bromide or chloro-bromide plate is developed to the full extent until the picture can be seen at the back of the plate. It is then laid in a 1 per cent. to 2 per cent. solution of iodide of potassium in alcohol. For gelatine plates, it is preferable to employ a solution consisting of potassium iodide 1 to 2 parts, potassium bromide 10 parts, and water 100 parts. The original image disappears entirely in this solution, and a picture consisting of iodide of silver on bromide of silver remains. The plate is then washed and treated with pyrogallic or ferrous oxalate developer, which attacks the bromide, and leaves the iodide of silver unaffected. In the fixing bath, the iodide is dissolved away.

Moonlight Photographs.—Gelatine plates, owing to their extreme sensitiveness, are available for this purpose.

Portraiture by Artificial Light.—In England, France, and Belgium, the electric as well as gaslight is made use of in various studios with gelatine plates. The results are highly satisfactory. In using gas, a Wigham or Sugg's burner is employed. Mr. Laws, of been to cause gelatine to respond in such an orderly manner, as detailed by Dr. Eder, to our requirements. It was like the "Taming of the Shrew" to

Newcastle, makes use of a large burner by Wigham, consisting of sixty-eight jets, giving a total intensity of light of 1250 candles. Reflectors are used for diffusing the light, and a shade of blue glass interposed to protect the sitter from the heat. The use of this shield increases a possible exposure of seven seconds to eight seconds. For cartes, Mr. Laws gives an exposure of about eight seconds, and for cabinet portraits twelve to fifteen. The use of gas is well worthy of attention by photographers, owing to its economy as compared with the electric light.

On Blurring in Emulsion Plates.—This defect, which is very familiar in photographing interiors, is common to collodion plates as well as thin emulsion films, owing to their transparency, and the consequent reflection of light from the back of the plate. The best remedy is to back the plate with some dark, non-actinic substance. Dyeing the film has also been suggested; but this has the effect of reducing the sensitiveness considerably. Plates coated with an emulsion containing iodide of silver are less liable to this defect.

Chloride of Silver in Emulsions.—An addition of chloride to a gelatine emulsion will not be injurious as long as there is an excess of soluble bromide present. Whilst this lasts the chloride of silver, as fast as it is formed, combines with the potassium bromide to form fresh bromide of silver.

The Choice of a Bromide in Preparation of Gelatine Emulsion.—We are limited practically for emulsion work to the bromides of either potassium or ammonium, as if the salt of a heavier metal, such as zinc, be employed, it either coagulates the gelatine, or affects its setting power. Potassium bromide, owing to its stability, appears more suitable than the hygroscopic ammonium salt, which discolors under the action of light. The potassium bromide may with several methods be neutral or slightly acid, but not alkaline. The same degree of sensitiveness can be obtained with either the potassium or ammonium salt, and the bi-products have no injurious effect on the gelatine. I have observed, however, that a solution of ammonium bromide, when heated, is readily decomposed into ammonia and hydrobromic acid. The former, at a temperature of 30° C., goes off in the form of gas, and still more abundantly at a temperature of 100° C.; hydrobromic acid remains behind, giving a strong acid reaction, which may be very injurious to the emulsion.

Nearly every sample of bromide in the market contains a slight trace of chloride. A small quantity, such as half, up to one per cent., is of no consequence so long as an excess of soluble bromide is present. If, however, the bromide and silver nitrate exist exactly in their combining proportions, chloride of silver is formed; and the same result obtains if the silver is in excess.

Printing with Gelatino-bromide or Gelatino-chloride of Silver without Development.—An ordinary gelatino-bromide plate darkens in a few seconds under the action of light, and, if exposed under a negative for some hours, a picture full of detail is obtained, which, however, disappears in the fixing bath. By fuming the plates with carbonate of ammonia, the darkening proceeds much more rapidly, and denser pictures can be obtained. In make that substitute for collodion answer. The work began with the manufacturers of gelatine, who by careful experiment conquered all difficulties and

producing prints by this method an emulsion containing an excess of silver is preferable to one containing an excess of bromide, as the former darkens more rapidly under the action of light. Such plates, if previously fumed with ammonia, can be employed; but a longer exposure must be given than when ordinary albumenized paper is employed.

Gelatino-chloride of silver for printing without development should also contain an excess of silver, and requires an exposure of several hours. The prints are brownish-red in color, and can be toned with gold.

Emulsions prepared with a large excess of silver are not subject to decomposition. By long keeping, however, they are apt to discolor, owing to a reduction of silver.

Testing Gelatine Negatives before Varnishing.—It is always well to take a print from a gelatine negative before varnishing, in order to judge whether intensification is necessary. This can always be done if the negative is thoroughly dry; otherwise red stains are apt to make their appearance. Mr. England is in the habit of laying a piece of talc between the negative and the albumenized paper to protect the film.

Retouching can be carried out on gelatine negatives if necessary before varnishing, if a small quantity of turpentine be rubbed over the film in order to give a tooth to the pencil. It is safer, however, to varnish the film first.

Removing the Varnish from Gelatine Negatives.—This operation is often necessary when varnished negatives require intensification. It can readily be done by soaking the plate in strong spirit of benzine, which dissolves the varnish, and the plate may then be gently wiped clear of the varnish with a tuft of cotton-wool.

Recovery of Silver from Waste Emulsion.—For this purpose the emulsion may be boiled for a short time with from one-third to one-sixth of its volume of a strong lye of soda or potash and grape sugar. When the mass blackens throughout, owing to the reduction of silver, and becomes fluid, water is added, and the mixture, after being allowed to settle, is decanted. The precipitated silver can be heated, and melted into a globule. This method is also suitable for collodion emulsion. The silver may also be recovered by boiling the emulsion or treating it cold with hydrochloric acid, which decomposes the gelatine, and when the silver has separated to the bottom of the vessel, the liquid may be decanted off. The best method, however, that I am acquainted with, is the following: To every 100 parts of emulsion 10 parts of concentrated sulphuric acid diluted with 100 parts of water are added. The mixture is boiled in an earthenware jar for ten or twenty minutes. The bromide of silver becomes granular, and after the solution has been diluted with an equal bulk of water it settles to the bottom of the vessel. The liquid may then be poured off, and the precipitate thrown on to a filter and allowed to dry. As this operation is unaccompanied by any disagreeable escape of gas, it is preferable to the preceding.

Cleaning off Old Films.—This is a matter of greater difficulty with gelatine, than with collodion plates. The former may be soaked in a solution of chromic acid, or in a warm solution of soda. The latter decomposes the gelatine, and the films can then be readily detached by washing. The plates should be soaked in a bath of weak hydrochloric acid, to remove any trace of alkali, and then rinsed.

produced an article that met all the wishes of the emulsion maker, as rapidly as it became possible to do so.

Increasing the Sensitiveness of Gelatino-Bromide Plates by Fuming.—Plates which have been exposed to the fumes of strong ammonia at ordinary temperatures, immediately before exposure, will develop rapidly either with alkaline pyrogallic, or, after rinsing, with ferrous oxalate, and give pictures full of detail. This method should be useful in studio work.

Keeping Qualities of Gelatine Plates during the Summer Months, and the Value of Antiseptics.—It has often been remarked that gelatine emulsion which has been kept for some time becomes fluid; and the value of the bromide of silver becomes ruined for photographic purposes. In order to prevent this process of decomposition, the addition of antiseptics, such as carbolic acid, thymol, salicylic acid, etc., has been recommended. Experience on this point is rather conflicting. Szekely finds that an emulsion treated with thymol or salicylic acid is equally liable to decomposition during the hot weather. On the other hand, we noticed that while an emulsion containing no antiseptic becomes fluid after three days, another in which thymol or salicylic acid was incorporated kept sound for six or eight weeks, so long as it was not subjected to a high temperature. General experience is in favor of the fact that both thymol and carbolic acid are better than salicylic acid for preserving emulsions for decomposition.

The Function of an Excess of Soluble Bromide or Chloride in an Emulsion.—The fact is familiar that an excess of soluble bromide restrains the attainment of the highest sensitiveness in bromide of silver, and that an emulsion containing a large excess of bromide, if insufficiently washed, is insensitive, and the reverse if thoroughly washed. The same fact obtains in the case of a collodion emulsion. In reference to this, Wetzlar remarked as early as 1827 that chloride of silver in a solution of sodium chloride becomes converted into a double salt, which is affected by light, whether it be in a moist or dry condition. If an emulsion is prepared with a large excess of soluble bromide or chloride, the slightly sensitive double salt is formed, and it is only by thorough washing that it can be decomposed. We may consequently infer from this the necessity of thoroughly washing an emulsion which has been prepared with a large excess of soluble chloride of bromide. The value of a large excess of soluble bromide or chloride lies in the fact that it restrains any possible decomposition of the gelatine which may arise during the preparation of the emulsion.

The Value of Gelatine in Preventing the Precipitation of Bromide or Chloride of Silver.—Hecht has described some experiments that he made with a view of determining this point. A solution of silver nitrate was added to a simple solution of a metallic chloride or bromide, as well as to solutions of the same to which gelatine had been added until turbidity in the solution denoted a precipitation of chloride of silver. The results were as follows:

(*a*) 100 parts of a 1 per cent. solution of sodium chloride at a temperature of 39° C. or 40° C. retained in solution .00954 part silver chloride.

(*b*) 100 parts of a 1 per cent. solution of sodium chloride to which 5 per cent. gelatine had been added retained at the same temperature .05736 part silver chloride.

Success came through much tribulation and trial, but since it came what marvels have transpired.

(*c*) 100 parts of a 1 per cent. solution potassium bromide retained at a temperature of 39° C. and 40° C. .01099 part bromide of silver.

(*d*) 100 parts of the same to which 5 per cent. gelatine had been added retained .05950 part bromide of silver.

These experiments indicate that the presence of gelatine retards to a certain extent the formation of the haloid salts of silver. Practically, a solution containing 5 per cent. gelatine retains five times as much as a solution in which no gelatine is present. After the solution has cooled down, and has stood for some time, a small portion of the salt separates out.

On the Gradual Increase of Sensitiveness in Emulsions by Keeping.—Captain Abney and Mr. England have stated that an emulsion goes on increasing in sensitiveness, and that plates coated from an emulsion which has been kept for fourteen days are twice as sensitive as when the latter is used fresh. In the case of an emulsion made with either gum or gelatine, which contains, in the first instance, the insensitive modification of bromide of silver, no amount of keeping will produce any appreciable increase of sensitiveness. It is only when an emulsion is extremely sensitive at first, that keeping at ordinary temperatures produces any increase of sensitiveness. An emulsion prepared with ammonia gains in sensitiveness very much if it is allowed to stand for twenty-four hours before washing.

In order to obtain films of uniform thickness, the best way is to determine how much emulsion is required per square inch of surface in order to give a fairly thick film, and to measure out the necessary amount each time; in general, 0.04 to 0.06 c. c. suffice per square centimetre.

Relief Exhibited in Gelatine Plates after Fixing.—An appearance of relief is often observed in gelatine plates after development with ferrous oxalate, and is very apparent in places where strong contrasts of light and shade exist in close proximity. It may be possible to turn this fact to account in various photo-mechanical processes, in the same way that Scamoni employed it with collodion plates.

On the Proper Strength of the Fixing Bath.—A very strong solution of hyposulphite of soda appears to act very slowly, owing probably to the difficulty with which it penetrates into the film. It will often be sufficient in such a case to flow pure water over the film, when the fixing will proceed rapidly. The correct proportions of the fixing bath are about 1 to 5 or 10. Cyanide of potassium and sulpho-cyanide of ammonium are not to be recommended for fixing gelatine plates. If the fixing solution is too strong it attacks the silver, and leaves a thin, useless picture.

Substrata for Gelatine Plates.—If an emulsion has a tendency to frill, and it is decided not to correct the emulsion itself, the best method is to coat the plates with the following substratum: 1 part of gelatine is dissolved in 300 parts warm water, filtered, and, when cool, 6 parts of a filtered 1.50 solution of chrome alum is added. The plates are washed, and, while still wet, the chrome alum and gelatine solution is flowed off and on. The first coating will mix with the water, and a second coating may be flowed on, and the

There are more successes to come provided the mantle of noble generosity, which led the experimenters of the past to give of their knowledge, falls upon their artistic and earnest successors.

plate allowed to dry. It is somewhat difficult to flow emulsion over plates prepared in this way. The best way, perhaps, is to place the plates on a levelled support, and to guide the emulsion up to the edges with a strip of glass. A solution of water-glass (sodium silicate) 1:200 may also be employed for the same purpose. A very useful substratum may be prepared by mixing 3 or 4 parts water-glass with 7 or 8 parts albumen, and 80 to 100 parts of water. The plates are washed, and, after draining, are coated with the substratum. Forrest recommends in the *Photographic Almanack*, the following solution: The white of one egg is mixed with 500 grammes of water, to which 30 grammes methylated spirit and 20 drops of carbolic acid have been added. The solution, after filtering, can be kept for months, and has been found a perfect cure against frilling.

The Sensitiveness of Bromide of Silver under the Action of Different Forms of Developers.—Vogel made some experiments with his new emulsion in reference to the above, and found that, by the use of acid development, customary with wet plates, the emulsion was five times as sensitive as wet collodion, and considerably more so than collodion dry plates prepared with excess of potassium bromide. Ferrous sulphate as a developer did not give a better result than pyrogallic acid. Ordinary collodio-bromide plates are three times as sensitive when treated with a pyrogallic chemical developer, as when treated with the same in the form of a physical developer.

The Use of Alum or Chrome Alum in Emulsions.—These substances may be added to an emulsion, either to improve its setting power, or to prevent any tendency to frill. The same result can be obtained by placing the plate, after development, and before fixing, into a concentrated solution of alum. The alum bath used after fixing is recommended for hardening the gelatine, as well as to destroy any traces of hyposulphite of soda which may remain in the film. The brown color often present in a negative after development with alkaline pyrogallic can easily be removed by soaking the plate for a short time in a concentrated solution of alum, to which 1-32 of its volume of hydrochloric acid has been added. Mr. Carroll and Captain Abney claim that a gelatine plate which has been soaked in a concentrated solution of alum can be intensified with silver without difficulty.

Treatment of the Gelatino-Bromide Image as in Carbon Printing.—Warnerke has found that an image upon gelatino-bromide, developed with pyrogallol, is insoluble in warm water. Such an image may, therefore, be transferred, and further developed, just as if it were upon bichromated pigment tissue. But, as pyrogallic acid hardens the film, the water for developing must be hot, or contain a little alkali; fixed with hyposulphite, the film is more easily dissolved. An image thus treated may also be used for collotypic printing, ammonia applied to the surface before inking assuring clear prints.—Dr. J. M. Eder.

CHAPTER XVI.

NEGATIVE-MAKING—"PAPER" AND "FILM."

176. DURING the many years that collodion held its place in the dark-room its difficulties and defects came to be accepted as the necessary adjuncts of a process which, after all, combined most of the qualities desirable in a negative process. It was simple and inexpensive, comparatively quick, and left little to be desired in chemical effect.

When the extraordinary sensitiveness of gelatino-bromide of silver became known, new possibilities were revealed, and that quality of itself proved sufficient to enable the new process to oust the old after a struggle. But the enthusiastic photographer is never content. Flushed by his success in throwing off the bath and collodion, he asks for more—a substitute for glass. He feels

176. After exposure, of course, the method of treatment is similar to that of the dry plate. It is best, in hot weather, to use ice in the developer and the wash water.

In treating negative paper prepare the developer as follows:

No. 1.—Sulphite of sodium crystals, pure, 6 ounces; distilled or boiled water, 1 quart; pyrogallic acid, 1 ounce. No. 2.—Carbonate of soda, pure, ¼ pound; water, 1 quart.

To develop take in a suitable tray No. 1, 1 ounce; No. 2, 1 ounce; water, 1 ounce.

Immerse the exposed paper in clean *cold* water and with a soft camel's-hair brush gently remove the adhering air bells from the surface. As soon as limp transfer to the developer, taking care to avoid bubbles by gently lowering the paper by one edge so as to slide it under the surface of the developer.

The image should appear in 10 to 20 seconds and the development should be carried on in the same way as for a glass dry plate. If the image appears too quick and is flat and full of detail add 5 to 10 drops of the restrainer—Bromide potassium, 1 ounce; water, 6 ounces. This will keep back the shadows and allow the high lights to attain density.

If the exposure has been too short and the image does not appear except in the highest lights, add instead of the restrainer not to exceed one ounce of No. 2; this will help to bring out the details and compensate in a measure for the short exposure. As soon as sufficient density is obtained slightly rinse the negative and put it in the fixing-bath—Hyposulphite of soda, 4 ounces; water, 1 pint; common alum, ½ ounce. To be mixed fresh for each batch of negatives.

The completion of the fixing operation may be ascertained by looking through the film. When fixed wash in 5 or 6 changes of water for 15 or 20 minutes and then lay the paper negative face down upon a sheet of polished hard rubber. Press the negative into conhampered in the free use of gelatine dry plates by their cost. Everything conspires to render gelatine dry plates expensive. Until this is corrected we can scarcely be said to have a perfect negative process.

There are, however, two methods now coming into use which promise well. First a little as to their history, and then instructions how to use them.

While many another ingenious plodder was experimenting with gelatine sheets and translucent paper, reviving the old Talbotype process, or treading on the heels of the manufacturers of carbon tissue, Mr. George Eastman turned aside from all makeshifts, and attacked the conundrum in an entirely different direction, in which he met with the success he deserves.

One of Mr. Eastman's products is an *emulsion film* supported on paper or its equivalent, and is supplied to the purchaser either in "endless" rolls, or in "blocks" of a dozen or more sheets together, flat and compact.

I am hardly called upon to go into the details of the manufacture of these films, for the possible processes are various. There are methods given further on. Given the "film," what concerns us most is, how are we to make it available?

tact with the plate by the scraping action of a squeegee, and allow to dry, when it will peel off from the plate with a fine polished service.

The Oxalate Developer.—This developer also works well with negative paper, and I recommend it for trial—Saturated solution oxalate of potash, 6 ounces; saturated solution protosulphate of iron, 1 ounce. The separate solutions keep well and should be mixed fresh for development and about 25 per cent. of old developer added for use.

To render the paper negative translucent so that it will print quickly, lay it face down upon a clean piece of paper and rub over the back a liberal quantity of translucine; allow it to soak into the paper until it is of an even dark color. This will take four or five hours in a moderate warm room. Then wipe off the surplus with a squeegee and afterward with a soft cloth. The negative is then ready to print. If the negative is wanted for immediate use the action of the translucine may be accelerated by heat.

Castor oil has heretofore been recommended for making paper negatives translucent, but after an extended series of experiments I have adopted a preparation which has no odor and does not require the use of a hot iron to make it sink into the paper.

Thus prepared, negative paper will print remarkably free from grain and quicker than most pyro and ammonia developed glass negatives. To print simply lay the negative with the glossy side up on a piece of glass in the printing frame, lay upon it the positive paper and print the same as a glass negative. The negative does not require fastening to the glass in any way. These negatives should be kept between paraffine paper, or back to back in a printing frame, or suitable box. If the translucine dries out after continued use, the negative may be given a fresh application.

When the negative is to be retouched, as in portraiture, it should be done after oiling.

Were the paper or other support simply coated with sensitized emulsion, there would be no profitable way of utilizing it for negative purposes. Refer to the diagram (Fig. 334) and this fact will be made plain. *A* is the support; *C* is the layer of emulsion; and *B* is a *gelatine* layer which comes in between for a purpose which will be found necessary when the method of using the film is further explained.

FIG. 334.

The *construction* of the film is now understood, and we expose it in the camera. It is developed and fixed as though it were on glass. After being thoroughly washed, the film is detached from the paper in the following, or in some equivalent, manner:

The fixed and washed film is floated face downward in water, and a glass plate being introduced under it and lifted out of the water, the plate will lift the film with it, which is then made to adhere closely to its surface by pressure on the back of the paper. The adhesion is preferably secured by the sliding pressure of the edge of a straight piece of rubber or other flexible substance carried along the back of the film. The application of the pressure should be

The paper takes the pencil freely and persons unskilled will find it comparatively easy to "work."

When it is necessary to intensify it may be done before oiling by soaking the negative in a saturated solution of corrosive sublimate, washing and then blackening the image with a solution of 10 drops of strong ammonia per ounce of water.

Where *strong negatives* are desired add 5 drops of the restrainer to the developer before using.

The negatives may be printed *without rendering transparent.* The only advantage in oiling is to make the negative print quicker, the grain of the paper being imperceptible, either with or without oiling. When a negative is not to be oiled, it is a good plan to coat it on both sides with plain collodion. This gives the paper a glazed surface and prevents it getting soiled in printing. The best way to apply the collodion is to immerse the negative in it in a shallow tray for the instant, remove and hang up by one corner to dry.—GEO. EASTMAN.

Having heard many complaints of paper negatives curling, and being hard to handle in the printing frame, etc., I have concluded to give my way of managing them, as I am using them right along for all sizes from 5 x 7 up, with *fine success,* and am greatly in love with them, on account of their very many advantages over glass.

Develop as per directions (I carry the development a little further than with glass). When developed rinse in clean water, then fix in hypo and water, leave out the alum. When *thoroughly* fixed, which is shown by the negative being of a uniform color, looking through it, or simply showing the grain of paper with no opaque spots, wash and immerse in a saturated solution of alum for five minutes. Wash thoroughly and squeegee face repeated until contact is secured at all points by the entire removal of the water between the glass and the film. The paper support is now detached from the film by the application of the requisite degree of heat to the glass plate, the effect of which is to soften the gelatine layer between the paper and the relatively insoluble gelatine layer containing the image, so that the paper may be readily stripped off or removed, leaving the image adhering to the glass. The heat may be applied uniformly by placing the glass on a heated plate of metal, or on a water bath, or by the application of hot water to the plate. Any remaining traces of the soluble gelatine layer may be sponged or washed off with warm water, and the glass and adhering film, when dried and varnished, if desired, is ready for the printer.

By the use of wax on the glass or other support, the film may be stripped and used or preserved independently. Thus the glass having been coated, with beeswax dissolved in turpentine, and subsequently polished, the gelatine image may be removed therefrom by applying a moist gelatine sheet to it and allowing it to dry, after which the two gelatine sheets may be removed together from the glass or other support, and may be subsequently used to print from, or mounted, or preserved in any preferred manner.

The operation may be performed in different order. Thus, the paper may

down on a sheet of ebonite. When thoroughly dry it will peel off, giving a beautiful glossy face (I prefer using the alum solution *after* fixing, as it gives a clearer and *cleaner* negative than when mixed *with* the hypo). The negative will invariably curl *face in* on being lifted from the ebonite, and may be straightened by the scraping action of a ruler applied to the back. Lay the negative on a sheet of glass with a clear piece of paper between the negative and glass. Apply the ruler, the corner behind the ruler being lifted as the ruler is passed along. When straight, lay face down on a piece of smooth pine board (with a piece of clean paper on it), and tack the four corners with thumb tacks. Apply the "trauslucine" or oil, and hold over the oil-stove, keeping the negative in motion till it presents a uniform dark color all over. (The board keeps the negative from curling as it *would* do if not tacked to the board when heat is applied.) When cool repeat the operation. I repeat it because one is then *sure* it is transparent, and it takes but a moment to do it. When *cool* the second time, wipe off the surplus oil with a clean rag. The retouching can be done from either side. If from face, I apply the retouching fluid with the ball of the finger same as with a glass negative. If from the back no preparation is necessary, simply use a harder pencil.

I keep the negative in place in the printing frame by tacking the corners with small pieces of sticking paper. For copies one can do four times the amount of retouching that can be done on glass—working out backgrounds, etc. In storing away for further use I oil a piece of paper in the same way I oil the negatives. Place it between two negatives (back to back). This keeps the negatives saturated a long time, not allowing be stripped from the film before development or after development, and before fixing or after fixing.

I ought to have said as to the gelatines in the composition of the gelatine layer *C*, and the emulsion layer *B*, that the last is less soluble than the first (though both are insoluble in cold water), because of the addition of chrome alum, and is rendered so in order that it may be transferred to glass or entirely detached from any support, if preferred, as described above.

The matter will be made still plainer if I quote the claims of the inventor:

"I claim, as a new article of manufacture, a sensitive photographic film consisting of a coating of insoluble sensitized gelatine, *C*; a paper or equivalent support, *A*; and an interposed coating of soluble gelatine, *B*."

Or, to be more definite, as a new article of manufacture, a sensitive photographic film composed essentially of a paper or equivalent support, a film of sensitized gelatine, and an interposed attaching-film, the said sensitized film being insoluble, and the said intermediate attaching-film being insoluble with respect to the developing-fluids, but rendered soluble in water by the application of heat, substantially as described.

them to dry out. It is easier to oil the separating paper, than it is to have to *re-oil* two negatives.—W. B. Glines.

As my work is largely in the line of paper negatives, I may be excused for confining myself to this subject.

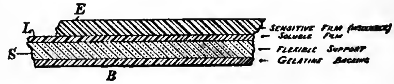
Not unfrequently have I read of various mediums being recommended for drying the negative upon, to enable one when they are dry to strip them off straight and smooth, and it has led me to believe that others may have as much trouble as I have had. It cannot be questioned that polished hard rubber is the best known medium, but where a large number of prints are to be mounted at one time, rubber is too expensive. I have always used glass, but many a good negative have I scraped off with my knife, being unable to pull it off, even though it was well greased. I have tried ferrotype plates, as has been recommended, but without success.

I have discovered that polished glass is much better than ordinary French glass, and I have also found that it is better to rub it thoroughly with whiting, let it dry, and then polish clean, than to wash it. I use an oil made by combining sperm oil and fresh lard to the consistency of cream.

But with almost any support they are apt to dry uneven, the upper part (if set in a rack) will dry first, and leave the support, causing the paper to cockle up and prevent lying flat in the printing frame. This is very annoying, as I have been obliged in some instances to wet them and mount them over. This difficulty is very much lessened by setting the negatives up in a rack until surface-dry, then place one or two blotting-pads between them, lying flat on the table over night; in the morning, set them up in the rack again, and dry slowly. This is the best way I know of to proceed with oiled glass.

177. When Mr. Eastman was working the process described above in connection with his friend and partner, Mr. William H. Walker, they found that when the support was coated on one side only, the coating would swell from the absorption of water during the various stages of development, and the films would consequently manifest a tendency to curl backward. Patient experiment revealed the fact that this annoyance could be overcome by giving the support a coating of gelatine on its back or reverse side. A new invention was thus born, and jointly the gentlemen named have received a second patent for process and product. Fig. 335 represents the film as it is now offered to the trade. *S* represents the flexible support; *E*, the sensitive coating; *L*, the interposed gelatine layer; and *B*, the gelatine backing.

Fig. 335.



In practice, the emulsion layer containing the image may be stripped from the flexible support by the application of warm water, which dissolves the interposed gelatine layer *L*, and the detached film may then be used alone or affixed to any suitable support for printing purposes. The second new method, then, is the art of preparing sensitive photographic films, the process consisting

I have recently discovered what I believe to be a more satisfactory way than oiling, although I speak from less experience. In experimenting with Eastman's stripping films I used a rubber solution which they supply; it is usually flowed over each plate, and allowed to set before the negative is adjusted; but this being too tedious for a number of prints, I took one of my oiled plates and wiped it off as thoroughly as I could, and with a piece of chamois skin, dampened with the rubber solution, I went quickly over the plate and adjusted the negative at once. It remained in perfect contact until thoroughly dry, and then I cleaned the glass with a fine surface and without a wrinkle. I have no doubt it would have done the same had not the glass been previously oiled. I shall investigate further, and if what I have written will help any one, I shall feel repaid for giving my experience.—C. M. French.

177. To make gelatine film negatives, I give you several methods.

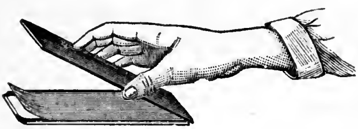
Preparation of the Negative Film.—Ordinary white writing paper is allowed to lie for a short time in water, then placed upon a clean glass plate, which has been previously rubbed with a little wax, and bordered around with strips of albumen or gum paper. When the paper is dry, it is stretched tightly over the plate, and sprinkled over with talc powder; the excess of powder is brushed off with a camel's-hair pencil. The paper is now coated with a mixture of—Ether, 50 grammes; alcohol, 50 grammes; pyroxylin, 1 gramme; oil of ricinus, 8 drops.

As soon as the collodion is perfectly set, the bromide of silver gelatine emulsion is spread over smoothly by means of a glass rod. As soon as the emulsion is set, the edges are cut round by a penknife, and the film easily lifted up and cut to any desired size.

in applying to a sheet of paper, or like support, a layer of soluble gelatine and drying the same, then calendering the sheet to harden and polish its surface, and finally applying to the soluble layer of the calendered sheet a coating of relatively insoluble gelatino-argentic emulsion. These are known in the trade as "American films." The inventors prefer to attach the film to a glass support before removing the paper, as described by Mr. Eastman in his individual patent.

As I have already said, the manufacturers supply both the new films and negative paper in "blocks" of a dozen or more, or upon rollers containing sufficient film for fifty or more exposures. Those preferring them in blocks, can remove them film by film, and use them backed with glass in the ordinary holder. Or a "film carrier" (Fig. 336) is provided. This last is made so light and strong, that with the film attached it may be placed in any holder as though it were a sheet of glass. Its use is obvious.

FIG. 336.



For greater facility in their use, a roll-holder may be attached to the camera. At one end of the holder a roll of film is inserted, and its loose end drawn

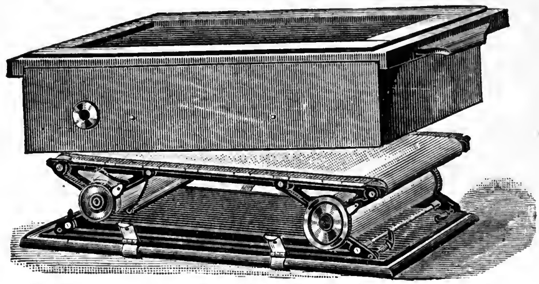
Another method consists in coating over the same kind of paper or albumen paper laid upon a warm plate with—Wax, 2 parts; benzine, 100 parts.

The paper so prepared is dampened, and, as in the former recipe, stretched over a clean glass plate, and coated with the gelatine emulsion. This plan affords more brilliant results than the former; besides, the sensitive film seems to adhere firmer to the paper, a circumstance desirable for the subsequent manipulations to which it is to be subjected.

A third method: A sheet of double transportation paper is stretched over a glass plate, and coated with collodion as before; and, after setting, separated from the glass. A second glass plate is sprinkled with talc powder, coated with emulsion, and laid after the setting of the gelatine (about a quarter of an hour) in a dish of distilled water. The collodionized paper is also laid in another dish of water, and when wet through, laid upon the gelatine plate, the collodion surface against the gelatine film. The plate and paper are now taken from the water, and contact thoroughly secured by means of gentle pressure. The paper is now cut around the edges of the glass, and, if properly performed, the gelatine film will detach itself from the glass and be found adhering to the paper, in which condition it is ready for exposure in the camera. In separating the film from the glass, care must be taken to do it quickly and without any pause, otherwise there is danger of tearing the film.

Fourth method: Ordinary white paper or albumen paper is waxed as before, and the glass plate strewn with talc powder, coated with gelatine, and, after the setting, together with the paper put in the water bath. If both are carefully taken out, it will be found across and fastened to a roller on the other side. After the first exposure is made a light and peculiar system of machinery within the holder is then wound up, and set in motion. Thus, the film is drawn across the face of the holder until a given signal is sounded, when the works halt, and the film is ready for another exposure, and so on to the end of the film. A method of registering the exposures is supplied, and a puncture is made in the film automatically, as the film moves from roller to roller, to show where one exposure ends and another begins. The drawing makes it very plain (Fig. 337). It consists essentially of a metal frame carrying the spool wound with the supply of paper, and a reel for winding up the exposed paper, suitable devices for maintaining a tension upon the paper, and measuring and registering mechanism. The frame is hinged at both ends to the panelled board which forms the back of the enclosing case. The cut shows the holder with the case partly raised. The movement raised for changing the spool is shown in Fig.

Fig. 337.

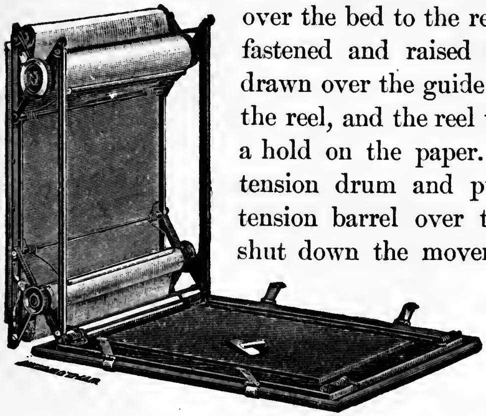


that the two surfaces are in contact, and all that is necessary is to separate them. This process avoids the coating of the paper with collodion, as in the first method. These leaves or films may be preserved in a book, so as to keep them flat.

Development.—The films are laid in distilled water, and suffered to lie there until they become perfectly flat. The water is then poured off and the developer applied. When the shadows of the negative begin to appear gray, the developer is poured off, the negative well washed and put in a bath of hypo and alum, where it is allowed to remain until all the unreduced bromide of silver is eliminated, which is indicated by the paper becoming pure white. The negative is then washed for hours. If it is desirous to have a firm, inflexible negative, take a glass plate sprinkled with talc, and coat it with collodion; then, after the setting, with a mixture of—Water, 100 parts; white gelatine, 40 parts. As soon as this sets, treat the plate to a bath of water. In the same bath place the negative film; let it remain therein about five minutes, and press it in contact with the gelatinized glass. The attached film is allowed to dry thoroughly, and the paper cut about 6 mm. from the edge with a penknife. The paper is loosened from the plass plate. If a thin film is needed, the glass plate is sprinkled with the talc and coated with collodion. The negative is dipped in a thin gelatine solution, laid upon the collodionized plate, and the excess of gelatine pressed out. The whole is allowed to dry and the paper detached, and the negative film from the paper, in the same manner as before described. An evil attached to the method is, that the negative film curls up too easily.

338. To fill the holder, the movement is raised, the spool inserted in its place *under* the brake and fastened with the thumb-screw on the side of the frame; the pawl on the tension barrel is thrown off, the bank on the spool broken, and sufficient paper drawn out to reach over the bed to the reel; the movement is shut down and fastened and raised at the reel end, the paper is then drawn over the guide roll and slipped under the clamp on the reel, and the reel turned sufficiently to give the clamp a hold on the paper. Now, throw in the pawl on the tension drum and put on the tension by turning the tension barrel over to the left until the paper is taut; shut down the movement and put on the case, insert the key and turn it over until the alarm strikes once, draw the slide and mark the limits of the first exposure with a lead-pencil. The holder is then ready to attach to the camera. After the first exposure turn the key until the alarm strikes four times (three in the 4 x 5 holder). This brings a fresh sheet on the bed for

FIG 338.



The paper negative may be dried between blotting paper, but must be first treated to an alum bath. It is then well washed and flooded in a mixture of—Water, 1000 parts; glycerine, 50 parts; alcohol, 50 parts; by which means the films become soft and flexible.

Of the above methods for preparation of negative films, I especially recommend the third and fourth as giving very brilliant negatives, without spots or pinholes. Although the methods may occasion some little trouble, I think that the photographer will be richly repaid for the labor expended.—ROBERT CHENEVIERE.

For the "American films" the manipulations vary somewhat from those for the negative paper.

Development.—No. 1. Sulphite of sodium, pure, 6 ounces; distilled or boiled water, 1 quart; pyrogallic acid, 1 ounce.

Dissolve the sulphite first and then add the pyro. No. 2. Carbonate of soda, pure, ¼ pound; water, 1 quart;

To develop pour into a clean tray the following: No. 1, 1 ounce; No. 2, 1 ounce; water, 1 ounce.

Immerse the exposed film in a tray of clean cold water, and with a soft camel's-hair brush gently remove the air bells that cling to the surface of the film. As soon as limp, remove the film to the tray containing the developer and proceed with the development the same as with a dry plate. The image should commence to appear in ten or fifteen seconds. If the lights come slowly and with no detail in the shadows, add not to exceed one ounce of No. 2. If the image appears too quickly, add 10 to 20 drops of the restrainer exposure, after which turn the key and make as many exposures as required. When done, take the holder into the dark-room, remove the case and insert the point of a penknife in the slot in the guide roll and separate the exposed from the unexposed by drawing it along the slot. Throw off the pawl from the reel and draw out the exposed paper and cut it off at every fourth mark (third mark in the 4 x 5 holder), with a pair of shears. If any unexposed paper remains on the spool draw over the end and attach it to the reel as before, and the holder is ready for work again.

This is a most ingenious and satisfactory arrangement, and proves the consideration of the inventors in not only giving us a new product, and a new process, but in producing the wherewithal to make its use easy, certain, and therefore enjoyable. The roll-holder, for fifty films, weighs one pound less than two ordinary double holders filled.

Here is a *great* advantage among a hundred others. The inventor modestly states but a few in his specifications, as follows:

—Bromide of potassium, 1 ounce; water, 6 ounces. Keep this in a dropping bottle consisting of an ordinary bottle having two notches cut lengthwise in the cork, on opposite sides.

The film may be examined from time to time by transmitted light by holding it up by the corners. When sufficient density is obtained, wash the film in two changes of cold water and then immerse in the fixing bath—Hyposulphite of soda, 4 ounces; water, 1 pint.

Mix fresh fixing bath for each batch of negatives. Use no alum in the fixing bath.

Films fix quicker than glass dry plates, and the completion of the operation can be ascertained by the even, translucent appearance from the back while lying in the bath or by examination by transmitted light.

Oxalate Developer.—The oxalate of iron developer works well, and has no tendency to attack the soluble substratum and render it insoluble. No. 1. Oxalate of potash, 1 pound; hot water, 3 pints.

Acidify with sulphuric acid. Test with litmus paper. No. 2. Protosulphate of iron, 1 pound; hot water, 1 quart; sulphuric acid, ½ drachm.

No. 3. Bromide of potassium, 1 ounce; water, 1 quart.

To develop, take of No. 1, 6 ounces; No. 2, 1 ounce; No. 3, 10 drops. Mix in the order given; use cold.

After exposure, soak the paper in water until limp, then immerse in the developer.

The image should appear slowly, and should develop up *strong, clear, and brilliant.* When the shadows are sufficiently black, wash well and fix.

After fixing, wash in three or four changes of cold water for five or ten minutes, and the film is then ready for transferring to glass. Coat a clean glass plate, one size larger than the film with the following rubber solution: Eastman's pure para gum, 5 grains; benzine, 1 ounce.

"The advantages which the sensitized films possess over the ordinary glass dry plates are obvious. Thus, one is enabled to dispense entirely with the glass, the original cost, and the expense arising from the handling, cleaning, breakage, and transportation of which is saved; also to effect a considerable economy in the amount of emulsion used, as the glass, owing to its curvature and uneven surface, requires to be coated thicker than the gelatinized paper; and, as the operation of coating the gelatinized paper with the emulsion, may in manufacturing operations be carried on by machinery in absolute darkness, the highest sensitiveness may be given to the emulsion employed in the improved films without danger of fog from too much light; and the operations necessary to secure the desired image are so simple as to be readily learned by the most inexperienced person."

When dry, slip the plate under the negative, which should be face down in a tray of water. Grasp the film by one edge on the glass and lift from the water, allowing the water to drain from the side furthest from the operator. All surplus water can now be removed by the scraping action of a rubber squeegee, and the plate supporting the film set aside to dry. When dry, soak the film and plate in a dish of warm water, increasing the temperature until the paper commences to blister. Lift one corner of the paper with the point of a pin and gently pull it off from the negative film, which will adhere to the glass. Remove from the film with warm water all traces of the soluble substratum which is between the paper and the film.

The image-bearing film is now on the glass with the paper removed. If intensification should be necessary, the operation can be performed in the same manner as with dry plates.

Intensification.—Soak the plate in a saturated solution of bichloride of mercury, until the image turns a dull gray color; wash thoroughly and apply a weak solution of ammonia, say—Strong water ammonia, 10 drops; water, 1 ounce.

The plate may now be dried and proofs taken or retouching done; or it may, without drying, be immediately prepared for stripping from the glass by coating with the stripping varnish—Clear white gelatine, ½ pound; glycerine, 800 grains; carbolic acid solution, 1 ounce; water, 40 ounces.

Carbolic acid solution. Carbolic acid crystals, 2 ounces; alcohol, 4 ounces; water, 2 ounces.

Soak the gelatine in the water until soft, dissolve by heat, and add the glycerine and carbolic acid solution. Filter carefully, and allow to stand in warm water until the bubbles disappear. This preparation will keep indefinitely and can be melted for use. In damp climates the proportion of glycerine may be reduced.

Coat the film on the plate thickly with the hot gelatine varnish and put on a level shelf to set. When dry, cut around the edge of the film with a sharp knife and peel the film negative from the glass. Remove the adhering thin film of rubber with the palm of the hand dry or a bit of cotton moistened with benzine. The film is now ready for printing.

178. Since these inventions have been introduced European and other manufacturers and experimenters have been busied in perfecting the processes by which they may be worked with most success.

The printing of a film negative may be done from either side if required, but the side that was next to the glass is the correct side. The film should be laid on a piece of ground glass in the printing-frame with the rough side of the glass next the film. This gives fine, soft effect and prevents mottling of the paper caused by partial contact of the film with the glass.

In general. Solutions used in developing the films should not exceed 75° Fahr., and the hands should only touch them at the corners while wet to prevent softening of the soluble gelatine layer that holds the film on the paper.

Alum must not be used on the films or in any of the solutions, lest the soluble gelatine layer be rendered insoluble and prevent subsequent transfer.

For photo-mechanical printing processes and carbon single transfer, the films may be printed while on the glass.

It has been found that when the ammonia developer is used, or if the proportion of sulphite in the formula given is increased, there is a liability of the pyrogallic acid attacking the soluble gelatine layer and rendering it insoluble. I therefore guarantee the stripping of the films only when the developer used is mixed according to formula and all directions are strictly followed.—George Eastman.

178. *M. Thiebault's Support for Emulsion Films.*—The chief difference between this emulsion and others in the market lies in the fact that it is spread on cardboard; the cardboard is first enamelled, which enables emulsion to be spread over it evenly, and to adhere thereto with sufficient tenacity to enable it to bear the ordinary processes of exposure, development, fixing, and washing with impunity. After these processes have gone through, the emulsion remaining on the cardboard can be detached therefrom, and the photograph is then left on a clean, perfectly transparent, and tough sheet of gelatine, from which prints can be taken from *either* side. Thus the weight of glass, the chance of breaking, and imperfections arising from a process in which a paper base has to be made transparent, are avoided.

Development.—This is done either by oxalate or pyrogallic acid, in accordance with the known processes repeated hereafter.

Pour the developing liquid, which must be prepared in a graduated glass measure beforehand, over the card.

The white or bright parts of the negative enable the operator to watch the progress of the development, which must be allowed to go on long enough, because of the great transparency of the film.

After having poured back the developing liquid, without removing the negative, rinse it twice in water, which should be changed each time.

Pyrogallic Acid Developer.—Solution A. Water, 1000 parts; carbonate of potash, 45; sulphite of soda, 12.

Solution B. Water, 1000; pyrogallic acid, 12; sulphite of soda, 12; citric acid, 2.

Mix an equal quantity of Solution A with Solution B, and place the card in the mixture as soon as it is made.

Efforts have been made, too, to improve and push forward old inventions. Likewise other and new methods of supplying a substitute for glass have been

Ferrous Oxalate Developer.—Solution A. Warm water, 1000; neutral oxalate of potash, 300; bromide of potassium, 3. (To be filtered.)

Solution B. Warm water, 500; ordinary ferrous sulphate, 200.

After solution add 3 c. c. of sulphuric acid in order to prevent oxidation.

Mix 80 c. c. of Solution A with 20 c. c. of Solution B. This developer may be used for developing successively two or three negatives.

Fixing.—Place the card in the fixing bath, taking care that the image be turned downwards. It requires about a half an hour in order that the operation be well done.

Several negatives can be fixed in the same bath, provided there be liquid enough.

After this, two hours of washing are sufficient, during which the water should be changed three or four times.

The following formula should be strictly observed: Warm water, hyposulphite of soda, ordinary pulverized alum. Let this solution settle for several hours, and then filter it.

Drying.—This operation is very simple. After having cleaned the surface of the film with a piece of wet cotton, dry it several times between sheets of blotting paper, and then fix it firmly on a board by means of four or six pins, the image being turned toward a sheet of blotting paper.

It is only after being completely dry (*this is very important*) that the gelatine film can be detached from the card by raising it at one corner, and round the edges, previously being careful to remove the holes made by the pins.—INCE and ADDENBROOKE.

M. Balagny's Flexible Gelatino-bromide Plate.—Contemporary with the invention of M. Thiebault, is the method of Mons. G. Balagny of Paris. The ingenious experimentalist has been working in an entirely different direction from those who found it quite easy to manufacture a support of small size from a combination of castor oil and collodion, and now supplies a flexible body "as colorless and transparent as glass." It is composed of a succession of very adhesive films of collodion, varnish, and gelatine. Each one of the substances employed gives one or more of the qualities desirable in the result, namely, transparency, flexibility, impermeability, and extensibility.

M. Balagny admits some trifling difficulties in the manipulation of his films, owing to the disposition of gelatine to "take in water," but these he will entirely overcome. For all classes of work he recommends them, and gives the following details of manipulation:

To develop, use a dish made of oak, having a glass bottom and a glass opening on one of the longer sides. The bottom of this dish is wet with a little water, which is entirely removed. There remains enough dampness to cause the plate to adhere. The bath, as usual, is in a glass vessel, and is thrown on the plate, which has been placed on the bottom of the dish. The development is made with either iron or pyrogallic acid, with ammonia, carbonates, etc. M. Balagny says: "I make use of the development with soda crystals, which I have before mentioned, and I obtain agreeable tones with entire absence of the yellow color which causes many persons to avoid the use of pyrogallic acid. Whatever the mode employed, the development goes on exactly as if it were a glass plate; neither slower nor quicker. There is no necessity for hurry or fear, as it is with great offered, the most promising of which are herein considered with the hope that some good may be found in them and lead to more.

At this writing the adoption of films is not general enough to enable me to

difficulty that the liquid can penetrate the support. From time to time the dish is lifted so as to bring all the bath in the space formed by the cover, and it is possible to follow from second to second the progress made in the development by examining the cliché by transparency. This is a point that I have always held, and that I have always wished to see realized by any support whatever, for to develop by reflection without being able to follow the development by transparency, is to go at haphazard; it is to create another difficulty when photography already presents so many, and to yield up everything to chance. If necessary, the negative is strengthened by any of the known means; then, when it has reached the desired point, it is placed for two or three minutes in a six per cent. alum bath. Now fix in a fifteen or twenty per cent. hypo bath, then wash in five or six consecutive waters, allowing the cliché to remain in each from five to ten minutes. The oftener the water is changed, the better the negative is washed. However, do not allow the negatives to remain too long in the last water; in one hour all should be ended. I have sometimes allowed negatives to remain in the water three hours in succession; but this is useless, as it is the change that does the washing. It is therefore possible, by frequently changing the water, to wash very quickly, and that without handling the negatives. All the negatives being in the same dish, the water which it contains is poured out by one of the corners; the negatives remain at the bottom, and the water is renewed.

Here too is a method which promises much, but it is not just what we want. The total depravity of gelatine, better known to dry-plate makers than to the users of plates, has made it, if not as objectionable on account of brittleness, yet fully as much so on account of its susceptibility to atmospheric changes. We, therefore, want something that will enable us to dispense with both glass and gelatine. It will probably come to us some day, with a substitute for albumen.

The placing in the frames is very simple. Stretchers are very good but not necessary. We may gum the upper and lower edges of a plate of glass, of wood, of metal, or even of cardboard, and the flexible plate, which is exceedingly plane, will stretch on this plate without the least difficulty. *A fortiori*, sticking plaster may be used with perfect success. The rapidity is the same as for the best plates. It is, therefore, possible to make portraits, groups, and instantaneous views. It is known that certain kinds of work give what is called halos. Such are the interiors lighted by plain or painted glass, the sky detaching itself on a background of trees, and strong whites alongside of blacks in the subject; in these cases, it is customary, to prevent the double reflection of the luminous rays, to coat the reverse of the plates with a mixture of burnt sienna, earth, and dextrine. Now, as we have here a body absolutely similar to glass, it is probable that the same thing might be reproduced.

I will here make an observation applicable to alum and hyposulphite baths, and to the washings. In all these cases the kind of dish to be used is immaterial. Stiffened cardboard is very suitable. It is well during these operations that the gelatine film quote largely from the experiences of my co-laborers. But so it was, at first, with bromo-gelatine plates. Film photography will grow.

should be turned toward the bottom of the dish, whilst in the developing bath the film which forms the negative should always be on top.

When the washings are ended, the cliché is quickly passed through bibulous paper, used solely for this purpose, to remove the excess of water, and finally plunged for five minutes in the following bath, contained in an enamelled sheet-iron or glass dish: Alcohol at 40° (95 per cent.), 16 ounces 7 drachms; glycerine, 1 ounce 5 drachms.

This bath has for its object to accelerate the drying and to give very great flexibility to the negative.

You now remove your negative from the bath, drain it for half a minute over the dish, and place it between two sheets of thick bibulous paper, laid on a clean plate, or even on the plate itself without any bibulous paper. Place on the back of the negative a sheet of rubber or oil-cloth, and with a roller gently press to remove all excess of the liquid. After using one sheet of bibulous paper, should any humidity remain, change it; you thus dry your negative, keeping it flat on a plate and pressing over it the roller with the interposition of one or two sheets of thick bibulous paper. When all apparent humidity has disappeared, that which is not visible and which is in the body of the plate, is removed by placing it for half an hour between thick bibulous paper laid flat on a table, or, when travelling, at the bottom of the dish, which should be carefully wiped. In a word, the negative should be kept perfectly plane whilst drying, but there is no need for any support. Placed between a book of bibulous paper on a table or between plates of glass, or books, the result is the same. At the end of half an hour or one hour, and to render the negative very plane, it is placed in a bound album of the thick bibulous paper mentioned above, in which it may be allowed to remain indefinitely. When the album is full, the negatives are laid one over the other in piles, or are placed in a spring box such as is used for the preservation of positive paper. There is nothing to fear from scratches or rubbing, the new support being solid. When the bath has been used several times it becomes excellent; but from use it diminishes, and then some new bath should be added in the proportion of two to one. A bath is old when a small quantity placed in the flame of a candle takes fire with difficulty. It should always weigh about 60 degrees with a centesimal alcohometer. Four, five, or even more negatives may be placed in the bath at the same time. In this case, and after they have remained five minutes, they are placed one over the other on a single plate; finish by using a sheet of oil-cloth or caoutchouc. When the roller is used all the liquid exudes and is received in the dish. Then, with thick bibulous paper, each negative is separately dried, still making use of the roller. The negatives are then placed one after the other in the first blotter, and then in the last, in which they remain until required for use.

With this process carbon printing is very simple, requiring but one transfer. Positives by transparency are made with very great rapidity, and projections and stereos, notably, show a clearness worthy of albumen.

Finally, as the flexible plates do not stretch, they can be used for printing two superposed negatives, one giving a greatly exposed landscape, and the other, persons who

For interiors flexible negatives are far preferable to anything else, because halation is an almost unknown occurrence with them under any circnmstances.

posed instantaneously. With little practice it will be possible to develop these negatives lightly, although with all the details, so that in printing one of the two negatives, the bottom one should receive the light only through the other.

Before glass dry plates have reached the perfection which was hoped for, it is already sought to replace them in most of their applications by the pellicular processes. I am convinced that these new preparations will be solely used in the future. But to supplant glass plates, they should possess the same qualities—fineness, transparency, rapidity, and regularity—without the objections to such plates—their fragility and weight. This is a very complex problem, and up to the present time only very unsatisfactory substitutes have been offered. Most of the pellicular processes lack rapidity, which is a serious obstacle in the matter of instantaneousness. Moreover, some are not sufficiently rigid, and placing them in the frame is more or less difficult; others, on the contrary, owing to the presence of a cardboard support, are sufficiently rigid and plane, but completely opaque. Under these conditions, development is uncertain; and anyone desirous of obtaining an irreproachable cliché, may well hesitate in operating in this manner. Finally, the pellicle may swell in the divers liquids and present enlargements or distortions.—M. Balagny.

We have recently examined a new process due to our friend, M. Balagny. This process seems to us the most perfect of any that exists. It consists of the use of a sensitive pellicle obtained by special processes, and possessing the following qualities: absolute transparency, inextensibility, great delicacy, and sufficient rapidity for the requirements of current instantaneous photography. It requires no support, and may be printed on both sides, which is important for carbon reproductions and those made with fatty inks. In one thing it is deficient, namely, it is not sufficiently rigid to be used in

Fig. 339.

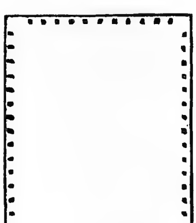
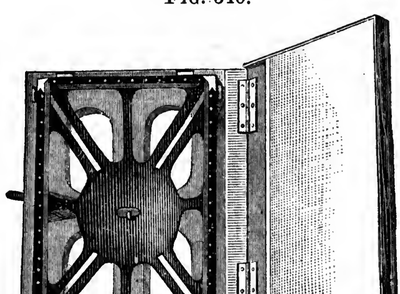


Fig. 340.



the frames like glass plates. This difficulty may be overcome if we can stretch by any practical means this pellicle, to which the inventor has given the name of flexible plate.

28

For landscapes and for some kinds of architectural work they are full of advantages.

A word of caution as to development. Do not be misled by the appearance of a paper negative under the developer. It is rarely as dense as it looks. As a rule further pushing is needed than with a negative on glass. Again, after a flexible negative has been fixed it will be found that greater reduction has taken place than would be the case with a glass plate. The process of rendering the film transparent also reduces the density of the high lights, and causes greater contrast with the shadows.

Certainly there is so much that is desirable in a properly made pellicular negative that our ingenious and industrious experimentalists will not rest until they have mastered all the difficulties attendant upon their production.

The appliance for obtaining this result was not easy to make; we must admit, however, that it has been found by M. Dessoudeix. This appliance is called a *stirator*, and is composed of a perforated steel plate of the size of the flexible plate used. The edges are furnished with points at a distance of one centimetre ($\frac{4}{10}$ of an inch) from each other (Fig. 339).

To affix the pellicle to the stirator, a hinged box is used (Fig. 340). On the inside of this box and on one of its sides, the pellicle is placed; on the other, the stirator, the centre of which is deflected in order to fasten it to a catch placed in the central portion of the box. The box is now closed, using slight pressure. In this operation the points perforate the pellicle, and when the box is opened it has been transferred and fixed to the stirator. By loosening the catch the centre of the stirator is again straightened, owing to the elasticity of the metal, and the sheet is stretched in the most perfect manner. The stirator, thus provided, is used in all the cases where glass plates are made use of.—ALBERT LONDE.

CHAPTER XVII.

RETOUCHING AND "DOCTORING" THE NEGATIVE.

179. THIS subject is so fully treated in *Wilson's Photographics* and in a dozen other volumes, that further instructions would seem superfluous.

Moreover, the instructions given have been so *mal*-treated by photographers as to discourage further suggestion.

179. *Colored Collodion for Retouching and Improving Negatives.*—*Orcanete,* or red collodion, when poured upon the back of the negative, lends itself very rapidly to the manipulations of the retoucher, who can wholly reduce certain limited parts, or by a regular gradation attenuate its non-actinic coloration as his good taste may dictate. Not only can feeble or strong negatives be ameliorated, but even good portrait negatives can be improved by diminishing or augmenting the effects of light on the face, or by rendering details more perceptible in white and light-colored clothes, dresses, hair, etc.

With landscape negatives it is possible to give better relief and to separate the different planes of the pictures one from another, to bring out with advantage the details of foliage, and to soften the over-strong high-lights; in fact, by this means negatives can be considerably modified, and yet without destroying the resemblance or rendering the effect unnatural. Proofs can be thus printed by which the effects and the different colors of nature are more agreeably interpreted.

In order that the film of *collodion a l'orcanete* may be rendered more resistant during the processes of decoloring, recoloring, and scraping, it is advisable to employ a preliminary coating of albumen made as follows: Take the albumen of three eggs, say 90 c. c., and 75 c. c. of water, well beaten together into a stiff froth; and add 50 c. c. of liquid ammonia; after agitation add, a little at a time, 100 c. c. (3 fl. ozs. 3 drs.) of sulphuric ether and 50 c. c. (1 fl. oz. 5 drs.) of alcohol at 95°. The larger the quantity of ammonia added the greater is the proportion of ether and alcohol that can be introduced without coagulating the albumen. The ammonia, ether, and alcohol are intended to preserve indefinitely the albumen, to render its application to glass more easy, and also to hasten the desiccation. When the above mixture is freshly made and allowed to settle, a part of the ether separates and rises to the surface; but when reshaken it again mixes, and after some days the ether no longer separates itself, and the whole may be filtered through paper.

The back of the negative is covered either by means of a soft color brush, or by pouring it on like collodion. This solution of albumen when wet does not attract small particles of dust like simple albumen; and it dries upon a draining-stand in from ten to twenty minutes, according to temperature.

There is a disposition however to return to "bottom facts," or, in other words, to do less retouching and doctoring and to endeavor to secure a better

The ethereal tincture of *orcanete* is obtained by placing in a wide-mouthed bottle the dry roots of *orcanete*, and filling nearly up with sulphuric ether at 62° or 65°. It must then be well corked, and left for one or two days to digest, with agitation from time to time; finally it is left to settle for twelve hours, and may then be filtered through paper into a smaller bottle.

The alcoholic tincture is produced in like manner, employing alcohol at 95° instead of ether.

To prepare the red collodion, take filtered ethereal tincture 100 c. c. (3 fl. ozs. 3 drs.), filtered alcoholic tincture 50 c. c. (1 fl. oz. 5 drs.), and low-temperature cotton 1½ grammes; it is scarcely necessary to say that this collodion may be made lighter in tint by the addition of plain collodion. It is very handy to have three different bottles, one containing a lightly tinted solution, the second a darker one, and the third a saturated solution of *orcanete*. Upon the dried preliminary film of albumen the red collodion is flowed as desired.—*French Photographer.*

Chemical Retouching.—I have a method to offer, simple, expeditious, and under control, as follows: After the negative is fixed and washed, flow with a thick solution of albumen, say—Albumen, 1 ounce; water, 4 ounces; and dry. When dry, coat with iodized collodion, sensitize in the bath; and to expose, put the plate in the dark slide, or plate-holder reversed, the film uppermost. Place four small pieces of glass at each corner, and gently lay on the pieces of glass a plate the same size as the negative, which will preserve the sensitive film from injury; close the door and expose a few seconds, by drawing out the slide, in the light. It will be understood, of course, that the sensitive film is on the collodion side of the negative, not on the glass, so that a transparency is printed in close contact. After exposure, develop with the ordinary developer, wash, fix, dry, varnish, and the whole is complete. The transparency on the negative will not need intensifying, and will rarely be too dense by the application of the developer alone; the intensity, however, can be reduced by cyanide of potassium.

Now the advantages of the idea, no matter how carried out, are manifold. Freckles are softened, if not obliterated; scratches and pinholes are mollified, if not "stopped out;" "heavy blacks" are toned down, and shadows softened; the faintest detail in the shadows which otherwise would be lost in printing is increased, preserved, and harmony pervades the whole picture instead of a chalky, freckly, spotty, undertimed thing. All undertimed negatives, or those with heavy shadows and dense high-lights, can be made, by the above method, to yield passable prints; but remember, O, courteous reader, that experience must be acquired ere you meet with unequivocal success.—DAVID DUNCAN.

Obliterating Opaque Defects in Negatives.—Certain negatives are rendered apparently worthless by the presence of numerous opaque spots upon the surface.

After various suggestions respecting the reproduction of the negatives through the instrumentality of transparencies, upon which the offending spots would be touched out previous to making use of them for forming printing negatives, the idea occurred to us to dissolve the spots themselves out of the negative, and then to have the transparent quality of negative by careful manipulation in the dark-room. This is a cheerful sign and warrants me in confining the chapter before us to some

holes thus made properly filled by pigment of the same density and color as the portions immediately surrounding.

The following is the method I follow, and I very strongly recommend it as being at once simple, expeditious, and certain: Take a bit of caustic potash (there is no necessity whatever for weighing it, a piece the size of a bean, greater or less, answering quite well); to this add about an ounce of water, and when it has dissolved, which will be the case in a couple of minutes, add a quantity of methylated alcohol equal to the water present. Now, holding the negative either by one corner, or, as we prefer, upon a pneumatic holder, pour this solution upon the surface, taking care that every portion is covered. Allow it to remain on for about half a minute, pour off into a porcelain or glass measure, and again apply it to the surface, as if it were a developing solution. Pouring off once more, apply to the surface a little plain water with alcohol, and follow this by copious washing with water. When the plate is dried there will not be a vestige of the varnish found on its surface.

If by accident, bad varnish, or inadequate temperature, a negative has been damaged in varnishing, the method just described will prove a most effectual means of denuding the collodion film of its resinous, pellicular coating.

By means of the treatment described, the opaque spots upon the plate are rendered in a proper condition for being operated upon by a solvent. The solvent I use is a somewhat strong solution of iodine in cyanide of potassium, the relative proportions being such as to leave the solvent salt in excess. This is easily effected by adding iodine until the cyanide solution is incapable of dissolving more, and then making a further addition of cyanide. The mechanical conditions are secured by the addition of a few drops of mucilage of gum arabic.

The negative having been placed upon the retouching-desk, and a tolerably strong magnifier utilized, a camel's-hair brush, charged with the solution described, is deftly applied to each opaque spot, which, after a few seconds, is seen to become quite transparent. When the whole of the spots have been touched in this manner, a gentle stream of water is applied to the film, so as to clear away all the solution of iodine. The spots, previously opaque, but now transparent, are next touched in by means of an appropriate pigment to be selected from the color-box, a mixture of burnt sienna, Prussian blue, and China ink, forming a pigment which answers every purpose.

The negatives treated in this manner yield points which do not demand any artistic operation, and in which it is almost impossible to discover any fault indicating there having been at one time something seriously amiss with the negative.—W. P. Bolton.

Take a penknife with a very small, pointed blade, sharpen the point well, and with it, using a magnifying glass, you can remove, by scraping, small opaque spots on gelatine negatives, when dry. You can also modify or remove an objectionable light in the eye, or any little defect of that kind. Your first trials will probably be failures, but practice will show you the proper shape of blade needed. Of course, care and patience are essential to success, but it can be done.

selected notes gathered from the suggestions of practical workers. So much for general work.

Retouch on the gelatine film by grinding with resin, fine pumice-stone, or any of the methods in use; coat with plain collodion, and when dry and hard, coat with good varnish; when hard, grind again carefully, and retouch off those black freckles or moles that you could not fill up on the first film, and soften those heavy lines about the eyes and mouth that would not "yield" on the gelatine, and that stray lock of hair that refused to "budge" before can now be made to vanish. Scan the whole work over, and put on the finishing touches, and you will be pleased with the result.

Clean the back of your negatives before printing, with dry pumice-stone (powdered), using the ball of the finger; perhaps a knife will be needed to scrape the largest gelatine stains or spots that may happen to be there, but the pumice-stone will make them shine and print clean.—F. M. Rood.

When retouching his negatives the photographer can, if he has the genius, do almost anything, so that he has shadow enough as a basis. Here he becomes, as I have said, the creator, and of all the different operations of a negative, this is the portion where the artist stands out most prominently and proves what stuff he or she is made of. There is no end to the variety of work one may introduce—grains to look like engravings, hatching, stippling, brush work. It is not enough to be able to remove spots and blemishes, or soften off harsh contrasts; girls mostly get up to this mark of excellence, and produce those smooth, meaningless, pleasant portraits of everyday life. The retoucher must learn to keep an expression of the negative, or make one if not there, and this is the lofty calling of a true retoucher. He must put a soul into his model, else he cannot call himself an artist any more than the painter can claim the title who only daubs potboilers. But if the retoucher can do this, and has art enough in himself to prefer soul to beauty or beautifying, then he has as much claim to call himself a painter or an artist (if he prefers that title) as any R. A. in the clique divine.

Expression, or soul, is what photographers are as yet deficient in, and that is the province of the retoucher. I want to see a photographer rise above the prejudice of the flattery-loving public, and lead them by intensity; give to the public faces, ugly as Rembrandt's portraits, yet pregnant with character. I want to see seams, and wrinkles, and warts, as the Great Creator left them—indexes to the wearer's character—and not doll faces, which simper and mean nothing. I want noses in all their varieties, with their own individuality intensified; cheek-bones standing out as they may be in the originals. I want men and women sent down to posterity as they are and not as they would like to be; for I never yet saw a face in its natural state that I could call ugly, although I have seen faces by rouge, and powder *cosmetiques*, and false eyebrows, and also by the retouching which they were themselves so delighted about.

Vice and crime darken the souls which sit behind the eyes—make chins hard, and lips thin or coarse—destroy curves which are upon all lips when innocent; yet to me, the most demoniac face that ever peered out upon a hunting world is better in its sombre gloom than that same face smoothed by a bad or mechanical retoucher. Beauty is expression, not chiselled features. A baby is not beautiful until it can notice its mother;

Where special objects are to be attained, special resort may be had to artificial means. Wisdom and care should always be exercised.

then the meaningless bit of flesh is lighted up with a ray from heaven. That God-beam the photographer must catch; yet it is not a smooth surface, but a light breaking through torn-up cloud mists.—HUME NISBET.

For plain photographic work I advise you to have by your side a palette, upon which are ground moderate portions of a good *black* India-ink, warm sepia, and scarlet lake. With combinations of these you can readily imitate the photography upon which you are working, whether it be cold or warm in tone. Of course, it is necessary to apply these tints with a brush; and if you use plain water as a dilutant, you will leave a dead surface that betrays your trail. Everyone will exclaim: Why not then use gum water? that will leave a gloss. Perfectly right! but it leaves too much gloss. In addition, I don't believe that the half of you know how to make gum water.

Accept my formula, and adopt it or no, as you see fit: Picked gum arabic, 1 ounce; loaf sugar, 1 drachm; acetic acid, 30 minims; alcohol, 30 minims; water in sufficient quantity, say from six to eight ounces.

Don't be frightened at the mention of the acid, and at the idea of putting a modicum of it upon the surface of your photograph. Used in this way it will not, I assure you, prove destructive in the slightest degree.

The gum water, however, I do not use for the indicated purpose. There is a better vehicle—the much-abused, always useful, *albumen*.

I have before this published a method of making a stock albumen that is equally as serviceable for this as it is for many other purposes. It is not original with myself, but I have used it for many years, and have come to consider it an indispensability in a studio or gallery.

Take the whites of eight eggs, carefully separated from their germs, and add to the mass twenty-four drops of glacial acetic acid, diluted with one ounce of water. Stir well for a minute with a glass rod, making no attempt to beat into a froth. Let the liquid rest for at least an hour, and then strain through cambric muslin, Finally add half a drachm of liq. ammonia, F. F. F., bottle, cork tightly, and use as required.

Slightly diluted with water, nothing can excel this as a vehicle for water-color painting upon albumenized paper. Of its utility for the preparation of negative glasses, for transparencies, and for porcelain work, I have already spoken

If you cannot touch out the spots neatly, you had better allow them to remain. On numberless occasions I have seen prints from what were supposed to be good negatives, that might readily have passed for maps of the heavenly constellations. They were filled with white spots, crescents, and lines. I have frequently asked the privilege of inspecting the plates from which they were made. In most instances the printer had endeavored to conceal small pinholes or light scratches with that very useful paint of my manufacture (Opaque), and instead of having a scarcely discernible dark speck on his paper, caused the appearance of a white blot, somewhat difficult to eradicate. To remove these transparent imperfections upon the negative, you must possess a sharp eye, a steady hand, a fine brush (Opaque, of course), and a clear comprehension of what you

A neat photographer will punctiliously number his negatives, and when necessary title them. An engraving diamond is a convenient tool for such work.

are doing. Almost invariably when I have washed away the color that had been applied, I have found that at least three times the necessary quantity had been used.—JOHN L. GIHON.

Many a valuable negative has been lost because no system adopted by the photographer has existed for numbering the same. The engraving diamond (Fig. 341) will prevent loss in this direction, if its use is adopted. It is, in form and size, something like a short stylographic pen, and consists of a metal handle about five inches long, at the end of which a diamond is permanently set for the purpose of writing and figuring upon glass. We are assured by the manufacturer that it will even write on steel.—GEORGE MAY POWELL.

FIG. 341.

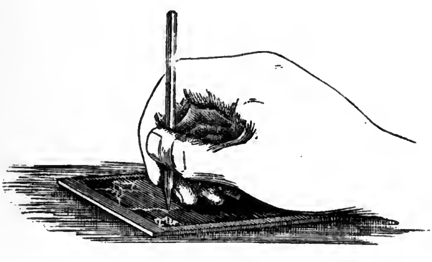
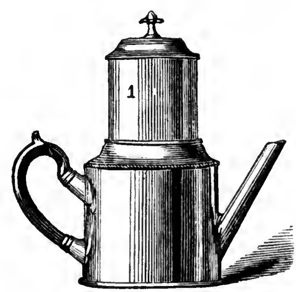


FIG. 342.



Below are some hints regarding the use of the well-known style of coffee-pot shown in Fig. 342, as a varnish pourer and as a means of separating the clear varnish from the particles of dirt, etc., apt to get in the varnish when coating plates. The engraving will show exactly how it works. A piece of cotton flannel is made to fit into the inside of the top portion, and on that some filtering-cotton. After flowing the negative the surplus varnish is poured back into the top, and by filtering back into the pot we have the varnish always clean and nice. The bottom of the part marked 1 is covered with a fine wire gauze, They can be obtained at any kitchen furnishing store.—A. MARSHALL.

For the Production of Artificial Negatives by Scratching in Lines with One or Several Needles.—Prepare a thin negative collodion, containing much iodine, which is as usual poured over a glass plate and prepared in a silver bath. After having taken out the plate, and cleansing the same on both sides with water, it is dried and laid on a black cloth, with the prepared side on top.

If the collodion contained much iodine, the coating will appear of a light-yellow hue, which in this case is just the thing wanted.

Now make several instruments, with two to eight needles ranged together in a straight line, with sealing-wax, with which a drawing can be scratched in the yellow

The varnishing of the negative should not be neglected. And if, for any reason the varnish must be removed, extra care will be rewarded by the best possible success.

layer of iodide of silver. The diagram herewith (Fig. 343) represents the instrument, *a* being the sealing-wax, and *b* the points of the needles. After tracing carefully the outlines of a drawing upon the yellow layer, so that the layer does not get injured, we proceed to the production of the whole drawing. For delicate details only an instrument of two to three needles is used; but large spaces are rapidly covered with an instrument of many needles. Each scratch appears black, as the yellow layer is removed, showing the black sub-layer.

FIG. 343.

The picture is extremely pleasing, as the lines run beautifully parallel, and afford many very delicate gradations. The scratched-off yellow dust must be often removed with a broad marten-brush. When the drawing is finished, pour on the plate a concentrated solution of fuchsine in alcohol, and wash off with water. The fuchsine colors only the porous collodion, but not the clean spots of the glass, and renders the picture more opaque, so that it is perfectly suitable for heliographic or photo-lithographic purposes.

Finally the negative must be varnished, but a diluted solution of gelatin or gum arabic answers better, because an alcoholic varnish dissolves the fuchsine. The intensifying can also be done in other different ways.—JOHN L. GIHON.

To Remove Varnish from Negatives or Ferrotypes.—Use saturated solution of cyanide of potassium, one part; alcohol, 95°, two parts; flow on and off as in redeveloping; will clear of varnish very rapidly, so the negative or positive can be washed under the faucet, dried, and revarnished, bright and fresh as new.

I discovered this method—partly by accident—some months ago, and have used it many times since, always successfully; and having never heard of any other method as good, I send it for others to try.

I have at various times tried most of the published methods for removing varnish from collodion films—for instance, pure alcohol bath, ammonia and alcohol, common crude potash and alcohol, vapors of hot alcohol, etc.—all more or less available, but in my experience all more tedious, more expensive, or more dangerous to such films than this method.

Whether the cyanogen aids the solvent action of the potash or not, the materials for this combination are ready in almost every gallery, and seem perfectly reliable in action.

Of course, it must not be used on negatives strengthened with bichloride, or similar chemicals especially soluble in cyanide.—E. K. HOUGH.

CHAPTER XVIII.

PRINTING ON ALBUMEN PAPER.

180. THE printing has long been considered the most mechanical part of photographic work. It may be made purely so, thereby producing all grades and qualities of pictures according to conditions. On the other hand, it may be made as productive of uniform results, as any department of photography.

A mere mechanical printer will handle all negatives alike; the weak, the intense, the clean, the streaked, all are printed by him on the same paper and subjected to the same treatment. His results show as many varieties and qualities of prints as there are varying circumstances of light, shade, subject, chemicals, etc., under which the negatives were made. The prints are but a reflex of all these uncontrollable variations. With the artistic printer this is different. He expects variety in negatives, and proceeds accordingly. He carefully studies their qualities, retouches and masks, if necessary; he prepares his paper to correspond with the varying conditions of the negatives; he prints from each negative according to its individuality; he masks one part of the background, and prints in deeper another part, as may be required to give the best effect; he tones down the intense lights of the face or drapery, by exposing those parts while the rest is protected; and in various ways controls the work as it progresses, so as to produce the best possible results. Printing in this way becomes as much an art as negative-making, and requires as much study and well-directed skill to do justice to the work. The negative manipulator should well understand printing, and the printer should be a good dark-room manipulator.

181. Every facility should be given the printer. He should have abundance

181. Our rooms are located on the roof, so that nothing obstructs the light. They are fitted with plenty of shelf and cupboard room. I will give separate sketches of some of the most important conveniences.

The first is the printing-room table for changing prints, and keeping all necessary articles (Fig. 344). It is 9 feet long; 40 inches wide; 36 inches high. The partition for shutting off light should reach nearly to the top of the room.

Changing Stand.—On the opposite side from that seen in the cut are cupboards, in which all printing-frames are kept, when not in use, free from dirt.

of light all the day long; from the south if possible; access to shade in case of need; the best of materials and a convenient, well-accoutred work-room.

Drawer No. 1 is for albumen paper, fumed, ready to print; in the upper half of the drawer is a shallow tray or box for paper after it is cut or torn ready to print. No. 2. For prints, with tray, same as in No. 1. No. 3. Ground glass for vignettes; sticking paper, cut for use; printing clips or clothes-pins; waste strips of cardboard, on which I keep memoranda and printing-lists. No. 4. Vignette blocks, all sizes and shapes. No. 5. Orange and tissue-paper for vignettes; cut-outs of all sizes. No. 6. Cotton, lead, and sundries. No. 7. Large basket for silver waste. No. 8. Large printing-frames, odds and ends. No. 9. Shelf for odd negatives, which are either thrown out, or carried to the negative-room, once a month or so; at the left end I keep hammer, tacks, opaque, paste, shears, brush for dusting negatives, etc. No. 10. All negatives ordered from. I always have these assorted in piles according to the manner in which they are to be printed, vignette or otherwise. No. 11. On this shelf the negatives are put, when the order is printed, and from here they are taken to the negative-room for cataloguing. These shelves are on a partition which shuts off the strong light from the printing window, which would otherwise damage paper and prints while charging.

FIG. 344.

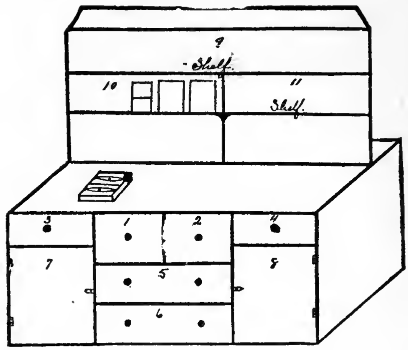


Fig. 345 is the silver-bath stand. It is 28 x 24 x 33 inches high. I keep the bath in the tray ready for use at any moment, pouring it back only when it requires fixing over or filtering. By lighting the gas in the cupboard below, the temperature of the bath, in

FIG. 345.

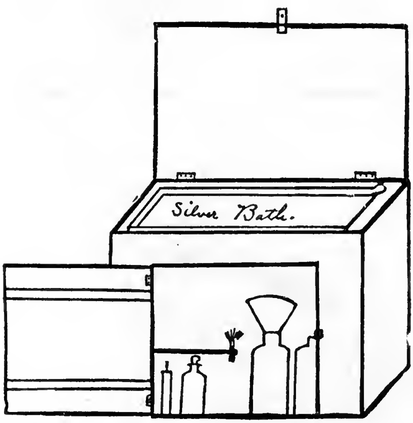
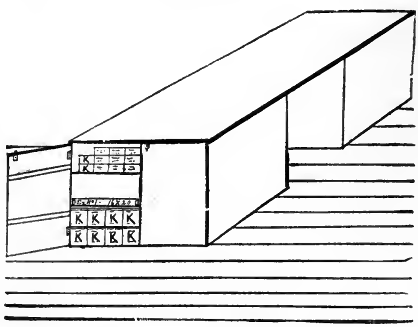


FIG. 346.



Supplied with all these and a genuine feeling for his vocation there should be no drawback to his production of the best prints.

To the really artistic printer his art becomes an intellectual study which develops into real enjoyment.

cold weather, can be raised to the required degree in a few minutes. In the cupboard, all bottles, filters, chemicals, etc., used for the bath are kept. The bath is kept free from dust by the cover.

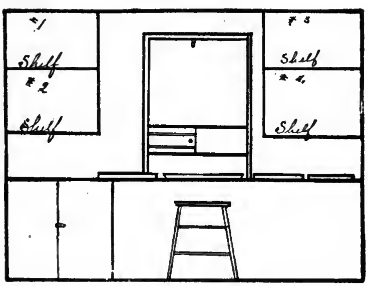
Fig. 346 is the mounting-table. It is 7 feet long, 3 feet wide, 2 feet 5 inches high. The cut gives a better idea of this useful piece of furniture than any explanation. The large cupboards at each end can be arranged with suitable shelves, and, when done, many thousand mounts of various sizes can be kept therein—a very convenient arrangement, preventing loss of time.

Fig. 347 shows the plan of the north end of the mounting room, with the arrangement of the light for toning.

Our toning window faces north, and we have a light board which just fills the window. In this board is a shutter which slides to the left, admitting more or less light, as required in toning.

Toning and washing trays are kept in the cupboard beneath the toning shelf at the left.

FIG. 347.



Shelf No. 1, Dry-plate camera, lenses, and plate-holders; No. 2, toning chemicals, No. 3, carbon materials; No. 4, glass cut-outs, Robinson trimmers, forms, etc.

FIG. 348.

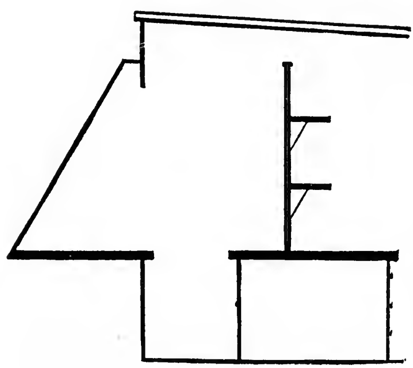


Fig. 348 is of a sectional view of the printing-room window, and end view of the changing table.

The large amount of cupboard and drawer room which we have, is considered of great importance, inasmuch as all the manipulations are conducted with freedom from dust and dirt, enemies which injure and destroy so much work that would otherwise be good. The rooms are painted a chocolate-brown, a pleasing, subdued color, and one from which no disagreeable reflected light from the printing window can come. A speaking-tube and an elevator for carrying negatives back and forth connect with the rooms below, saving much time and many steps.—HOWARD A. KIMBALL.

There is nothing in science or art more beautiful, except always the development of a latent image, than the coming up from the pure white sheet of paper of the positive print.

182. The theory of silver printing can be very concisely stated as follows:

When nitrate of silver is brought in contact with an organic substance, the resulting compound is found to be affected by light in a somewhat peculiar way: the compound slowly darkens to a reddish tint; the exact chemical reaction that takes place is very complex to trace, but it may be accepted that an oxide of the organic matter and silver is formed. This oxide is stable, unlike the suboxide of silver, and is not acted on by fixing agents to any great extent.

183. The most important of the organic substances used in printing is albu-

182. The negative having been obtained, the next step is to produce positives from it. The fact long known to man, that nitrate of silver in the presence of organic matter, darkens in sunlight, is utilized for this purpose. In darkening, it is probably reduced to a subnitrate, but why it should be reduced, and why in the presence of organic matter, is a question that will not be proposed here, because its answer would lead so far into the fields of theoretical chemistry that we might find ourselves more in shadow than before we entered those domains. The fact is certain, that the nitrate does darken when exposed to the sun, and it is also true that this fact is utilized in obtaining positive prints. The paper is first albumenized, because it gives a fine, smooth finish to it, and allows it at least to work as fast as the plain paper. When this is floated upon a nitrate of silver bath, albuminate of silver is formed; but as there is also free nitrate of silver present, and as it is a so much simpler salt, and as the reactions are similar, we will consider it as nitrate of silver, in the presence of organic matter—albumen. A piece of paper is then taken, with a coating of albumen, and coated with nitrate of silver and allowed to dry. If now this is used to print with, it would be found that the reaction would be retarded by the nitric acid that would be set free (nitric acid being liberated in this case in the same way that we have seen chlorine, bromine, and iodine liberated before). Something is evidently needed to seize upon the escaping nitric acid, and by uniting with it prevent it from doing any damage. This "consummation devoutly to be wished" is obtained by the "fuming," when the sensitized papers are hung up in a box and subjected to the fumes of ammonia. Those fumes, acting upon the nitrate of silver on the paper, form with it ammonio-nitrate of silver. So, then, when the paper is placed under the negative, and the light acts upon it, and in acting upon it disengages nitric acid, this nitric acid instead of escaping, instead of retarding the action of the light, seizes upon the ammonia, forms nitrate of ammonia, and then as a retarding agent its work is at an end. The sensitized paper having been exposed for a sufficient time is, as everyone knows, taken from the printing-frame and washed in water—washed so as to remove the free nitrate of silver; after being washed in several changes of water it is transferred to the toning bath.—HENRY M. M'INTIRE, M. E.

183. All paper, but especially albumenized paper, is stored in an unheated room, so that it may not become dry and brittle, but always remain soft and supple. In the heat

men. It has been used hitherto in preference to any other organic compound, on account of the delicate film it forms on the paper, free from all roughness, and also on account of the beautiful color the print takes by the production of the albuminate of silver. The albumen should be used fresh, and in a slightly alkaline condition. The principal commercial objection to its employment in such a condition as the foundation of the picture, arises from the difficulty that is experienced in coating the paper evenly with it. Makers of paper prefer old albumen, which gives a slightly acid reaction. When in this last condition,

of summer, when it might be too hard and brittle, I take it some hours before silvering it, or the night before, and place it in the damp-room so that it may attract a little moisture, as nothing is more perverse than paper that will not lie flat upon the bath, but always rolls up—except, perhaps, when air-bubbles make their appearance. This dry paper also does not take on the silver so equally as that which contains a certain quantity of moisture; and, in fact, the whole process goes much more smoothly with the latter sort. I now place my sheet upon the bath and let it float, with a gentle movement, for a minute and a half or two minutes. In order to produce the same result, the time of floating should be the same for all the sheets. At the end of that time I draw each sheet slowly out of the bath and place it, wet side lowermost, upon a sheet of chemically clean blotting-paper, placing above it a sheet of strong, smooth, packing-paper, and with the palms of my hands I smooth it out in all directions, giving the pressure, which, having the sheet between my hands and it, it can now bear, so that all the moisture may be sucked up by the sheet of blotting-paper below it. Of course, the table upon which the three layers of paper are laid ought to be perfectly flat. The paper may be rubbed until it is almost dry, and then laid aside at once, but that is not necessary, as without it, by the time I come to the fourth sheet the first will be ready for use.

There is really not much silver absorbed by the blotting-paper, since what it does suck up is merely the solution that would otherwise run off, and which contains but little silver; so that really there is none lost if, when the blotting-paper can be used no longer, it be reduced to ashes in order to recover the silver.

Besides the comfort of being able to prepare a great quantity at a time, and to expose it soon after, this way of preparing paper possesses the advantage over the other that, owing to the quick drying, the sensitive film is entirely on the upper surface, and cannot sink into the substance of the paper itself. The print is, therefore, more upon the upper surface, and is consequently softer and more brilliant, and considerably more easily fixed. A very weak soda bath can then be used, five per cent. of the salt being sufficient, and a very small addition of bicarbonate of soda has a favorable effect on the whites.—F. W. Geldmacher.

Cutting the Paper.—The following methods are most extensively used:

Fold the paper into halves lengthwise, then into thirds crosswise, making six 4 x 4 pieces, which folded again lengthwise will make twelve cabinets, which stretch in the width, or four panels and eight cabinets.

Folding the sheet into halves crosswise you will obtain two 11 x 14 pieces, which the paper is easily coated, though the toning is retarded, and inferior pictures are the result.

There are two kinds of paper used principally for albumenizing: Rives and Saxe. They are both starch-sized papers.

184. The "sensitizing bath" has been a subject of dire tribulation among

folded again will make four 8 x 10; these folded again will make eight boudoirs; when folded again sixteen cabinets will be obtained, *all stretching in the width.* If cards are wanted, each cabinet will make two cards when doubled, thus getting thirty-two cards out of a sheet, all *stretching up and down.*

Fold a sheet of paper in length three times and fold each strip five times, thus getting fifteen cabinets *stretching up and down.*

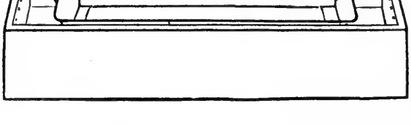
Detach a strip off the sheet six and a half inches wide, which doubled twice will make four cabinets or four panels. The remainder of the sheet will make eight cabinets or four cabinets and four panels. For cabinets fold the paper evenly, then turn it half around, and double turn again and double. This gives you eight cabinets. All the above pieces will stretch the same way. If you want to make panels and cabinets cut as follows: Place the end of the piece next to you, fold over so as to make one strip six and a half and the other seven and a half inches wide, now turn and fold as you did for cabinets.

All pieces of the last-described method will *stretch alike in the width.* Photographers having German customers, as a general rule, cut their paper to stretch in the length, as the Germans principally have round faces, while American faces are usually lacking in width.—CHARLES KRAUSS.

184. Having been bothered with albumen paper curling up when silvering, and many times becoming dizzy by constant breathing on the back of the paper, to keep it down, I contrived a device to obviate this trouble. I will explain:

Have a box made of half inch stuff (pine), 25 inches long, 19 inches wide, and 6 inches high inside (if measured from outside, half an inch larger every way); then have the box sawed so as to make the cover two inches high, leaving the main box four inches high inside (Fig. 349). Put a handle on each end of the box, and on top of the cover, in the centre. Have this box—cover and all—lined inside with zinc, and let the zinc extend above the top of the box all round, so that when the cover is on it will fit tight, and make it air-tight, or nearly so. Then have a pan made out of galvanized iron, 20 inches long, 14 inches wide, and 3 inches deep, with a piece of stiff wire around the top, to make it substantial—the same as any ordinary pan. Have a wire handle on each end of this pan; also a leg not quite an inch high, under each corner. Now put water in the box, so that the pan, when it has albumen paper in it, does not float. I then cut the sheets of albumen paper in half, as I only silver

FIG. 349.



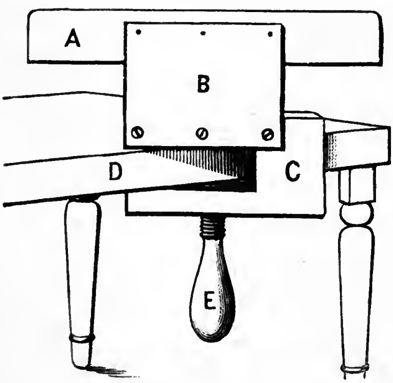
inexperienced photographers, or those who seem unwilling or incapacitated to receive instruction. The subjoined formula is recommended: Silver solution, 35 grains strong, ½ gallon; muriatic acid, ½ ounce. Shake well, and add enough ammonia to make it slightly alkaline; shake well, filter. The filter may be used over and over again. Every time you strengthen, add a little acid and ammonia. Add a little C. P. nitric acid when red tear-drops appear. Fume with strong ammonia eight or ten minutes.

half a sheet at once, and trim off the ends that have no albumen on, and put from two to three dozen sheets in the pan—albumen side down, after first placing a piece of clean blotting paper on the bottom of the pan; put on the cover of the box, and let it remain for forty-eight hours. The paper is then in splendid condition for silvering. The way I do is to take off the cover, and carry the pan (paper and all) to where I want to silver; have about two thicknesses of blotting paper, which place on top of all the paper whilst you are silvering a piece; this keeps the back of the paper from drying. I leave these blotters now on the albumen paper all the time, after the paper seems to be moist enough. The blotters seem to absorb the moisture that would otherwise fall to the paper. You can regulate it now to suit yourself. When through silvering, carry the pan back and put it in the box again, and shut it up. The next time you want to silver, whether it is a day or a week, you will find the paper in splendid condition.—G. W. Wise.

A great many good negatives are ruined after considerable use by scratches from the finger nails when removing prints from the pressure-frames, and from the ragged, horny edges of the albumen-paper as it passes over them.

I have adopted a plan which entirely prevents injury to the negative from the latter cause. Fig. 350 illustrates this. *A* is a strip of steel, the upper edge very smoothly ground, fastened firmly in the block *B*, and to the table *D*, by means of the hand-clamp *C*. This strip may be, say, a foot long. The sensitized paper is cut to size for use, and then drawn, plain side down, from end to end over the steel edge, holding it in the same manner (*i. e.*, by each end) as you would when ironing a ribbon over a stove-pipe. In this manner all the rough, ragged edges are removed, and rendered perfectly harmless. This idea is worth hundreds of dollars in saving valuable negatives.

Fig. 350.



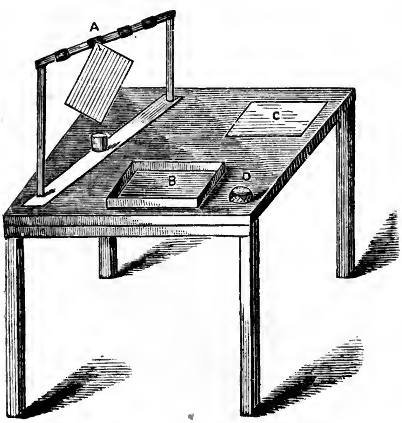
The little hand-screw clamp, *C*, is a valuable little thing, too. It is easily made, and will answer for any machine, such as the card-cutter, press, steel strip, and so on; for any of these may be screwed to the clamp, the clamp to any table or bench, and any or all quickly removed if the space they occupy be needed.—B. W. Kilburn.

The method of floating the paper surely needs no particular description. It is by no means imperative that a certain corner should be first approached to the solution. The photographer soon acquires peculiarities of manipulation that enable him to do his work better and with more satisfaction to himself, than if he followed a prescribed rule. There is one general principle to be observed. It is, that if the negatives are very hard the strength of the silver solution can be lessened, and if they are weak, it should be much increased.

This sketch will serve to explain the arrangement of the table when silvering paper (Fig. 351). *A*, the frame, with corks glued on the wooden rod nine inches apart, upon which I have placed one piece of paper; under it a glass to catch the drops of silver. *B* is a glass dish. *C* is a paper cut and ready for silvering. *D* is a pin-cushion.

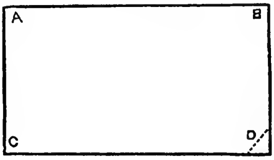
Now let me try to explain just how to silver a piece of paper. First I will sketch a sheet of paper as it lays before us face down, and mark it with letters in each corner (Fig. 352). Bend up a small corner at *D* at right angles to face, so as to better take hold of it in removing it from the silver, and so that this little corner may be kept dry, through which to stick the pin.

FIG. 351.



Now take hold of paper with left hand at corner *A*, and with right hand at corner *D*; keep left very low and right very high as you place it on the silver, so that the bend in paper

FIG. 352.



may be as close to corner *A* as possible; let this rounding or bent part first touch the solution; keep the finger holding the paper at *A* as near the solution as you can without touching, and hold well over to left side of dish, lowering slowly and steadily the right hand; thus the contact of the paper will be diagonally across the sheet, and will expel to right side of dish all bubbles that may incline to form.

Bubbles, if formed at all, will most likely be at first point of contact close to *A*. Carefully lift at *A* with small glass rod, and remove any that may appear, lifting the paper half its length from this end for examination, and immediately do the same at *D* end.

After the paper has lain for from one to one and a half minutes, lift it at corner *D* by the bent-up portion with left hand stick a pin through it, and raise *slowly and steadily* from

185. After removal from the silver solution, the paper is allowed to become thoroughly dry, and is subjected to the fumes of strong ammonia. It is then ready, when cut into the required sizes, to be placed in contact with negatives in printing frames.

The print should have the highest lights *nearly* white, and the shadows verging on a bronzed color, before toning.

There are a great many defects which should be carefully observed and prevented or cured.

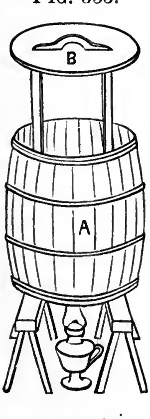
186. Small white spots, with a black central pin-point, are often met with in prints. Dust on the paper, during sensitizing, will cause them, the dirt forming a nucleus for a minute bubble. All paper should be thoroughly dusted before being floated on the sensitizing bath.

Gray, star-like spots, arise from small particles of inorganic matter, such as oxide of iron, lime, etc., which are present in the paper. They become apparent by decomposition during the printing operations. They may generally be discernible by examining the paper by transmitted light.

the solution to wooden rod, where you will fasten it upon the first cork, albumen side out. After all four corks are filled, proceed to remove paper from cork one to dark-room for drying.—CHAS. WAGER HULL.

185. I inclose you a rough sketch and short description of a paper-drying apparatus that I use (Fig. 353). It consists of a common flour barrel with a sheet-iron head in the bottom and the top open, covered with a lid about one inch thick and two or three inches larger than the top of the barrel. To the under lid is a frame almost as long as the barrel; the paper is fastened to this frame, and then let down into the barrel. The under side of the cover has some thick cloth tacked around it, so that it serves to keep the heat in the barrel by packing the joint. A common coal-oil lamp is used under it for heat.—A. E. TURNBULL.

FIG. 353.



186. It sometimes happens that the paper prints are *rea* even after very strong fuming. Why? By the action of light the chloride of silver is reduced to a subchloride, evolving chlorine, and if the paper be damp the chlorine is taken up by the water in the paper probably as hydrochloric acid, and reddens the paper just the same as it would redden litmus paper, and also serves in a measure to assist the printing. The remedy is easy; dry the paper and the pad just before placing it upon the negative. An oil or gas stove should be kept handy for that purpose, but care should be exercised not to dry the paper too much, as some little moisture seems also to facilitate the reduction of the chloride of silver. Very dry paper is also both brittle and disagreeable to handle. I have seen prints come out weak from excessive dryness of the paper when it was fully

Bronzed lines (straight) occur through a stoppage during the floating of the paper on the sensitizing solution. Should the lines be irregular, forming angles and curves, it is probable that a scum of oxide of silver, etc., may be detected on the surface of the sensitizing solution. A strip of blotting-paper drawn across will remove the cause of the defect.

Should the print appear marbled, it may be surmised that the sensitizing solution is weak, or that the paper has not been floated long enough. In some cases it may arise from imperfect albumenizing, but, in ordinary commercial samples, the cause can be easily traced.

After printing the toning follows.

silvered. Having produced a rich print with clear high-lights and deep, slightly bronzed shadows, it ought to tone up rich and strong, and if it does not do so the error was surely *after* the printing; look for the failure close to the point where failure first revealed itself.—F. M. Spencer.

187. A solution of chloride of gold. What can this do? Gold is what might be called an ascetic metal; it likes to live alone. In other words, it is easily reduced from its salts to the metallic state. So when this sheet of paper, covered all over with silver salts, is brought into a solution of chloride of gold, the silver, having a great attraction naturally for chlorine, and the gold parting willingly with its chlorine, it is no more than can be expected to find the chlorine leaving the gold and uniting with the silver, forming, of course, chloride of silver—the dark subchloride, when the silver has been reduced to the subchloride by the action of the light, and the white chloride when the silver is unaltered, and then the gold, having lost that which held it in solution, has nothing to do but come down as a precipitate of metallic gold, and so metallic gold is deposited upon the picture. It is noticed that the toning bath has a lowering effect upon the picture; and also that if it be alkaline, this effect is reduced to a great extent, so for this reason alkaline toning baths are often used. There can, however, be three kinds of toning baths evidently: acid, neutral, and alkaline. An acid solution will tone brownish, a neutral violet, and an alkaline bluish violet.—Henry M. M'Intire, M. E.

Toning-bath.—No. 1. Stock solution. Take a quart bottle, in which you keep a thoroughly saturated solution of sal soda as stock solution. Place two ounces of this stock solution in an eight-ounce bottle, and fill with water.

No. 2. Take a half-pound bottle, in which you dissolve 15 grains of chloride of gold in 15 ounces of water.

No. 3. Toning-bath. Take about a half-gallon of lukewarm water, add a small teaspoonful of salt and two ounces of gold solution, then test it; the litmus paper should turn red; to this add enough sal soda to turn the same piece of litmus paper blue again; very little is required—two teaspoonfuls will, as a general rule, suffice. Be sure and measure everything, especially the sal soda, because, if too much is used, the prints will not tone, but bleach.

With this toning-bath you can get any desired tone with very little effort. The prints will tone in about twelve minutes. The prints should be toned blue on surface, as they

187. The object of "toning" a print is to change the reduced silver to a sightly color that will not be destroyed after it has been immersed in the fixing-bath. The action of toning may be considered somewhat analogous to that of intensifying the negative, by change of color; the reduction of metallic gold from the chlorine on certain portions of the print, being similar to that of the metallic silver from the nitrate. The position of the portion of the picture on which it is thrown down is determined by the position of the reduced silver on the paper. Where there is metallic silver, there the metallic gold is thrown

will go back a little in the hypo; by doing so, you will get as rich a tone as can be produced by any bath in use. The vignettes are toned separate to secure uniform tones in them. The large prints are always toned first, to keep them safe from tearing and breaking the albumen surface by too much handling.

Both baths can be used over, but are generally made new every day, the gold being pretty well used up by the last batch of prints.

Waste toning-baths should be kept in a large crock, throwing the gold down with bicarbonate of soda or protosulphate of iron.—CHARLES KRAUSS.

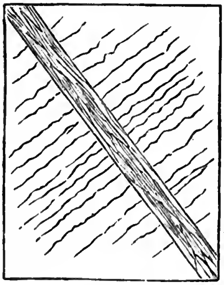
Why do different portions of a sheet of paper, silvered intact, tone so differently?

I would venture the following explanation: If a printer notices carefully his paper as received from the dealer, he will observe a diagonal line of slightly crumpled appearance running from corner to corner. This is produced by the line or stick over which the paper is hung to dry when albumenized, and is the line of unequal tones, as it might be called.

After silvering, there is to be seen, though very faintly, other lines running at right angles with the first toward the corners of the sheet, and forming, when the sheet is spread flat, the appearance as shown in Fig. 354.

As before stated, these small lines are very faint and hardly discernible before printing; but put a piece under a negative having heavy shadows and a great deal of clear glass, and, lo! you have a map of rivulets and streams of all sorts running parallel to each other, rising in the centre line and losing themselves as they come to the edge.

FIG. 354.



These last lines are caused by the albumen running toward the corners as the sheet hangs to dry, forming a regular drainage from the centre toward the edge. Whether this results from the condition of the albumen, or from some adulteration of it, I am not certain, but it seems to disintegrate (if I may be allowed the use of the word in speaking of a liquid), it loses its homogeneous state, and seems to separate like curds and whey, robbing the centre of the sheet, and building up the edges.

Such paper is poor at its best estate, but the centre is remarkably so, and as the print made on it goes to the toning-bath its poor qualities become more apparent at every stage till they reach the culmination of "cussedness" under the action of the gold salts, when, before the other parts of the same down. The process might be almost called "electro-gilding." The terchloride of gold, or a double salt of the terchloride of gold and potassium or sodium, is invariably used for the toning-bath, as it is necessary that the electro-gilding action should take place with a salt of gold *in solution.* It is also found advantageous that the solution should be neutral—*i. e.*, neither acid nor alkaline, the reduction taking place more rapidly than with an acid solution. The deposition of gold is further aided by the addition of an acetate or carbonate of an alkali, to form oxychloride of gold. When the terchloride of gold alone is reduced, chlorine is liberated, which attacks the silver in the print, forming fresh chloride of silver. That this action does occur may be shown by the diminished depth of color the prints assume in the toning-bath. The formation of an oxychloride of gold in the solution, however, somewhat reduces this change, a larger deposit of gold being thrown down in a shorter time than if the addition of the carbonate had been omitted.

188. The list of well known and much used toning-baths is a very long one. They resemble each other more or less in character. I add only one.

The bath is made as follows: Always keep in stock the following solutions:

Solution No. 1. Dissolve fifteen grains chloride of gold in fifteen ounces of water.

Solution No. 2. Dissolve a quarter of a pound of acetate of soda in forty-eight ounces of water.

To make the bath, take of water, thirty ounces; then add solution No. 1, three ounces; and next add solution No. 2, three ounces. Let stand a whole week before using; if wanted sooner, make it with hot water.

This bath will tone day after day if your operations are small, until at least

sheet begin to tone, this has arrived at the point that ten or twelve years ago would have passed for good, when pictures were toned "till all was blue."—M. L. DAGGETT.

Now for the secret of pure whites, and the only way you can get them pure. Procure your half ounce of aniline blue, letter I, and dissolve it in 16 ounces of water. When your fixing bath is made up, add from 15 to 20 drops of the blue to every 40 ounces of fixing bath. Fix your prints from 12 to 15 minutes, and remove to a strong solution of salt and water. Let them remain five minutes, and then gradually dilute with fresh water, so that the change of temperature will not be so sudden, and you will never be troubled with blisters, and will always have *pure* whites.—FRANK THOMAS.

188. For splendid violet-black tones I recommend the following: Water, 2 ounces; chloride of gold, 1 grain; benzoate of ammonia, 4 or 5 grains.

It is a variation of Lea's bath, but much simpler to prepare. The bath is very regular. —*Photo. Archiv.*

four sheets have been toned, and when apparently exhausted, throw away six or ten ounces of it, and add a similar quantity of fresh bath, made according to the same formula, taking care its age is not less than one week, as the acetate bath if used too new, would tone unevenly, and the prints would lack that brilliancy so easily obtained when the bath is of the proper age.

Always take the prints out when of a *purplish* brown, but never at the *rusty* brown stage.

If the washing has been carefully done, you will find that nearly all of the batch will be finished about the same time, vignetted portraits first, and then the plain portraits. The latter always take up the larger proportion of gold.

189. When the toning is finished, pour your bath back into the jug or bottle, and keep the same for next time. Should there be a slight deposit of chloride at the bottom, decant carefully, so as not to disturb it; this will save all filterings, which are always better avoided.

According to the minuteness of the grains of gold, so will the print assume, by reflected light, colors varying from purple to the ordinary yellow. The organo-chloride of silver appears through this layer of gold, and the colors of the two mingling together give the different tones in ordinary prints. When a print is overtoned it becomes blue; this is due to the greater amount of gold

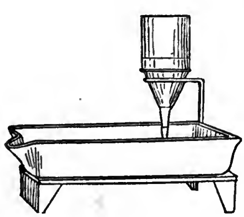
I use phosphate of soda in toning. My method is to make two solutions: No. 1. Phosphate of soda, 15 grains; nitrate of potash, 10 grains; water, 2 ounces. No. 2. Chloride of gold and sodium, 4 grains; water, 1 ounce.

To each three sheets of albumen paper, take 2 ounces of No. 1, same of No. 2, and 4 to 6 ounces of water.

I use the gold solution until entirely spent. When weak, begin the toning in that which is already partly exhausted, and finish in fresh.—W. F. WILDE.

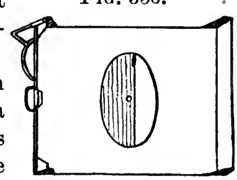
We all know how perplexing it is when one is toning to have to stop and get two bricks to place under a toning-bath to raise it so we can use an alcohol lamp. Usually one end is higher than the other, so the solution runs all to one end; then the lamp heats all in one spot. I have a tin stand three inches high, just the size of the bottom of the toning-dish (Fig. 355).

FIG. 355.



The top-piece is one-quarter of an inch from the bottom-piece, which forms a hot-air chamber. The bottom-piece has a large hole in it, covered with a loose piece of tin (Fig. 356).

FIG. 356.



The lamp-flame strikes the loose piece and fills the chamber with hot air, which warms the whole top evenly. This also makes a fine thing to dry plates on.—S. L. PLATT.

deposited over the surface of the silver. The change in color, on the immersion of a print in the fixing-bath, is due to the solubility of the chloride of silver.

190. Fixing is the next operation.

Hyposulphite of soda is almost invariably used for fixing. A strong fixing-bath is recommended, on the ground that a double hyposulphite of soda and silver is formed, and that this double salt is soluble in hyposulphite of soda. Consequently, if only enough hyposulphite of soda be added to form the double salt in the paper, the fixing is imperfect; whilst an excess of hyposulphite will dissolve it out of the paper, and leave the print amenable to washing. On these grounds the strength of the fixing-bath has been made as follows: Hyposulphite of soda, 4 ounces; water, 1 pint.

Mem.: One ounce of hyposulphite of soda will fix *with safety three sheets of paper.*

190. Hyposulphite of soda should be bought by the keg, kept as far away from other articles as possible, to prevent stains. All washing and toning-trays should be washed and removed before touching the hypo. Mix the hypo in a large crock, using one pint of soda to two and a half gallons of water, which should be a little warm—not too warm, though, as warm hypo will bleach prints too much. By keeping the bath in the crock after using, it can be used twice without any risk. After fixing prints, place them in a salt solution for five minutes, to guard against blisters. I have never been troubled with blisters with the above baths, but it is better to be sure, therefore I have always continued to use the salt bath. Galleries that have no stationary zinc or asphaltum-lined washing tanks, should get a box larger than the other trays, line it with zinc or asphaltum, and have a false perforated bottom to it. A hose should be attached to this tank under the false bottom, and the prints should be washed in running water all night, the water running slow. The large prints are generally washed separate and under the tap.—Charles Krauss.

I will now proceed to describe my combined toning and fixing process:

Solution: Water, 32 ounces; hyposulphite of soda, 8 ounces; acetate of soda, 4 drachms; chloride of gold, 15 grains.

Dissolve the gold previously in an ounce of water, and then add it to the stock solution. Keep the stock solution in an open bath all the time, and add to it fresh gold and hyposulphite when required. It is a good plan to dissolve fifteen grains of the gold salt in two ounces of water, and add a drachm of the solution to the bath each time or day just before you are going to tone. Throw into the solution also, about half an ounce of hyposulphite of soda after each day's severe strain upon it. In this way it will work for a long time, care being taken to supply fresh water as it becomes exhausted by evaporation or connection with each print when removed from the bath. The solution, too, is always ready and in good working condition to receive the prints direct from the pressure-frame without any previous washing. In this way the bath is seldom over-crowded

191. Between toning and fixing, it is well to wash the prints slightly. After taking them out of the toning-bath they should be placed in a dish of water, face downwards, till a bath is ready for fixing.

It will be noticed that the toning action on the print continues during this washing, presumably by the solution of gold contained in the pores of the paper continuing to deposit. The addition of a small quantity of common salt has been found useful to stop this action. If this precaution be not taken, the prints first toned should be left redder than it is intended they should remain.

The prints should be immersed in the fixing-bath for twelve or fifteen minutes. They should be kept in motion during the whole time of fixing, as for toning. Care should be taken to brush off all bubbles that may cling to their surfaces, as the cushion of air impedes the access of the liquid to the silver salt.

192. When the prints are fixed they will appear colorless in the whites, and free from red patches in the dark portions.

In some establishments, it has been found advantageous to add a drachm of ammonia to each pint of fixing solution. The ammonia aids the rapidity of

with prints at the same time, for, as one goes in, another, in general, is ready to be removed to the water-dish.—PROF. J. TOWLER.

191. *Washing the Prints.*—This is always an important operation, and must be thorough. We need not dwell upon this part; all know how to wash their prints, and have their own way and notions of doing the work—*do it thoroughly.* Finally, wash or soak them in a solution of common salt, which removes the last traces of the hyposulphite of soda; wash them again in fresh water, and then dry them. So prepared, the silver picture is more *brilliant and vigorous* than when toned according to our more modern plan; it remains to be seen whether it is equally permanent. Numerous yellow prints toned in this manner some years ago, attest to the contrary; but we believe that in those days the same care in washing was not observed as is now observed; for several prints before us, that were toned in the mixed bath then, are still as fresh and white in the whites, as the best prints now when taken from the wash-tub. If the fact of permanency can be proved to be a fact, we have no hesitation then in pronouncing the mixed toning- and fixing-bath as the easiest, the most economical, and the most reasonable of all existing toning and fixing methods.—PROF. J. TOWLER.

192. *Washing Prints.*—Washing-tanks are easily procured as follows: Get a set of boxes; all sizes required have one-inch wood. Buy some good white oil-cloth to line them with. Cut it large enough to cover the whole inside and to lap over the top an inch. Make some thick starch or glue; paste or glue the whole inside thoroughly, using plenty of material. Rub the cloth down thoroughly to prevent it from puffing up. The corners are then folded properly, and the cloth is tacked to the outer edge of the tray. Such trays can be used for toning and silvering (the silvering tray is flat, of course), and are perfectly safe if kept clean.

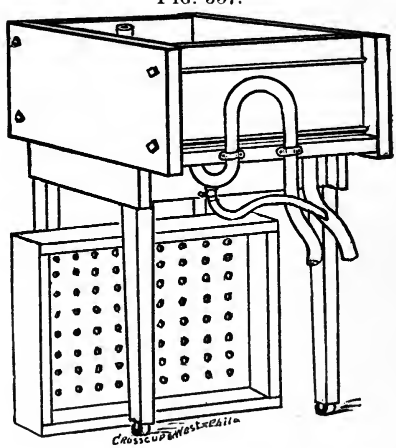
fixing; it also attacks the size of the paper, dissolving it out in a great measure. This renders the washing more perfect, and is found to prevent "blistering," which is common with so many albumenized papers.

The prints should be withdrawn slowly from the bath, in order that all excess of the hyposulphite solution may be drawn from them by capillary attraction, and placed in a trough of water. The methods of eliminating the soda, or of washing the prints, must depend upon the resources of the photographer.

Washing prints. Place prints into the water, face down, one at a time. They are then turned face up, and kept in constant motion to prevent the chloride from settling to the face of the prints. After a few minutes change the prints into another water, while the first water is put in a barrel, the chloride being settled with salt or sulphuret of potassium. When sulphuret is used, the hypo (developer), etc., can be saved in the same barrel, which is done in a great many galleries.

Into the third water, pour an ounce of commercial acetic acid to acidify the prints. Allow them to turn cherry red, keeping them well in motion to prevent them from acidifying uneven, which would result in uneven tones. Wash them twice more, then place them in a tank of *warm water*. This is done to avoid chilling the toning-bath every time you change prints. If this water is warm enough, it will keep the toning-bath in the same temperature (lukewarm). Get another tank, with water, to which add a small handful of salt; in this tank the prints are placed after toning. The salt prevents the prints from toning any further, and also guards against blisters in the hypo.—CHAS. KRAUSS.

FIG. 357.



The cut shown (Fig. 357) represents my automatic siphon washing-tank. It will be seen that I dispense with any rocking motion to fill the siphon.

I use what is known in the trade as "strong" lead pipe, $\frac{3}{4}$ inch. The reason for using it is that it will bend without kinking. My tank is 21 x 28 x $8\frac{1}{2}$, and it fills and empties every fifteen minutes. It gets the water through a hose, direct from the tap.

Now the size can be made to suit water-supply and any amount of business done. I use a wooden tray with a perforated bottom, allowing an inch space all around the sides and bottom of tank, so the prints will drain off.

The other large pipe is to clean the tank out, and the small one on the siphon is to drain it out in the winter to keep it from freezing.

The tank is well coated with asphaltum varnish, and will last a long time if kept so. I wash prints three hours, and find it enough.—GEORGE W. LEAS.

CHAPTER XIX.

PRINTING—DRAWBACKS AND DEFECTS; CAUSES AND REMEDIES.

193. THERE is no department of the art of photography that rewards the careful worker so satisfactorily as printing. But as printers are not always careful, drawbacks and defects are met. To turn them aside we must not only be able to recognize them when we meet them, but we must know their causes and have remedies at hand which will strike at the very root.

Trials and tribulations are liable to present themselves at all stages of the operation. Sometimes, however, their effects are not discovered until the work is almost done and the prints are ready for the finishing.

I draw a line between drawbacks and defects. The drawbacks come and go with change of season, and vary according to the care of the printer. When the silver solution and the toning-bath are not replenished, poor prints will follow. That is a drawback. So is neglect to wash the hands between the operations apt to cause very serious drawbacks. A dry-plate negative, if not most thoroughly washed free from hypo, will spoil all the prints made with it, especially if the air or paper is moist, and cause a serious and wasteful drawback. Any carelessness creates a drawback.

Some defects I have already hinted at. I tried to mention all I ever heard of in *Photographics*, and history is not to be repeated here. Coarse and spotty paper, impure chemicals, weak negatives, blisters, and hypo cause the majority of them. The remedies I leave to the notes.

193. Again, another topic—clean hands. It is much more easy to keep them from being stained than to remove stains when made. The remedy is *care* and *dexterity* of manipulation. I would recommend the use of a pair of good dog's skin gloves, well rubbed with warm wax or paraffine, as being comfortable to wear, and effectually keeping the fingers clean. India-rubber gloves answer the purpose very well, but some are very unpleasant to wear. I mention this subject not so much to call attention to appearances as to affecting the health of the operators. I quite believe eruptions upon the hands we hear so much about might be entirely avoided if the operator was rather more imbued with the spirit of economy and manipulatory neatness. For my part, I always look on so many stains as so much wasted material.—EDWARD DUNMORE.

194. During the past few years there has been quite a revolution in the use of paper. Formerly Rives paper, owing to its tender quality, was used for small prints only. Its manufacture having been improved, it is now almost universally used, and its once fierce and tougher rival is laid aside. But with this change came another, namely, an increase of blisters. I have no cause to describe them. I know no remedy except extreme care as to the uniform temperature of the various solutions. There are those, however, who "know a sure preventive," and they shall generously speak.

194. For over a year I have not been troubled with a blister. I am using the N. P. A. Dresden paper exclusively. All that is necessary to head off blisters is to use alum in the fixing-bath. I give the formula I have been using for over a year:

Printing bath, fifty grains, slightly acid, with C. P. nitric acid; when foul, add one-half drachm liquor ammonia, sun a few days, filtering.

After printing, I wash in rapid changes of water until the water remains perfectly clear; then in acetic acid, one drachm to one quart of water, until the prints are evenly reddened; then in three changes of water; tone, wash in two changes of water, then fix in—Hyposulphite of soda, round handful; water, 2 quarts; alum (dissolved in warm water), 2 drachms; Aniline blue (1 m. to oz. solution), 1 drachm. (The aniline blue I make after Wilson's *Photographics*, page 222, note 284.)

Fix from ten to fifteen minutes; wash through three changes of water, then from five to ten minutes through acetate of lead water, then through three changes of water. (The acetate of lead I keep in stock—Acetate of lead, 1 ounce; hot water, 7½ ounces. For use, ½ ounce to 1 quart of water.) Drain all prints on a sheet of glass; place between blotting paper, with light pressure, for about fifteen minutes; take out, place in pile under light pressure, and mount at leisure.

As to the alum, I read so much about it that I concluded to try it in the fixing-bath in place of bicarbonate of soda, and find it works admirably; never a blister.—HENRY LISTER.

Blisters are due simply to the employment of too strong and too freshly prepared toning and fixing solutions. I found this out by remarking that, for some days running, blisters were to be observed upon the carte-de-visite pictures, while others, prepared from exactly the same description of paper, were altogether free from the defect. On nearer inquiry, I discovered that my assistant was in the habit of commencing work by toning and fixing the small pictures, while the larger ones were left till the last, and treated, consequently, in weaker solutions. To convince myself of the truth of this circumstance, I directed that on the following day a weaker solution should be used, and found then that my paper remained free from blisters.—FRANZ FRIEDRICH.

My remedy for measles is this: Silver the paper the evening before it is to be used; dry and fume it, and lay it on an open shelf in a dry room. This plan enables the printer to get his frames filled early the next morning, and thus utilize all the light. The paper keeps perfectly.

I have no theory to offer for the above statement, but it works well in practice, and

195. Perhaps the greatest difficulty the printer must meet is in securing the thorough removal of traces of hyposulphite of soda from the prints. Samples of paper and hyposulphite, and water, too, vary, and thought must be exercised in this matter with great constancy.

Thorough washing is a safe remedy, but it does not succeed always, unless the prints are treated individually. Sorry looking prints, disgracing the photographer, follow any lack of conscientious care in this department.

that is the essential point. Should you have an attack on some of the cold mornings, don't throw your paper away in disgust, but lay it aside on a dry shelf until next day, and the chances are that it will print smoothly.

Let me also remind you of an old dodge to prevent paper from curling up when first placed on the silver solution. Get a flat curtain stick, and cut it in two; put a tack in each stick to lift it up by, and as soon as the sheet is placed on the solution, quickly lay a stick at each side, on top of the sheet, so near the edge that it cannot curl. Try it, and save your breath, for you will need do no more blowing in that direction.

Thirdly, should you be troubled with those very large blisters or bubbles that sometimes put in an appearance in the fixing-bath, put some salt right into the fixing-bath when you mix it. It will prevent blisters, and if harmful to the finished prints, let some photo-chemist speak.—FRANK ROBBINS.

195. Great care should be taken to remove all the silver from the prints before toning; this washing should be done in rain or distilled water, and on no account should salt be added until they are well washed.—JOHN STUART.

My mode of working and the results of using J. R. Clemons's "alum process" for eliminating hyposulphite of soda from photographic prints, is thus: I take my prints from the hypo and immediately immerse them in a saturated solution of alum, letting them remain from ten to twenty minutes; I keep them moving continually; then remove them and rinse them thoroughly in clean soft water. This process I repeat four times, taking particular care to rinse them well each time; then mount them. If my prints are thoroughly washed before toning, so as to remove all free nitrate, they come out of the alum bath clear and bright, and so far stand the test better than when I did not use the alum. I consider John R. Clemons's "alum process" one of the greatest improvements in the art.—HOWARD M. SEDGWICK.

I have succeeded in finding a test for hypo which is at least very simple. It is based on the reaction of hypo on iodide of starch. When you add hypo to iodide of starch, the same is discolored instantly; the more concentrated the iodide of starch, the more hypo will be necessary for discoloration; if, therefore, a very dilute solution of hypo—such, for instance, as the water in which prints have been washed—is to be tested, a very dilute iodide of starch will be necessary.

I prepare the same in the following manner: One part of arrowroot is dissolved in a little cold water, and afterward about 100 parts of boiling water are added. In this manner I obtain a colorless solution of starch; this solution of starch is mixed with one-fifth of a straw-colored solution of iodine in iodide of potassium; this gives a beautiful

196. Sometimes impure cardboard will cause the turning and fading of prints after they are mounted. Hyposulphite of soda is employed in the manufacture of paper and unless it is thoroughly eliminated, it will cause mischief. With the productions of our well known cardboard makers in America there can hardly be any fear in this direction.

197. Sometimes silver becomes a very destructive element in paper prints,

blue solution of iodide of starch, which will keep for several weeks, and might be kept on hand by stockdealers. If the water in which prints have been washed is added to this solution of iodide of starch, it of course becomes diluted, and consequently paler, even if the water is perfectly pure; this might easily be mistaken for a discoloration, therefore it will be better to proceed in the following manner: take two test-tubes of about equal diameter, and put in each of them about a cubic centimetre of iodide of starch; add to the one about eight times as much pure water, of the same kind as has been used for washing, and to the other, the same quantity of water in which the prints have been washed, and it will then only be necessary to shake both test-tubes up well, and hold them against a piece of white paper and compare them; even by lamp-light it is an easy matter to discover discoloration, if the same has taken place. The easiest mode is to look vertically down into the tubes. I have tried this process carefully, and find that when only one-millionth part of hypo is present, a distinct discoloration takes place. On account of this extraordinary sensitiveness, great cleanliness in the glasses and the hands is required.—Dr. H. W. Vogel.

196. Mounting-boards are the cause of much of the fading of photographs, and I suggest the following method as a preventative:

Our prints must be mounted; and, as paper boards are the only thing on which we can mount them, we must do our best to check, if possible, the bad effects of hyposulphite and other deleterious matter in the boards injurious to photographs. The mode I propose is to saturate the prints with collodion.—John Stuart.

After careful experiment I have concluded that freshly-made starch, paste, and glue, either in watery or alcoholic solution, may be thoroughly relied on as safe mountants, and that when fading occurs in prints mounted with either of these substances, it may fairly be concluded that it has not been caused by the mounting material.

I am aware, of course, that such a negative conclusion does not help to indicate the true cause of fading; but it is quite evident that the greater the number of probable causes that we can eliminate, the more nearly will we approach to a solution of the difficulty which has so long been a puzzle to the experimentalist in silver printing.—Dr. E. Liesegang.

197. The existence of silver in the highest lights, the purest whites of the finished picture, cannot be looked upon otherwise than as a very great evil. So long as it is, there are far fewer chances for the permanence of the print, and if any way could be found for removing it, without injury to the rest of the picture, it would be a great advantage. This is a very difficult problem, and one which I have as yet been unable to solve.—M. Carey Lea, M.D.

attacking them with all the ferocity of a blood disease. A learned contemporary has given much careful attention to this subject and provides some very valuable instruction, but does not offer a cure.

198. Over-printing should not occur as a rule, and when it does, generally the best and easiest remedy is to cast aside the defective print and make another. Oftentimes, however, say at the close of the day, when the silvered paper is exhausted, that would be impossible. In case an order must be filled on time, a method of reducing an over-printed picture would prove a boon.

199. The improper drying of prints, after washing, also causes much loss. Whatever the means of drying, the whole print should have a uniform chance to dry. If globules of water are permitted to hang upon the prints; or if they are permitted to adhere to each other in part, or if they are dried upon cards or between papers that are unclean they will show defects which render them unfit for use.

If photographers would *think*, there would be no occasion for alluding to these matters at all. Given a defect or drawback, the cause would be then known and the remedy applied at once.

199. The best plan we have seen adopted for drying prints by the sheets is as follows: The prints, taken out of the water one by one, are laid upon well-washed pieces of linen till each "sheet" is covered; another sheet is then placed on the top to be covered with prints, followed by another sheet, and so on till all are arranged. A little gentle pressure then removes the greater part of the moisture, and the prints are now placed between sheets of blotting paper for a final drying, where they are left till ready for sorting or cutting.

Some photographers use linen cloths only, others merely blotting-paper or board. Now, this double-drying plan, carried out in its integrity, is very good, but most particular care has to be taken that the routine is thoroughly followed day after day. No holiday time and short hands, no press of work, no oversight, no neglect in consequence of a bad printing day leaving few prints to attend to, can be permitted to interfere and allow a batch of prints to be left in the sheets over the day, or everything will go wrong.

Perhaps the most popular method is to hang up the prints by American clips till quite dry, and it is one which has much in its favor, the only foreign enemy being dust, and that can easily be guarded against if there be suitable space at command. One chief drawback to the use of the clip, beyond the space required for hanging, is the liability of the prints (if on paper) having a gloss at all beyond the average, to show when quite dry a multitude of fine cracks, which gives the mounted print a very unsightly appearance. There is no remedy for this except taking the prints down before they are quite dry, or drying between sheets of cloth or blotting-paper.—*British Journal.*

CHAPTER XX.

PRINTING-ROOM PARTICULARS.

200. THE cutting and preparation of the paper for the printing-room require a great deal of nice care. The first should be done economically, and the second with as little fingering of the silvered surface as possible. A hundred little wrinkles and dodges will occur to the tasteful printer who puts heart in his work. These are the result of "knack" and can scarcely be taught by another. I have however culled a few notes of experience which tally with my own and have shaped them so they may be readily followed.

200. The bath I use is from 30 to 40 grains strong, containing a strong dose of nitrate of ammonium, and is alkaline from the same. The sheets are immersed, face up, one at a time until from ten to twenty are covered by the solution. The dish being rocked back and forth to loosen bubbles and make sure that each sheet is thoroughly wet, I then turn the whole mass over, which brings the first ones immersed to the top, face down. The next operation is as follows: Have a sheet of double thick glass, a little larger than the paper (I am speaking of whole sheets of paper), which place at a proper inclination to drain the surplus solution back into the bath. Float the paper to one side of the bath to get them even, then take them all out together and lay them face down on the inclined sheet of glass, near enough to the top to be held.with two wooden clips, one at each end; the drainage is now all back into the bath (Fig. 358). To hasten this operation I use a squeegee, a strip of rubber set into a stick a foot or more long, which is applied lengthwise at the top of the paper and pressed forward toward the bottom, forcing the solution out of the paper into the bath (Fig. 359). If desired to secure the largest amount of silver absorbed by the paper press the solution from the top sheet, then the next, and so on, or the whole can be squeegeed at once. What I claim for paper so prepared is greater depth and transparency to the picture, and perfect uniformity in the paper, with facility and equable toning. The paper prints clear through, giving great body to the darker parts. On the score of economy of silver I think the loss less than when paper is hung up to drain (on the *floor*) in the usual way. The

FIG. 358.

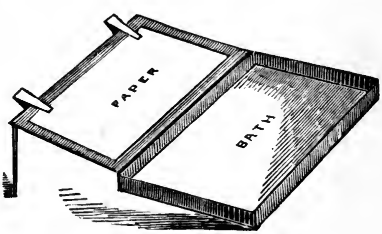
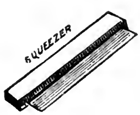


FIG. 359.



201. The fuming of the paper is considered a great point among American printers, although in some countries it is not practised at all.

The paper should be well dried after silvering before this operation is attempted, or else nothing but yellow prints will be returned for your labor. And some careful thought must be devoted to the operation, as the time of fuming is governed by the character of the sample of paper used. One is never justified in plunging headlong over any road, even though it be a familiar one. The careful person always comes out best. Any contrivance by

saving of time in silvering by this method would largely overbalance the waste of silver by extra absorption, if there be any.—John L. Gihon.

201. The construction of my fuming box, I think, can easily be seen from the accompanying diagrams. In Fig. 360, I have purposely left the front out of the box. *AA BB* are the grooves that the frames slide into. It can be made to take any number of frames. Mine will fume six sheets at a time, and is about all I require at one fuming. We have never, since using the box, had one case of uneven fuming, but the paper works splendidly at all parts of the sheet. As soon as the paper is ready, we take about one ounce of ammonia (which will fume enough for all day and more) in a saucer, and put in chamber, having previously ascertained that the box was "*closed*;" put in frames with paper, shut down top cover, one pull at the ring handles shown in the front of the box, "*and off she goes.*" When fumed enough, push back handles again, open cover, take out paper, and as the paper goes out, so will the small quantity of "*exhausted*" ammonia. In the meantime, that in the chamber is gathering fresh strength from the saucer, and is fully charged for the next batch. In Figs. 361 and 362, I have shown the end and side sections. It will be seen that the bottom, which the inside box slides upon, and also the sides, are carried from front to back, and supported in this way. The

Fig. 360.

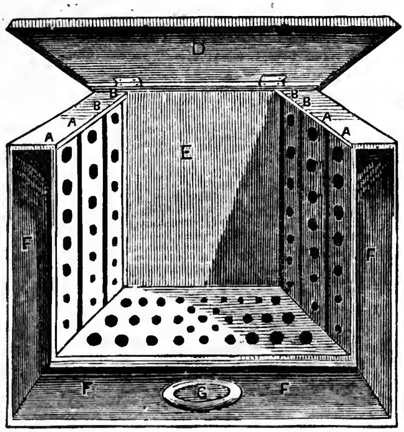


Fig. 361.

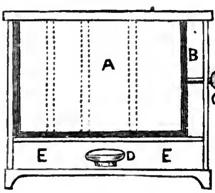
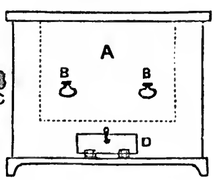


Fig. 362.



inside box is about two inches shorter, which will be just enough to open or close the holes when slid either way. It is best not to have it any shorter than is absolutely necessary, as then there will be no danger of pushing it too far either way.—S. H. Parsons.

means of which the sensitized paper may be sufficiently reached by the fumes of ammonia will answer, yet it will be found well to have a carefully planned fuming box even for small operations. A good model is given below, with full instructions for use.

202. Proper pressure-frames are a great essential. And they must *be* pressure-frames, such as will secure the close and uniform contact of the paper with the negative or film to be printed. As the press printer by "making ready"—by "underlaying" and "overlaying" secures all possible effect from the

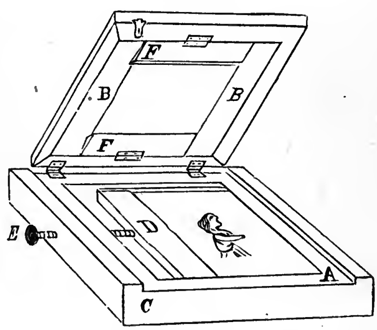
202. As to the breaking of negatives, that is to be avoided in various ways—by using elastic packing, and not, as some do, sheets of paper, or mill-board. By not leaving the negatives in the closed frame and under pressure after the printing is done. But most of all, by using thicker, stronger, and flatter glass than is generally done.

Some may be disposed to say, What is, after all, the need of so much pressure? Why is it not sufficient to apply the paper with a gentle pressure to the negative, without forcing it into contact so strongly?

I answer, if we would carefully calender our paper after sensitizing and drying (after fuming, if that is to form part of the preparation), we would require much less pressure, for then we should have two surfaces flat, or so nearly flat, that a moderate pressure would bring them into contact. But our silvered paper is not thoroughly smooth and even. And the albumen, coagulated by the bath, is more or less horny, so that the paper is not very flexible, and does not easily fit itself closely even to a plain surface. To bring it into close contact, pressure is required, and no inconsiderable amount.—M. Carey Lea, M.D.

I send you a drawing of a printing-frame I have for making aquatints, similar to the mezzotints (Fig. 363). *A* is the outside of the frame, made of walnut, 6 inches square and 1¼ inches thick, but rabeted out ⅝ inch on the sides, to let the cover down flush with the top, as you will see, and then fastened with a little catch at *C*. *B B* is the cover hinged on to the frame, 6 inches long, but ½ inch narrower, to let it down into the frame, ⅝ inch thick, and just a piece of board with two strips on the edges to prevent warping. *D* is a cross bar, that slides in grooves in the frame *A*, and is to hold the negative with the help of the thumbscrew *E*. *FF* are two little pieces 1¼ inches wide and 3 inches long, hinged to the cover to hold the paper, and are made thickest at the outer edge.

Fig. 363.



The operation of the frame is very simple. Fasten your paper on to the cover with the little clamps, which will keep it straight, and fasten your negative with the thumb-screw, putting it back from the paper as far as you choose, and thus you get your picture without "*printing through any transparent sub-*

30

engraving, so should the photograph printer secure his best results by means of the close contact suggested. I have often seen a large print—say a full sheet—ruined by a fuzzy spot here and there caused by a little crinkle in the paper or a tiny curve in the glass preventing close contact. A bit of cotton, a small rag, or even a single thickness of paper in addition to the regular padding, would prevent all such blemishes. Watch everything.

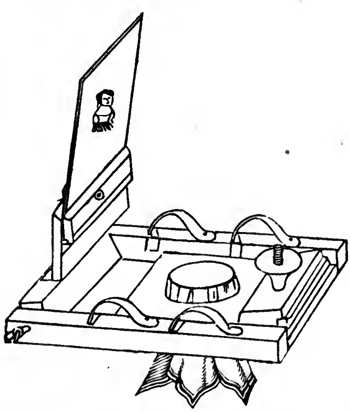
For special styles of prints like medallions, prints with a halo, mezzotints, fabric pictures, and vignettes a dozen contrivances will suggest themselves to every ingenious printer to whom mother necessity need only make a suggestion to secure a proper invention to answer the purpose. For small work the ordinary "flat" printing-frame answers admirably, but for larger sizes the "deep" construction is not only stronger but safer for glass plates. As an additional protection to the negative a plate glass should be supplied with every printing-frame.

203. The favorite style for portraiture is the vignette. It is considered "the most artistic" by many. Its strong rival is the "medallion." There was a time when vignettes properly graded were very difficult to secure, and a higher

stance," and also secure much better effects. The idea is to create a small space between the negative and the paper.—FORESTER CLARK.

Those who are accustomed to printing photographs on handkerchiefs and other fabrics, know what a trouble it is to get the same drawn tight and even, and to hold them so during printing. A little device we use answers the purpose admirably, and is very simple. Take any ordinary porcelain printing-frame, and through the bottom part bore a hole, say $2\frac{1}{2}$ inches in diameter. Fit this with a nice, smooth, tapering cork, so that the further it is pushed up through the hole the tighter the fit. Now over the face and small end of the cork lay the fabric, push it up through the hole in the printing-frame, and thus you secure a surface as hard, even, and easily printed upon, as a piece of ground porcelain. The cut (Fig. 364) will make the whole matter plain. The hole does not prevent the frame from being used for porcelains, either.—MOORE BROTHERS.

FIG. 364.



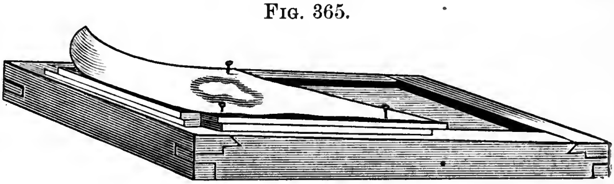
203. The drawing (Fig. 365) will show how I use the Waymouth Vignette Papers. I do not consider the process of nailing the strips of board on the outside of the printing-board (to which the papers are nailed or tacked, as shown in the drawing), as the very best way for quickness in arranging the papers, but I have the strips

price was asked for them. But now the Waymouth vignette paper and other contrivances render the process an easy and regular one. There is always room for the exercise of taste in deciding how much of the person should be indicated in a vignette—how much "bust"—how much "sky." A little practice will soon teach the eye to judge quickly. A nice style that seems to have fallen into disuse is made by vignetting full and three-quarter standing and sitting figures. They are a pleasant relief from the rather common bust picture. Use your genius.

204. Combination printing is attempted more than formerly. The objection to it is the time it requires, and, moreover, as a rule, the results are not considered artistic. An artist who succeeds admirably in making them artistic, however, is my esteemed colleague, Mr. H. P. Robinson. His excellent manual of instructions must be consulted by all who are ambitious to follow him. These will be so few, that I am not warranted in appropriating more

constantly near by, and as it does not take many seconds to tack one or two thicknesses on the outside of the printing-frame, for the purpose of separating the paper more or less from the negative to get soft vignettes, I therefore use this way. When, after having built up the outside of the frame by means of strips of backboard, and when, upon looking at the print, if there should be too much blending out at the dark drapery of the print, although the grading may be beautiful around the head, it can easily be overcome by removing one or more of the strips of wood nailed on the bottom of the frame, and where the lower part of the vignette paper is placed, and thus bringing that part of the vignetting paper *nearer* to the negative (leaving the rest of the paper as before), and then as the distance between the two is diminished, there will, of course, not be so much blending.

Fig. 365.



Another thing: in placing these papers on, place the negative in the frame first, hold it up to the light with one hand, and match the paper to the negative by placing it on the further side of the frame, and looking through to the light, being careful not to let too much space above the top of the head, as it will then print too dark.—Charles W. Hearn.

204. For combination printing the landscape negative must have a dense sky, or, if it be weak or have any defects, it must be stopped out with black varnish. In this case it is better to apply the varnish to the back of the glass; by this means a softer edge is produced in printing than if painted on the varnished surface. With some subjects, such as those that have a tolerably level horizon, it is sufficient to cover part of the sky while printing, leaving that part near the horizon gradated from the horizon into white.

than a few notes from his work. I heartily commend the production of combination pictures as most excellent schooling, sure to bring good returns.

205. I have already alluded to some of the various styles printed from the photographic negative, but there are many others. Many of our leading artists resort to styles all their own. I cull from these a few suggestions, which will be useful to the tasteful and inventive printer in producing many more. Quality should ever be the *first* thing in style.

One kind of style (?) should be studiously avoided, namely, that of ornamenting portraits with the shocking borders and make-up margins one often sees. The introduction of anything incongruous should always be resisted. Scratching and etching upon the negative are bad. Flying angels and plumed birds have no place in the human portrait. When you hunger after such incongruities seek out some of the advertisements of our railroad "trunk lines," and ye shall be filled. Anything introduced in a picture which detracts from the special object of interest, is incongruous and out of taste.

It may here be remarked that in applying black varnish to the back of a negative, occasions will often be found where a softened or vignetted edge is required for joining, where a vignette glass or cotton-wool cannot be applied. In such cases the edge of the varnish may be softened off by dabbing slightly before it is set, with the finger, or, if a broader and more delicately gradated edge be required, a dabber made with wash-leather may be employed with great effect.

When an impression is taken, the place where the sky ought to be will, of course, be plain white paper; a negative of clouds is then placed in the printing-frame, and the landscape is laid down on it, so arranged that the sky will print on to the white paper in its proper place. The frame is then exposed to the light, and the landscape part of the picture is covered up with a mask edged with cotton-wool. The sky is vignetted into the landscape, and it will be found that the slight lapping over of the vignetted edge of the sky negative will not be noticed in the finished print. There is another way of vignetting the sky into the landscape, which is, perhaps, better and more convenient. Instead of the mask edged with cotton-wool, which requires moving occasionally, a curved piece of zinc or cardboard is used. Here is a section of the arrangement (Fig. 366). The straight line represents the sky negative, and the part where it joins the landscape is partly covered with the curved shade. Skies so treated must not, of course, be printed in sunlight.—H. P. Robinson.

Fig. 366.

205. The method I use is simple, and requires no labor. I have applied it in different ways for marginal printing, for monograms and autographs on portraits, and descriptive lettering on views in landscape photography.

For portraits it is as follows: I first make a print for the usual medallion style, masking out the mat part. After the print is made I insert, between the print and the glass

206. "Keeping tally"—*i. e.*, keeping an account of how many prints have been made toward the filling of an order—is a tax to the memory, and therefore the plan given below will prove useful. One or two prints should always be made in excess, to provide for failure in the after operations.

207. The printer in a large establishment has often been compared to a manufacturer making many styles of goods each day, and no two days alike. This is literally true and just, for there is always a lack of uniformity, both in quality and in subject, in the negatives which come to his hands. He is

which holds the oval mask, a thin sheet of paper, such as is used for foreign correspondence, upon which the autograph is written or the monogram drawn or printed in non-actinic ink, then exposed to the light for a short time. When for landscape it is difficult to get paper sufficiently large, I do the lettering reversed on a glass that holds the mask which prints the outside tint or mat. The best thing I have found for lettering is Gihon's Opaque.

The mats for portraits can be embellished very much by designs drawn on the same kind of paper. French note paper with fancy designs, used in the same manner, makes very good mats.—J. LANDY.

The following will be found a durable process for securing the tinted picture called "Au deux crayons:"

Make two solutions, viz.: No. 1. Aloes, powdered, 1 ounce; alcohol, 12 ounces. No. 2. Water, 12 ounces; liq. ammonia, 15 drops.

Immerse the albumen prints in solution No. 1, until they take a bright lemon color; then wash them well, and put them in solution No. 2. Let them remain until they take a warm orange color, and again wash them. Mount and touch up the whites with Chinese or any good white, and the blacks with India-ink. After touching up the whites and blacks, coat the pictures with the following: Plain collodion, 6 ounces; castor oil, 12 drops.

The deeper the tint required, the longer the prints must remain in the aloes solution. Too long immersion in the ammonia solution will reduce the tint.—WILLIAM BELL.

207. To secure a good print from a hard negative I make a positive on glass from the negative, and when a print in the pressure-frame has acquired sufficient depth in the shadows, I use the transparent positive as a mask, placing it outside the pressure-frame over the image. As this mask is opaque in the shadows and transparent in the lights, it will be seen that the printing in the shadows is stopped or retarded, whilst in the lights it still progresses; the detail and modelling in the face are thus gradually secured without the minor lights, which give transparency to the shadows, being obliterated or overdone. It will be seen that some judgment must be exercised in using such a mask, as, if it were applied too soon, the negative and its inverse counterpart neutralzing each other, would issue in negation of all detail. The want of sharpness, which, at first sight, it would seem, should follow from placing such a mask outside of the printing-frame, is not found in actual practice.—SAMUEL FRY.

To obtain brilliant tints from flat negatives "extra brilliant" paper is recommended.

governed very much in his work, therefore, by the negatives supplied him. They are "weak," "strong," "harsh and hard," "soft," and what not, and should be studied carefully before they are placed in contact with a single piece of paper. Then the paper must be prepared and the light chosen to suit the varied characters of the plates in hand. But it is such a fascination to see excellent and uniform results created by his care and thought, that the earnest printer is only too ready to practise all the deftness of his art upon his subjects.

but the effect of the quality obtained by glossy papers is rather that of brilliancy, such as is produced by varnishing, than an actual increase in the contrast between the higher lights and the shadows; but for negatives only slightly deficient in density nothing more will be required.

When, however, the negative requires still greater effects of contrast other means must be resorted to. One of the most successful modes of effecting this, to a certain degree, is of so simple a nature as almost to raise a presumption against the possibility of its usefulness. It consists in applying to the *back* of the negative a yellow coating, which is most easily done by dissolving iodine in the ordinary negative varnish, and coating as though varnishing the film.

We have communicated this to friends, and have found them apply it to the film under the idea that the iodine played some part in strengthening the deposit of silver. Such is not its action. A negative yellow varnished at the back will give prints possessing a striking amount of brilliancy from negatives that would otherwise print faint and flat. The advantage of this method is that it can be used in conjunction with other plans, and thus intensify the effect of the other. For example: When a negative is too weak to give a good print with either extra-brilliant paper or yellow varnishing, if both are combined it may be quite possible to get excellent results. In the case of a negative still too weak to print well when even both these methods are combined, further plans entail an extra amount of labor, but still not to a prohibitive degree. Such a negative will require fumed paper.—*British Journal.*

Extremely soft and beautiful prints having the appearance of being printed from finely retouched negatives are done by the "Berlin" process. I use Hance's "Ground-glass Substitute," which gives to glass coated with it a most beautiful ground-glass surface. Moreover, this substitute gives us advantages over the old process, besides cheapness and the ease with which it may be obtained. When albumenizing a plate in the old process, the albumen which run over on to the ground surface, could only be removed by cleaning it with powdered emery, thus endangering the film. Now the "Substitute" need not be applied until the negative is entirely finished, even to varnishing.

The whole process as at present worked, therefore, stands thus: Albumenize the glass and make the negative soft, thin, and full of detail in the usual way; varnish and coat the reverse side with Hance's ground-glass substitute, and print in soft light. This is not a mezzotint process. The effect is apparent over the whole picture, and is not lost in the shadows; we think it only needs to be tried to be liked. Best of all, it may be applied to negatives already made with the best of success, so that it is easily tried, and no charge for the secret.—G. W. WALLACE.

208. "Glacé" or "enamel" pictures are coming into use again. For a time the "shine" of the burnisher drove them out. They have their attractions as well as the matt surface of platinum and bromo-gelatine papers; and some insist that the "happy medium" surface of the albumen print, simply rolled or treated with cerate, is the most approved. All shall have attention here.

208. For a fine finish with the "glacé" or "enamel" use plate glass, or the first quality of French negative-glass will answer.

Clean the best side in an ordinary manner, and when perfectly dry apply very lightly, with cotton-wool, a little prepared chalk; then, with a soft brush, dust the plate, and gum the edges with any kind of gum. Before the gum is dry, collodionize the plate with plain collodion—consistency of collodion as will flow well. The next thing is to soak for one or two hours one ounce white French gelatine in eight ounces settled water, and dissolve fully by heat. While yet hot, strain through a piece of muslin into a small porcelain dish; immerse your print in this solution, and when well saturated take it out, scraping the back of the picture over the edge of the dish, to avoid waste. Place the print down on your prepared plate and press out the air-bubbles by means of a piece of sheet rubber five inches long and two and one-half inches wide, inserted into a wooden handle, like the well-known rubber squeegee.

Now, when the picture thus put on glass is nearly dry, damp a two-ply piece of bristol-board, previously cut to size; paste on one side, put it over the print, pressing it well down with the scraper, especially the edges.

The Mounting.—After thirty-six hours, or when perfectly dry, cut the picture with the point of a knife along the edge, leaving about one-quarter of an inch strip, and raise the picture slowly; then trim to size and gum the edges only; place down on the card, and for a weight, cover it with the same glass from which you cut it, or any piece of glass that is straight and clean. All dust and carelessness must be avoided or a bad result is certain.

You can put one or more prints on one glass, only be careful to keep away from the edge about half an inch or so. Keep the gelatine solution as cool as you can work it.

If the picture leaves the glass quite clean, you can use it again without recleaning; thus you may use it a lifetime, being cleaned but once.—John A. Scholten.

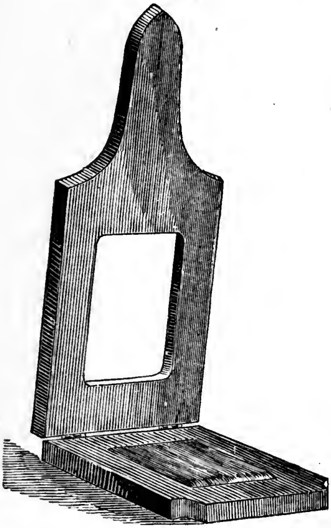
I wish to present a wrinkle given me by a friend. You will notice that this print has a very fine gloss, and this is produced simply by taking the print out of the washing trays and squeegeeing it on a marble-top table. When the print is dry, it remains flat. This one is a little crooked there, on account of being in proximity with my heated body. It was printed on ready sensitized paper, eight months old, and the printing, toning, washing, and drying occupied but a few minutes less than one hour. After fixing, it was treated with the alum bath.—John H. Janeway, M.D.

While on this subject, I would like to say that I read a few days ago that it is possible to get a gloss on gelatine prints with the ordinary ferrotype plate. I have prints here about a year old, and simply moistened them and placed them on a tintype, and you see

209. After all the care possible in printing, unless pictures are mounted upon tasteful cards, and in a cleanly manner, they will be utterly spoiled. Clean and sweet mountants must also be used, and cardboard free from dele-

the result. [He pulled the prints off from the varnished side of the plates and passed them around.] The reason I have brought this matter up is that some time ago we had quite a discussion in regard to the use of hand-finished vulcanized rubber, which was so hard to obtain, so I saw the suggestion of using the ferrotype plate, and I find that it works very well, and that the pictures strip off as easily as when on rubber.—F. C. Beach, M.D., at N. Y. Photo. Society.

Fig. 367.



For the enamelled cameo or glacé portrait process, I use a press as represented in Fig. 367. Any carpenter will make one for about three dollars. It is made of maple wood, three-quarter inch thick. The raised centre for moulding is glued on. The top and bottom are hinged together.—E. D. Ormsby.

209. Now comes the question as to whether the pictures should be mounted wet or dry, and what particular adhesive material should be used. A happy medium between the two conditions of the paper should be chosen. The photographs should be sufficiently damp to prevent their curling up, and insure their lying flat; they should not be dripping wet. This state can readily be obtained by allowing them to lie for a few moments between wet cloths. All sorts of compositions have been suggested and used, but of them all, the plain starch-paste has remained most in favor.

From the commencement of the application of our art to wholesale requirements, such as the illustration of books with photographs, it has been a vexatious matter to mount the albumenized prints upon paper sufficiently thin for bookbinders' purposes, without showing a most objectionable and unsightly cockling or drawing of the edges and corners of the supporting paper. The result *can* be perfectly accomplished, but, unfortunately, the method entailed involves too much labor for the occasion. The following is from one of my "scraps," and answers tolerably well.

The only mounting material hitherto in use, by which all risk of cockling is avoided, is India-rubber in solution, but, unfortunately, it is altogether untrustworthy; sooner or later, the prints are sure to leave the mounts.

The cause of cockling in prints mounted on thin boards is, of course, well known. A print treated with starch-paste, gum, or any adhesive preparation of which water forms a large part, absorbs the water and swells or stretches. If, in this condition, it is attached to a dry board, it contracts again as the water evaporates, and necessarily drags the board to which it is attached out of shape, causing cockling or buckling. The point to terious substances employed, if the pictures are intended to last at least one generation.

be secured, then, is an adhesive substance containing little or no water. India-rubber solution answers this condition, but, as I have shown, it fails in other respects.—JOHN L. GIHON.

To make the best paste brush: 1st. Procure a *cork-puller*, an implement used for removing, or rather extracting, corks from the *inside* of bottles. 2d. Purchase a fine sponge, free from any grit or sand, and insert the same in your cork-puller, leaving about one inch extending to serve as the brush; now push down the sliding ring, and the sponge will be held firm and steady. (Figs. 368 and 369.) Make your paste of the proper consistency, and use but little on the brush. The entire cost of this contrivance will not exceed twenty-five or thirty cents, and will last you three times as long, work nicer, *smoother*, and quicker than any ordinary hair brush. The same size sponge will do equally well for any size photo., from card to 14 x 17. Having finished your mounting, remove the sponge from the holder, wash well, squeeze, and lay aside for future use.

FIG. 368.

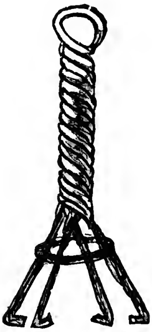
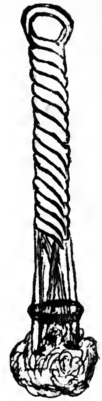


FIG. 369.



A brush of the same construction may be used with advantage in the dark-room, for removing the surplus water from dry plates after the final washing. It will absorb the water and particles of sand quicker than a camel's-hair brush. Keep the wires dry, to prevent corroding.—EMIL FREY.

In the first place, a picture that has not been mounted upon a proper mount is not susceptible of the best finish; but supposing it is properly mounted, my instructions are, first, to see that the picture is not too much dried, as all know the swell of the card when a picture is first mounted bends the picture backward. Let the picture dry until the contraction of the paper just commences to bend the picture forward. It will be found that the picture in this stage is about three-fourths dry, and it is absolutely necessary that it should not be allowed to dry any more than this until after the picture has gone through the burnisher. This is best done by piling the pictures in one or two piles, and placing them under a weight. They should be carefully taken from this pile and spotted out, and immediately placed in another pile under weight. The same precaution should take place in applying the lubricator to the print. They should be taken to the burnisher in this condition.—J. H. SCOTFORD.

I venture to give my method of mounting with Slee's mounts. Place the prints right side up in a basin of water at your left; cut several sheets of ordinary white blotting-paper into halves; lay one of these pieces on the bench, length from right to left, and spread ten cards in two rows on the paper; lay the prints in place on each of these, place another piece of the blotting-paper over them, and roll the whole first lightly with a common kitchen rolling-pin, and afterward heavier. The blotters serve again after drying, till soiled. These mounts are great labor savers.—JOHN L. GIHON.

CHAPTER XXI.

PECULIAR PRINTING PROCESSES.

210. Besides the method of printing on albumen paper—the one most commonly used, and the one treated in Chapters XVIII., XIX., and XX.—there are several other processes for producing positives. Some of them are on paper and some on glass. Some attention will be given to each one in what follows:

Ready sensitized paper, or paper washed and fumed after sensitizing, is now in common use, especially among amateurs. Its convenience is undis-

210. The process I have now adopted is as follows: Sheets of blotting-paper are steeped in a solution of bicarbonate of soda and dried. The strength of the solution is not of importance; I use an almost saturated one, but I believe a weaker one would answer. The silver bath should be made neutral by the addition of bicarbonate of soda until there is a permanent precipitate, and allowing this precipitate always to remain in the bottle in which the solution is kept. Float the paper for the usual time, perhaps a little longer, and then absorb the superfluous silver solution by placing the paper between folds of blotting-paper. When almost, but not quite dry the sensitive paper is interleaved with the already prepared blotting-paper, and the whole put under a slight pressure. Paper prepared in this way will retain its whiteness for, at the very least, a month, and probably longer; thus a large stock can be made at any time, to last for weeks, which is always at hand ready for use. If an insufficient number of prints be produced in a day to be worth toning, they can be kept until the following day by replacing them between the sheets of blotting-paper. This process is particularly useful for amateurs, who can print one day and leave the toning and fixing until they have another opportunity.—Edward Smithells.

There is a great deal being said in the transatlantic journals about washed paper, that will keep in its sensitized condition for longer or less time. I give you a formula that I find will keep the paper I use, for three or four days in perfect condition, without washing or the trouble of fuming pads or paper.

Silver Bath.—Nitrate of silver, 480 grains, water, 16 ounces. Dissolve, and add a few drops of concentrated aqua ammonia, and then add nitrate of ammonia, 1 ounce.

For giving pure whites and many other excellent qualities, I recommend the E. A. paper.

This paper is floated on the silver solution for one minute; it is then drawn over the sharp edge of the dish, for the purpose of removing all the surface solution, and laid face puted, because it is always ready. For the large printer it would be expensive and troublesome. Its preparation is held as a secret by several who manufacture it. It was first made by washing the paper right after silvering, then drying and storing, and when needed for use the sensitiveness which the removal of the free nitrate of silver had destroyed was restored by fuming with ammonia. The keeping qualities were secured by the use of citric acid in the silver bath, say ten grains of citric acid to each ounce of a forty-grain nitrate solution.

It is not recommended to small consumers to manufacture it, yet for general information some useful hints are given for what they may be worth.

211. Plain paper, or matt surface paper, was in vogue until albumenized paper drove it nearly out of use. It still does good service, however, where a matt or plain surface is needed for coloring, India-ink work, and so on. It is sometimes called "arrow-root" paper. It now has several compeers in the

downward on a quire of common paper, such as is used for printing newspapers, then lay a couple of sheets of the same paper on the top of the sensitized sheet, and press backward and forward with your hand, until all the solution is taken up by the paper on which it is laid, remove the upper sheets and hang the paper up to dry; serving the next sheet of sensitized paper the same way, and on the same paper as the first was laid, which need not be renewed for at least a dozen or more sheets of silvered paper. The drawing the paper over the edge of the dish, leaves the paper comparatively free from solution. Paper of the kind mentioned above, will keep three days in the hottest weather. The silver solution is weak, and there is no waste of dripping. The next time you silver you remove a sheet or two of them, and put among the cuttings. After returning the silver solution to the bottle, I take one of those sheets of blotting-paper to wipe out the dish. The paper thus prepared will give any tone up to a pure black, and with all the required brilliancy.—Jex Bardwell.

I recommend a toning-bath upon which M. Carrier lays especial stress, as necessary to the production of fine pictures, especially if black tones are required. It stands as follows: Chloride of gold (or double chloride of gold and potassium), 2 grains; chloride of cadmium, 1 grain; sulphocyanide of ammonium, 15 grains; water, 5 ounces.

This bath gave more brilliant prints, and it was not difficult to obtain a deep black tone. I found the paper best suited for very vigorous negatives, yielding soft, delicate tints from such; but, from soft negatives, the prints had less vigor than those obtained by the ordinary albumenized paper process.

An ordinary excited albumenized paper, if washed by floating, face downward, on water, will keep a long time without discoloration; but it is almost impossible to obtain vigorous prints from paper so treated, and, although these prints lack some vigor, as you will perceive from examples inclosed, which were produced from good but soft negatives, still, they are much more brilliant than I have obtained from thoroughly washed sensitive albumenized paper.—G. Wharton Simpson, A.M.

platinum, bromo-gelatine, and kindred processes, all of which will have attention presently. They will probably supersede the good old stand-by altogether, but it is entitled to mention here as an item of history.

If, for an emergency and in haste, a sheet of plain paper is required for any special purpose, it may be obtained by a very simple expedient. Albumenized paper is floated on the silver bath with the plain side in contact with the solution, treating the albumenized surface as the wrong side. It seems that the albumen and salt penetrate and pass through the paper in sufficient degree, to form, when floated on the silver solution, a sensitive surface capable of yielding an excellent image, in no degree inferior to an ordinary plain paper print—delicate, vigorous, and of good tone.

212. As many attempts have been made at the life, so to speak, of albumenized paper as have been aimed at the subversion of the "wet" negative method. But not with equal success. Excellent substitutes have been pro-

212. Aristotypic paper is the name of a new paper for making photographic prints in the pressure frame. The paper is sensitized and preserves its good qualities for several months; it should be kept in a very dry place, and the surface should not be touched with the fingers. The paper having been cut the required size, is placed in the pressure frame quite dry, as is done in the case of albumenized paper. Print until the blackest portions are a little metallized. The paper is much more sensitive than albumenized paper. To wash the prints they are placed in water, one by one, the printed side underneath. The water is changed five or six times, until it is no longer milky. The first water should act in from three to five minutes; it is kept to extract the silver, which is precipitated by chlorhydric acid, or ordinary salt. From a sheet of aristotypic paper of 50 to 60 centimetres (18 sheets, card size), 23 grains of chloride of silver are obtained.

Toning and fixing in one bath has been found to have many advantages. The print coming out of the printing-frame, is left in the bath till the color is arrived at, then washed and dried. The bath is composed of two solutions, and will keep for a long time.

Dissolve: Water, 24 ounces; hyposulphite of soda, 6 ounces; sulphocyanide of ammonium, 1 ounce; acetate of soda, 1½ ounces; saturated solution of alum, 2 ounces.

Fill the bottle containing this solution with scraps of sensitized paper, bad prints that are not fixed, and leave it for a day. Then filter and add the following solution: Water, 6 ounces; chloride of gold, 15 grains; chloride of ammonium, 30 grains.

It is necessary to print deep enough and to leave the prints in the bath till, in looking through them, the desired color—brown, dark, or bluish—is observed.

Wash well for several hours, then lay the print, face downward, upon a ferrotype plate that has been cleaned with a wet sponge; go over it with an India-rubber squeegee and let dry. It will come off with a fine glaze.—Ed. Liesegang.

Uranium printing. Good photographic paper, not too thin, is first to be sized with arrowroot starch, prepared as follows: Some arrowroot is to be mixed with three or four times its weight of cold water, and left to stand several hours, till it becomes thick dough.

vided, it is true, but none which secures the charm of a brilliant surface like that of albumen paper, or by the use of which such a variety of pleasing tones are obtainable with the same ease and certainty in working.

But the war will go on against albumenized paper notwithstanding the peculiar beauty of its results. They are false at heart, fugitive, and apt to fade away at the very time when one's affections are most set upon them.

It would be useless for me to detail all the well-known attempts at the assassination named.

I have selected carefully some notes on those methods which have come nearest to success, for the consideration of my readers. I have reserved two or

It is then to be poured over with a hundred or a hundred and fifty times its weight of boiling-hot water. This starch is applied to the paper, stretched on a board with pins, by means of a very soft sponge (sponge digested in dilute chlorohydric acid and well washed), first removing from the starch the hard skin which comes over it in cooling.

The best mode is to fasten all the sheets down with pins; to rub the upper one with one sponge, evenly and gently; then, to render still more even, with a second; and, finally, to complete the work, with a flat (2-inch) broad camel's-hair pencil. The sheet is then detached, hung up to dry, and the rest treated likewise.

The uranium collodion is prepared as follows: Ether, 80 grammes; alcohol, 120 grammes; pyroxyline, 2 grammes; castor oil, 2 grammes; nitrate uranium 20 grammes; nitrate silver, 2 grammes.

The nitrates must be perfectly neutral; a fact important, as the commercial nitrate of uranium is generally very acid, and must be purified by recrystallization several times, finally from ether. The nitrate of silver must be dissolved in distilled water, and so added to the collodion. If the uranium salt is acid, the collodion is thereby partly gelatinized, and no longer flows evenly.

The castor oil serves to render the layer flexible, to make it adhere to the paper, and to keep the picture in the collodion film. It may be replaced with other substances; for example, with Venice turpentine. The collodion must be kept in the dark.

Provide a board, and attach the paper to it, overlapping a little to right and under sides, and leave the near right hand free. Pour on the collodion as on a glass plate. Pour it off again into a separate bottle, provided with a funnel. These portions, after being properly diluted, to compensate for the thickening by evaporation, and filtered, can be used over again. If the paper by this treatment becomes transparent, it is a proof that it was not sufficiently sized with the starch, and the picture will sink in. If spotty, it may arise from the same cause, or from an excess of oil added to the collodion.

The prepared sheets must not be dried near a fire or stove, as they are very sensitive to heat. When dry, to be pressed and rolled.

The printing is not to be made any stronger than is desired in the finished print; on the contrary, should be rather less strong, as it darkens in the subsequent operations. As the paper has about the same sensibility as chloride paper, the printing occupies considerably less time.

three processes for special consideration, for the reason that they have themselves created somewhat of a new field for their own usefulness. They can hardly be considered among the assassins, though it may be they would not have existed but for the hated qualities and weaknesses of the still popular albumen paper printing process. I refer to the bromo-gelatine and platinum processes.

213. The bromo-gelatine paper has proven the most popular of all the printing processes after albumen, and has many advantages, though it will not in its present development succeed in displacing the old favorite.

The proofs are thrown into water, which is to be renewed until the whites are perfectly colorless, which result may be hastened by dilute acetic acid. They are then to be toned and fixed in a bath of sulphocyanide of ammonium, to which a little chloride of gold has been added.—Ed. Liesegang.

My method of printing upon gelatino-chloride paper is as follows: The paper is exposed under a negative to ordinary light on a cloudy day for a few seconds; the light of burning magnesium wire immensely diminishes the time of exposure.

The paper is then softened for a minute in clear water, after which it is treated to the developer, formed as follows:

No. 1. Neutral oxalate of potash, 4 ounces; neutral citrate of potash, 1½ ounces; chloride of ammonium, 80 grains; citric acid, 120 grains; distilled water or water from ice, 40 ounces.

No. 2. Protosulphate of iron, 480 grains; water, 40 ounces; sulphuric acid, 10 drops.

Fixing bath: Hyposulphite of soda, 4 ounces; water, 20 ounces.

Clearing solution: Water, 20 ounces; pulverized alum, 1½ ounces; sulphuric acid, ½ ounce.

Take one ounce of No. 1 and one ounce of No. 2 and add one ounce of water; pour over the paper and move the dish as in ordinary development. The image will very soon begin to show itself and develop to perfection. If the paper has been rightly timed, a beautiful sepia tone will be produced full of soft and rich gradations; if the time has been a little full, a rich russet-brown is the result. Delicate purplish tones can also be secured by toning the print with gold, as with an ordinary silver print. The tones produced by the development alone are very rich and pleasing, but if the purple tones are preferred, with the use of the gold bath, care should be taken thoroughly to wash out the iron from the paper before subjecting it to the bath, otherwise there will be an unevenness in the tone, and the bath will be ruined. To prevent this, all that is necessary is to subject it to the clearing solution given above; let it lie in this for ten minutes, then wash before placing in the fixing bath, where it should remain ten minutes; keep the prints in motion in the hypo solution as with ordinary silver prints. Wash after removal from the hypo and the operation is complete.—John Carbutt.

213. Development is accomplished in a simple and cleanly manner. The well-known oxalate of iron developer, in a slightly modified form, is being found the most suitable.

Paper coated with sensitized gelatine is not a new invention, since it is well known that Baldus, twenty years ago, made experiments with paper prepared with iodized gelatine. This was slow; to-day we require more rapidity in the operation, and in most all our preparations bromide has taken the place of iodide.

In 1873, Mawdsley had already proposed the use of bromized paper; but, notwithstanding his advice, the experiments made with it were unsuccessful, his formulas, and especially the mode of preparation, being still defective. In 1883, Mr. Lamy gave us a very good paper. Morgan, in Paris, has had good success, contemporary with Roche and Eastman in America. "Alpha" paper is an English production of the same character.

On permanent bromide paper one can make an enlargement from a card negative. The exposure is, say, fifteen seconds in diffused light, and the development, that given in the formulæ furnished with each roll. The sensitiveness is so great that it is possible in a few seconds, by the light of a candle, to obtain by contact with any negative whatever a very good print; even moonlight will print quickly.

This extreme sensitiveness has been utilized by science in divers ways: medicine uses it to ascertain the presence of subtle poisons, observatories to register the atmospheric changes, which previously it had not been possible to

Developer: A. Oxalate of potash, 8 ounces; hot water, 24 fl. ounces. Make acid with acetic acid No. 8. Test with blue litmus paper.

B. Anthony's pure iron, 8 ounces; hot water, 16 fl. ounces; sulphuric acid, C. P., 10 minims.

C. Bromide of potassium, 1 ounce; water, 32 fl. ounces.

Note.—The dry measure above quoted is based on 437 grains to the ounce. Keep these solutions separate; they must be mixed only for immediate use.

To develop: A, 3 ounces; B, ½ ounce; C, 10 minims.

Mix in the order given; use cold. After exposure, soak the paper in water until limp; then immerse in the developer.

The image should appear slowly, and should develop up strong, clear, and brilliant. When the shadows are sufficiently black, pour off the developer and flood the print with the clearing solution—Acetic acid, 1 drachm; water, 1 quart. Do not wash the print after pouring off the developer and before applying the clearing solution.

Use a sufficient quantity to flow over the print—say 2 ounces for an 8 x 10. Allow it to act for one minute, and then pour it off and apply a fresh portion; repeat the operation a third time, then rinse in pure water and immerse for ten minutes in the fixing bath—Hyposulphite of soda, 8 ounces; water, 40 ounces.—E. & H. T. ANTHONY & Co.

After fixing, wash thoroughly for two hours and hang up to dry. Use fresh developer do, etc. In photography it is certain that it can render great service when it is necessary to produce a great number of prints in a short space of time. One can, in five minutes, produce alone, by gaslight, forty prints from the same negative. The gelatino-bromized paper is placed under a negative in the pressure-frame, exposed to gas or any other light, developed with oxalate and iron, then fixed. The operation lasts between five and six minutes, whatever may be the number of prints.

Thus obtained, these prints, although strong, have the softness of crayon drawings together with photographic delicacy and preciseness.

For enlargements, the gelatino-bromized paper has considerable value. With the ordinary processes with a print, or even small negative, several difficult operations are indispensable to obtain an enlarged print. First, it is necessary to print by contact or to enlarge slightly, either a gelatino-bromized, or chlorized plate, or collodion plate, or a positive by transparency, from which is obtained a large negative to be used in printing; finally, the enlargement, either with carbon or on albumenized paper. With gelatino-bromized paper all these operations are done away with. It is the little negative itself that gives the enlarged picture.

The manufacture of this paper is no more difficult than albumenizing. Three grades are in the market:

for each batch of prints. With a glass-bottomed tray, seven ounces of developer are sufficient for a 25 x 30 print.

The clearing solution is to prevent the precipitation of the iron from the developer in the fibre of the paper. This can only be done by keeping the paper acid while washing out the developer.

Citric acid may be used instead of acetic in the clearing solution, in which case use $\frac{5}{8}$ ounce to the quart of water. Citric acid is less liable to cause blisters.

Blisters may be avoided by using a little common salt in the first washing water after fixing. The hypo must not be stronger than 3 ounces to the pint of water.

The final tones are obtained entirely by development, and range from a soft gray to a rich velvety black, depending somewhat upon the density of the negative and the quality of the light used in printing.

The faintest trace of hyposulphite of soda or of pyrogallic acid is fatal to good results with bromide paper, and the operator cannot be too careful to avoid any contamination. The tray used for developing with oxalate should never be used for anything else.

Mention has been made in these directions regarding the use of a dilute solution of acetic acid and water immediately after development, and before washing with water at all. Pure whites cannot possibly be *obtained* and *retained* where this precaution is neglected.

After fixing, another important measure is the use of a first washing water containing

Smooth surface, thin, for proofs, positive printing, copying drawings, etc., by contact.

Smooth surface, heavy, for positive printing, enlarging, and working in ink, oil, and water colors.

Rough surface, heavy, for positive printing, enlarging, and working in crayon, ink, water colors, and oil.

The best paper is uniformly and heavily coated by machinery with silver bromide, mixed with the least possible quantity of gelatine to avoid curling and to preserve the tooth of the paper for working with crayons.

The rough paper is recommended for plain enlargements and contact prints of all kinds, on account of the fine artistic effects to be obtained.

From good original negatives, enlargements may be obtained that *require no finishing.*

I add, condensed, the directions given by the makers:

In contact printing with permanent bromide paper, the exposure is preferably made by artificial light, to insure uniformity, and to avoid overexposure.

Yellow post-office paper is the best medium for filtering the light through for working permanent bromide paper; two thicknesses should be used for daylight and one for gas or kerosene.

Permanent bromide paper is about one-half as sensitive as a collodion wet

common salt—say half a pound to two gallons of water. This will most effectually prevent blistering, unless provoked by some unusually careless manipulation.

Two hours' washing in ten or twelve changes of water, is sufficient to remove all traces of hypo, and the prints are ready for mounting immediately, if desired, or may be dried by allowing to drain on a screen covered with cheese-cloth. Mounting on muslin-covered stretchers may be accomplished either wet or dry, the first method being the most expeditious and satisfactory. This is conducted as follows: Drain your print of all surplus moisture, and lay it face down on a table, over which is thrown smoothly a well wetted sheet of rubber-coated cloth; apply the paste thoroughly to the back, paste also evenly and without lumps over the face of the muslin stretcher. If the print is accurately centred on the sheet of paper, the mount may be laid on it, face down, and rubbed in contact with a wad of soft cloth, care being taken to avoid rubbing too close to the stretcher, as this would present a visible outline on drying and mar the appearance of the print. All air bubbles being carefully pressed as nearly toward the side as is safe. Take hold of the stretcher by one corner and lift together with the rubber cloth; on dropping the latter, it will leave the surface of the print without resistance, which may be placed, face up; and with the palm of the hand wetted, the edges can be brought into perfect contact. Drying may be hastened by exposure to a current of air in a well-ventilated room.

Mounting on cardboard may be accomplished in a somewhat similar manner. The plate, or one-twentieth as sensitive as a good dry plate, and should be exposed accordingly.

The exposure varies with the intensity of the negative and the quality and intensity of the light, but may be approximately stated to be, using as thin a glass or American film negative as will make a good print, one-quarter second by diffused daylight, or ten seconds at a distance of one foot from a No. 2 kerosene burner. With an oiled paper negative it requires twice as much and with an unoiled paper negative about three to five times as much exposure. Very thin negatives should be printed by weak yellow light, like that obtained from a kerosene lamp turned down a little below the normal intensity. In this way a strong, vigorous print may be obtained from a negative that would otherwise be too thin and flat.

The Developer.—Formulæ: No. 1. Oxalate of potash, 1 pound; hot water, 48 ounces; acetic acid, 3 drachms. No. 2. Protosulphate of iron, 1 pound; hot water, 32 ounces; acetic acid (or citric acid $\frac{1}{4}$ ounce), $\frac{1}{2}$ drachm. No. 3. Bromide of potassium, 1 ounce; water, 1 quart.

These solutions keep separately, but must be mixed only for immediate use.

To develop: Take in a suitable tray—No. 1, 6 ounces; No. 2, 1 ounce; No. 3, $\frac{1}{2}$ drachm.

Soak the exposed print until limp, then transfer to the tray containing the developer, taking care to avoid bubbles.

print is pasted lying face down on the wetted rubber cloth; it is then raised and centred on its mount as an ordinary mounting; the only precaution necessary is, that the damp rubber cloth is laid down on the face of the prints, and with a squeegee uniformly and rapidly moved back and forth, contact is assured. Lift the rubber cloth by one end, and the mounted print will fall to the table by its own weight.—DAVID COOPER.

Failure is chiefly due to utter ignorance of a certain law in optics, which may be found stated in the text-books as a thing which must be digested by the student, but which is seldom explained in a rational manner. Here is the law: "The intensity of illumination on a given surface is inversely as the square of its distance from the source of light." Let us see whether this matter cannot be explained in such a way that a child can understand it, and turn it to practical use in photography.

Referring to Fig. 370, let the four squares numbered 1, 2, 3, and 4, be printing-frames placed at distances of 1, 2, 3, and 4 feet from a candle flame. Let us suppose, also, that we have ascertained by experiment that the plate or paper in the first position (No. 1) is sufficiently affected by the light if it remain there for one minute. (This is, of course, merely stated as a case in point. Bromide paper at such a distance would be sufficiently exposed, under a normal negative, in about eight seconds, while a chloride plate under such conditions would want two minutes or more.) Then, if we remove the frame to position No. 2, at two feet from the light source, the necessary exposure will not be doubled, as some might think, but quadrupled. For the square of 2 is that number mul-

The image should appear slowly, and should develop up strong, clear, and brilliant. When the shadows are sufficiently black, pour off the developer and flood the print with the clearing solution—Acetic acid, 1 drachm; water, 32 ounces.

Do not wash the print after pouring off the developer and before applying the clearing solution.

Use a sufficient quantity to flow over the print, say 2 ounces for an 8 x 10. Allow it to act for one minute and then pour it off and apply a fresh portion; repeat the operation a third time, then rinse in pure water and immerse for ten minutes in the fixing bath—Hyposulphite of soda, 3 ounces; water, 16 ounces.

After fixing, wash thoroughly two hours, in at least twelve changes of water and hang up to dry. Use fresh developer for each batch of prints. With a glass bottomed tray, seven ounces of developer are sufficient for a 25 x 30 print.

The object of the clearing solution is to prevent the precipitation of the iron from the developer in the fibre of the paper. This can only be done by keeping the paper acid while washing out the developer.

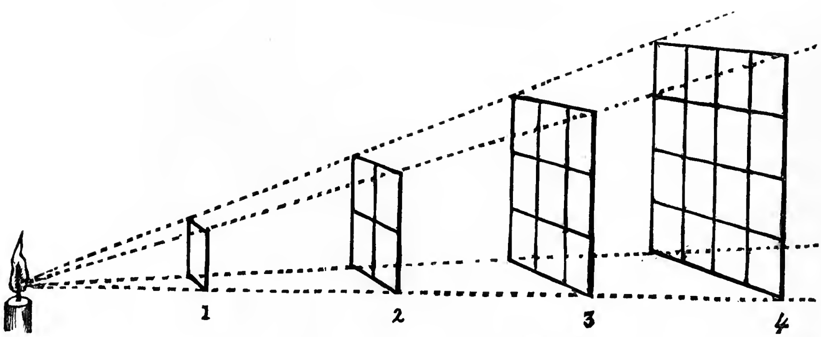
Citric acid may be used instead of acetic in the clearing solution, in which case use $\frac{1}{8}$ ounce to the quart of water. Citric acid is less liable to cause blisters.

If a matt surface is not satisfactory the prints may be enamelled.

No toning is required. All the points accompany each roll of paper.

tiplied by itself—*i. e.*, 4. The right exposure, therefore, will be four minutes. Removing the frame to position 3, we must once more square that number in order to arrive at the

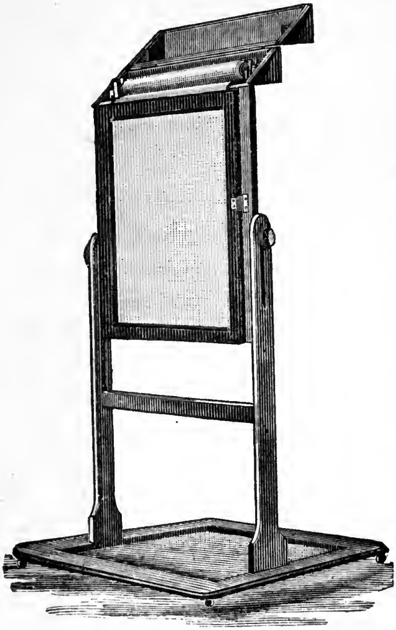
FIG. 370.



right number of minutes for exposure at this increased distance, 3×3=9. Therefore nine minutes will be the time. It is easy to see that when the printing-frame is removed to the furthest distance of all, which is four feet from the light source, the exposure will be increased to sixteen minutes. To make the diagram (Fig. 370) more explicit, the

For enlarging, an easel and an enlarging camera are needful. First, the easel (Fig. 371). It consists of a firmly supported pair of uprights, which are slotted a distance of about six inches. This admits of the focussing-screen being moved up and down so as to locate the picture correctly in the centre of the sheet. On the face of the board is the black frame which is hinged on one side and caught by a spring catch on the other; its object I will describe in its order. Seated on brackets which are screwed to the back of the focussing-board is a long narrow box that is designed to hold the sensitive paper, which comes wound on a paper tube that slides on an axle journaled on the box. At the back is a brake of simple construction which prevents the paper unwinding faster than is desired. This box is perfectly light-tight, and the dark-room may be opened after use without at all affecting the paper if kept in the box closed.

Fig. 371.



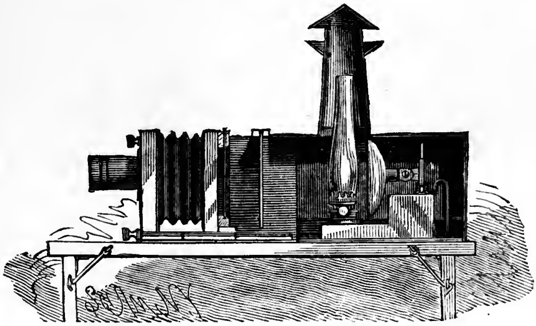
The engravings (Figs. 372, 375, and 376) illustrate forms of apparatus for exposing upon bromo-gelatine paper, devised by Mr. F. C. Beach, whose instructions for use are added.

vertical squares 1, 2, 3, and 4 have been so subdivided that the number of spaces in each indicates the number of units of exposure, be that unit a second, a minute, or an hour. The same rule holds good for enlarging operations. Thus, supposing that we are working with a magic lantern, and that the necessary exposure at one foot from the lens is half a minute; at two feet the time will be two minutes; at three feet four and a half minutes, and so on. The practical worker will have this little bit of theory in his mind whenever he is operating, and he will soon prove that the theory holds good.

Another help in enlarging, which will be found useful, is a little piece of apparatus—if it can be dignified by that expression—which I have lately made, and which I call an exposing gauge. It is so simple in construction than anyone can make it out of a couple of strips of cardboard. The arrangement is shown in Fig. 373. The size of the gauge is immaterial, but a length of twenty inches will be found convenient. A slip of card of that length, and about one inch in breadth, is cut with pointed ends, each point having a hole picked in it as shown. By these holes, and with the assistance of a couple

A short focus lens of the portrait combination type, provided with a diaphragm of an inch aperture, produces the best results.

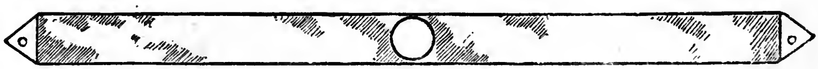
FIG. 372.



The negative, with the film side toward the lens, is held in the slide in an inverted position, and is slid into the grooved frame upon the exterior side of the partition, as shown. This arrangement allows different sized negatives to be quickly and easily adjusted. On an adjustable shelf, which can be raised or lowered, are located the ground-glass, kerosene lamp, and reflector. The centre of the lamp-flame reflector, negative, and the lens of the camera should be in one focal line.

of drawing pins, the contrivance can be readily attached to any flat surface upon which the enlarged image from the lantern is focussed. Placed above this slip is another piece

FIG. 373.



of card slightly shorter, and with a round hole in the centre. The two slips are bound together with strips of tape glued over their upper and lower edges, the two ends being left open, like a sleeve, for the reception of a slip of paper, like that shown in Fig. 373.

FIG. 374.

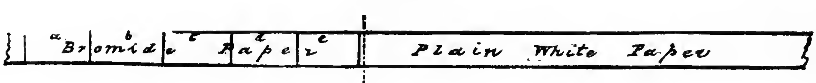
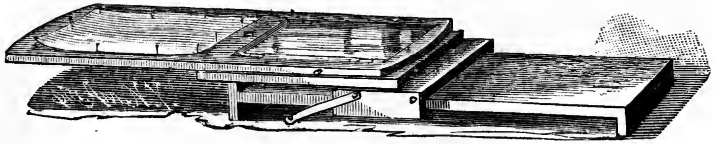


Fig. 374, as indicated, really consists of two slips of paper gummed together end to end. One is sensitive bromide paper, ten inches in length, which has been spaced out into five divisions, and marked *a*, *b*, *c*, *d*, *e*, with an aniline ink pencil. The other part is

The ground-glass in front of the lamp diffuses the light equally over the negative; an ordinary magic lantern condenser may be used in place of the ground-glass, thereby materially decreasing the time of exposure.

FIG. 375.



When obtaining a focus the room is to be closed to all outside light, except that which comes through the lens, and the enlarged image of the negative is seen very distinctly upon the ground-glass of the focussing board. The saddle is moved back and forth until the correct focus is obtained, as, for instance, when the hair of the head or the pupil of the eye looks sharp and distinct.

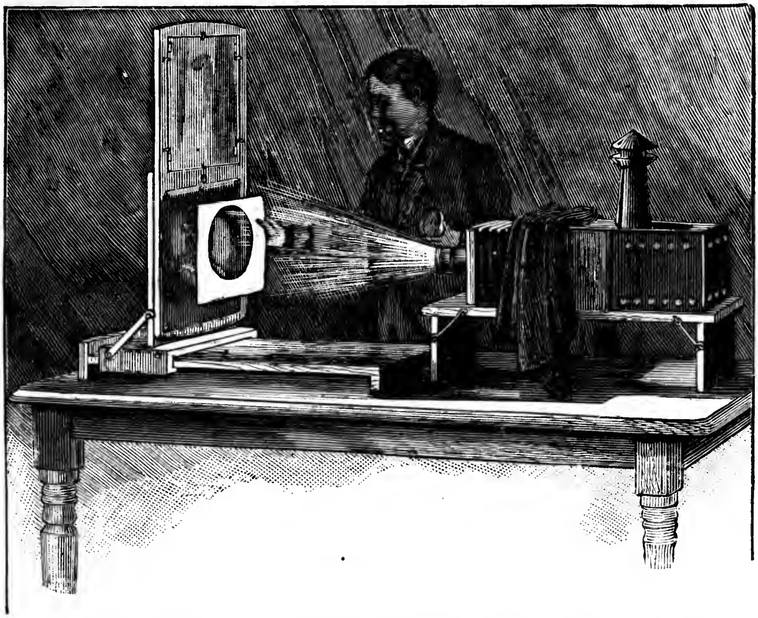
Having obtained the correct focus on the ground-glass on the focussing board, the operator covers the lens with a cap of ruby glass, turns the ground-glass end of the focussing board up, and fastens on the lower portion, in proper position, the sensitive sheet. When the sheet is rightly located the hook may be unlatched and the board turned flat, as shown, so that the paper may be more easily pinned to the face of the board; the latter is again raised, secured,

ordinary white cartridge paper, slightly longer than the sensitive slip. Its purpose is to serve as a handle by which to pull the sensitive paper through the sleeve, and also to furnish a white surface upon which a small part of the picture can be focussed, that small part being confined to the central circular hole in the upper card.

Now let us see how the gauge is used in practice. It is first pinned on the focussing board so that a distinctive part of the image is thrown upon the central hole. In the case of a portrait this should be the eye. Having focussed carefully on the blank paper, the first division of the sensitive slip, which will be that marked *e*, is pulled in front of the opening. Let this be exposed for, say, fifteen seconds, then pull the slip onward and expose *d* for twenty seconds, *c* for twenty-five seconds, and so on. The gauge is then taken into the dark-room, its slip of sensitive paper torn from its yoke-fellow, and carefully developed. It will then soon be seen which of the lettered spaces has received the correct exposure; and a memorandum noting time and distance of lens from screen can either be attached to the negative or entered in a book against a number corresponding with a number scratched on the glass negative.

The same principle can be applied to printing in the printing-frame on bromide paper by gas or lamplight. When the frame has been charged with its negative and bromide paper, support it upright at a distance of, say, eighteen inches from the turned-down flame. Now, place in front of it an opaque card, sufficiently large to cover more than and made ready for the exposure. As a vignetted picture is the most pleasing, and can be easily made, the operator needs to provide before exposure a card-

Fig. 376.



board having a notched oval aperture, which, during the exposure, is held between the lens and focussing screen, as shown. Looking upon the screen the dull-red enlarged image may now be seen, but the moment the exposure is made by removing the red cap from the lens, the picture becomes suddenly bright and brilliant. The operator then moves the vignetting card to and from the exposed sheet, thereby decreasing and enlarging the vignetting circle.

the frame. This card should have a hole about one inch in diameter cut in it in one corner. Turn up the light and expose for five seconds. Alter the position of the hole and give ten seconds, and so on. When the paper is subsequently developed these several exposures can be readily identified, and the negative can be labelled to the effect that it requires so much exposure at a given distance from a flame. Thus, bromide paper, 18 in. 25 sec. This negative will then be an infallible guide for the exposure of negatives of a similar type; for a systematic worker—unless he be quite a beginner—will fall into the way of producing negatives of much the same character and strength, and printing from them by lamplight will then become an easy matter to him.—Dexter, in *The Camera.*

In this way the beautiful soft blending so characteristic of vignetted pictures is easily produced. With a lamp like a No. 3 Leader kerosene burner, giving a flame about three and a half inches wide by an inch and a half high, and of about twenty-six candle powder, an exposure of four minutes has been found sufficient. The exposure may be quickly stopped by replacing the red cap on the lens.

214. The platinotype printing process, though not a new one, has not had the attention it deserves. At first it was hampered by patents, but now the inventors are content to derive what revenue they expect from their processes by selling the properly prepared material to their licensees.

An exhaustive paper on platinotypes was published, after much industrious experiment, by Captain Pizzighelli and Baron A. Hubl, of Vienna. The practical workings of the method as detailed by them are given below. Of platinotype, these gentlemen, after giving full credit to Mr. W. Willis, Jr., for its invention, write as follows:

"The chief advantages of this process are (1) the simple nature of the manipulation, which can be carried out much more plainly and readily than in any other printing process; (2) the great sensitiveness, to which attention has been already drawn; (3) the perfect permanence of the prints; (4) the peculiar character of the pictures, which, from an art point of view, give them a much higher value than belongs to silver prints. Owing to the exceeding sensitiveness of the platinum process, from three to four times as many prints may be

214. *Printing the Picture.*—Printing by the platinum process requires greater care than in silver-printing, because the actinic impression, although distinct, is, comparatively speaking, only faintly visible. It is necessary to get accustomed to controlling the progress of the printing operation; but the experience for this purpose is acquired after a few trials. By the action of the light, the yellow color of the paper becomes changed to brown, and after longer exposure this again turns of a lighter shade, so that often the deepest shadows appear lighter than the darker half-tones.

Accurate instructions as to the time required for printing can, of course, not be here given, as it depends entirely on the density of the negative and on the conditions of light prevailing at the moment. We can, however, state with certainty that platinum paper is at least three times as sensitive as silver paper, and that this greater sensitiveness makes itself more felt in dull than in bright weather. This is owing to the greater sensitiveness of ferric oxalate to the less refrangible rays of the spectrum. For a good portrait negative of average intensity, we gave from twenty to twenty-five minutes with a clear sky in April; with a thinner negative we printed for fifteen minutes. When the prints have been taken, and it is not desired to develop them at once, they are kept, as already described, in a chloride of calcium box.

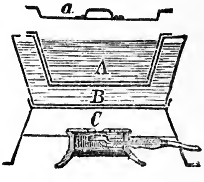
taken in the same time as is possible with the silver process. This advantage should, as we have already pointed out in the introduction, be appreciated in dull weather, more especially in winter-time, when printing by the silver process is nearly impossible.

"After being printed, the pictures can be completely finished in half an hour, and are then ready to be mounted. All the wearisome washing, toning, fixing, and again washing, which are necessary for silver prints, are dispensed with in the platinum process, and the great care which must be taken to obtain good results by the former is quite unnecessary in the latter process. Only very careless treatment causes the picture to be spoiled. For producing platinum prints only one operation—that of sensitizing—requires any degree of attention; while for silver prints, time, trouble, and care must all be given to obtain pictures which, after all, are only of doubtful permanence. When we take into consideration, also, that if silver prints are not washed with extreme care and attention they, in a short time, are quite spoiled, while a mistake in the same direction with platinotypes is of no importance, we cannot fail to see the great advantage which platinum prints possess over those in silver."

215. With such high recommendation, platinotype printing is bound to find a useful place. Nothing can be more soft and beautiful than its results.

215. *Developing the Picture.*—To develop the picture we take a saturated (in the cold) solution of potassium oxalate, acidulated with oxalic acid. For heating the solution we may employ either a glass boiling-flask or a vessel of enamelled iron; but this supposes that only a small number of pictures of moderate size are to be developed in a basin by pouring the solution over them. When they are of large size and in greater number this method would not answer, as the solution cools by being poured over the picture, and therefore will have to be heated afresh. In this case we prefer to use a vessel of flat or bent enamelled iron of the same width as the picture, which can be placed over a water bath. The section of a developing-tray of this kind is shown in Fig. 377; *A* is the enamelled iron vessel, containing the oxalate solution, *a* its cover of zinc plate; *B* is another hollow vessel, with double wall of zinc plate, which acts as the water bath; *C* is a gas or spirit lamp. The vessel *B* is filled with hot water through a tube let into the upper side, and the hot solution of oxalate is then poured into the tray *A*; it can readily be kept at the required temperature by means of the lamp underneath. To develop it, each print is taken separately by two opposite sides and drawn slowly through the solution. Development takes place at once, the brown color changing immediately to a deep black. If, by chance, any part of the picture does not come in contact with the solution—as, for instance, where any air-bells adhere to it—it must be again drawn through the solution. When there is danger of the print having been too

FIG. 377.



Moreover its operations hold a fascination which make it a great favorite with printers. Those who are artists claim that no matt surface process yields so near their ideal of what is " artistic as does the platinum print, and therefore it is a particular favorite with them.

long copied, a somewhat cooler solution of potassium oxalate may be used, though the hot solution always works best. The temperature of 80° C., as given above, may be exceeded when the print has been copied for too short a time; we have ourselves very often employed a developing solution in a boiling state.

Finally, we would again direct attention to the necessity of having always an acid reaction in the developer. When the solution is kept continuously at a high temperature, it may happen that the evaporation will cause crystals of potassium oxalate to form, which will be deposited on the sides of the vessel; those being over-heated will partially decompose and form potassium carbonate, so that in certain circumstances the solution will become alkaline. It is, therefore, imperatively necessary to keep testing the liquid from time to time with litmus paper, and, if necessary, to acidulate the developer with oxalic acid.

After being used, the developing solution may be poured back into a flask, and can be employed again. The water which has evaporated should occasionally be replaced, and, as often as necessary, fresh potassium oxalate should be added.

Finishing the Picture.—Directly the picture is developed it must be immersed in a solution of—Hydrochloric acid, 1 part; water, 80 parts; and left there until any of the iron-salt still present has been removed. This solution of hydrochloric acid must be changed (twice or three times) until it no longer turns yellow. We ourselves generally change the solution three times, and leave the print in it each time for about ten minutes.

Finally, the print should be laid for a short time in a pan of water in order to remove the hydrochloric acid; ten to fifteen minutes will suffice for this purpose. Should any hydrochloric acid remain in the paper, it would not have any bad effect on the print itself, but might injure the substance of the paper, so that in the course of time it would be destroyed. To be perfectly easy on this point, it may be advisable to try the last wash-water with litmus paper, whether it comes off quite neutral.

After washing, the picture is dried in the ordinary way, and can then, if desired, be mounted on cardboard. Prints on smooth paper may be hot-pressed, to give them a slight sheen, which brings up the deep parts.

Prints on wood or linen are treated just the same as those on paper. As the plates of wood are very liable to warp, through being moistened with the sensitizing solution and then heated to dry, they should be fastened by small points or drawing-pins flat on a strong board. Linen can be kept stretched on wooden frames after being coated with the sensitizer.

At this stage we ought further to point out that platinum prints in a wet state appear always more brilliant and lighter than they do when dry. A print, therefore, which while still wet after development seems to be quite right as regards tone, would be too dark when dried.—PIZZIGHELLI and HUBL.

216. Rapid and inexpensive methods for reproducing maps, drawings, proofs, and other emergent pictures, have been practised for a long time, the one known as the "blue" process being the most in use.

It has been published many times and is given again in the notes.

Mr. C. G. Busch, a practical and valued friend, has given me a modification which I have the privilege of including here. He says:

"I have been experimenting to make my own blue paper, and I enclose a few blue prints made on this paper. The best result I get in the following way: I make out of the sticking-paper which is sold by the roll, four loops one inch long, fasten these on each corner of a sheet I wish to paint, put through those loops a thread—of wool is best, it does not cut through the loop so easily—and put a little weight on the end of each string, to hang down over the table I want to use to paint the sheet. This is for keeping it in place, and by stretching, to remain flat. I use a fine camel's-hair brush about $1\frac{3}{4}$ to 2 inches wide. Put into a dish 2 drachms of water and let the brush fill with water, besides the 2 drachms, which is also a drachm or a little more. I brush these 2 drachms of water on to the sheet as uniformly as possible, by taking it

216. The "blue" process is most used in America, and has been largely adopted by our manufacturers. The drawings are reproduced in white lines on a blue ground, and I understand the paper is sold in the market already sensitized, although it can be prepared cheaper and just as well as the bought article. Almost any heavy well-glazed printing paper will answer the purpose, but, as this is the only expense, a good quality should be used. The sensitizing bath consists of (*a*) Citrate of iron and ammonia, 1 part; clear water, 4 parts. (*b*) Red prussiate of potash, 1 part; water, 6 parts.

The two solutions are dissolved separately, and preferably at the ordinary temperature; when in complete solution they are mixed, and kept in a yellow bottle, or carefully excluded from the light, which would cause a blue precipitate. If the paper is not sufficiently sized, gum or gelatine should be added to give it body and prevent the liquid from soaking through. The sensitizing is performed as follows, in non-actinic light: The sheet of paper, cut to the required size, is pinned to a clean board; some of the solution is poured into a vessel, and the paper painted with it by means of a soft camel's-hair brush three inches wide. The brush is dipped into the solution and the paper completely moistened in one direction; then, without removing the liquid, it is smoothed until no streaks or lines appear. Some prefer to use a sponge, but this causes uneven spots, and mars the beauty of the picture. In this way a very little solution will cover quite a large surface. Before putting the brush away it must be carefully cleaned. The paper is unpinned, hung upon a line, and when dry will keep a long time in the dark. It should be a brass-yellow color when rightly prepared. To make a copy, the drawing, on tracing cloth, is put into the printing frame, as usual, with a sensitive sheet, and exposed to sunlight for six to ten minutes, or to diffused light for one to two hours. The up in at least six to eight times. The sheet is pretty well saturated now. I have two solutions: No. 1 is 1¾ ounces of citrate of iron and ammonia in 8 ounces of water; No. 2 is 1¼ ounces of red prussiate of potash in 8 ounces of water; or both, if less is wanted, in proportion. Take of each of the solutions ¾ to 1 drachm, mix, and brush on the wetted sheet as evenly as possible in all directions; bear on very lightly, and take it up, say, six to eight times. Now your brush contains a very strong solution. Put 1 more drachm of water in the dish and work it up, and after this add ½ drachm more water; there will be now a very weak solution in the brush. If you want to do more than one sheet, I would advise two brushes and two dishes to use, one for wetting and the other for putting on the solution. If you do so, ¾ drachm of each solution for each sheet is just right and enough. By examining the print during printing, the details show up very nicely, almost as a silver print. Too much of the solution put on makes it only harder for you to see if the print is done or not.

"The paper prints the quickest fresh, but the most delicate tones are obtained

double salt is reduced to the ferrous state where the light strikes it, and immediately combines with the red prussiate present to form Turnbull's blue, while the protected parts remain unchanged. The exposure should be continued, until, on opening the frame, the white lines have almost disappeared and the background is grayish-green. The sheet may also be exposed on a board padded with flannel, over which is placed a sheet of plate-glass, but this requires to be always horizontal, and needs more apparatus than it would cost to get a regular frame. When exposure is finished the print is removed, and put immediately into a tank of running water, when the lines will become white (unless overexposed or not in contact), while the ground becomes dark blue. After sufficient washing, the ground can be improved by transferring to a bath of hydrochloric acid, 5 parts; water, 100 parts; when it must be again thoroughly washed, and then dried. The color always darkens on drying, and prints that would otherwise be underexposed have very beautiful light-blue ground.

This process has become the favorite one, owing to its great simplicity, and the ease with which any one can work it; the objections to it are: the length of exposure, especially on cloudy days, and the impossibility of copying drawings from anything but tracing cloth or paper. In very large sheets the fine lines are apt to be reduced, thus making the picture somewhat uncertain in parts. If, instead of mixing the solutions, the paper had been sensitized with the citrate bath and then exposed, the reduction would have been very rapid (fifteen or thirty seconds), as this is the most sensitive salt of iron. The picture could then be developed in the ferricyanide bath, and finished as described; but in this case it is better to sacrifice sensitiveness to convenience. The other double salts could be used to replace the citrate, but they require a longer exposure.—David Townsend.

when it is a week or ten days old. It requires more time then, but the details are better By this method I think the sensitive material lies in more compact form on the surface, than if floated or put on without wetting the sheet.

217. A white line on a blue ground is not so pleasing to the eye as the reverse would be, and a goodly amount of ingenuity has been expended to discover methods which would be as simple and easy as the "blue" and more pleasing in appearance. Among the most practical are Willis's aniline process, the gallate or tannate of iron process, cyanotype, and the varied uses of salts of iron.

In addition to what are mentioned, there is the "powder" process. It is hardly desirable enough to give in full.

One of the best has been given by Dr. J. H. Janeway, U. S. A. It is named after the deceased inventor—a friend of his—"the Powell print."

His process is as follows: He passes any good, hard, sized paper suitable

217. The details of the aniline process I use are as follows:

1. *Sensitizing.*—The best paper, Saxe preferred, must be used, as nothing else will give satisfactory results. The sensitizing solution consists of bichromate of potassium, 1 part; phosphoric acid, sp. gr. 1.124, 8–10 parts; water, 10–12 parts.

The paper is cut to size, and then fastened with pins to a clean, flat board. Some of the solution is poured into a dish, and the paper is sensitized by means of a stiff brush about one inch wide, which is dipped into the liquid, and then painted on paper, first lengthwise and then across, without removing the liquid in the brush. Finally, a soft camel's-hair duster, three inches wide, is used to remove all superfluous liquid, and smooth out any streaks left by the first brushing. The solution can also be applied with a soft sponge, but I prefer the first method, as the fingers are then not brought into contact with the bichromate, which is a violent poison.

The sheet is now hung up, and allowed to dry slowly, it being complete in from fifteen to twenty minutes. This operation should be performed in a dark-room, such as is used for wet plates, owing to the extreme sensitiveness of the paper, which is easily spoiled by the least actinic light. When dry, the paper may be exposed at once, or kept in a dark place unaltered for a long time. The brushes should be thoroughly washed and dried after each time they are used

2. *Exposing.*—The prepared paper is now put in the printing-frame under the tracing, covered with a black cloth, and carried into the sunlight. The time of exposure will vary with the time of the year, in summer being about twenty to twenty-five seconds, and in winter forty to forty-five seconds. The surest method is to use Vogel's photometer, and carry the exposure to sixteen degrees, but if the instrument is not handy, experiments will have to be made to determine the exposure.

for the cyanotype picture through a bath of dilute gelatine, which he prepared as follows: Two and a quarter grains of gelatine to each ounce of water; after passing the paper through the gelatine bath it is hung up to dry and drain, using all precautions to avoid unevenness of coat, streaks, and marks; when quite dry the sized paper should be, in the dark, evenly coated with a solution composed, say, of seventy grains of ammonio-citrate of iron, with sixty grains of ferridcyanide of potash in two ounces of water, which should be prepared and kept in the dark. This is then the prepared paper, which, when duly exposed under a negative to light, may produce the variety of image desired. When printed it is washed in two or three changes of clear water, and we have the developed print no longer sensitive to light. This print needs now only to be blotted off from superfluous water, when it is ready for immersion in the discharging bath. The discharging bath may be composed of a variety of agents, such as:

Here is the most important part of the whole process, because underexposure will not reduce the bichromate sufficiently, and overexposure renders the paper less liable to form aniline colors. When the paper is rightly prepared, it should be of a yellow color, and after exposure on opening the frame, a faint yellow picture will be observed on a greenish ground.

3. *Fuming.*—When the exposure is judged sufficient the cloth is replaced, and the frame carried back into the dark-room, where it is opened, the picture removed, and pinned to the lid of a fuming-box. The box is provided with a sheet of glass, on which is blotting-paper soaked with a solution of aniline oil, 1 part, benzine, 10 parts, and which can be lowered or raised at pleasure by means of crosspieces of wood at different heights. It is allowed to remain for thirty minutes, when the picture, if rightly exposed, will be sufficiently developed, and will show dark brown to black on a grayish ground. If the image be rather faint, it should be allowed to remain for two or three hours longer.

4. *Washing.*—On taking out the print, it must be washed for some time in at least four changes of clean water, when the colors will be sufficiently fixed, and after drying the picture is finished.

Great care must be taken not to handle the sensitive paper any more than is absolutely necessary, and then only with *perfectly* clean hands; also to perform *all* the operations in absolutely non-actinic light. With these precautions, I think success may be assured.—DAVID TOWNSEND.

Prints with gallate or tannate of iron, giving directly positives in black, of a drawing or of a positive cliché, are made as follows:

The process, which is also called heliography, is very simple, easy, and inexpensive; it gives half tones, and the prints made by it are ink-black and directly positive from a positive or negative from a negative.

We owe this process to Mr. Poitevin, but it has been slightly improved.

(*A*) The carbonate, bicarbonate, sesquicarbonate of soda.
(*B*) The soluble alkaline silicate of potash and soda.
(*C*) Biborate of soda, known as borax.

Any of the above reagents dissolved in the proportion of ten grains to the ounce of water will discharge the color of the "blue print," still leaving the salt of iron in the form of a nearly invisible and perfect image on the paper.

He preferred to combine the discharging bath of ten grains of efflorescent sesquicarbonate of soda with each ounce of water. In this bath immerse the "blue print" till the color is discharged and the paper loses nearly all trace of the picture, except a rusty color more or less distinctly marked with the image in the strong shadows. When the blue color has vanished in the discharging bath the paper is washed in two or three changes of clear water and is then blotted off to remove any remaining traces of soda salts, which, if left in the print, would modify final color. The print is now discharged and ready for the toning-bath, for which we may employ gallic, tannic, or pyrogallic acid,

A. Sensitizing solution: Dissolve separately—1. Gum arabic, 13 drachms; water, 17 ounces. 2. Tartaric acid, 13 drachms; water, 6 ounces 6 drachms. 3. Persulphite of iron, 8 drachms; water, 6 ounces 6 drachms.

The third solution is poured into the second, well agitated, and then these two solutions united are added to the first, continually stirring. When the mixture is complete, add slowly, still stirring, 100 c. c. (3 fl. oz. 3 drms) of liquid acid perchloride of iron at 45° Baume. Filter into a bottle and keep away from the light. It keeps well for a very long time.

B. Sensitizing the paper: Here especially it becomes necessary to select a paper that is very strong, well sized, and as little porous as possible. By means of a large brush or sponge apply the sensitizing liquid very equally in very thin and smooth coats; then dry as rapidly as possible with heat without exceeding, however, a temperature of 55° C. (131° F.). The paper should dry in obscurity, and be kept away from light and dampness; notwithstanding all these precautions, it does not keep well long, and if it is desired to act with some certainty it is better to have a stock to last only a fortnight. Freshly prepared it is better than a few days afterward. It should be of a yellow color.

C. Printing: The tracing, made with very black ink, is placed in the printing-frame, the drawing in direct contact with the plate; then place over it the sensitized paper, the prepared side in contact with the back of the tracing. There is no necessity to make use of photometric bands as the progress of insulation is sufficiently seen on the sensitized paper during the exposure. From yellow that it was it should become perfectly white in the clear portions, that is to say, upon which there is no drawing of the transfer or positive cliché that is to be copied; this is ascertained by raising from time to time the shutter of the frame. The exposure lasts from ten to twelve minutes in the sun; in or any other suitable compounds of tannin or such other agents as are known and employed to produce color reactions with salts of iron. Mr. Powell prepared his coloring bath of four grains of gallic acid to the ounce of water, in which immerse the print and then watch carefully for the development of the desired color, which, when it appears, is the signal to remove the print from the coloring bath and to pass it once rapidly through one bath of clean water so as to wash it fairly, then immediately blot off all superfluous water and dry it in full daylight, and preferably in the sun, which strengthens and increases its brilliancy. There can be no doubt that by the above process brilliant pictures, with varied and agreeable tints and tones, can be produced; sharp, and at the same time pleasantly graded. By the old process with the alcoholic solution of caustic potash, there was almost always a blurring effect produced, which no doubt caused it to fall in disuse. The time elapsing between the printing and drying of these prints, together with the ease of manipulation, variety of tones, and I think durability, would seem to recommend this process.

summer less, in winter more. When the exposure is ended remove the print from the frame, and it should show a yellow drawing upon a white ground. If in the sensitizing bath a few cubic centimetres of a rather highly concentrated solution of sulphocyanide of potassium have been added, this bath becomes blood-red and colors the paper the same; in this case the print also whitens during exposure, but then the image instead of being yellow is red on a white ground. This substance, however, is, if we may so speak, inert, or without any other action; it is very fugitive and even disappears in a short time in obscurity; it has no other use, therefore, than to render the drawing or the image more visible after exposure.

D. Developing the prints: When the print has been sufficiently exposed it is taken from the pressure-frame and floated for a minute in the following solution, so that the side upon which is the image should alone be in contact with the surface of the liquid, avoiding air-bubbles between the two surfaces. Otherwise defects would be found in the print; to ascertain this, raise in succession the four corners. The developing bath is composed as follows: Gallic acid (or tannin), 31–46 grains; oxalic acid, 1¼ grains; water, 34 ounces.

In this bath the orange-yellow or red lines are changed into gallate or tannate of iron, and form, consequently, a veritable black writing ink, and as permanent as it. The print is then plunged into ordinary water, well rinsed, dried, and the print is now finished. The violet-black lines become darker in drying, but unfortunately the ground which appears of a pure white often acquires, in drying, a light violet tint. For prints with half tones this is of no importance; but for the reproduction of plans, for example, it is very objectionable. By this process we have the satisfaction of obtaining a drawing in black lines similar to the original, and in most cases this is sufficient.—A. Fisch.

218. Photographs on Porcelain Glass.—History repeats itself in photography as well as in other departments of the world's work. There are indications of a revival in the always beautiful photographs on porcelain glass. The old collodion method was productive of lovely results, but the difficulty of washing them properly rendered them liable to be fugitive. For this reason they grew unpopular.

218. The glass should first be albumenized, and then coated with collodio-chloride and dried.

Formulæ.—Collodion: Alcohol, 8 ounces; ether, 8 ounces; iodide of ammonium, 40 grains; iodide of cadmium, 40 grains; bromide of potassium, 32 grains; soluble cotton, 80 grains.

More or less, as the case may require, to give the collodion the proper flowing consistency.

Dissolve the iodides in the alcohol and ether; then dissolve the bromide of potassium in a minimum quantity of water, and add it to the alcohol and ether; filter out the precipitate, and then add the cotton and enough tincture of iodine to give the collodion a positive wine color.

Silver bath: Water, 64 ounces; nitrate of silver, 7½ ounces.

Dissolve the silver in two-thirds of the water, and add a solution of iodide of potassium, dissolved in water, enough to give a precipitate which will not dissolve in about five minutes. Then add the other kind of the water, and filter perfectly clear. Acidulate with two drachms of pure glacial acetic acid. Then try the bath, as it should give clear, brilliant effects on ordinary glass, by the camera.

Salt solution: Water, 1 quart; salt, 160 grains.

Preservative solution: Water, 8 ounces; gallic acid, 8 grains; citric acid, 8 grains.

This solution and No. 1 of the developing solution should be mixed fresh every time they are to be used, as they will lose their properties by standing about a day.

Developing solutions: No. 1. Water, 4 ounces; pyrogallic acid, 6 grains; citric acid, 6 grains. No. 2. Water, 1 ounce; nitrate of silver, 20 grains; citric acid, 40 grains. This solution may be kept and used until the precipitate begins to fall, when it is better to mix more fresh solution.

Toning bath: Dissolve 45 grains hyposulphite of soda in 32 ounces of water; then dissolve 15 grains chloride of gold in 16 ounces of water, and add it, little by little, to the hyposulphite solution. Shake well, and when the mixture becomes clear as water, it is then fit for toning. Pour about an ounce of this solution in a small bottle, then apply repeatedly, until the desired tone is attained. After using, reject the solution, as it does not tone well a second time.

Coloring solution: Alcohol, 8 ounces; gum camphor, 2 grains; bleached shellac, pulverized, 24 grains.

Place the ingredients in a bottle, and set in a warm place, shaking it occasionally, for about a day. Filter through paper, and it is ready for use. It is necessary to state that all the solutions should be filtered clear, and kept free from suspended particles.

219. The albumen process was offered as a substitute for collodion, but, though giving more assurance of permanence and equally fine results, it came too late and porcelain pictures went out of fashion so to speak. It may be that there was a little unfairness about this, for as late years have proven, some porcelain pictures nearly twenty years old, still retain their color and beauty.

220. Thanks to Mr. Carbutt and others, newer and surer methods have been given us, wherein gelatine offers a helping hand. Those who were disappointed

Fixing solution: Hyposulphite of soda, 1 pound; water, 24 ounces.

In order to obtain sharp pictures on uneven glass, I use an extension box or tube placed in front of the printing-frame, the length of which should be about three feet and tapering toward the end, so as to admit of an aperture large enough to receive a quarter-plate tube. By placing the tube toward the heavens, and receiving the light from it on the negative, a sharp picture can be made on glass which would otherwise be useless.—H. M. Johnston.

219. For the collodio-albumen process, proceed by making up the following: Silver nitrate, 1200 grains; water, 4 ounces.

Dissolve the silver in the water, take out one-third, and set aside; add concentrated ammonia to the remaining two-thirds, which will, of course, turn chocolate color; keep on adding until clear; now add the one-third to the two-thirds. Now add nitric acid until almost acid, but still neutral. It will be observed that you commenced with a little better than four-ounce silver solution; by pouring into the graduate, you will find that it has doubled itself, that is, you have a prepared silver solution of eight ounces; this can be used until it is entirely used up. Filter, and it is ready for use. In printing, it should print a rich sepia, but should only be printed a shade deeper than the regular paper print.

Tone in the toning bath used for albumen prints, but carry the tone a little further than you would prints that have been salted previous to toning. The porcelain print is merely washed under the tap a few minutes, and then placed in the toning-dish and toned. Soda them in the same soda as used for paper prints, letting them remain for five to eight minutes. Wash in running water same length of time as paper prints. I usually wash both porcelains and paper prints about three hours, and let them dry spontaneously.—George W. Schell.

220. The development of chloride films on opal plates is similar to the development of the chloride paper, which refer to on page 478.

The sensitive film is exposed in contact with the negative to diffused or artificial light. The image should show gradually; if it flash out, either the exposure is too much or the developer needs a little bromide; one to three drops of a fifty grain solution of bromide to each ounce of developer has a strong restraining action in the presence of the citric acid and chloride of ammonium; for very warm tones, dilute developer with equal parts of water and add one or two drops of bromide solution to each ounce of developer, but be sure and give at least double the exposure; do not carry the development of the opals too far, as they lose very little in fixing. For a positive picture on opal, the by the destruction of their old efforts may come back now, assured that the danger is over.

221. Porcelain pictures may be made by contact printing as in the copying camera. By the latter method old or any size of negatives may be utilized.

development should be arrested the moment the detail shows in the high lights, and this is most effectually done by quickly removing the plate from the developer, and flushing over the surface a five grain solution of potassium bromide; this instantly arrests development and preserves the brilliancy of the image.

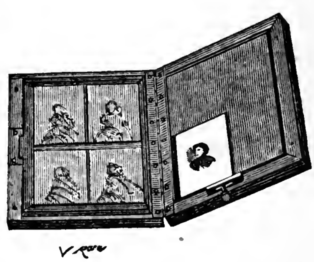
Wash and fix in solution No. 3, wash a few minutes and immerse for one minute in solution No. 4; wash thoroughly, and before placing to dry go over the surface with a swab of absorbent cotton while water is flowing over it, then dry spontaneously. Opal plates with matt surface for artistic work are also made.

There are few productions of photography more pleasing than these opal plates. There is a softness and harmony in the gradations of tone and a brilliancy in the whole, which make it a pleasure to look at them.—JOHN CARBUTT.

221. The negative to be copied on the porcelain plate is fixed in the shield wrong side up, and with the film to the lens. The negative which is suited for such sort of work, must be very thin, transparent, and yet full of detail; it must be much thinner in the opaque parts than an ordinary negative for paper prints; and it is well not even to varnish the negative, because a layer of varnish is apt to detract from the transparency of the film or to leave small particles of opaque matter on its surface.

Most generally the picture is required to be of the same size as that on the negative; therefore, slide the camera under the lid until the middle of the lens is about sixteen inches from the negative, and focus the negative on the ground-glass by moving the bellows part of the camera. If the picture on the ground-glass is now of the same size as that on the negative, no further adjustment is needed; but if it is larger, then draw the whole camera (not the bellows part) a little back and focus and measure again. If, on the contrary, the picture on the ground-glass were larger than that on the negative, you must slide the camera forwards to the front. As soon as the exact position is once found where the two pictures are of the same size, the camera is fixed or clamped in this position; and a mark is made by means of which the camera can again be placed in the same position if it should be removed for other purposes. Top light is best.—A. N. ADEPT.

FIG. 378.



I have devised an elastic frame specially adapted for the printing of positives on opal glass (Fig. 378). This frame, owing to its construction, allows the following of progress of the impression without disturbing the negative, which is kept in its frame against the plate, by means of a spring; on the other hand, when it is desirable not to cut a negative on which there are several images, a piece of sheet-iron, rather thinner than the opal glass, is fitted to the frame. Of this plate a corner is removed of the size of the positive print, which is thus rigidly

By the former a special printing frame is most convenient, though a plan for dispensing with it is added to the notes.

222. One of the prettiest applications of the porcelain or opalotype process is the making of pictures on watch-dials. It is a wonder that more of it is not done. And now, tiny miniatures on porcelain for pins, decorations, and so on, would meet the fashion, and should become very popular.

For such the polished glass would be best for plain pictures, and the ground surface for such as are to be colored.

It seems as though porcelain transparencies should also become much sought after if properly presented to lovers of the beautiful.

held by the spring shown in the figure. The lower part of this frame being elastic, the image is always in perfect contact with the negative by the pressure of the spring.

The contact should be very rigid to obtain the half tones; because, besides losing a great deal of its intensity in the toning and fixing baths, the image seen by transparency through the opaline medium never has the same vigor as when seen directly by reflection.—M. LIEBERT.

222. I do not claim the idea of photographing on a watch-dial, in fact do not know the author, but send you mine. I have put from one to three heads on one dial from as many different negatives. After taking off the dial, or having it removed by a watchmaker, take a square piece of cardboard, half an inch larger than the dial, place the dial centrally on it, and press very lightly, just sufficient to make an impression of the pins that hold the dial to the watch. With a large pin, or other metal point, pierce through the card at the spots marked, place the dial on the card, gently pressing the pins through the holes. Now supposing you wish to put one portrait on, place a straight edge of cardboard over the dial so as to bisect the XII and VI, make a mark on the cardboard from the dial to the edge. Should there be lettering immediately under the XII, then draw the line to one side of the centre. Now place the straight edge across the dial so as to cut about nine minutes on each side of the XII, and mark to the edge of the card; take up the dial and card, make short marks on the back to correspond with those on the front. These are to be the guides to aid you in placing the dial in its proper place on the negative. Remove the dial from the card, clean the face with chamois leather to free from dust, etc., flow over it a mixture of albumen and water in equal proportions. Coax off any surplus that hangs to the edge with blotting-paper. When dry, replace on the cardboard, and flow with collodio-chloride of silver; set aside in the dark to dry. While thus drying, prepare the negative by drawing a line with a pencil on each side, and in a line with the top of the head, also a line above and below the head, that would bisect the figure, if drawn through. Make a small vignette mask out of strawboard, one-eighth of an inch thick, and sufficiently large in surface to shield the dial from all action of light, except what passes through the vignette opening; fasten to the back of the negative with gum paper; secure the negative in the printing-frame. The dial being now ready place it face down on the negative, observing that the lines on the back of the card

223. Carbon Printing.—Several futile efforts have been made to substitute carbon or pigment printing for the albumen paper process. The manipulations are so entirely different as to make them distasteful to the conservative photographer; and the results, though charming and doubtless permanent did not take with the public. So, like an unpopular comedian, carbon had to step down and off the stage of popularity.

exactly correspond with those on the negative. On the card and between the pins lay a piece of the straw-board, thick enough to protect the pins of the dial from receiving any pressure. If not so protected, the dial might be injured. Place a piece of cotton velvet over the whole, taking care not to change the position of the dial. An ordinary stereoscopic plate and printing-frame can be used, taking the negative on one end of the plate. Block up one end of the printing-frame to the thickness of the dial and cardboard; let the pressure of the springs be light; by holding the frame in such a position as to lift the negative off from the dial, the progress of the printing can be examined with very little danger of moving the impression. When printed, wash, tone, and fix, as recommended for other collodio-chloride prints. Dry and replace on the watch. I use no varnish, as I think it best not to do so.—J. Carbutt.

223. Carbon tissue is the material upon which the prints are made. A mixture, in proper proportions, of gelatine, water, sugar, and India-ink, or other pigments, is applied warm to paper, and adhesion thereto secured by pressure.

To prepare and sensitize the tissue lay the sheet to be sensitized on any hard, smooth substance, and rub or wipe the printing surface gently with a clean soft linen cloth or piece of cotton-flannel. Avoid touching the tissue with the hands or fingers. After rubbing, take it by two corners, immerse it in the sensitizing solution, and drawing it through the same, dexterously turn it over and allow it to remain, face down, three or four minutes. The sensitizing solution is made as follows: Bichromate of potash, 1 ounce; cold water, 30 ounces.

This solution will keep in stock any length of time, and it is wise to make more at a time than is actually needed.

Lighting the Tissue.—When about to print, place the tissue in the printing-frame as usual with other papers. It appears a little singular to place black instead of white paper in the frame and expose it to light.

The time of exposure must be judged of by the skilful printer.

After lighting, the tissue is fastened by the corners on a glass plate, with the printing surface uppermost, by means of clothes-clips. Then, with a soft camel's-hair brush, varnish the printing surface with an even coating of the "hydrocarbon varnish," and lay away to dry. Take a piece of Saxe paper, which has been previously *floated till saturated* on the hydrocarbon varnish, and very thoroughly dried, and place the varnished side of it on the varnished surface of the tissue, and gently press them together with the hand.

When dry remove and lay the two adhering sheets on a piece of smooth cardboard, with the Saxe paper uppermost, cover them with a piece of felt cloth, the Saxe paper being next to the felt cloth; then place another piece of cardboard on the felt cloth, and

It is yet used in Europe very largely for enlargements, reproductions, and fac-similes, though bromo-gelatine has recently had a pick at its usefulness too.

For these reasons only a few descriptive notes are added concerning two or

pass the whole through a press. The pressure must not be too heavy nor too light, but about equal to the weight of a roll weighing about eight hundred pounds. This will be found quite sufficient for 4 x 4 prints, and all smaller, and the same proportion of pressure for larger sizes.

After coming from the rolls, the print must be handled carefully, and placed, with the Saxe paper uppermost, in a water-bath, heated from 95° to 100° Fahrenheit. When it is found that the corners will slip or slide apart, commence to pull, very delicately, on the two papers, keeping them all the time below the surface of the water. As soon as they are separated, throw out the paper which first held the tissue. Continue to wash the prints in this water heated from 95° to 100° F., until all the unaltered gelatine and bichromate are dissolved, and until the print is fully out.

As soon as the print is thoroughly developed, it must be placed in a vessel of clean cold water, which must be very frequently changed, or placed under a tap, and allowed to remain there for two or three hours or more, then removed and hung up by clips to dry.

When dry, the picture is to be nicely and evenly coated with a solution made of—Cox's sparkling gelatine, 1 ounce; cold water, 8 ounces; glycerine (pure), 80 drops; white sugar, ½ ounce.

This should be made in quantities as wanted; fresh every time, in order to insure a good, sweet strong glue. It ferments very quickly, which reduces its strength.

Warm slowly, just enough to melt the gelatine, and use warm. When a number of prints are to be done, it is well to tack them by the four corners to a board, and let them be coated and dried on it.

As soon as the coating of glue is dry, the print is to be laid, face down, on a piece of wet or moist paper, on which it is to remain *permanently*, and passed between rollers, with the felt-cloth and cardboard, as before described; but this time with a *heavy* pressure

When dry, take a very fine sponge—or a wad of cloth, made like a copper-plate engraver's "rubber"—and *moisten* it, not saturate it, with some of the liquid from the bottle labelled "Transferring Solution."

If the "transferring solution" is well applied, the Saxe paper will, from the peculiar action of the solution, in combination with the peculiar nature of the varnish, frequently roll off itself from the picture.

After the Saxe paper is removed and the print becomes dry, it must be immersed for about five minutes in a solution of alum and water, made by dissolving one ounce of alum in thirty-two ounces of water. Immersing the print in alum is called *tanning* it, as the action of the alum makes leather of the picture. After tanning, wash or rinse, under the tap, for four or five minutes. This completes the operation, and the picture may now be mounted with starch, or any other adhesive material, in the usual mode of mounting silver prints.—EDWARD L. WILSON.

three of the numerous so-called carbon processes, generally classed as "double transfer," "single transfer," and "direct."

Those who need further details for practice can find them in full in the magazines and manuals specially devoted to carbon printing.

The manipulations for producing Argento pictures are briefly as follows:

A carbon print is made by exposing a piece of carbon tissue, sensitized by bichromate of potash, under an ordinary negative in the usual way of printing carbon prints. The difficulty heretofore in making carbon prints has been on account of bad carbon tissue. I therefore prepare the tissue for this process according to my own method.

After the carbon print is printed, a metal plate with a silvered surface is taken and ribbed by rubbing it with a sanded brush, to deaden the polish and to give effect to the picture.

The plate is then cleansed with spittle (rather paradoxical, but nothing else answers the purpose as well), and then laid upon a sheet of paper on a table and flowed with diluted alcohol. The carbon print is now laid face down upon the plate, paper laid upon it, and a squeegee (of the form shown in Fig. 379 and made of a piece of wood and several thicknesses of ordinary bed-ticking wrapped over one end; see cut), used to force out the superfluous alcohol between the picture and the plate, and to make the one adhere to the other. The alcohol also serves to prevent the occurrence of air-bubbles.

The whole is now immersed in a pan of water of about 90° temperature. In a very few moments the paper may be detached from the gelatine, and the parts of the latter unaffected by light will shortly be dissolved, leaving on the plate a picture the shades of

Fig. 379.

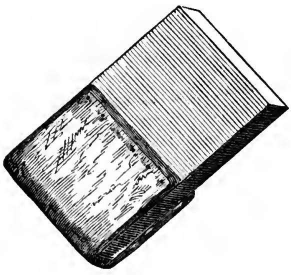
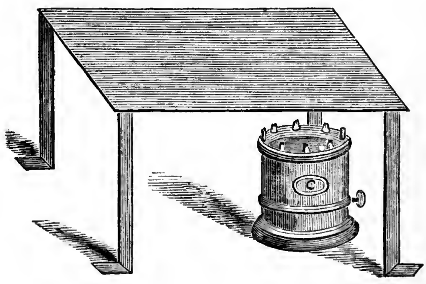


Fig. 380.



which consist of the colored gelatine, and the lights, or rather the highest lights, of the surface of the plate exposed under colorless gelatine. This part of the operation is most fascinating and beautiful—more like the developing of a collodion plate than anything else.

As soon as the superfluous color is all washed away, the pictures (now on the metal plates) are removed from the water, and hung upon a line by clips to dry.—F. A. Wenderoth.

CHAPTER XXII.

COLOR-SENSITIVE PHOTOGRAPHY—ISOCHROMATIC; ORTHOCHROMATIC.

224. To secure the proper color tone of nature in a resulting photograph has been the effort of many an industrious worker for many years. To give a history of all such experiments would require more space than can be afforded here.

Be it known that, thanks to Vogel, Ives, Mallman, Scolik, and a few others, bromo-gelatine plates are supplied which will secure color-value and which are almost as sensitive as ordinary plates. Thus a *light-looking* color results light in the positive print, and *vice versâ*.

For landscapes, copies of paintings, interiors of dwellings; for portraiture where the costumes are colored, and in many ways the color-tone plate will be found a great help.

224. My method consists in treating ordinary collodio-bromide emulsion plates with blue-myrtle chlorophyl solution, exposing them through the yellow screen, and then developing them in the usual manner. The emulsion which I have employed is made with an excess of nitrate of silver, which is afterward neutralized by the addition of chloride of cobalt; it is known as Newton's emulsion. I now prepare the chlorophyl from fresh blue-myrtle leaves, by cutting them up fine, covering with pure alcohol, and heating moderately hot; the leaves are left in the solution, and some zinc powder is added, which helps to keep the chlorophyl from spoiling. A glass plate is flowed with the emulsion, and as soon as it has set the chlorophyl solution is applied for a few seconds, after which the plate is washed in pure water until smooth, when it is ready for exposure.

My color-screen consists of a small plate-glass tank, having a space of three-sixteenths of an inch between the glass, filled with a solution of bichromate of potash about one grain strong. I place the tank in front of the lens, in contact with the lens-mount. The advantage of this tank and solution is that it can be more easily obtained than yellow plate glass, and the color can be adjusted to meet any requirement.

The plates require about three times as much exposure through the yellow screen as without it, and may be developed with the ordinary alkaline pyro developer.

In order to illustrate the value of this process, I made two photographs of a highly colored chromo-lithograph, representing a lady with a bright scarlet hat and purple feather, a yellow-brown cape, and a dark-blue dress. One by the ordinary process, represents the blue as lighter than the yellow-brown, the bright scarlet hat as black, and

225. To accomplish this the ingenious discoverers immerse their plates in a bath, or else expose them with a peculiarly stained glass placed between the lens and plate. I have selected from the best instructors we so far have in the

the purple feather as nearly white. The other, by the chlorophyl process, reproduces all colors in nearly the true proportion of their brightness, but with a slight exaggeration

FIG. 381.

From ordinary photograph of chromo-lithograph.

FIG. 382.

From isochromatic photograph.

of contrast produced purposely by using a too strong color solution in the small tank. These photographs are herewith reproduced (see Figs. 381 and 382).—F. E. IVES.

225. My invention relates to an improved process for manufacturing color-sensitive isochromatic or orthochromatic photographic emulsions or plates by dyeing the same with dyes highly sensitive to light. In the year 1873, I discovered that the sensitiveness of the haloid salts of silver for green, yellow, and red rays of light, which is very feeble, can be augmented by the addition of bodies which absorb such rays.

I discovered that all the red, violet, and blue chinoline and pyrodine dyes, which cannot be employed by dyers, on account of their fading so rapidly when exposed to light, are first-class optical sensitizers for photographic plates.

early youth of this promising discovery, such notes as will make the matter plain before my readers and keep history up to the date of publication.

The application of the aforementioned dyes is extremely easy; for instance (*a*), the dye is either dissolved in alcohol in the proportion of about 1 : 1000 alone or mixed with other colors, and then mixed with the prepared emulsion, and with or without an addition of liquor of ammonia or carbonate of ammonia; or (*b*), the dye is dissolved in water alone, or mixed with other dyes, with or without adding liquor of ammonia or carbonate of ammonia to the solution. The quantity of dye to be added to the emulsion varies according to the quality of the latter, and must be determined by an experiment. An excellent formula for many emulsions is: 2 to 4 cubic centimetres of a solution of chinoline red in alcohol (1 to 500), 5 drops of a solution of cyanine (1 to 500), 100 cubic centimetres of water, 1 cubic centimetre of liquor of ammonia. The emulsion plates are dipped or steeped in this solution for one minute, and then dried.—Dr. H. W. Vogel.

After trying various proportions, I find the following to work fairly well: Silver nitrate, 20 grains; ammonia carbonate, 90 grains; water, distilled, 16 ounces; erythrosin (2 : 100), 10 drachms.

The plates are placed in this for two minutes. A rinse in distilled water gives less chance of stains, and then place in a rack to dry. Let me here state that if they are used in the moist condition the orthochromatic effect is practically *nil;* they must be used quite dry. By this treatment the plate is rendered three times more sensitive.

I must insist on the necessity of using only ruby light, the plates having now become so sensitive to yellow that the greatest precaution must be taken in handling them.

Fog is got rid of by soaking the exposed plate before developing in the following: Potassium bromide, 120 grains; ammonia, ½ ounce; water, 12 ounces.

Do not allow to remain more than thirty seconds, well rinse under the tap, and proceed to develop with any of the usual developers—ammonia, potash, or ferrous oxalate.

If there be much blue in the object to be copied, a yellow screen must be used if exposure is to be made by daylight, although by gas or lamplight it is quite unnecessary. The best effect is always secured by gaslight exposure.

A very good substitute for colored glass is to color a collodion film and strip it up from glass. The glass should be rubbed over with talc or a solution of wax in ether, and well polished off, and coated with collodion containing methyl orange. The dried film should appear decidedly orange. The stripped film can then be gummed to the cap of lens, having cut out the centre first, and used preferably behind the lens.

The carbonate of silver and erythrosin may be mixed with an emulsion, but requires great care. It should be mixed at as low a temperature as possible, and the plates used as soon as they are dry, as their life is very short. The orthochromatic effect is very marked, and the speed increased about ten times. If anyone is desirous of trying this, I give the following: Emulsion (containing, say, 200 grains of silver), 10 ounces; silver nitrate, 10 grains; ammonium carbonate, 45 grains; erythrosin (2 : 1000), 5 drachms.

Before development they must be treated with the ammonia and bromide.—J. B. B. Wellington.

226. I have no doubt that some of the drawbacks which now attend the working of color-sensitive plates will be entirely overcome ere long.

226. *Eder's Formula.*—The plates receive no preliminary treatment, but are soaked for two minutes in erythrosin solution (1:500), 2 to 4 parts; ammonia, 1 part; water, 200 parts, and dried. Exposed plates are developed in the ordinary way, but with a somewhat larger proportion of restrainer.

Spitaler's Formula for Stellar Photography.—Bathe the plates for five minutes in erythrosin solution (1:400), 4 parts; ammonia, 1 part; distilled water, 200 parts, and allow to dry.

Loescher's Formulæ.—No preliminary bath is used, but the plates are soaked for one minute in either of the following solutions:

No. 1. Erythrosin, alcoholic solution (1:1000), 10 parts; ammonia, 1 part; water, 90 parts.

No. 2. Saturated azalin solution, 4 parts; ammonia, 1 part; alcohol, 20 parts; water 75 parts.

If sensitiveness to red is required, No. 2 solution must be used.

Hasselberg's Formulæ for Spectrum Photography.—The plates are steeped for about one minute in a weak solution of ammonia, and are then immersed for two or three minutes in one of the following solutions:

No. 1. From C to wave-length 5600. Cyanin, alcoholic solution (1:400), 2 parts; ammonia, 1 part; distilled water, 100 parts.

No. 2. From wave-length 5600 to F. Chrysaniline solution (1:1000), 3 parts; eosin solution (1:1000), 5 parts; ammonia, 1 part; distilled water, 100 parts.

Ives's Process with Collodio-bromide Plates.—This process consists in the application of chlorophyl, or chlorophyl and eosin, to a plate coated with collodio-bromide emulsion. Up to the present time chlorophyl has not been used successfully in conjunction with gelatino-bromide plates, but some recent experiments by Dr. Maddox indicate that chlorophyl from the leaves of the tomato or beet may give useful results, and the question is worthy of careful investigation. The chlorophyl solution must be fresh and strong. That from the American blue myrtle or English periwinkle (*Vinca minor*) gives the best results, but that from the leaves of the plantain answers almost equally well and gives slightly greater relative sensitiveness to red. The fresh leaves are cut up into small pieces, washed repeatedly with warm water, then heated with five times their weight of pure alcohol for about fifteen minutes, and the solution filtered and allowed to cool, when it is ready for use. The solution will keep for a few weeks in a cool place in the dark, but in this case it is advisable to leave the leaves in the liquid, and to add a small quantity of powdered zinc. A plate is coated with collodio-bromide emulsion, allowed to set, then covered with the alcoholic solution of chlorophyl for a few seconds, and finally washed with distilled water until the surface is smooth.

If eosin is also to be added the distilled water used for washing is just tinted with this dye. It is important to avoid the use of too large a quantity of eosin, which would diminish the sensitiveness to yellowish-green.

Exposed plates are developed in a dim yellowish-green light by means of dry pyro-

227. It may be that, by their help, we are led one step further in the production of photographs in colors, but the sanguine photographer must not confuse color-tone with color-production.

gallol, and sodium carbonate and sulphite, with a little bromide. The ordinary stock solutions of pyrogallol do not give good results. In all cases development takes place quickly, and there is a tendency to fog.

It is found necessary to use a yellow screen in order to get the best results, notwithstanding the behavior of the plates to the spectrum (?), and a tank containing a solution of potassium bichromate (1 : 1000) or a solution of picric acid, or, better, a glass plate coated with gelatine dyed with picric acid, answers satisfactorily.—C. H. BOTHAMLEY.

227. In our experiments with erythrosin, cyanin, and azalin we find that plates washed with the first-named substance are most sensitive to yellow, and the greater the quantity of blue in the light used, this yellow-sensitiveness of the erythrosin plate decreases in the same ratio as that of the ordinary plate increases, and inversely.

Mr. Schumann gives a table showing the difference in the sensitiveness of blue and yellow in plates obtained by different processes, viz.:

	Yellow-sen.	Blue-sen.
Pure black silver gelatine	0.0	1.00
This washed in iodeosin	3.6	1.01
" " erythrosin	15.6	1.67
" " cyanin	15.6	0.00

Cyanin is a coloring material discovered by Mr. V. Schumann, of Leipzig. Its use excited considerable controversy among photographers, and was, at first, attended by some difficulty owing to a certain dimness and some spots which appeared on plates washed in it; but accurate directions for its application now given by its inventor make it of greater benefit, and permit excellent results. In an orange-red sensitiveness, the cyanin plate surpasses every other color-sensitive plate, not even excepting the azalin plate.

Since the erythrosin plate is deficient in this very red-orange-sensitiveness, a combination of cyanin and erythrosin produces very satisfactory results.

Azalin, another coloring substance, was brought out in 1884 by Prof. Vogel—or, rather, plates sensitized with it were manufactured in that year. This dye, in an alcoholic solution and in a concentration of about 1 : 500, is a deep carmine (carmoisin) red fluid with an active reddish-brown flow.

Chinolin red is a dye discovered by E. Jacobsen, of Berlin, in 1882. A mixture of the two, cyanin and chinolin, in the proportion of 1 : 10, will correspond to azalin. Let 1 gr. chinolin red dissolve in 500 c. cm. alcohol. To this add 50 c. cm. of a solution of 1 gr. cyanin and 500 c. cm. alcohol.—MALLMAN and SCOLIK.

CHAPTER XXIII.

PHOTO-ENGRAVING.

228. THE method of applying photography to the production of printing-blocks to be used with type in the printing press is commonly known as photo-engraving or autoglyph.

It is employed not only by the daily newspapers for their somewhat crude illustrations, but is rapidly reaching a place in the magazines and books which makes it a fierce compeer of wood-engraving.

The classes of results may be known as "line" and "half-tone," the latter, of course, being the superior.

229. The "swelling" or photo-relief, the "etching," and the "photo-electrotype" processes, with their modifications, are the ones most used. For "half-tone" subjects a good negative direct from nature will serve every

229. As is known, one of the chief requisites for its proper chemical reproduction is that it should exhibit deep black lines, and a pure white ground. By the usual method of bleaching photographic prints with bichloride of mercury, it often happens that, in spite of every precaution, the whites of the picture appear yellow or brownish-yellow, a circumstance which greatly increases the difficulty of making a proper negative. To overcome this fault, Mr. W. Bode recommends the following receipt: Distilled water, 9 parts; nitrate of silver, 1 part. When the silver has dissolved, pour three parts of the whole into a glass, and add ammonia to it until the oxide of silver which has formed dissolves, and the solution becomes once more clear. Then pour this back into the other six parts. If oxide of silver forms again, it can be run off from the bottom of the vessel, or it can be poured out and filtered. Use only good, salted paper. Print until all the details are out, yet not too deep, then wash the print with cold water until it is red. When the residue of silver is completely washed out by frequent changes of water, the print must be fixed in a solution of soda, say equal parts of hypo and of double carbonate of soda. Let it stay in this solution ten to twelve minutes, then wash it many times in clear water and then mount it.

Since the picture will only keep for a few days, the drawing should be made as soon as the print is dry. The bleaching material—a solution of thirty grains of bichloride of mercury in one litre of alcohol—should be poured over the picture in the same way as collodion. In a quarter of an hour the drawing can be had on pure white paper, and does not show a vestige of a photographic picture.—*Photo. Archiv.*

purpose. For line work a pen drawing must be made, and from it a negative for the photo-engraving. For this latter purpose the drawing may be made directly upon the photograph, and then the parts of the original not wanted are bleached away so that only the drawing remains. The photo-print should be upon arrowroot paper, not toned, but well fixed in a thoroughly fresh solution of hyposulphite of soda. When dried the drawing may be made with Higgins's waterproof American India-ink. Now immerse the picture in a bath of bichloride of mercury and alcohol, and allow it to remain there until thoroughly bleached. Rinse very carefully in clean water and allow it to dry spontaneously. The drawing only remains ready for reduction to the desired size.

230. Experience alone can teach the photo-engraver how to succeed with the rest of the process. I can only give him hints. In every case the negative

230. I will illustrate the difference between the three processes for newspaper work by diagrams on the blackboard, showing a section of line, and the steps taken in each process toward its production.

Fig. 383 shows the several stages in the photo-relief method. First the negative film is brought in contact with the sensitized gelatine, when the latter is exposed to light,

Fig. 383.

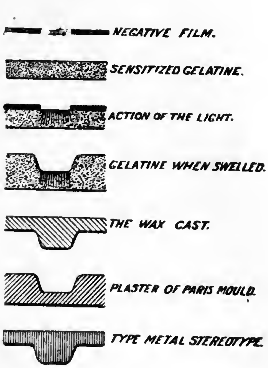


Fig. 384.

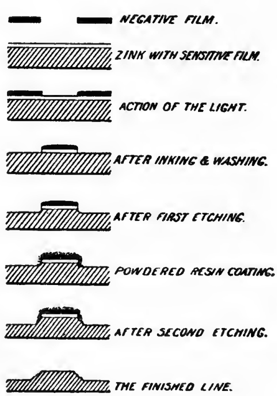
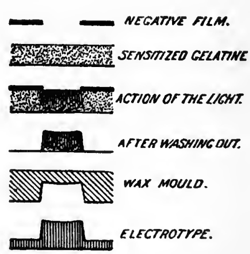


Fig. 385.



after which the gelatine which has been so exposed is placed in a tray of water. The portions unhardened swell; then a cast is taken in a waxy composition, from which is made a plaster-ot-Paris mould, in which to cast a type-metal stereotype, the peculiarity of the resulting line being that the corners of the line are slightly rounded. For book and magazine printing, where the press cylinder turns perfectly true, and time can be given to the process of overlaying, in the hands of an artistic printer this line with the must be fully intense, and exceeding care taken in every stage of the manipulation.

231. The negative secured, if the "swelling" method is to be followed proceed as follows: Make a gelatine relief as in the carbon process or as

rounded face can be taken advantage of to produce a light or heavy line, according to the pressure of the paper on it during the operation of printing.

With the photo-electrotype line, which is produced by the action of light on a sheet of sensitized gelatine, as in the photo-relief process, the unhardened gelatine is washed out with a soft brush and a tepid solution, leaving the portions acted on by the light in relief. From this an electrotype is made in the usual way.

The face of the line produced by this process is the reverse of the photo-relief line—that is, it is concave where the other is convex, the corners being sharp and highest where the wear is greatest. This makes the most serviceable plate for newspaper work, giving a square, honest line at each impression.

Figs. 384 and 385 illustrate the various steps of the zinc-etching process. A plate of zinc is coated with a film of albumen sensitized with bichromate of ammonia. After the exposure to light, the plate is rolled with a fatty ink, then the unhardened albumen film is washed away, leaving the ink only on the lines, protecting them from the action of the acid in which the zinc plate is immersed. After a slight etching, the plate is removed from the acid and dried, then powdered dragon's-blood is brushed against the sides of the line. The zinc plate is heated, the powdered dragon's-blood combines and forms a resinous coating, which protects the sides of the line from the further action of the acid. This process of drying, dusting with the powder, heating, and etching, is repeated many times, till the requisite relief is obtained, the finishing line showing, as in the diagram, a series of steps down the side corresponding to the number of etchings.—S. H. Horgan.

231. Dissolve 1 ounce of Coignet's Gold Label Gelatine in 6 ounces of distilled water, and to 1 ounce of this solution add 30 grains of nitrate of silver, previously dissolved in ½ an ounce of distilled water; to the other 5 ounces of solution of gelatine, add 2 ounces of a saturated solution of bichromate of potass. (saturated at a temperature of 60° F.), and, whilst still warm, add to it the gelatine solution, containing the nitrate of silver (which solution has also been kept warm); stir up well with a glass rod during addition, and continuing the stirring, add 100 grains of crystallized calcium chloride; and when dissolved, add 150 grains of glycerine, which must also be thoroughly mixed with the gelatine solution.

Level a glass plate (¼ inch thick, and rather coarsely ground with emery powder), and pour over it as much of the above solution as, when dry, will leave a film about the thickness of thin writing paper. Dry in the dark.

When dry, expose under a negative for about three hours, or until all details of the picture are fully visible when viewed by transmitted light.

After exposure, immerse in clean cold water until those portions of the film acted upon by light filtered through the negative become granulated or reticulated; the plate is then removed from the water, drained, and remainder of moisture removed by blotting-paper.

described further on. After thoroughly dry, make a plaster cast from this relief, and from that again the stereotype plate. Some manipulators use wax instead of plaster.

232. This method is being abandoned, however, for the zinc-etching process, which is less complicated and more expeditious. Some may make the objection to it, that it "requires more head to work it" than the other. This cannot be denied. The relief is made as described below, and then transferred to a zinc plate. There it is built up by a series of applications of lithographic ink and

A mould is now taken from the film in gutta-percha or sulphur, and from this mould a block is made by electrotyping or stereotyping.—MAX PRETSCH.

232. This is a good zinc-etching process. The reverse negative should be made on a perfectly level plate, so as to get the nearest possible contact with the zinc plate. To obtain a good result it is necessary that the negative should show every line and every point with the greatest sharpness. Give attention to the exact time of exposure. If the exposure be too long, the delicacy will disappear in the development and in the strengthening of the negative. As a general rule, the development should be stopped as soon as the image appears distinctly and with all its details, after which the plate is washed, fixed with cyanide of potassium, and then again thoroughly washed; afterward the following solution is poured on the plate, on which it is allowed to remain until the pellicle becomes almost white: Sulphate of copper, 1 ounce; bromide of potassium, 1 drachm; water, 8 ounces. After which the plate is thoroughly rinsed and plunged into a solution of one part of nitrate of silver to ten parts of water. The plate instantly becomes black. If upon the application of the sulphate of copper, the fine lines should fill up, it is because the negative has been overexposed. If the exposure has been good, all the white portions (of the paper) will be opaque, whilst all the lines and outlines will be perfectly transparent.

The negative finished, take a well-polished zinc plate of the required size, which is again repolished with finely powdered pumice-stone and water. After washing the plate in clear water in a dark room, pour the following solution on the zinc plate whilst still damp: Place the white of an egg, beaten to a froth, in six ounces of water, to which add thirty grains of bichromate of potash finely pulverized, which are allowed to melt; then filter the whole. The first quantity of the solution poured on the plate is thrown away, but the solution used afterward is returned to the bottle to serve again. The plate is dried by holding it by one corner, inclined over an oil lamp or gas jet, care being taken, however, that it shall not become heated. When it is dry and cold the plate is ready for exposure. Now place the negative, the front in contact with the prepared zinc plate in a pressure frame similar to those used by photographers. By means of springs a good pressure is obtained, so that the negative presses closely to the zinc plate; then expose the frame to the light for from two to four minutes according to the nature of the work. It is preferable to make the exposure in full sunlight. The frame is now brought back to the dark-room and the zinc plate rolled with a good lithographic roller, finely grained, with good transfer ink, not too thin; the fatter the ink, the better the result will be.

powdered resin, until the proper depth is attained, the degree of which must be judged by the manipulator, who, in turn, is guided by the subject in hand.

233. The taste will direct to both grain and line according to circumstances. There is no royal road to success in this department. An exact and expensive plant is required; artistic feeling is essential; a stereotype furnace is required, unless one be convenient to the studio.

Thus far experts have kept their information closely to themselves; but I

After having inked the plate in this manner it is placed in a dish filled with clear water, and the superfluous ink on the non-exposed parts is removed by means of a cotton cloth well soaked in water. This should be done very slowly and carefully, giving to the hand a motion in small circles commencing at the corners, advancing slowly over the whole surface, as the too rapid motion would partially destroy the sharpness. If the time of exposure has been correct, the image will develop itself easily; if there has been overexposure the ink will stick to the plate, and cannot be easily removed, which offers more or less danger of spoiling the work. If the time of exposure has not been sufficiently long, the result will certainly be defective, especially in the plates that have great delicacy. In both cases it is far better to repolish the plate with a strong solution of potash and finely powdered pumice-stone, wash in water, and begin the operation anew.

By careful attention to what has been said and a little practice, the operator will soon be able to determine the necessary time of exposure. After having removed the superfluous ink, the plate is cleaned in water and dried by means of heat. When cooled it is dusted over with finely powdered resin, well rubbed, and the excess removed. The plate is then heated until the resin begins to melt. This is shown by the slightly darker tint of the plate; after etching, the plate is again inked, dusted with resin, heated, and the operation continued until the necessary thickness or depth is obtained.

233. This grain is produced either on a film of bichromatized gelatine or on one of gelatino-bromide, by means of a reticulation. For films of bichromatized gelatine, the plate, coated as for printing with fatty ink, is dried at a low temperature, 21° C. (70° F.), exposed under a negative, washed with great care, then plunged into a mixture of—sulphuric acid, 2 grammes (31 grains), and water, 310 grammes (10 ounces), for thirty minutes. Wash in several waters, the plate being drained each time, and place in a saturated solution of alum for fifteen or twenty minutes, then repeat the washing. The plate is now placed in a dish containing water heated from 32° to 38° C. (89° to 100° F.), just enough to cover it. At the expiration of ten minutes the plate should present a uniform matt appearance; this is the time to withdraw it and plunge it into cold water. For gelatino-bromide films operate in the same manner, except as regards the exposure and the development. If a grained negative or transparent print is wanted, it is best to give a rather longer exposure and develop rapidly to obtain much detail without too much density. Different grains are obtained by adding to the acid mixture other acids, such as citric, tartaric, nitric, chlorhydric, or in mixing the acid with an alum solution, and by varying the time of contact. Great care should be taken to have the film of

am gradually drawing information from all sources and countries, which will enable me presently to publish a complete manual of instruction.

For examples of photo-engraving, I need only point to the beautiful pictures in Chapters IX. and X., to the lovely pictures in Chapter XXII., and on every side and in every home.

234. The pictures by Mr. Ives's process, in Chapter XXII., are by a process which has not been excelled by the highest of its family. Kindred results are produced in Europe, and are known as "Meisenbach"—here as "Autoglyph"—but they are by processes entirely different from Mr. Ives's.

equal thickness, otherwise the grain would be unequal. A thick coating gives a stronger grain than a thin one.—*Paris Moniteur.*

234. The Meisenbach process is described as follows: A transparent plate is etched or stippled in parallel lines. A transparent positive is made of the object, the two plates are joined, preferably face to face, and from the combined plates a definite negative is photogravėd in the ordinary way. In order to cross-hatch and break the lines of the shading, the hatched or stippled plate may be shifted once or twice during the production of the negative. The photographic negative thus obtained may be either applied direct to a zinc plate, or a lithographic transfer may first be made in the usual manner, and the plate subsequently bitten by acid to form a block in relief. Considerable importance is attached to the shifting of the hatched or stippled plate, this being the part of the process which is especially sought to be protected by the patent.

The following makes a very good fusible alloy. It melts at 160° F., and can consequently be used for moulding gelatine reliefs used in photography: Bismuth, 47.38 per cent.; cadmium, 13.29 per cent.; lead, 19.36 per cent.; tin, 19.37 per cent.—E. L. W.

Prints on Wood.—The block of wood receives first a white layer, consisting of a solution of one part gelatin and eighty parts water, mixed with some white, moist water color, which is laid on with a broad brush. After drying, the following solution is laid on with a brush, in broad strokes: A. Red prussiate of potash, 6 grammes; water, 50 grammes. B. Ferric citrate of ammonia, 7 grammes; water, 50 grammes. Mix both solutions in the dark, and guard the same against the influence of the light. The wood-block which is coated with the solution is dried in the dark, and it is to be lighted under the negative from ten to twelve minutes in the sun. Then it is wiped, in the dark-room, with a soft, wet sponge, when a beautiful dark-blue picture will appear which does not crack off in cutting.

To produce a red picture, dissolve from four to six grammes of sulphuric deutoxide of uranium in one hundred grammes of diluted solution of gelatine or gum, and coat the wood block with it, in the dark. After drying, light the same from ten to twenty minutes under the negative in the sun; then wipe it well with a wet sponge, and quickly lay on, with a clean, moist sponge, a solution of four grammes red prussiate of potash in one hundred grammes of water, which operation will cause the picture to appear at once. When the whole picture is visible the chemicals have to be washed out with a fresh wet sponge. In case the picture has been copied too dark, pour a few drops of sulphuric acid into water, and brighten up the same with it.—*Photographische Archiv.*

CHAPTER XXIV.

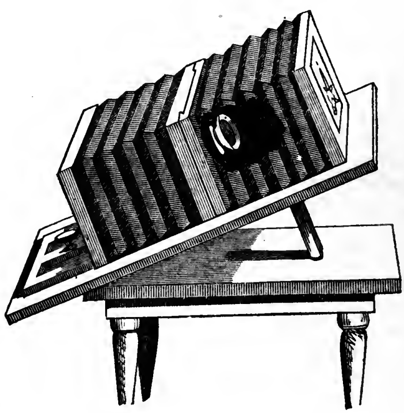
LANTERN SLIDES AND TRANSPARENCIES.

235. I MUST make the chapter on this most delightful of all photographic productions, brief, and confine what I say to the processes which are most convenient and practical for my readers.

The most important uses made of glass transparencies are for decoration and for the magic lantern. The technical quality for these two purposes is by no means the same. Though an impression exists that a transparency which appears pleasing to the eye when viewed by transmitted light is all one could wish for the lantern, it is not true. A transparency for window purposes or for a screen should be full of detail, and color given to every part of the film;

235. By the wet plan the positive can be made any size desired, either larger or smaller than the negative. To make wet positives it is necessary to have two cameras placed front to front, or one regular camera box, with an extension attached to the front, so that it can be adjusted to the size wanted. My own (Fig. 386) is arranged in the following manner: A camera box, 8 x 10, having a movable front, is used for exposing the plate. I shall call it No. 1. On the edge of the front, extending up and down, on both sides, is screwed a piece of wood, making a groove into which the extension, or camera box No. 2, slips, having a flange on its edges corresponding to the grooves in No. 1.

FIG. 386.



Box No. 2 is made with a large opening in the front, or part joining No. 1. The upper end, instead of having a grooved glass, has an opening arranged to fit a $6\frac{1}{2} \times 8\frac{1}{2}$ negative, with a dark slide immediately behind. This box has a bellows and rack adjustment similar to any camera; in size it must be made to draw out at least thirty inches. To put the boxes in working order, take off the movable joint of No. 1, on which the lens is fastened; then push them together, joint to joint; pull out the dark while a magic-lantern slide needs to be much more transparent in the shadows, and the lights should be as near clear glass as is possible. For this reason, "dry" lantern slides are not as good as "wet."

The proof of a good slide is not the sight, or one's color taste, but the effect of its projection upon the screen.

In the exposure and in the development the utmost precision and care must be practised.

All the beauty of the glass picture may be spoiled in the mounting and finishing. A light-colored obtrusive border or mat should never be used. A gilt line upon a black mat and an absolutely black border for slides is best. Window transparencies must be backed with Hance's "ground-glass substitute" or ground glass.

slide of No. 2, and adjust the front of No. 1 (containing the lens) in its position. Then place the negative in the frame of No. 2, inclining the boxes so that the line of vision will strike the sky or any white object.

I use the sky, fastening the boxes on a copying board seven feet long, raising the upper end so that the negative is clear of the line of houses or trees, which can be readily done by looking through the ground glass. If possible, use a north exposure; and do not let the sun strike the negative. The lens in No. 1 must always be uncovered, using the slide behind the negative as a covering.—J. C. Browne.

Transparencies can be made the same size of negative by contact and exposure to artificial light, or enlarged or reduced in the camera by day-light, with equal perfection in result. To make lantern slides by contact, place one of the Keystone thin crystal glass transparency plates over the negative in printing-frame, lay a piece of dark, soft material over it, close down the back, and expose to the *clear* light side of a Multum in Parvo Lantern, or other light, for ten to fifteen seconds at a distance of twenty inches from the flame. Use the ferrous oxalate developer. Let the development continue until the blacks look quite strong, and detail plainly showing in the high lights; wash off developer thoroughly before fixing; use fresh hypo solution; when fully cleared, wash for half an hour, then immerse in alum bath for five minutes: Chrome alum, ½ ounce; citric acid, ¼ ounce; water, 36 ounces. Wash for half an hour, then carefully go over the surface with a soft camel's-hair brush, or pledget of cotton, to remove any particles of dirt; place in rack to dry. When dry, cover with matt and clean crystal glass cover, and bind with binding strip.

The tone, both of lantern and large transparencies, can be varied from a warm brown to a velvety black. Increased exposure and weaker developer (adding water) with more bromide gives warm brown tones. Short exposure and stronger (undiluted) developer gives dark tones. The same solutions given for negative intensification can also be used for toning transparencies.—John Carbutt.

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