

tension, nine times out of ten your twisted saw, to your surprise, will show up straight. Sometimes a saw gets twisted through accident; such saws will show the center a little loose, and when they do, take the twisted saw to the block with a long pene, as stated. High-speeded saws require to be more open in the center, many of them dishing through with a snap. A saw too open will heat in the center and crowd from the log, while a saw too loose on the rim will snake and assume a complete wind or twist when a little hot on the rim. In such cases the center has to run hot in order to get anything like work out of the saw. A saw too open in the center is stiffened by hammering the rim, not nearer than two inches of the teeth; very little work on the rim will change a saw. When the saw has about the right spring, straighten it up on the block; then a trial will determine its tension. If the saw will not screw up true, the collar should be turned. If a saw is to remain on the mandrel, it may be papered if the collars dish it.

It is very essential that unequal tension be corrected in a saw that runs at a high or even moderate speed. Not one man in fifty knows anything about this, to say nothing of how to remove it.

Unequal tension is this: One part of the saw being tighter or more open than the other. I could write a volume on this important part of the saw's life. Now, to remove it, and in the simplest way, screw the saw up on the mandrel, take hold of the tail of the saw with the right hand (if it is a right hand mill), and spring the saw all you can to you, and at the same time apply the long straight edge and notice closely the opening. Apply the straight edge say every six inches, moving the saw and noticing the variation in light. You will find some places spring more, while others remain nearly to the straight edge; mark these places plainly. Now go on the outside of the saw, having everything free, so you can spring the saw, except the guide pins, which must be close to the saw. On this side mark the variations as before. If your saw has a loose place, you will find that it stood off more on both sides at that place. A tight place will stand off less and alike on both sides. In simpler words, loose places appear as though the plate was very thin, while tight places appear thick because they stand closer to the straight edge on both sides of the saw, loose places the farthest away. An open place on one side which shows high on the other indicates a lump; such a saw is not true, and must be taken to the block and trued up.

To remove loose places, hammer near the rim opposite such a place. Tight places are stretched right where they show it. For practical purposes, the saw should show very nearly the same spring all around. Always test both sides, and when even a slight variation is found it should be removed, then, if the saw is too open or too stiff, treat the center or rim a little on the anvil.

The foggy method is to always hammer a saw on the anvil, striking it as heavily as possible. When a saw requires a little straightening, it is mostly on the rim (the outlet of the saw); if this is done on the anvil, what is the result? Lumps partly beaten down, with all the tension gone; then the hammerer goes to the center to overcome just what he ought not to have done. A few blows on the block, and the saw would have retained its tension—been in better shape with ten times less work. No man can remove a twist in this way, directly on the rim. I have noticed over fifty such men, and they never get right up to the rim of a saw. Why? Because it will curl up, every time, on the anvil.

Test this with a piece of sheet iron, and be convinced. The tinner, iron and copper smith are sensible men; they have their copper or mallet hammer and a smooth block to straighten their work on. Why? Because only a blow or two on an anvil would stretch it into a wind, and then they are done. The saw is precisely the same way, and it remains only a question of time that the saw will be unequally tensioned, and then it is done. A man that knows anything about tension in a saw will take care of that vital part. Take a dished saw that requires only a few light blows near the collar, on the block. What does the foggy do? Stretch the rim, "pulling the dish" out, and a lot of other foolish things. A saw too open requires the rim stretched, but never a dished saw. Another idea is to hammer in lines from the center to the rim, only to result in tight and loose lines, and to buckle the saw. A man of gumption ought to know better than this, and this is the cause of many fractured saws. Others' theories are, that when a saw is sprung it must be sprung more to get the lump back. My idea is, if it is sprung it ought not to be, and should be gotten back without additional stretching, namely: The block.

Small saws are treated precisely as larger ones, but much more mildly. An expert changing from a thick saw to a thin one invariably will strike too heavily; great care must be exercised. They require but little tensioning, and should be stiff. Blue spots are treated on the block, and when they come back the rim should be stretched opposite such a place. Their appearance continually indicates a loose place.—N. W. Lumberman.

CELLULOID AS A DRAWING AND PRINTING MATERIAL.

By Colonel J. WATERHOUSE, B.S.C., Assistant Surveyor-General of India.

I HAVE lately been trying some experiments with celluloid films as a material for drawing and printing upon in connection with the photographic processes of reproduction, and a brief account of the results may not be uninteresting. The advantages celluloid possesses as a drawing material are:

1. Its great translucency, which enables tracings to be very easily made upon it, and also renders it an excellent material for being used as a transparency or transmitted positive or negative for photographic printing. The absence of all grain makes it much better for these purposes than paper or cloth.
2. Its impermeability to and unabsorptiveness of water or moisture, which make it quite free from any tendency to be affected like paper by hygrometric changes, or to be attacked by mildew and damp.
3. The fine matt surface, which takes pencil, chalk, or ink very readily, and can easily be renewed, if necessary, by graining with fine sand or emery powder.
4. The facility with which drawings can be washed

off and renewed for purposes of correction or for making new drawings. The surface can easily be kept clean and free from dirt.

I have tried the films as obtained from America, in three thicknesses, the $\frac{1}{16}$ th, $\frac{1}{8}$ th, and $\frac{1}{4}$ th of an inch. The first is about the thickness of thin paper, and is almost free from color; the second, which seems to be the kind in ordinary use for negatives, etc., is about the thickness of a sheet of stout writing paper, and shows a light buff color if laid on white paper; the third is about the thickness of an ordinary playing card, and shows a strong buff color over white paper.

On account of its freedom from color and great flexibility, which would permit of its being rolled without damage, the thinnest kind would probably be found the most suitable for drawing upon; but as the surface of the thin sample sent me was not so evenly grained as the others, I used the medium kind for the trials. It was found that a soft black lead pencil worked very pleasantly on the matt surface, and gave a fair opacity of line when viewed through the film, so that pencil drawings on this material might be copied in fac simile very easily by various photographic processes. Black chalk, also, works very well, and gives more opacity in the lines than lead pencil does. The softer kinds work better than the hard. With the latter, as with hard lead pencils, there is a tendency to make lines which polish the surface and render it transparent when viewed through the film.

Indian ink drawings in line can be made with perfect fineness and delicacy, either on the matt or polished films; with pen or brush; but, as far as I have tried, it is not easy to produce shaded or colored tints in washes; the surface of the material is too unabsorbent, and cut shades are produced on drying. Stippling or work with the air brush would probably answer better for shaded drawings in Indian ink or color.

Our trials have already shown that drawings in pen and ink and in chalk on celluloid can be reproduced very effectively by the photo-etching processes on copper, either by the direct methods, in which asphaltum or bichromated albumen is used as the sensitive surface, or in the manner used for ordinary half-tone heliogravure work with carbon tissue. In the latter case, the drawing must be reversed, unless the film of celluloid is thin enough to allow the drawing to be printed with sufficient sharpness through the film. The drawings would also be suitable for reproduction by certain of the block processes now in use, and blocks could be produced directly from the artists' drawings. For all fac-simile work, negatives could easily be obtained, if necessary, by contact printing on dry plates.

The drawing can, in fact, be reproduced by any of the photographic processes now used for reproducing tracings; and as the material is perfectly free from all inequality of grains, is sold in large sheets, and will soon be available in continuous rolls, it seems likely that it might well replace tracing cloth or paper, for all copying or tracing purposes, and especially for tracings to be copied by photography.

The cost of the celluloid sheets, in any case, is not great, and if not required to be kept, the drawings can be washed off, and the same materials used over and over again. For sketching purposes the celluloid would be very useful, and could be made up into blocks like paper. It would keep much better than the latter in a damp climate. For drawings for decorative purposes, the material could, no doubt, be also usefully employed.

For preparing factitious negatives, celluloid also offers great advantages and facilities. In this way a drawing in Indian ink or other pigment can at once be turned into a reversed negative suitable for photo-mechanical printing by the collotype processes, or by any of the block processes depending on a direct photographic impression from the negative on a zinc plate, coated with asphaltum or chromated colloid. For this style of work, lamp or ivory black, with a little gum, is the best ink to draw with, Indian ink being rather inclined to become insoluble by keeping. As soon as the drawing is completed, it is evenly coated with a mixture of lamp black and gold size, as recommended by Major Gore, R.E., or with printing ink and turpentine with a little gold size, so that it may dry quickly. As soon as this is the case, but not before, the film is placed in water, which will at once clear the ink off the lines of the drawing, leaving them quite transparent against the opaque ground. For fine work a little clearing of the lines with a soft sponge may be necessary.

The new films have been tried as a printing surface, in place of stone or zinc plates, and have been found to answer fairly well, excepting that it is very difficult to keep the ground clear and white, and free from a slight dirty tint. Gum and gelatine, with various acids and with bichromate of potash, have been tried as "etching" preparations, but so far without effect. If with further trial this defect can be overcome, the films might be very valuable as a substitute for zinc or stone in printing. With the delicate cream color of the stone, which is so much pleasanter for draughtsmen's work than the dark gray color of the zinc plates, they possess all the lightness, portability, and infrangibility of the latter, without their liability to corrosion. Their ready flexibility would be of value in printing from curved surfaces.

I have not yet had an opportunity of trying the films as a support for the gelatine printing surface in collotype work, but it seems most probable that the thicker kind of celluloid ($\frac{1}{8}$ th of an inch thick) would be suitable for this purpose, and would have the great advantage over glass plates of not being liable to break. The transparency of the films would admit of the sunning of the gelatine coating from the back, in exactly the same way as with glass plates.

The celluloid films can be printed on from stone or zinc fairly well, though the ink takes some time to become thoroughly dry. Printing from copper plates was not found to answer. Type can also be printed from, but the impressions obtained were somewhat weak, and the type indents the films very much; but further trial might give better results. Such prints from type would be useful in a variety of ways, for typing names and titles, etc., on heliogravure plates, and for many other miscellaneous purposes. The impressions from type seem rather too weak to use at once for photographic printing, but they can easily be strengthened by brushing over them some red bronze powder or black lead.

The acquisition of a material like celluloid, obtainable

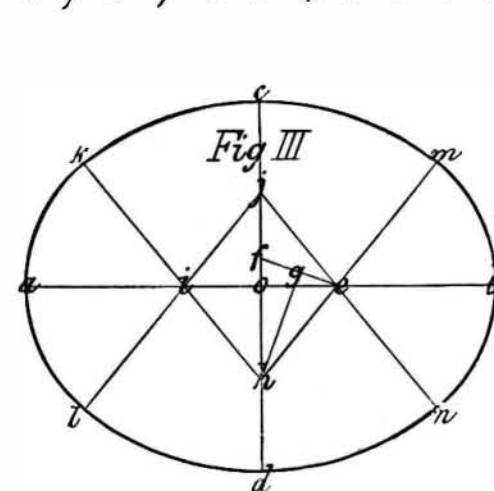
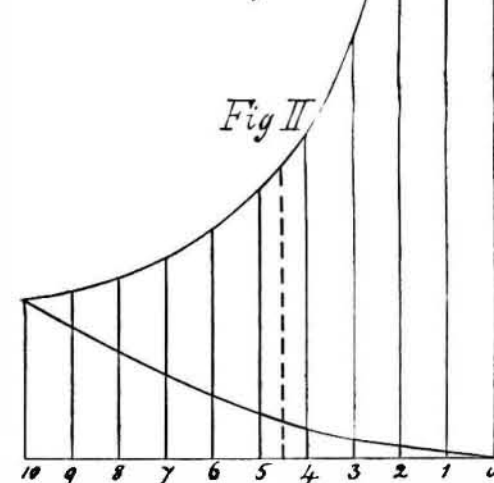
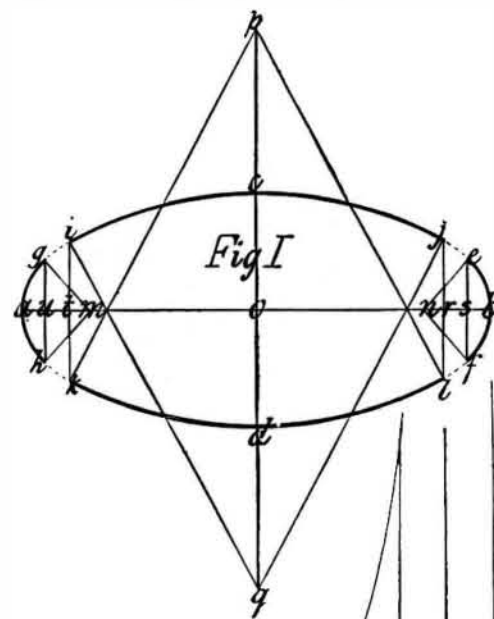
in sheets of large size and fine surface, which is practically transparent, inextensible, and unabsorbent of moisture, nor readily acted on by most acids (acetic acid attacks and dissolves it), is a great advance for all work connected with photography and printing, and it seems probable that we may see a very large extension of its use in these directions before long.—*Photo. News.*

A TABLE FOR DRAWING ELLIPSES BY ARCS OF CIRCLES.

Constructed by FREDERIC R. HONEY, Ph.B., lecturer on perspective, Yale University and Smith College; instructor in geometrical drawing, New Haven public schools.

VARIOUS methods have been adopted for representing ellipses by arcs of circles, with more or less degree of accuracy. This method of drawing the curve is recommended, because if the centers be taken on the axes, symmetry is easily maintained when the figure is drawn in ink. A careful examination of the ellipse has shown that very nearly the whole of the curve may be constructed in this way, and that within certain limits it may be drawn *wholly* by arcs of circles.

The following table is so constructed that the four arcs (Fig. I.) are limited at points which are absolutely



correct, i. e., they are determined from the equation to the curve. The extremities of these arcs, together with the vertices of the axis, thus give twelve points which conform to the theoretical locus:

THE TABLE.

	a b s.	a b s.	R	r.
$\frac{1}{16}$	.....	.....	.....	0.829
$\frac{1}{8}$	.....	.....	.....	0.676
$\frac{1}{4}$	.....	.....	.....	0.542
$\frac{3}{8}$	0.8	0.9	1.451	0.392
$\frac{1}{2}$	0.8	0.9	1.700	0.288
$\frac{5}{8}$	0.8	0.95	2.081	0.181
$\frac{3}{4}$	0.8	0.95	2.724	0.112
$\frac{7}{8}$	0.8	0.975	4.040	0.051
1	0.8	.....	8.010	0.022

Having given the major and minor axes of an ellipse, the table is used as follows:

We first ascertain the fraction which is obtained by