

China, and excellent silk may be made by dexterous management with a good hand-reel.

"Raw silk is classified into organzine, tram, and floss. Organzine is considerably twisted and is the choicest. Tram is made from inferior cocoons and is but slightly twisted. Floss is made of the loose silk, carded and spun like cotton or wool.

"The thread of silk as it unwinds from the cocoon is valueless for manufacturing purposes, several of them combined going to make the staple of commerce. The persons employed in unwinding silk are mostly women, one standing or sitting before each basin, of which she has entire charge. The basin is made of copper, and, in the large establishments, the water in each basin is heated by steam, at the control of the operator. The cocoons are plunged into the water, when it is near the boiling point, and moved about so that the gum which fastens the threads becomes uniformly and thoroughly softened. They are then beaten with a small birchen broom, having the tips split, so that the loose threads readily fasten to them. After beating a short time, the operator gets all the cocoons fastened, and, taking the bundle of threads, shakes the cocoons till each hangs but by a single one. She now takes up five or more threads (*brins*), according to the quality of silk wanted, unites them, and introduces the combined staple or strand (*fil*) into a little glass eye on one side of the basin. She then forms a second similar strand and introduces it into a second eye on the other side. The strands are then brought together, twisted several times, separated above the twist, and introduced into two other glass eyes or ringlets, through which they are led, one to each end of the reel or *tambour*, which is kept revolving in a steady, rapid manner, and to which is also given a certain back-and-forth side motion. The great object in reeling is to get the threads uniform, rounded, well joined, properly freed from moisture, and so crossed on the reel that they will not stick or glaze, as it is termed. These objects are attained by the twisting and the to-and-fro lateral movement of the reel, as also by properly regulating the distance between reel and basin. The uniformity of the thread depends on the skill of the operator, who must supply a new thread as soon as one begins to give out. This is called nourishing the silk, and is done by dexterously casting, with the thumb, the new thread upon the combined strand, to which it immediately adheres. In this she must use much judgment, for the silk of a cocoon gradually gets lighter and finer as it approaches the end, and the uniformity of strand does not entirely depend on the uniformity in number of the individual threads forming it. Whenever the silk rises in locks the temperature of the water is known to be too hot, and when it unwinds with difficulty the temperature is, on the contrary, too low. The operator is supplied with a skimmer with which to remove all chrysalides and refuse silk; also, with a basin of cold water in which to cool her fingers, which are being constantly dipped in the hot basin. This constitutes the whole operation of unwinding, but before the skeins, as they come from the reel, are ready for the manufacturer they must undergo still further manipulation. The staple is first passed through a cleanser, consisting of a clasp lined with cloth, which catches any loose silk or other matter that may be adhering to it. It is then further cleansed and purged by being passed through four similar cleansers (*purgeurs*), then twisted about 500 times to the yard, then doubled and again twisted about 400 times to the yard. It is finally run on to reels about 1½ feet in diameter, and taken off and twisted in a peculiar knot or hank. Through all these operations the oscillating to-and-fro lateral motion is kept up, so as to produce the diagonal crossing of the strands, and it will be readily understood that each staple is, in the end, composed of ten or more of the simple threads first spun by the worm.

"The loose or flock silk, together with all which, from one cause or another, cannot be reeled, is soaked in water for three days, boiled for one half hour in clear lye, washed in rain-water, and when dry, carded, and spun it makes an inferior floss silk."

In order to better illustrate these principles, we have introduced figures of three reels. Fig. 5 is the old Piedmontese reel, which for many years held its supremacy, and which has been the foundation of numerous improved reels. It is formed of four bars or arms, and is usually about a yard in circumference. One of these bars is provided with hinges so that it may fold inwards towards the center when it becomes necessary to slacken the silk in order to carefully remove it from the reel. The lateral movement so necessary in order that the consecutive circles shall not stick together is gained in rather a clumsy manner by means of cogs. The strands after being twisted several times at *c*, in order to round and smooth the threads by friction, are passed over the guides, *b b*, which are inserted in the traversing bar, *a*. To this bar the lateral movement is imparted by a pin connected with the outer circumference of the cog-wheel, *d*. This is connected at *e* with the cog revolving with the shaft of the reel. *f* represents a charcoal-furnace under the copper basin, *g*. The cross-bar, *h*, to which are attached the glass eyes through which the threads from the cocoons first pass, is usually widened into a shelf, upon which to place the broom and the cold water for the reeler's fingers.

Figs. 6 and 7 represent, respectively, a plane view, seen from above, and a longitudinal vertical section of an old French reel differing somewhat from the Piedmontese, and the principles of which are employed in all the improved reeling establishments of to-day.

*a*. The oblong water-basin heated by a charcoal-furnace or by steam, and frequently divided by partitions.

*b b*. Hooked wires or eyelets to guide several threads and keep them apart.

*c c*. Points where the threads are twisted upon each other to clean their surfaces and compactly round them.

*d*. Cylinder on shaft, with a spiral groove in its surface, in which fits a pin from the traversing-bar, thus giving the lateral movement to the thread which goes through a guider on the front end of the bar, which moves through the arc of a circle.

*e*. The reel.

*f*. Pulleys which transmit by a belt the rotary motion of the cylinder, *d*, to the reel, *e*, that connected with the reel being the smaller of the two.

*g*. Friction lever, for tightening or slackening the endless cord, in setting or stopping the winding operation. There is usually a series of such reels in one apartment, driven by the same motive power, but each of them, as has been shown, can be stopped at pleasure. In case the reels are driven by a steam engine, stop-cocks and pipes are so arranged that the water in every basin can be instantly or gradually heated by steam. If desired to run the reel by hand, a handle can be placed upon the shaft of the cylinder, *d*, or of the reel, *e*.

Fig. 8 represents a hand reel, of much the same style as

the last, set up and ready for work. This machine was illustrated in the *American Artisan* for February, 1874, in the course of an article by W. V. Andrews, of Brooklyn. It is as good a hand reel as is now in use, though it is made on the same principle as the old French reel of forty years ago.

*a*. Tin basin with copper bottom for holding the water in which the cocoons are boiled, fitting tightly over the tray, *b*.

*b*. Square tin tray for reception of cocoons, etc.

*c*. Short stick inserted in a holder, on which the ends of the cocoons are wound, so as to be ready for use.

*e*. Cock to let off water from the basin. This should be done every night after use.

*f*. Door of furnace lined with fire-bricks, wherein the charcoal fire is lighted to heat the water in *a*.

*g*. Flue-pipe to carry off fumes; this, as supplied, is short, the length and direction in which it may be carried varying in every case. It is necessary that all the charcoal fumes should be carried either into a chimney or into the open air.

*h h*. Glass eyes on wire holders, through which the threads from the cocoons pass upward to the pulleys at *k*. It is of importance that the glass eyes should be so placed that the threads pass upward in a straight line from the water to the pulleys at *k*, and also from the pulleys to the top of the wheel at *o* (except so far as when diverted laterally by the long guider at *l*); friction is thus reduced to a minimum, and the elasticity of the thread preserved.

*i*. A former arrangement for twisting the threads one upon the other; this is now discontinued as unnecessary, since the twist given to the threads at *k* and continued downward to the point *h* effects its purpose with a minimum of friction, and produces a superior thread. This twist is effected by the very simple method of passing one thread round the other, as shown in the small drawing of the pulley, *k*.

*k k*. Rollers or pulleys revolving on bent wire stands, over which the threads pass.

*l l*. Porcelain tubes on wire holders, between which the threads pass to reach *o*. Glass eyes may be substituted for the first pair of these tubes with equal advantage.

*n n*. A grooved arrangement by means of which the long guider working to-and-fro distributes the thread to the reel "in the cross." Unless the thread is thus wound "on the cross," it cannot be unwound at the mills when required to be thrown, and is, therefore, unsalable.

*o*. The top of the reel on which the silk is wound. One of the arms is furnished with the screw-hinge attached, by means of which the length of the arm is diminished to take off the silk.

*p*. Handle of the machine. (The letter in the cut is in the wrong place.)

The adult reeler sits on the stool in front of the cocoons, and the other stool is occupied by the child who turns the crank.

#### FOOD PLANTS.

The traditional food plant of the silkworm is the mulberry (botanical genus *Morus*). There are two species of mulberry indigenous to the United States, namely, the red mulberry (*Morus rubra*) and the small-leaved mulberry (*Morus parvifolia*), neither of which is suitable silkworm food. I have tried in vain to rear the worms upon *rubra*, but they either refuse its leaves entirely or dwindle and soon die upon it. The imported species which are most used are the white (*M. alba*), the *Multicaulis*, and the black (*M. nigra*). This last is inferior to the other two as silkworm food.

The mulberry grows readily, being easily propagated by cuttings or layers or from the seed. The white mulberry, in particular, grows well from cuttings, and this is perhaps the readiest and most economical method of planting to secure a stock.

The cuttings should be started in rows, 3 or 4 inches apart, in ground prepared by deep plowing and harrowing. They should be about 6 inches long, and should be cut just before an eye in every case. They should be almost entirely buried. The quickest way to get a supply of leaves is to grow dwarfs. Set out the young trees from the nursery in rows 10 to 15 feet apart, and 6 to 8 feet between the rows, and form the crown of the tree by cutting down to a foot or so from the ground. The height of the tree and its form are easily regulated by pruning, and upon this process depend not only the vigorous growth of the tree, but also the ease with which the leaves may be gathered when desired. The pruning may be done in February or March, either every year or every other year. All dead twigs and dried bark should be removed and the limbs kept as smooth as possible, as this greatly facilitates picking. The best time for planting is in the fall, from frost until December, and in the spring, from March until May.

For growing standard high trees, a practical raiser gives the following directions: The cutting should remain two years in the nursery without pruning. The third year it is cut down close to the ground and transplanted. The finest shoot is then allowed to grow, and in good land it will reach a height of 8 or 10 feet in one season. The fourth year it is cut back to 6 feet or thereabouts. Then, the three or four terminal buds only being allowed to grow, all others are removed as often as they appear, by passing the hand along the stem.

The *Moretti*, a variety of the white mulberry, is profitably grown in the form of a hedge, and the large size of its leaves makes it a very desirable variety.

#### OSAGE ORANGE.

The cultivation of the Osage orange (*Machura aurantiaca*) is so well understood in this country that there is no need of giving detailed instructions on the subject. Very generally used as a hedge plant in those sections of the country which are particularly adapted to silk culture, its leaves may at once be obtained without any special investment of capital. Indeed, as the hedges need trimming, the cutting off of the new year's growth, as the leaves may be wanted for feeding purposes, is a saving rather than an expenditure. Those who use this plant as silkworm food must, however, bear in mind that the shoots from a hedgerow become very vigorous and succulent by the time the worms are in the last age. These more milky and succulent terminal leaves should be thrown aside and not used, as they are apt to induce flaccidity and disease.

In avoiding these more tender leaves, and using only the older and firmer ones, especially when the worms are large, consists the whole secret of the successful rearing of silkworms on this plant; and if care be had in this respect there will be no appreciable difference in the silk crop from Osage orange as compared with that from mulberry.

Should the worms, from whatever cause, hatch before either mulberry or Osage orange leaves can be obtained, they may be quite successfully fed, for a few days, upon well dried lettuce leaves. It will, however, be worse than a

waste of time to attempt to feed them entirely on these leaves, or, in fact, on any other plants than the two here recommended.

#### BENNETT'S GELATINE EMULSION PROCESS.

By W. WAINWRIGHT, JR.\*

In January, 1878, a writer in the "Photographic Almanac" said of gelatine, "that it is equal in value to collodion, we think may be fairly predicated; that it is superior is not yet evident." The same writer goes on to say with collodion "one may digest with excess of silver nitrate for days, and, with due knowledge of the treatment necessary at the after stages, may arrive at a pitch of sensitiveness which is scarcely attainable with gelatine without detriment to other necessary qualities."

Since the article referred to was written, a revolution has taken place with regard to gelatine. Instead of being equal in value to collodion, it is far superior to it in point of sensitiveness, cleanliness of working, exquisite detail, and quickness in developing. This change is owing to the free publication to the public by Mr. Bennett of the proper method of working gelatine—a result at which he arrived after much careful experiment. I do not claim for the negatives and prints I send around to-night that they are the best or the quickest that gelatine can produce. I show them as an amateur, and as examples of what any one may do by following strictly Mr. Bennett's formula.

There are many formulæ of various process published, but it is a question how many of them are workable by ordinary photographers.

As soon as Mr. Bennett had published his formula (and even before, as the process had been shown to many), the market was supplied with gelatine plates by various makers who had never before produced anything like them in rapidity or quality, nor can they now, except they follow his process.

Only the other day it was a matter of speculation whether gelatine plates could be used in the studio. Now many are using them to the entire exclusion of wet plates.

The process claims for itself, I think, the following special peculiarities, the combination of all of which leads to success:

1st. Lengthened emulsification.

2d. Thorough washing, so that all the salts are eliminated.

3d. The power of using a strong alkaline developer without any restraining bromide.

4th. The working in an extra non-actinic light.

The negatives I exhibit are all taken with a rapid rectilinear lens in sunlight. The exposure in April on trees is 15 seconds, and on all the others 7 to 10 seconds, with the exception of one, which is nearly instantaneous. I have not, myself, gone in for very extra rapidity, which would entail emulsifying for from three to five days, but have contented myself for ordinary landscape work with an emulsification of 2½ days, and thorough washing, say 12 hours.

There is little doubt in my mind that owing to the liberality of Mr. Bennett a great impetus has been given to gelatine plates, and the trade and public will much benefit thereby. The formula I use is what Mr. Bennett has already published:

7 grains bromide ammonia.

11 do. silver.

90 do. gelatine.

I send round the prints and negatives together, so that members may be able to compare them together, and they will then see how vigorous and soft a print can be obtained from a comparatively weak negative.

#### PHOTOGRAPHY IN COLORS.

By M. K. VERSNAEYEN.

MANY people, latterly, have erroneously given to different systems of painting on photography the misplaced title "photography in colors." This was too much to say of the ingenious results, some of which were obtained by the transference of the photographic image, some by other means. Nay, attempts were even made to make us believe that photographic proofs, tinted by oil or water-colors, were proofs obtained directly in colors. The only process which, up to the present time, has really deserved the name of "photography in colors" is that of M. Ducos du Hauron, but it is only still in infancy, its practice being very difficult, and the colors obtained not always being of the required tone. To arrive at the real colors of nature is no easy task, but we doubt not that M. Ducos du Hauron will, sooner or later, solve this difficult problem.

M. Germeuil Bonnaud's process of photographing in colors—we use this term intentionally, because it is the only term strictly applicable—simply consists in causing the photographic action to operate directly on the color. To this end M. Germeuil Bonnaud has carefully sought the means of rendering a neutral color sensitive, and at the same time insoluble, so that it might be able to resist the numerous baths necessary to the photographic process. When this process is used, all the operations remain the same as in the ordinary method, with this great advantage, that the impressions made by the silver salts on the colored background give precisely the effect of the original model, and have not that hardness of tone that generally characterizes a "retouched" photograph. The print comes out of the bath completely colored. Thanks to the chemical agents and the sensitive paper used by M. Germeuil Bonnaud, the colors and the photograph are henceforward indelibly united. But, in addition to the great artistic results, the material advantages of this discovery are very considerable. Firstly, the true harmony of color is restored, while prints colored by any of the old processes—photo-painting, as one might call them—are always monotonous and wanting in durability. By oil painting on the photograph, the employment of water-colors, or even of transparent media, the cost of production was immensely increased. And this was not all, because to obtain really artistic effects it was necessary to employ artists of such a degree of talent as is rarely found in country towns, where one does not find every day a Millais, a Dickinson, or a Nadar. Now the photographer can do it all himself. So much the better for those who are neither painters nor draughtsmen. It appears that the cost of the colored photographs produced by the Germeuil Bonnaud process is very little, if anything, more than the ordinary uncolored ones. So we get at the price of an ordinary carte-de-visite a photograph in unchangeable and unfading colors.

\* Read before the Photographic Society of Great Britain.