silver one foot. In case of a watermill, where the pressure may not be sufficient, an extra chamber, I, may be introduced half way to bowl, O, which will be self-acting.

After the piping is well put together it should be first tested with water.

The burr, from cutting the pipes, should be reamed off.

AMALGAM.

A pan for scouring amalgam resembles a small settler, but should have attached to its arms a shoe extending from rim to cone, the outer end being five or six inches ahead.

Diameter of pan, 5 feet; depth, 1½ foot; speed, 25 per minute. Before retorting, the amalgam should be dried by a hydraulic press or by piling the amalgam some two feet high on a strainer, and allowed to drain for a couple of hours.

The choice of retorts is not of vital importance to success, but as a question of convenience and economy it is to be considered. The hooded central discharge retort, which admits of turning, was extensively introduced and is still largely used outside of the Comstock, where they are almost if not entirely discarded.

As a center discharge does not admit of being filled, a much smaller retort with top discharge will do equal work, for which due compensation is not given, by the turning of the former. In other words, the consumption of iron for a given amount of amalgam retorted is greatest with the center discharge. These are deductions from personal observations, where individual weights and number of charges were recorded, and was extended to several working side by side. The average life of a center discharge retort 14 inches by 5 feet, by 1½ inch thick, was under 35 charges.

The hood and the head with revolving bar attached to its center is doubtless the cheapest form of construction, but for large retorts decidedly inconvenient, and invite a bad job in adjusting the head.

A decided and unprecedented success was made, two years ago, by casting retorts on end, face up, rendering the metal dense and uniform.

Eight retorts cast in this way, of a plan similar to plate III., were made for the Brunswick Mill. They were 5½ feet long, 14 inches inside diameter, and 2 inches thick.

With charges varying from nineteen hundred to twenty-four hundred pounds, they endured upward of eighty-five fires. Compared with the previous average, the advantage is emphatic, the extra thickness of one half inch requiring no appreciable increase of fuel.

To avoid the hard labor of cutting the bullion of a large retorting, use paper to make divisions in the amalgam instead of sheet iron.

Quicksilver melts at -39°, evaporates slightly at ordinary temperatures, and boils at 662°. Its specific gravity is 13.6 at 32°.

2.038 cubic inches weigh 1 pound.

One cubic foot weighs 847.89 pounds.

In a column of quicksilver every foot in height gives a pressure of 5,888 pounds per square inch. That quicksilver will pass through a smaller aperture than water is a popular fallacy, naturally deduced from the fact that the former will often leak from a vessel that will hold the latter. An explanation for this seeming paradox is that quicksilver, being so much heavier, gives far greater pressure, and in wooden vessels, water, having the finer penetration, enters the fiber of the wood and swells it, thereby closing small openings, whereas quicksilver, entering only the open grain, has no expanding effect.

Gold melts at 2,016°, its specific gravity is.....19.3
Silver " 1,873° " " " ".....10.5
Copper " 1,998° " " " ".....8.9
Cast iron " 2,786° " " " ".....7.8
Lead " 612° " " " ".....11.3

1 oz. Troy of silver is worth.....\$ 1.2929
1 lb. " " " ".....18.854
1 ton " " " ".....37,709.50
1 cubic foot " " " ".....12,355.20

1 oz. Troy of gold is worth.....\$ 20.6717
1 lb. " " " ".....301.46
1 ton " " " ".....602,927.36
1 cubic foot " " " ".....361,808.64

3.89 cubic inches cast iron weigh 1 lb.
To compute the weight of an article of

Cast iron, multiply its cubic inches by.....0.2607 lb.
Wrought iron, multiply its cubic inches by...0.2816 lb.
Copper, multiply its cubic inches by.....0.3212 lb.
Lead, multiply its cubic inches by.....0.4102 lb.

Under a column of water 26.5 inches high there is a pressure of 1 pound per square inch.

A circumference equals the diameter multiplied by 3.1416.
The area of a circle equals one half of the diameter multiplied by one half of the circumference, or square of the diameter, multiplied by 0.7854.

The surface of a sphere is the circumference multiplied by the diameter.

The volume of a sphere is the cubic of the diameter multiplied by 0.5236.

TENSILE STRENGTH OF RODS PER SQUARE INCH.

Cast steel, breaking load, 50 tons; safety load, 12.5 tons.
Swedish iron, " 36 " " " 9.0 "
Common iron, " 28 " " " 7.0 "

STRENGTH OF ROPES.

Let C represent the circumference:

New hemp will safely sustain.....0.4 C² tons.
Iron wire will safely sustain.....2.6 C² tons.
Steel wire will safely sustain.....3.75 C² tons.

RUST JOINT CEMENT (QUICK-SETTING).

1 lb. sal ammoniac, 2 lbs. sulphur, 80 lbs. iron filings.
Mix to a paste with water.

Slow-setting—2 lbs. sal-ammoniac, 1 lb. sulphur, 200 lbs. iron filings.

For holes in castings, take 1 part gum arabic, 1 part plaster Paris, and 1 part iron filings. Mix with a little water.

Babbitt metal, 3.7 copper, 0.89 tin, 7.3 antimony.

Metal that expands in cooling—Lead, 75 parts; antimony, 16.7; bismuth, 8.3.

Taper for keys for shafting—One-sixteenth inch to four inches.

DECIPIUM—A NEW METAL FROM SAMARSKITE.

By M. DELAFONTAINE.

WHILE prosecuting my researches on the samarskite earths of North Carolina, I discovered in them a new metal, which I have called Decipium (from *Decipiens*). This metal, which possesses the properties common to those of cerite and gadolinite, forms an oxide, the equivalent of which is approximately 122, its formula being DpO (or Dp₂O₃=366).

I have not yet effected the separation of this new metal from didymia completely enough to affirm that its color is white. Its salts are colorless; the acetate crystallizes very easily, and seems to be less soluble than that of didymium, but more so than that of terbium. The decipio-potassic sulphate is only slightly soluble in a saturated solution of potassic sulphate, but dissolves easily in water.

The nitrate of decipium gives an absorption spectrum, composed of three bands at least, in the indigo and blue. In order to see them well the aid of sunlight is necessary, the best way being to direct the slit of the spectroscopic toward the disk of the sun, interposing a piece of blue glass before the eye piece. The most refrangible ray is a little narrower than that of philippium and the *m* of didymium. It is rather dark; its middle closely corresponds to the wave length 416, or to 195 of M. Lecoq's scale. It is nearly in the middle of the space between Fraunhofer's lines G and H, but more nearly approaches G. Neither didymium nor terbium gives any ray in this region. The band which characterizes terbium is hardly so broad; it is seen more to the right, and is so near to the limit of the spectrum which I obtain with my instrument that an intense solar light is necessary in order to clearly distinguish it. In exceptional conditions of light I have been able to observe the violet space beyond, and to recognize in it two well defined rays, which are probably H and H'.

The second band of decipium is narrower, more intense, and a little indistinct at the edges. It is seen in the less refrangible blue; its middle corresponds very nearly to the wave length 478. It is nearly in the same place as a band of didymium, but its intensity is incomparably greater. More to the left, and nearer to the limit of the blue and green, there is a rather indistinct minimum of transmission, which may be the result of the overlapping of the two faintly defined bands. I have not, however, succeeded in separating them. I intend to return to the subject shortly.

In the present state of my knowledge I recognize in the samarskite earths of North Carolina (more or less combined with other earths) the following:

Name.	Color.	Equivalent.	Characteristic Absorption Band.
Ytria.....	White	YO = 74.5 (Delafontaine)	None.
Erbia.....	Rose	ErO = 130 (Bunsen, Clève)	520 to 522
Terbia.....	Orange	TbO = 114-115 (Delafont., Marignac)	About 400
Philippia.....	Yellow	PpO = about 90 (Delafont.)	" 449
Decipia.....	White?	DpO = about 122 (")	416
Thoria.....	White	ThO ₂ = 267.5 (")	None.
Oxide of didymium	Brownish	DiO = 112-114 (Marignac, Clève)	573 to 577
" of cerium....	Pale yellow		None.

The equivalents* of the metals contained in some of these earths show rather interesting numerical relations to each other:

Yttrium.....	58
Philippium.....	74 or 58+2×8
Terbium.....	98 or 58+5×8
Decipium.....	106? or 58+6×8
Erbium.....	114 or 58+7×8

If the above metals are considered as triatomic, the difference will be 12, or one of its multiples, instead of 8.—*Comptes Rendus*.

NEW IMPROVEMENTS IN PLATINOTYPE PRINTING.

As would have been seen from the transactions of the recent meeting of the British Association, the platinum printing process of Mr. William Willis, Jr., which was described three years ago in the *British Journal of Photography*, has been subjected to further modifications, the alterations that have been made having the important effect of greatly simplifying this process. Previous to describing the details of the improved method—which were not given in the paper read before the British Association—we shall first present an outline of the process as formerly practiced, with an account of the chemical changes produced.

A sheet of smooth and plain paper having been partially excited by being floated for a short time upon a three-grain solution of nitrate of silver was, after being dried, washed over with a mixture of ferric oxalate and chloro-platinite of potassium, which, having been poured upon the surface, was distributed by means of a pad of cotton wool. The paper, sensitized in this manner was afterwards dried and exposed to light, in the printing-frame, the exposure given being only one-sixth of that which would have been required to produce an image upon silvered albumenized paper. When withdrawn from the pressure-frame the paper was immersed for a few seconds in a solution of potassic oxalate, followed by similar treatment—first, in a weak bath of solution of oxalic acid, then in a sulphocyanide of gold toning bath, and, lastly, in hyposulphite of soda followed by water.

In the improved method of carrying platinotype printing into effect the preliminary wash of nitrate of silver has been entirely dispensed with. There were two reasons for its adoption:—One was that through the agency of the subsequent toning bath a warm tint might pervade the finished picture. Another was that when it was made use of the image was found to be more thoroughly attached to the paper—sunk, as it were, in its meshes—than was the case when no such argentic treatment was had recourse to. Why it exerted such an influence upon the deposition of the platinum was never very well understood. Nevertheless the fact remained as has been stated. The withdrawal of the silver as an element in the preparation of the paper was of course attended by the simultaneous withdrawal of the sulphocyanide of gold toning bath, and also that of the hyposulphite of soda, neither of which existed save as adjuncts to the primary employment of the silver. The chemistry of the silver, the toning, and the fixing may, therefore, be expressed as follows:—The platinum image (of the formation of which we have not yet spoken) was of a black color; conventionalism demanded that all photographs be warm; a little silver, followed by warm toning, gave a sop to conventionalism; and hyposulphite of soda was the fitting

* This term is employed until the true atomic weights have been accurately determined.

wind up to the employment of the silver. But all this has been changed.

We shall now describe the process as we saw it carried out on the occasion of a visit we paid last week to the laboratory and *ateliers* of Mr. Willis.

A sheet of plain paper—plain in the sense of its having neither been albumenized, silvered, nor salted in any way—was laid down upon a large slab of glass, which was placed in a horizontal position. By convenient clips the paper was secured at the corners. The windows of the room, we may premise, were fitted with yellow blinds. A small quantity of a sensitizing fluid was poured upon the center of the paper and spread over its surface. The sensitizing fluid was composed of—

Ferric oxalate.....	60 grains.
Potassic chloro-platinite.....	15 "
Plumbic chloride.....	2 "
Water.....	1 ounce.

Why the lead salt in the above formula has been imported into the process we are not absolutely certain, unless it be that it helps to give the image, produced at a subsequent stage, a stronger hold of the paper than would be the case were it omitted. At any rate it seems to fill the place of the now discarded nitrate of silver in an effective manner. This solution is spread over the surface of the paper by means of a flannel squeegee, formed by bending the fabric over a piece of India-rubber tubing placed upon the edge of a slip of plate glass. The paper is now hung up to dry, and as soon as all surface moisture has disappeared the drying is finished before a stove or fire. The paper is now ready for exposure under a negative; it may either be used immediately or it may be kept until it is convenient to expose it, for it possesses excellent keeping properties. Prints have been obtained a month after the preparation of the paper, the quality of these being such as to indicate no difference whatever between them and prints upon paper freshly prepared. This is a valuable feature, and one which photographers will not be slow in appreciating.

The exposure under the negative is about one-third of that required in the case of albumenized silvered paper; in other words, it possesses three times more sensitiveness than ordinary albumenized paper. Although a *visible* image is provided by the action of light, it is found that the duration of exposure is more easily determined by an actinometer than by the inspection of the image. It may be recollected that in the account we gave of the original process three years ago we stated the sensitiveness to be five times greater

than that of albumenized silvered paper. This was the case, but the increased sensitiveness was owing to the presence of silver on the paper, and as this material is not now used the diminution of the sensitiveness is thus accounted for. However, as we have seen, it is still much more sensitive than ordinary silvered paper.

While the paper keeps well previous to being printed upon, it also keeps for a considerable period afterwards, or previous to development. The time of the operator may, therefore, be wholly bestowed during the day upon the printing, reserving the development till the light has diminished to too great a degree to enable the printing to be continued.

To develop the image a bath must have been prepared in the following proportions:—

Potassic oxalate.....	120 grains.
Potassic chloro-platinite.....	7 "
Water.....	1 ounce.

This solution is placed in an enameled iron dish, and strongly heated by means of a Bunsen gas burner placed underneath. Previous to immersing a print in this solution let us inquire what change has taken place in the paper by the exposure to light, so as to ascertain the functions of the developing solution.

The paper, it will be remembered, was coated with a solution of ferric oxalate combined with a solution of potassic chloro-platinite. Now, the former exerts no action whatever upon the latter; but upon being exposed to light it is converted into ferrous oxalate, which is a reducing agent for platinum. When, after exposure to light in the printing-frame, the picture is examined it is feebly though distinctly visible, although up to this stage the platinum has not taken any part in the performance. The visible picture is composed of ferrous oxalate, and it would have been equally visible had no platinum been present.

We have now to consider in what manner the ferrous oxalate which has been formed by the light is made to act as a reducing agent for the platinum. Before it can do so it must first be in solution, as no chemical action takes place between two bodies unless one of them be in a liquid form. So far as we know there is only one solvent for ferrous oxalate, namely, potassic oxalate; hence the print is drawn over or brought into contact with a solution of this salt, the result being an instantaneous reduction of the platinum with which the ferrous oxalate was in immediate contact. Up to the instant when the potassic oxalate is applied the atoms of the two agents are side by side in the paper, the ferrous oxalate being held in check, so that is incapable of reducing the platinum, until it is itself first acted upon by a solvent. No sooner, therefore, is the print placed in contact with such a solvent—in this case potassic oxalate—than the solution, simultaneous with its formation, attacks and reduces the platinum salts with which it formerly reposed harmlessly. The image is thus formed of metallic platinum—or "platin black," as we have sometimes heard it designated—which is well known to be one of the most stable substances in nature.

As far as the image is concerned the print is now finished; but in order to get rid of the salts in the paper it is washed for about five minutes in a bath containing a very small quantity of oxalate acid and a few drops of nitric acid. Subsequent immersion in about three changes of plain water, taking altogether about half an hour, completes the operation.

Prints produced by the process described are exceedingly durable. They have been subjected to several tests, which, if applied to silver prints, would have proved destructive.