until the heat inside is reduced by means of water. And when a hole has to be broken to let in the hose, the smaller it is made the better.—*American Engineer.*

WHAT IS STEEL ?

Steel has been defined as any kind of iron which, when heated to redness and suddenly plunged into cold water, becomes hard ; and every kind of malleable or flexible iron that can be hardened by that process is steel. But this definition, says "An Occasional Contributor" in the *Mechanical News*, is not applicable to the steel of mild quality now made for many mechanical uses. One of the requisites for this mild steel is that it will not harden after being heated to a cherry red and plunged into water. To include all the kinds of steel now used in the agricultural and mechanical, the better definition of steel will be a malleable iron combined with a percentage of carbon. Chemically considered, steel occupies a half way position between wrought and cast iron ; wrought iron being simply iron almost entirely free from carbon, while steel that is to be tempered contains from 1 to 1½ percent of carbon.

The reason why this very slight change in the chemical construction should produce such wonderful results in the properties of iron and steel, is as yet an unsolved mystery. We know that a bar of iron converted into steel becomes more granular or open, and while it loses to some extent its toughness, it gains, instead elasticity, greater strength and closeness of fibre.

Blister steel is made by heating bars of iron packed in charcoal, in a furnace, for a period of from 6 to 10 days. When the metal is withdrawn, the bars are found to be of a crystalline texture, and have a blistered surface—hence the name. Cast steel was formerly made of blister steel broken into fragments, melted in crucibles and cast into ingots ; but the modern practice is to charge the crucibles with pieces of good Swedish or American bar iron, adding charcoal and black oxide of manganese. The heat of the furnace soon seals the lid of the crucible, and the melting iron absorbs carbon from the fumes of the charcoal, thus shortening the tedious process of making "blister" bar. The cast steel is rolled or hammered from the ingot to any desired bar, sheet or plate.

The chief characteristic of steel consists in its capability of being hardened and tempered, and when exposed to heat it takes on in succession the following colours :

1. A faint yellow, which indicates a proper temper for lancets or small cutters that require the finest edge, with but little strength of metal.
2. A pale yellow, which indicates the temper for razors and surgical instruments.
3. Full yellow for penknives, etc., with increased toughness.
4. Brown, with purple spots—that being for axes and carpenters' tools.
5. Bright blue, for swords and watchsprings.
6. Full blue, for fine saws, daggers, etc.
7. Dark blue, for large saws or instruments that may be sharpened with a file.

The above colours are based on steel suitable for the requirements. A piece of steel suitable for razors, lancets, etc., would not take the colour indicated for large saws, as that quality of steel is but little above the "blister" quality. The finer steel is, the less heat it will temper at, requiring a lower temper of colour. Recently there have been some valuable discoveries in tempering, welding and restoring steel, both from burnt or a low grade.

COPYING INK WITHOUT PRESS, BLACK.

Nigrosine, C. P. fine	10 ounces
Glucose "A"	1½ "
Hot water	1¾ "
Glycerine	1½ "

Dissolve the nigrosine by trituration in the hot water and then add the other ingredients and strain through a piece of silk. If too thick when cold, dilute to the proper consistence with water.—*Ex.*

HOW TO DRILL GLASS.

Glass can be drilled with a common drill, but the safest method is to use a common broach drill. No spear pointed drill can be tempered hard enough not to break. The broach can be either used as a drill with a bow or by the hand. It should be selected of such a bore that it will make a hole of the required size, at about one inch from the end. It should be broken off sharp with a pair of pliers, at about an inch and a half, and when the sharp edges are blunted by drilling, a fresh end should be made by breaking off an eighth of an inch, and so on, until the hole is bored. It is always desirable to drill from both sides, as it prevents the glass from breaking. Drill lightly and lubricate with spirits of turpentine and oil of lavender. Holes may be drilled through plate glass with a flat ended copper drill and coarse emery and water. The end of the drill will gradually wear round, when it must be re-flattened, or it will not hold the emery. The best means of drilling holes in glass is by using a splinter of a diamond. A brass drill is made to fit the drill stock, sawn down a little way with a notched knife to allow the splinter to fit tight, and the splinter fixed in the split wire with hot shellac or sealing wax. The drill is to be used quite dry and with care. If the hole to be drilled is wanted larger than the tool, drill a number of small holes close together to form a circle as large as the hole required ; then join the holes with a small file.—*Ex.*

ARTIFICIAL IVORY.

Attempts have been made to produce a good artificial substitute for ivory. Hitherto none have been successful. A patent has recently been taken out for a process based upon the employment of those materials, of which natural ivory is composed, consisting, as it does, of tribasic phosphate of lime, calcium carbonate, magnesia, alumina, gelatine, and albumen. By this process, quicklime is first treated with sufficient water to convert it into the hydrate, but before it has become completely hydrated, or "slaked," an aqueous solution of phosphoric acid is poured onto it ; and while stirring the mixture the calcium carbonate, magnesia, and alumina are incorporated in small quantities at a time, and lastly the gelatine and albumen dissolved in water are added. The point to aim at is to obtain a compost sufficiently plastic and as intimately mixed as possible. It is then set aside to allow the phosphoric acid to complete its action upon the chalk. The following day the mixture, while still plastic, is pressed into the desired form in moulds, and dried in a current of air at a temperature of about 150 deg. C. To complete the preparation of the artificial product by this process, it is kept for three or four weeks, during which time it becomes perfectly hard. The following are the proportions for the mixture, which can be colored by the addition of suitable substance : Quicklime, 100 parts ; water, 300 parts ; phosphoric acid solution—1·05 sp. gr., 75 parts ; calcium carbonate, 16 parts ; magnesia, 1 to 2 parts ; alumina precipitated, 5 parts ; gelatine, 15 parts.—*Ex.*