good, should never exceed that of a low red heat; for if the water is dead cold, and the steel a little too hot, there is as much risk of its breaking as there is in pouring boiling water into a glass bottle; for dead cold water acting so suddenly on the outside of the steel, the expansion of the middle is more than the outside can bear, and causes the steel to break; therefore, to avoid such risk, get a quantity of lighted charcoal, or a bar of ignited iron, and put it in the water, just sufficient to take the chill off. In dipping any article in the water, if there is a stout part and a thin part, always let the stoutest part go into the water first, and as near the centre of the water as possible, so that there may be an equal pressure of water sur-Putting the stoutest part in the rounding it. water foremost causes the article to cool more equally, whereas if the thin part be put in the water foremost it is cold first, and the stout part having to contract after the thin part is cold, the thin part cannot give, consequently it has to break. But this cannot always be done, as there are no means of getting the stoutest part of some articles in the water foremost; for instance, such an article as a feather edge milling cutter, and many other things which have their stoutest part in the centre—these must be put in perpendicularly by putting a piece of strong wire through the hole in the centre, and putting it gently into the water; and instead of moving it backwards and forwards in the water, lift it up and down, so that fresh water may pass through the centre every time it is lifted up and down, and the deeper the tank the better. But in lifting it up it must not be allowed to come above the water, or it will be sure to crack; the outside edges of such articles being much thinner than the middle they are cold sooner, so that the middle is wanted cold as quickly as possible after the outside edges; and were it drawn backwards and forwards in the water, the water being warm in the hole in the centre, it would be longer in cooling.

"I speak from experience that the shape of different articles has to be studied; for instance, take such an article as an eccentric collar, which shall be 14 inch thick on one side, and 4 of an inch on the other, having a 2-inch hole in it for the shaft; in hardening this it is most certain to break in the weak side, for one side being so thin, it is cold almost instantly, and the stout side contracting after the other is cold, it pulls it asunder. By taking a little trouble all this risk is avoided. Before such an article as the above be put in the fire, fit a piece of iron round the thin part, so that it is made up to the thickness of the stout part, or a little thicker, and bind it on with a piece of binding wire, and coat it with potash, and I will guarantee that it hardens without breaking, be-cause one part then is cold as soon as the other. There are various things that steel can be coated with, such as soft soap, black lead, or plumbers' size; but in hardening in a common fire, or a furnace, the prussiate of potash is the best. In bardening in lead, soft soap, black lead, or plumbers' size answers exceedingly well. In coating of steel, you first get the article just red, draw it from the fire, having the potash already powdered up fine, and in a box with small holes in the lid; similar to a grater; shake the box till there is a

coat all over the articles, put it in the fire again till it gets to the desired heat, and it is then ready to put into the water, except in very large articles, where there is a great body of steel. It is requisite then to draw it from the fire a second time, and give it another sprinkle of potash, so as to give it a thicker coat. By binding a little binding wire about it, it assists to make the potash cling more firmly to it. There are many things that require to be hardened, where the substance of the steel is so great that it is necessary to bore holes about it in different places to make it cool more equally. In very large cutters, some are apt to have the hole where the spindle passes through too small, so that large and small cutters may fit the same spindle; but the larger the cutter the larger the hole should be; or otherwise bore a few holes round the middle hole, so that the substance of the steel is reduced, or it may be reduced by turning it thinner, so as to form a boss each side, thus greatly reducing the risk of its breaking in hardening. But if it happen that any article that has to be hardened has any holes about it near to the very edge, it is then necessary to stop these holes up with a piece of loom, and it will prevent the hole breaking out. Any size cutters, bushes, gauges, rings, or collars, or articles of any description may be hardened without breaking by following the rules I here lay down. Sometimes a steel ring or a cutter is required to have one thin edge; these must not be put in the water too suddenly. In very large round steel it is sometimes necessary to bore a hole through the centre to allow the water to pass through, and even then it will break asunder if it be drawn backwards and forwards in the tank; this should always be lifted up and down in the water to allow fresh water to pass through the hole, unless when it is under the water; if it be turned on to its side, it can then be drawn backwards and forwards with the same result. It sometimes happens that there is a fracture in the steel before it is hardened, this can be detected when the article is in the fire, and at a low heat. This fracture is sometimes found in the steel as it comes from the manufacturer, but is very often caused in the forging by excessive heating, and oftentimes the bardener gets blamed for faults which belong to other men. If there is a crack in the steel when it is just red, it can be detected, but hardening will not mend it. It may be useful to some to know that if a piece of binding wire be bound round any article, and a piece of loom wrapped round the wire, the wire merely to keep the loom from falling off, and the article, atter drying the loom, may be put in the fire and heated all over, and when sufficiently hot may be put into the water, and the part that has the loom round it will remain soft, because the water cannot penetrate through the loom quick enough to harden the steel. If the loom be on the middle, the ends only will be bard; but if the loom be on the ends, the middle will be hard, and the ends soft, and the mechanic will find this plan very useful in many cases. The less frequently the water used for the purpose is changed, the better it is for the hardening of steel; therefore, as it wastes, fresh water should be added, and as it is necessary to clean the tank out occasionally, it would be well before using fresh water, to make it hot by putting a bar of ignited iron into it, and