the polisher's and carver's arts to use them for such a purpose.

(6) The objects made should be such as to require as little wood as possible. Some models require much wood, but if the same exercises can be furnished by smaller objects equally useful, then these should be preferred. The value of the object must be in the child's work, and not in the amount of material used. This recommendation has a further value, inasmuch as it teaches the child to use small means in effecting ends. Children should be trained to be economical by taking care of those pieces of wood for smaller objects which they have spoiled in making larger ones.

(7) The children should be taught to work in harder and softer kinds of wood—but not in the hardest or the softest (8) Turnery and carving should be used very little. (9) Objects chosen should be such as will develop the sense of form (10) All the exercises (embraced by the particular kind of Sloyd in question) which the child is capable of making, should be properly graduated and included in the series in due proportions.

(1) The series should proceed from the easier to the more difficult, and from the simpler to the more complex; which expressions, as we have seen, are not identical in meaning. (2) A refreshing variety must be afforded. (3) In the early part of the series, the models should be capable of being quickly and easily made, and should be so progressively arranged that, later on, the objects arrived at should require more time and skill, and yet be capable of being done without help. Children expect to have results as quickly as possible. They have not sufficient patience and foresight to derive any benefit or satisfaction from results which are expected to crown their labors in a few days or months. For this reason the objects further on in the series should take more time, in order to cultivate patience and foresight. (4) In the production of the early models, few tools should be required, but as the series progress, new tools and manipulations should be introduced. (5) That every model should be so placed in the series, that the necessary qualifications for doing it exactly are found in the child, who therefore does not need the help of the teacher. It should not relatively be more difficult for a child to do one model than another. A model may be more complex, but this does not imply an increase of difficulty; for the child—when it reaches it—has acquired greater skill. A person who has used one tool will use a second better, although it be of another kind; he will use a centre bit better for having previously worked with a knife (0) The models must be so arranged that the pupils can always make not only a serviceable, but an exact copy. The degree of exactness is a very important feature. It is easy to make a table if exactness be not required. (7) That the knife—as the fundamental tool—be used frequently especially at the beginning By the fundamental tool, we understand that tool with which the *child is most acquainted and can most easily use*, hence we begin with it; secondly, that tool which cultivates the greatest amount of manual dexterity; and thirdly, the tool which in after life will be most useful to the child, and most ready to hand. These advantages the Sloyd knife possesses. We must not be understood to imply that this tool is the one most used throughout the series of models. (8) That generally in the early models the softest wood should not be used. It is more difficult to use a knife on a very soft wood than on a wood not so soft; so that it is advisable to avoid using the softest kinds of pine and fir.

THE PRACTICAL MAN.

IRON AND STEEL.

The following is from Fowler's Mechanical Engineer's Pocket Book for 1900, which contains some five hundred pages of valuable information:

1. Pig Iron.—Impure iron containing over 1.5 per cent. of carbon, and large quantities of other impurities always made in the blast furnace. Used for castings, and as the raw material for the production of malleable iron and steel.

2. Malleable or Wrought Iron.—Nearly pure iron. Has not been fused since the removal of the foreign constituents, *but has been prepared by the welding together of small masses* of spongy iron. It always contains particles of slag and oxide, the elongation of which during rolling produces the fibre. Commercial malleable iron is always made by puddling.

3. Steel.—This includes all varieties of iron containing less than 1.5 of carbon except malleable iron. It may have been fused as in crucible cast steel and mild steel, or it may have been prepared in the solid condition, as in blister steel and puddled steel; the latter is rarely if ever made now. When the steel contains less than .5 per cent. of carbon it is called mild steel, when more, hard steel. Hard steels harden when they are heated to redness and quenched in water.

PIG IRON—CONSTITUENTS AND IMPURITIES.

Pig iron is very impure, containing carbon, silicon, phosphor, sulphur and smaller quantities of other impurities. The carbon and silicon may be considered as being essential constituents. It is always smelted in the blast furnace. The iron ore, which contains oxide of iron and silica, and other earthy impurities, is charged into the furnace with coke and limestone, and air being blown in the coke burns, and a very high temperature is produced. The iron is reduced, and, combining with carbon and other substances present, forms pig iron. As various reducible constituents are always present in the materials, the iron always contains impurities. Carbon is the essential constituent in pig iron, the smallest quantity which will entitle the iron to be called pig iron is 1.5 per cent., and the largest amount the iron can take up—except in presence of large quantities of certain foreign elements—is 4½ per cent. *The carbon is present in two forms, (1) in a state of chemical* combination, (2) as intermixed flakes of graphite. The graphite has very little effect on the iron, except that it breaks the continuity, and thus weakens the metal. The combined carbon is one of the most important constituents. Its influence is to harden the metal, and, within limits to increase its tensile strength. It may vary in amount from about .08 in a soft No. 1 iron to 1½ or more in a white iron. The graphite is the carbon which is not combined. Silicon.—This constituent is always present in pig iron. Its action resembles that of carbon in many ways, and there seems to be no limit to the amount that can be taken up. Silicon has within limits a good effect on the iron, but when in large quantities makes it hard and brittle. Turner gives the amount of silicon which is best as being:

For maximum hardness, under	.8
For maximum crushing strength, about	.8
For maximum modulus of elasticity, about	1.0
For maximum density in mass, about	1.0
For maximum tensile strength, about	1.8
For maximum softness and working qualities, about	2.5
For lowest combined carbon, under	5.

Silicon has two actions, (1) a direct hardening action similar to that of carbon, only much less energetic, and (2) a tendency to throw the carbon out of the combined, and into the graphite condition, the second action being usually the more important. Thus when an iron contains, say 2.5 per cent. of silicon, this will harden the iron to some extent, but it throws the carbon almost entirely into the graphitic condition, and thus prevents the much greater hardening influence which the carbon would have if combined. Grey pig iron is usually high in silicon, whilst white is low. The amount of silicon depends largely on the temperature at which the iron is made, the higher the temperature the more silicon is reduced, so that modern hot blast irons are higher in silicon than those made years ago, when the air was sent in at a lower temperature. Sulphur is rarely present except in small quantities. It has a powerful hardening effect, tending to throw its carbon into the combined condition. It thus counteracts the action of the silicon, and the lower the silicon the more injurious is a small percentage of sulphur. Phosphorus is always present, the quantity varying from a mere trace up to three or four per cent. Phosphorus increases the fluidity of the metal, makes it run well, and set slowly; in large quantities it makes the iron hard and brittle. Manganese.—This element is almost invariably present. Like silicon it has a direct hardening action, and an indirect softening action, the latter being due to a strong tendency to eliminate sulphur. Aluminum tends to throw its carbon into the graphitic form more energetically than silicon. It also improves the *soundness of castings. Hematite or Bessemer Pig.—This iron* is made from hematite or other pure ores. It must not contain more than about .05 per cent. of phosphorus, and .01 per cent. of sulphur, and is usually high in silicon. It is used for