cent. manganese alloyed with steel. Manganese produces a material that is hard, tough, strong, and non-magnetic, and gives varying results according to the percentage. If 1 to 3 per cent. manganese be present the steel is brittle and unworkable, and up to 7.5 per cent. the steel may be likened to glass for brittleness, and beyond 7.5 per cent. the extreme hardness begins to disappear, but all manganese alloys possess extraordinary qualities of hardness combined with toughness, such as do not occur in the case of any other alloy. Manganese steels are so hard that they cannot be machined, but may be forged into various shapes as easily as very mild steel, and the ordinary process of quenching in water toughens but does not harden manganese steel. Sudden quenching at a high heat will improve the tensile strength and elongation.

Tungsten is chiefly prepared from wolframore, and the metal readily alloys with iron to form ferro-tungsten. When alloyed with carbon steels tungsten plays an important part in helping to confer great hardness upon the steel, but in the absence of carbon, the presence of tungsten will have very small influence on the physical properties of the steel. Further, whilst tungsten has practically no appreciable effect on the magnetic properties in low carbon steels, it is of great value in high carbon steel, since by its coercive-power with regard to magnetism it greatly increases the power of the steel to retain the magnetism, consequently tungsten is an important metal in connection with special magnet steels, and a high percentage will improve the magnetic properties of the steel very considerably. The composition of the steel used for permanent magnets is somewhat similar to a special tool-steel, but as a magnet steel is not required for cutting purposes, its composition is arranged so as to make most effective its properties of retaining magnetism.

The addition of tungsten will impart a fine-grained structure to a carbon steel, and the fracture of a tool steel containing about 1.3 per cent. carbon and 3 per cent. tungsten may be likened to a mole's back, so fine and velvety is the grain.

Self-hardening steels are alloys of iron, carbon, tungsten, and manganese, and in some instances chromium and other metals are added to bring about certain improvements in the qualities of the steel. These steels are called self-hardening, because if they are heated to a temperature of about 1,200 deg. C. (nearly a welding heat) and allowed to cool in the air, they become very hard.

The hardening and tempering of a piece of steel is an operation which, to the casual observer, may appear a very simple one, but it is undoubtedly one of the most delicate operations in connection with mechanical art.

The quantity and variety of tools and other steel articles that are handled in the Midlands, are so numerous that it is hardly possible to give a detailed description of the rules and methods for forging, hardening and tempering that can be applicable to the whole.

There are certain fundamental laws and principles relating to these matters, and if these are duly and properly observed, and correct methods adopted, they will invariably lead to satisfactory results. In my book, "Machines and Tools Employed in the Working of Sheet Metals," which was published in 1903, I mentioned how necessary it is to exercise special care in heating a tool to the required temperature before plunging it into the cooling bath for quenching, the principal points of importance to remember being gradual and uniform heating, and the quenching to be done in a plentiful supply of fresh clean water and brine, or rain water and brine.

A steel high in carbon will harden at a low heat as compared to the temperature necessary for a steel containing a low percentage of carbon, which fact makes it essential for the workman to have some knowledge as to the carbon content of the steel he is handling; also, he should at least have an approximate idea as to the correct temperature to which the steel had best be heated. What an important item the latter is—will be seen when we come to consider the actual application of the recalescence curve for fixing the correct hardening temperature.

At all stages in its manipulation, steel should be thoroughly and uniformly heated; that is, in the forge and rolling mill, in the smith's shop, as well as in the hardening and tempering shop, for if a piece of steel is hotter in one part than another, the expansion is necessarily variable, consequently contraction in hardening will also vary, there being higher tension in one part than another, resulting in either a warped or cracked tool.

In the forge, irregular heating means irregularity in forging, consequently inequality of tension in the article when in the rough forged state. But a reasonable amount of care on the part of a blacksmith will prevent trouble from this cause.

The difficulties of uniformly heating a piece of steel in an ordinary blacksmith's fire, or in a coal-fired furnace, are far too well known to need much comment from me. In the case of the coal-fired muffle, by exercising a certain amount of care, by occasionally turning round the steel, and by using a pyrometer in the muffle, it is possible to partly overcome the difficulties, but at all times experience and good judgment is necessary. Probably the next best way to ensure a regular heating is to use a gas-fired muffle or furnace, which can be readily arranged to maintain an even and correct temperature by adjusting the gas supply, and in this way considerably reduce the risk of burning the steel; and should a workman be unable to remove a tool immediately it is ready for quenching, the application of a pyrometer will guide him and so prevent disaster. An incidental advantage of the gas-fired furnace is the increased cleanliness, due to the freedom from smoke and dust, which are inseparable where the ordinary blacksmith's fire or coal-fired muffles are employed.

The International Marine Signal Company, Limited, of Ottawa, have closed their shop, and it is rumored in Ottawa that the company has been purchased by Mackenzie, Mann & Company. When a representative of *The Canadian Engineer* called at the company's office in Ottawa last Friday, an official of the company would neither confirm nor deny this rumor, but stated that Mr. Thomas L. Willson, the former president of the company, has resigned from the Board of Directors, and that Mr. Lewis Lukes, of Mackenzie, Mann & Company, Toronto, had been elected president of a new Board of Directors, which would have their headquarters at Toronto. When interviewed this week at Toronto, Mr. Lukes stated that he was not yet in a position to discuss the matter, and that he would be unable to give out a statement for a few days as to just how the affairs of the company would be arranged for the future.