# Appendix A

## Definitions: Types of Iron and Steel

The following definitions are used throughout the *Hand Tools in History* publication series. See *Handbook for Ironmongers: A Glossary of Ferrous Metallurgy Terms* for a more detailed description of the diversity of definitions of iron and steel.

Wrought iron: 0.0 – 0.08% carbon content plus slag inclusions

Malleable iron (modern definition): 0.08 – 0.2% carbon content plus slag inclusions

Malleable iron (pre-1870 definition): 0.08 – 0.5 carbon content

Natural steel (early Iron Age to 1900): 0.2% carbon content or greater

German steel (1400 to 1900): 0.2% carbon content or greater

Low carbon steel (post-1870 definition): 0.2 – 0.5% carbon content, no slag inclusions

Tool steel: 0.5 – 1.3% (– 2.0%) carbon content

Cast iron: 2.0 – 4.5% carbon content

There is a wide variation in antiquarian and modern definitions of iron and steel. Before the era of modern bulk process steel, “malleable iron” included what would now be called low carbon steel and can also mean any iron with a carbon content up to 0.5%, which is the hardening and quenching threshold for steel. Malleable iron contained varying amounts of siliceous slag; more slag was present in direct process bloomery derived iron, less in indirect process (blast furnace) derived puddled iron. In the modern era, the definition of low carbon steel is so broad as to range from 0.08 to 0.5% carbon content.

There is also a gray area between steel with a carbon content above 1.5% and cast iron at 2.2%; few, if any, tools have higher carbon content than 1.5%, and most cast iron and malleable cast iron products have a carbon content above 2.2%. The *Encyclopedia Britannica* defines steel as having less than 2.2% carbon content; other sources, such as Gordon (1996), define the limit at 2% carbon content. This text follows the latter definition.

Modern writers often call all iron that is not steel “wrought iron.” This is misleading; there is a great difference in the hardness and durability of tools made of malleable iron with a 0.3 or 0.4% carbon content and tools made of wrought iron with 1/10$^{th}$ as much carbon content. The latter artifacts would be much more susceptible to plastic deformation; in both cases, slag inclusions increased tensile strength and added qualities of ductility completely lacking in slag-free modern low carbon steel. Both wrought and malleable iron ceased to be produced in any significant quantities after 1930 as a result of the demise of the puddling furnace. Low carbon “steel” became the dominant form of iron produced after the advent of the Bessemer and open hearth bulk steel production processes after 1870.