Ductile cast iron has been an important engineering material in the past 50 years. In that time, it has evolved from a complicated material that required the foundry metallurgist's highest skill and strict process control to being a commonly used material that can easily be produced with modern process technology. Yet, for the skilled metallurgist and foundry engineer, it is a material that can be engineered to meet extreme demands with regard to mechanical properties and geometrical complexity. It is therefore a material that has been in growing use since its discovery. And the results of the latest years of research indicate that ductile cast iron in the future will become a highly engineered material in which strict control of a range of alloy elements combined with intelligent design and highly advanced processing allows us to target properties to specific applications to a much higher degree than we have seen previously. It is the aim of the present paper to present ductile iron as a modern engineering material and present the many different possibilities that the material hides. Focus will be on the latest research in solidification and melt treatment. But for completeness and to illustrate how ductile iron's properties are optimised, the essentials of heat treatment are described too. It is the hope that researchers will find a comprehensive treatment of ductile cast iron metallurgy and that engineers and designers will be presented with the latest information on, and references to, the properties and possibilities in ductile cast iron. © 2010 Maney Publishing.