The study of meteorites is important for a number of reasons but three aspects are of particular significance. On the one hand they represent, along with lunar samples, the only extraterrestrial material available for detailed laboratory study. As such they provide an important window on the chemistry of the solar system, beyond what is directly available on the Earth, and they give an indication of the variability of that chemistry between individual components of the solar system. Secondly they represent material which for the most part has been relatively unaffected by geological processes since the formation of the Solar System and hence provide the most direct evidence for events and processes which occurred during and immediately following the birth of the solar system. Finally, as a result of periods of exposure to cosmic rays, solar flare particles, solar wind and micrometeorites prior to arriving on Earth, they, and the lunar samples provide the only long term record of the interplanetary flux of these particles and of their effects.

The summary of meteorite science which follows will begin with a broad factual description of the major features of meteorite chemistry, mineralogy and petrology. This will be followed by a discussion of the relevance of meteorite observations to some of the current ideas of the origin of the solar system, leading into a brief reference to the recent exciting discoveries of isotopic anomalies. For a more detailed chronological discussion the reader is referred to the section on Isotopic Dating of the Solar System.

Meteorites are fragments from small bodies which are in orbits capable of intersecting the orbit of the Earth and are of a size
able to survive entry through the atmosphere. Accurate orbital information is only available for three meteorites, all of which were in highly elliptical orbits extending to the asteroid belt. The mechanisms for placing these objects into Earth crossing orbits, (which have capture lifetimes two orders of magnitude less than the age of the solar system) are still the subject of much theoretical speculation (1), as is the question of whether the parent bodies are asteroids or in some cases the cores of short period extinct comets.

The most obvious distinction between meteorite types is between the so-called stones and irons. However a more fundamental distinction can be made between the undifferentiated and differentiated meteorites. The undifferentiated meteorites, also known as chondrites due to the frequent presence of mm.
sized spherical mineral aggregates called chondrules, are characterized by an essentially solar composition for the involatile elements. They are thought by many to be the most primitive objects because of this. Mineralogically they are composed predominantly of iron magnesium silicates (pyroxene and olivine) and in some cases grains of iron nickel alloy. Variations in mineralogy are reflected in overall chemical composition which forms the basis of classification schemes (2) (3). The major chemical variations consist of 1) variations in oxidation state, 2) variations in the total Fe content, 3) the presence in some of volatiles (water, hydrocarbons and some trace elements) and hydrated minerals, and 4) the presence in some of highly refractory minerals (oxides of Ca, Ti and Al) which occur characteristically as white inclusions. These differences are taken to imply a variety of processes in the early solar system including; fractionation on the basis of volatility, a fractionation of metallic iron relative to silicates, and, the operation of an oxidation/reduction reaction sequence (4).

In addition to these major chemical distinctions the chondrites show petrological differences which have been taken by some to indicate the effects of thermal metamorphism on the parent body (2). The observational evidence includes the effects of recrystallization (larger grain size, chondrules indistinct or absent, absence of glass), variations in the degree of chemical equilibration of minerals (variability or otherwise of mineral composition on a microscopic scale), and the concentration of volatile species such as the noble gases (5).

The differentiated meteorites, which include the irons and a group of stones referred to as achondrites are, for the most part, presumed to be the end product of igneous melting processes on the parent asteroid or asteroids. The processes involved are similar to the processes of partial melting and fractional crystallization which produce igneous rocks on Earth. In this