

Table-1 Electronic structures and oxidation states

Element		Electronic structure	Oxidation states*
Carbon	C	[He] $2s^2 2p^2$	IV
Silicon	Si	[Ne] $3s^2 3p^2$	(II) IV
Germanium	Ge	[Ar] $3d^{10} 4s^2 4p^2$	II IV
Tin	Sn	[Kr] $4d^{10} 5s^2 5p^2$	II IV
Lead	Pb	[Xe] $4f^{14} 5d^{10} 6s^2 6p^2$	II IV

### INTRODUCTION

Carbon is extremely widespread in nature. It is an essential constituent of all living matter, as proteins, carbohydrates and fats. Carbon dioxide is essential in photosynthesis, and is evolved in respiration. Organic chemistry is devoted to the chemistry of carbon-containing compounds. Inorganic compounds produced on a large scale include carbon black, coke, graphite, carbonates, carbon dioxide, carbon monoxide (as a fuel gas), urea, calcium carbide, calcium cyanamide and carbon disulphide. There is great interest in organo-metallic compounds. Carbonyls and  $\pi$  bonding complexes.

The discovery that flint (hydrated  $SiO_2$ ) had a sharp cutting edge was very important in the development of human technology. Nowadays silicon is important in a number of materials produced in high tonnages.

These include cement, ceramics, clays, bricks, glass and the silicone polymers. The very pure element is important in the microelectronics industries (transistors and computer chips).

Germanium is little known, but tin and lead are very well known and have been used as metals since before Biblical times. Lead sheet was used on the floor in the Hanging Gardens of Babylon (one of the wonders of the ancient world) to prevent the water escaping.

#### OCCURRENCE OF THE ELEMENTS

The elements are all well known, apart from germanium. Carbon is the seventeenth, and silicon the second most abundant element by weight in the earth's crust (Table 2). Germanium minerals are very rare. Ge occurs as traces in the ores of other metals and in coal, but it is not well known. Both Si and Ge are important for making semiconductors and transistors. Though the abundances of tin and lead are comparatively low, they occur as concentrated ores which are easy to extract, and both metals have been well known since before Biblical times.

Carbon occurs in large quantities combined with other elements and compounds mainly as coal, crude oil, and carbonates in rocks such as calcite  $\text{CaCO}_3$  and magnesite  $\text{MgCO}_3$  and dolomite  $[\text{MgCO}_3 \cdot \text{CaCO}_3]$

Table 2 Abundance of the elements in the earth's crust by weight

	PPm	Relative abundance
C	180	17
Si	272000	2
Ge	1.5	54
Sn	2.1	49
Pb	13	36

Carbon is also found in the native form: large amounts of graphite are mined, and extremely small quantities (in tonnage terms) of diamonds are mined too. Both  $\text{CO}_2$  and CO are important industrially.