Bonding in Complexes:

Sidgwick made a noble contribution to bring Werner's theory in line with electronic theory of Valency.

According to Sidgwick all the neutral molecule or Anions which are capable of being Co-ordinated to central metal ion have atoms with at least one unshared (lone) Pair of electrons in their Valence Shell.

Sidgwic interpreted Secondary Valency (i.e. non-ionisable valency) of the central metal ion in terms of Electron sharing.

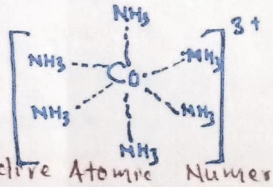
According to Sidgwick Electron Pair Present on an atom in a ligand is donated to central metal ion. In this way ligand get attached to central metal ion & the linkage so formed is called Co-ordinate linkage. or dative or Semi Polar bond. This bond is not very different from a co-valent bond, the difference only lies in the mode of formation. It is represented as M ← L i.e the atom of ion furnishing the electron pair is called donor and the central metal ion is called acceptor.

The Primary Valencies of Werner were regarded as Ionic Valencies this results by transfer of electron from one atom to other.

Hence in Cobalt amine Complex ($Co.6NH_3.Cl_3$)

i.e $[Co(NH_3)_6]^{3+}$ The Cobalt ion (Central ion) accepts 12 electrons from six ammonia molecules (i.e N atom has one lone pair in NH_3) Six lone pairs of electrons are donated to Central ion.

Now Str. of $[Co(NH_3)_6]^{3+}$ is given below.



Sidgwick Concept of Effective Atomic Number:-

Sidgwick Suggested that after the ligand have donated a certain Numbers of electrons to the Central metal ion through bonding. The total Number of electrons on the Central atom, including those gained from ligand in bonding is called Effective Atomic Number. In many Cases the total Number of electrons (i.e E.A.N) Surrounding the Co-ordinated metal ion is equal to the atomic Number of the Inert gas.

Effective Atomic Number = Atomic Number − Oxidation state + 2 Co-ordination N

Example:- [E.A.N.) of Co^{III} in $[Co(NH_3)_6]^{3+}$ can be calculated as follows.

Electrons in Co^{0} atom = Atomic No. of Co = 27 Electrons.

Electrons in Co^{3+} ion = 27 − 3 = 24 Electrons ✓

Electrons donated by Six NH_3 molecules $6(:NH_3) = 2\times6 = 12$ Electrons ✓

E.A.N. of Co (III) in $[Co(NH_3)_6]^{3+}$ complex = 24 + 12 = 36 Electrons

EAN = 36 of Co^{III} evidently equal to the Atomic No. of Kr.

This theory is
Following are

EAN rule as applied to Carbonyls:-

Metal Carbonyls and its derivatives frequently obey EAN. rule.

By using this rule to the metal Carbonyls it is possible to predict whether a given Carbonyl is a monomer.

Examples:- The effective Atomic Number of the Central metal ion in the Compounds ie $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$ $Fe(CO)_4Cl_2$, $Mn(CO)_5Br$, $Co(NO)(CO)_3$ and $Fe(NO)_2(CO)_2$ is 36.

To estimate the E.A.N. in these complexes it has been assumed that CO, Cl^-, Br^- contributes two electrons to the Central Metal ion.

$(CO)_6$ is the only monomeric Carbonyls which does not obey EAN rule.