The increasing use of sulphur compounds in medicine and industry has aroused a great interest in chemical and structural investigations of metal complexes involving sulphur donor ligands. The study of magnetic property is perhaps the simplest yet very potent tool for predicting the stereochemistry, the oxidation state and bond type in the complex compounds. The understanding of the nature of the metal sulphur link is of importance because of the anomalous magnetic behaviour of metal complexes of sulphur containing ligands coupled with their involved spectra. Unfortunately, the present available data is not sufficient to provide any coherent picture of the donor-acceptor relationship between sulphur and transition metals. The proposed work is, therefore, an attempt to seek a correlation between magnetic and other physico-chemical properties of these complexes which may lead semiquantitatively an understanding, in general, of:

(1) the donor property of the sulphur atom,

(ii) the nature of the metal-sulphur link,

(iii) the position of mercaptans in spectrochemical and nephelauxetic series and corresponding series of central metal atoms, and

(iv) the coordination number, stereochemistry and oxidation state of transition metal ions.

The present work embodies the study of metal complexes of Co(II), Ni(II), Cu(II) and Cd(II) with methylenebisthioaceticacid (MBTAA) and methylenebisthiopropionicacid
(MBTPA) and Co(II), Ni(II), Cu(I), Pt(II), Pd(II) and Os(IV) with di-isopropylaminoethanethiolhydrochloride (DIPAET). The structural formulae of these ligands are given below:

(i) Methylenebisthioaceticacid (MBTAA)

\[
\text{H}_2\text{C} \begin{array}{c}
   \text{S} \\
   \text{S}
\end{array} \begin{array}{c}
   \text{CH}_2 \\
   \text{CH}_2
\end{array} \text{COOH}
\]

(ii) Methylenebisthiopropionicacid (MBTPA)

\[
\text{H}_2\text{C} \begin{array}{c}
   \text{S} \\
   \text{S}
\end{array} \begin{array}{c}
   \text{CH}_2 \\
   \text{CH}_2
\end{array} \text{COOH}
\]

(iii) Di-isopropylaminoethanethiol-hydrochloride (DIPAET)

An effort has been made to isolate and characterize the above mentioned metal complexes of MBTAA, MBTPA and DIPAET. The stereochemistry, bond type and oxidation state of central metal atoms of these complexes have been studied by magnetic susceptibility, diffuse reflectance and infrared spectral measurements. The results of these studies could be summarized as follows:
Methylenebisthiopropionic acid, \( \text{CH}_2(\text{S.CH}_2\text{CH}_2\text{COOH})_2 \), forms stable complexes, with Co(II), Ni(II), Cu(II) and Cd(II) of the type \( \text{ML}_x \text{H}_2\text{O} \) (\( M = \text{metal}, L = \text{ligand}, x = 2 \) for Co(II) and Ni(II) and \( x = 0 \) for Cu(II) and Cd(II)). Their structures have been characterized on the basis of elemental analysis, magnetic moment, electronic and infrared spectral studies. The Co(II) and Ni(II) form high-spin octahedral complexes and the Cu(II) forms a distorted octahedral complex. The coordination takes place through both sulphur and carboxylate groups of the ligand. The Cd(II), however, forms tetrahedral complex and is not coordinated through sulphur. Relevant ligand field parameters have been reported for these complexes. The nephelauxetic effect seems to be more effective for Co(II) than Ni(II).

Methylenebisthioacetic acid, \( \text{CH}_2(\text{S.CH}_2\text{COOH})_2 \), forms stable complexes, with Co(II), Ni(II), Cu(II) and Cd(II) of the type \( \text{ML}_x \text{H}_2\text{O} \) (\( M = \text{metal}, L = \text{ligand}, x = 2 \) for Cu(II) and \( x = 0 \) for Co(II), Ni(II) and Cd(II)). Their structures have been characterized on the basis of elemental analysis, magnetic moment, electronic and infrared spectral studies. The Co(II) and Ni(II) complexes are high-spin octahedral, the Cu(II) forms a distorted octahedral complex and the Cd(II) forms a tetrahedral polymeric structure. The coordination takes place through both sulphur and carboxylic oxygen groups. Relevant ligand field parameters have been calculated for these complexes.
Di-isopropylaminoethanethiol-hydrochloride, 
\((C_3H_7)\_2N.CH_2.CH_2.SH.HCl\), forms stable complexes with Co(II), 
Ni(II), Cu(I), Pt(II), Pd(II) and Os(IV). The complex
\(\mathcal{L}_2\text{Co}(C_8H_{18}NS)\_2(\text{H}_2\text{O})\_2 \_2\text{H}_2\text{O} \) is probably octahedral with
magnetic moment of 3.49 B.M. This reduction in magnetic
moment value is due to the presence of both low and high-spin
states in equilibrium, with Ni(II) the complex \(\mathcal{L}_2\text{Ni}_2(C_8H_{18}NS)\_4 \_2\text{H}_2\text{O} \), so formed with magnetic moment of 2.24 B.M., is found
to contain two nickel atoms attached through a sulphur bridge,
one of them being surrounded octahedrally and the other one
remaining in a planar environment. The copper forms a dia-
magnetic and polymeric complex of the type \(\mathcal{L}_n\text{Cu}(C_8H_{18}NS)\_n \) in which the Cu(II) is reduced to Cu(I). The Pt(II) and Pd(II)
form the complexes of the type \(\text{ML}_2 \) (M = metal, L = ligand)
and their magnetic and spectral studies reveal that these
complexes are square-planar and diamagnetic. The Os(IV)
yields a complex \(\mathcal{L}_2\text{Os}(C_8H_{18}NS)\_2(\text{OH})\_2 \), with magnetic moment 
1.20 B.M., is paramagnetic having octahedral stereochemistry.
This anomalous magnetic behaviour of Os(IV) complex may poss-
ibly be attributed to a large spin-orbit coupling occurring in
this case. The infrared spectral studies indicate that coordi-
nation takes place through both nitrogen and sulphur in all
these complexes.

The present studies also reveal the position of
DIPAET in spectrochemical series some where between \(R_2S\) and
NH₃ and the positions of MBTPA and MBTAA near about H₂O. An attempt has also been made to explain the nature of metal sulphur link.