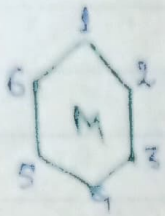
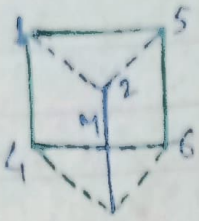
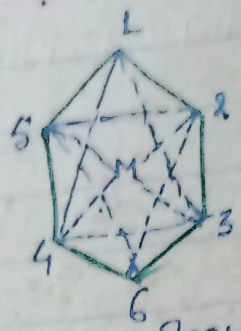
Concerning other possible Geometries (i.e hexagonal Planar and trigonal Prismatic Geometries.) has only historical interest.




Hexagonal Planar Geometry




Trigonal Prismatic Geometry




Regular Octahedral Geometry.

In order to show that other Geometries i.e, hexagonal Planar and trigonal Prismatic are not preferred Geometries for Six Co-ordination Complexes. Werner worked out the theoretical number of Geometrical Isomers that each of these geometries could give for the Complex viz, $ML_6$, $ML_5L'$, $ML_4L'_2$ $ML_4L'$ and then Compared with the Numbers of isomers experimentally Isolated in the following Table.

| Complexes | No. of Geometrical Isomers experimentally Isolated. | No. of Geometrical Isomers predicted theoretically for | | |
|---|---|---|---|---|
| | | Hexagonal Geometry | Trigonal-Prismatic Geometry | Regular Octahedral Geometry. |
| $ML_6$ | 1 | 1 | 1 | 1 |
| $ML_5L'$ | 1 | 1 | 1 | 1 |
| $ML_4L'_2$ | 2 | 3 (1,2) (1,3) (1,4) | 3 (1,2) (1,3) (1,4) | 3 (1,2) (1,6) |
| $ML_3L'_3$ | 2 | 3 (1,2,3) (1,2,4) (1,3,5) | 3 (1,2,3) (1,2,5) (1,2,6) | 2 (1,2,3) (1,2,6) |

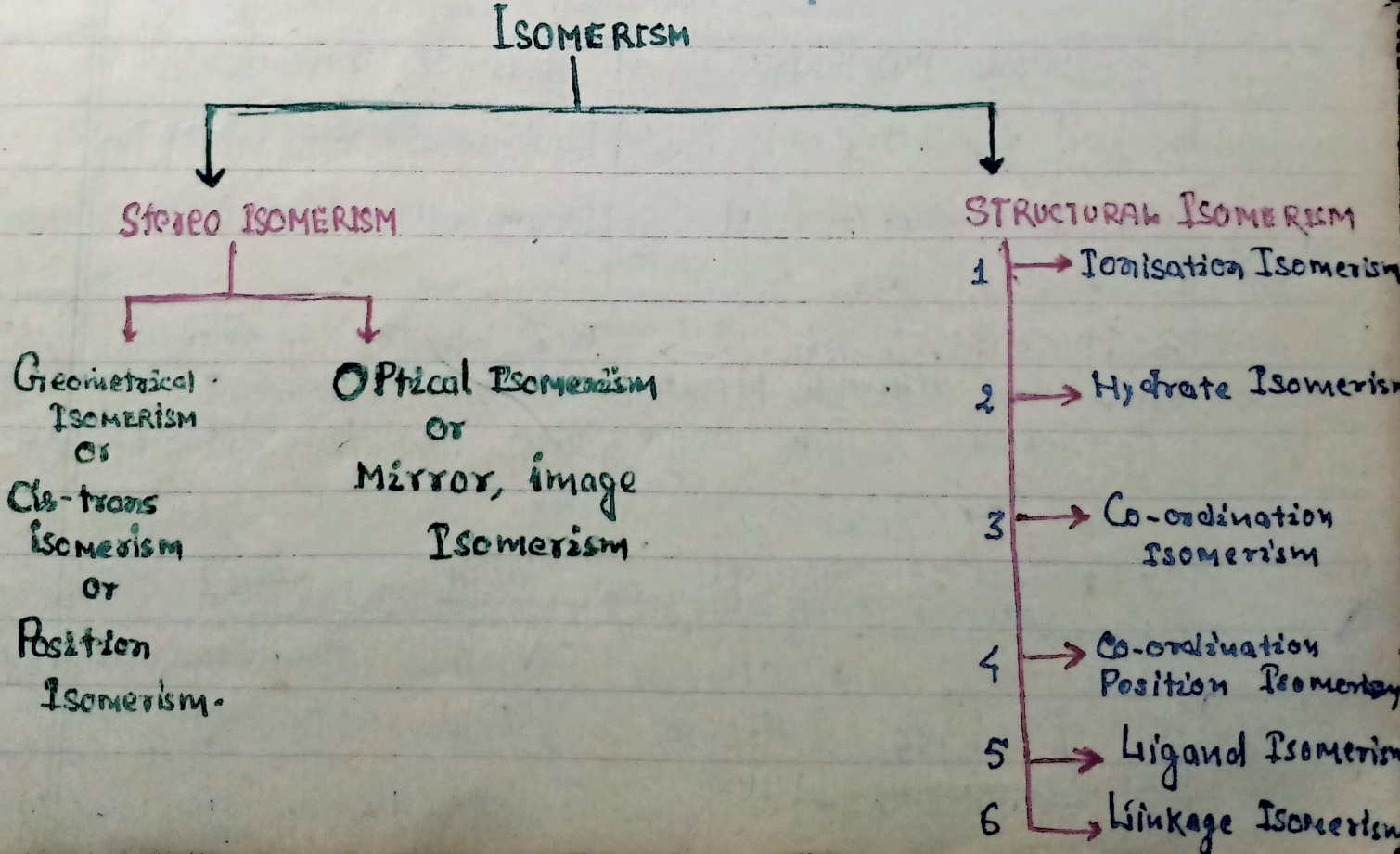
A single form is predicted by each Geometry for the Complexes $ML_6$ and $ML_5L'$. But for the Complexes $ML_4L'_2$ both Hexagonal Planar and trigonal Prismatic Geometries predict three isomers i.e. (1,2) (1,3) and (1,4) but regular octahedral Geometry predicts only two Geometrical isomers namely (1,2) and (1,6). The numbers of isomers isolated experimentally for $ML_4L'_2$ Complexes is also two.

Similarly for $ML_3L'_3$ Complexes the octahedral Geometry predicts two Geometrical isomers and experimently this number is (~~Confirmed~~) Confirmed.

## ISOMERISM IN METAL COMPLEXES:→

The Compounds having a same Chemical Composition but differs in the structural arrangement of their atoms are Called ISOMERS and this Phenomenon is Called Isomerism.

The Skelton of ISOMERISM is Given below.



## Structural Isomerism :→

### 1. Ionisation Isomerism :→

Complexes which have the same empirical formula (i.e stoichiometric composition) but gives different ions in solution on ionisation are called ionisation Isomerism.

for example → (i) $[Co^{III}(NH_3)_5Br]SO_4$

(ii) $[Co^{III}(NH_3)_5SO_4]Br$

The Compound (i) and (ii) has the same molecular formula. but the ionisation of these complexes are not identical.

When Complex (i) is treated with $BaCl_2$ it gives the white ppt of $BaSO_4$, but the Complex (ii) does not give the ppt. of $BaSO_4$.

Similarly the Complex (ii) gives yellow precipitate of $AgBr$ with $AgNO_3$ while Complex(i) does not.

Some other examples of the Ionisation Isomerism is given below.

| IONISATION ISOMERISM | Mode of Ionisation |
|---|---|
| (i) $[Co(NH_3)_4Cl_2]NO_2$ | $[Co(NH_3)_4Cl_2]NO_2 \rightleftharpoons [Co(NH_3)_4Cl_2]^+ + NO_2^-$ |
| (ii) $[Co(NH_3)_4Cl(NO_2)]Cl$ | $[Co(NH_3)_4Cl(NO_2)]Cl \rightleftharpoons [Co(NH_3)_4Cl(NO_2)]^+ + Cl^-$ |

### 2. Hydrate Isomerism :→

This type of Isomerism arises due to different positions of a water molecules in a Complex for example, three Isomers with the formula $CrCl_3 \cdot 6H_2O$ are known

(i) $[Cr(H_2O)_6]Cl_3$ ~~Violet~~

| Compounds of emperical formula $CrCl_3 \cdot 6H_2O$ | Colour | IUPAC Name. |
|---|---|---|
| (i) $[Cr(H_2O)_6]Cl_3$ | Violet | Hexa aquo chromium III Chloride |
| (ii) $[Cr(H_2O)_5Cl]Cl_2(H_2O)$ | Light green | Chloro penta aquo chromium III Chloride |
| (iii) $[Cr(H_2O)_4Cl_2]Cl(2H_2O)$ | Green | Dichloro tetra aquo Chromium III Chloride. |

The violet coloured compound (i) does not lose any water molecule on dehydration over sulphuric acid and all the three $Cl^-$ ions are precipitated by silver nitrate as silver chloride.

The light green compound (ii) loses one molecule of water, on dehydration over sulphuric acid and only two $Cl^-$ ions are precipitated as silver chloride..

The compound (iii), dark green, loses two molecules of water on dehydration over sulphuric and only one $Cl^-$ ion are precipitated as silver chloride. On treatment with $AgNO_3$

An example involving both ionisation and hydrated isomerism is provided by complexes: —

$[Co^{III}(NH_3)_4(H_2O)Cl]Br_2$ and $[Co^{III}(NH_3)_4Br_2]Cl.H_2O$