Boranes: Structure & Bonding

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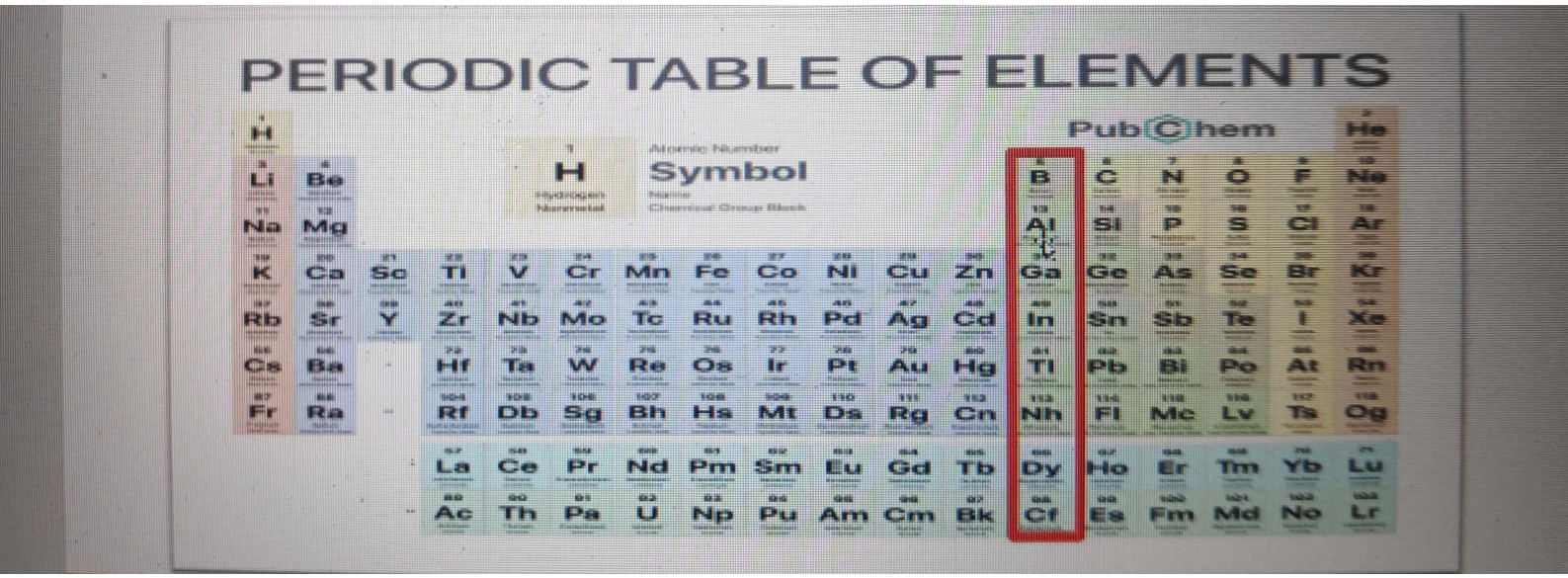
An Introduction to Boranes

- Boranes - **diborane .**
- Electron deficient but in classical sense only.
- Boranes are a class of compounds comprising of several hundreds of compounds ranging from simple to polyhedral to macro polyhedral types having intriguing structures.

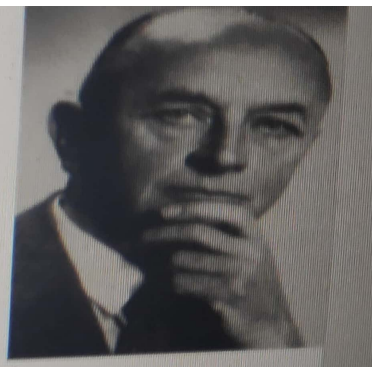


- Boranes are binary compounds of boron and hydrogen and are the fourth most extensive group of hydrides after the Carbon, Phosphorous and Silicon hydrides.
- BH_3 is the simplest of all the boranes but non-existent.
- B_2H_6 is the dimer of BH_3 and is the most primitive among the existing boranes.
- Boranes are not found in the nature. These are always synthesised in the laborator
- Very first synthesis was carried out in 19th century by protolysis of metal borides.

$$2Mg_3B_2 + 12HCl \longrightarrow 6MgCl_2 + \text{mixture of boranes}$$

- But neither correctly analysed nor identified.

- The first systematic study of boranes was performed by Alfred stock during the year 1912-1936.
- He used Schlenk line technique for the synthesis of boranes in a systematic way.
- He studied nature, stoichiometry and reactivity of boranes in a systematic way.

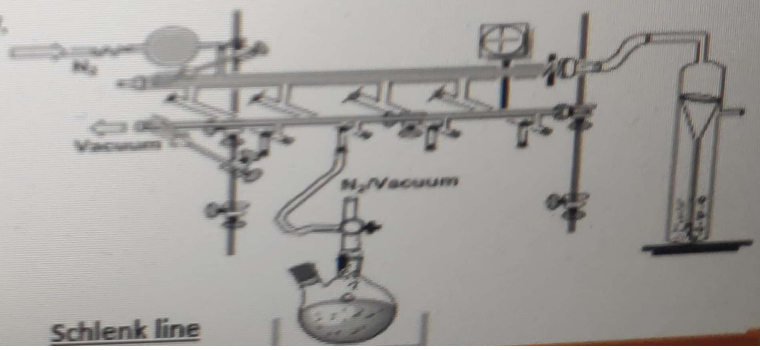


Alfred Stock

$3\ NaBH_4 + 4\ BF_3 \rightarrow 3\ NaBF_4$ + mixture of boranes

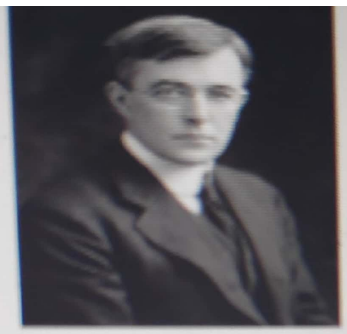
$BCl_3 + 3\ H_2 \rightarrow$ mixture of boranes + 3 HCl

$BH_4^- + BX_3 \rightarrow$ mixture of boranes + HBX^{3-}
(X = Cl, Br)

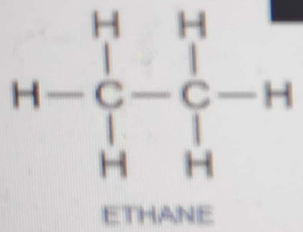


Schlenk line

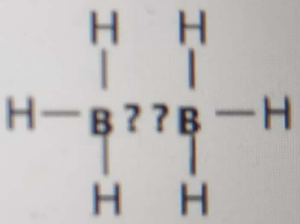
Kossel



Langmuir



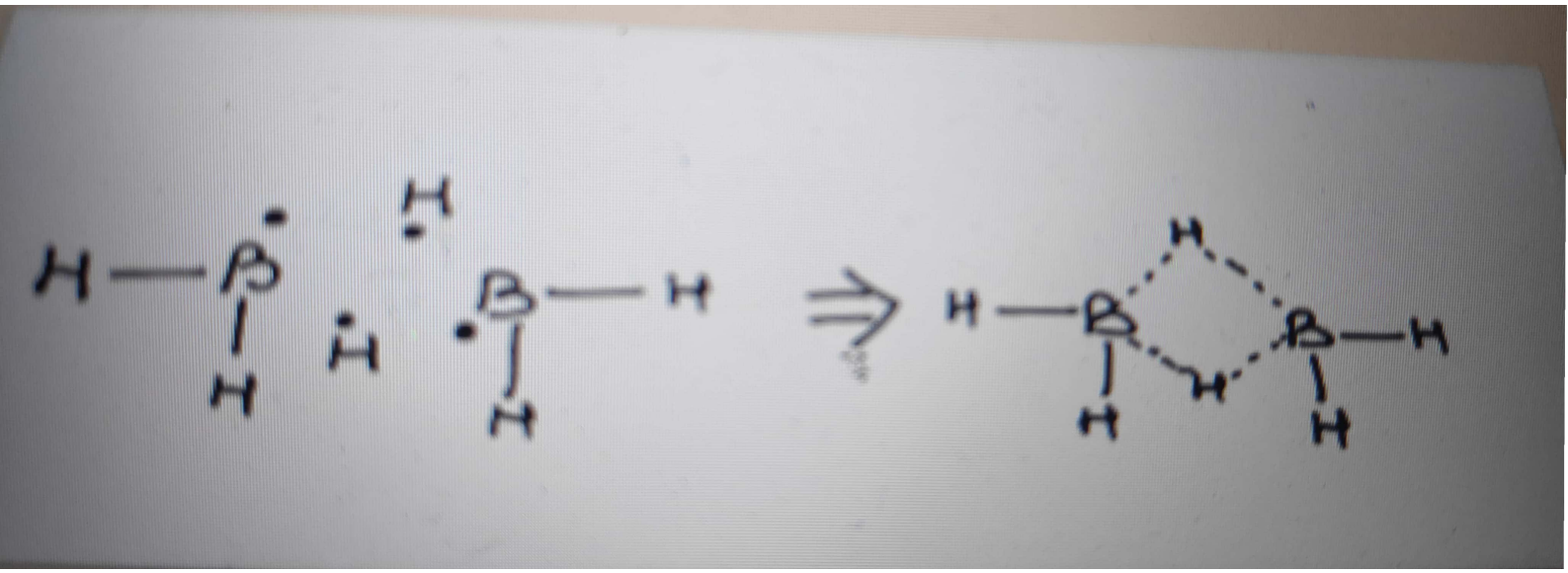
ETHANE



2x4 + 1x6 = 14 electrons

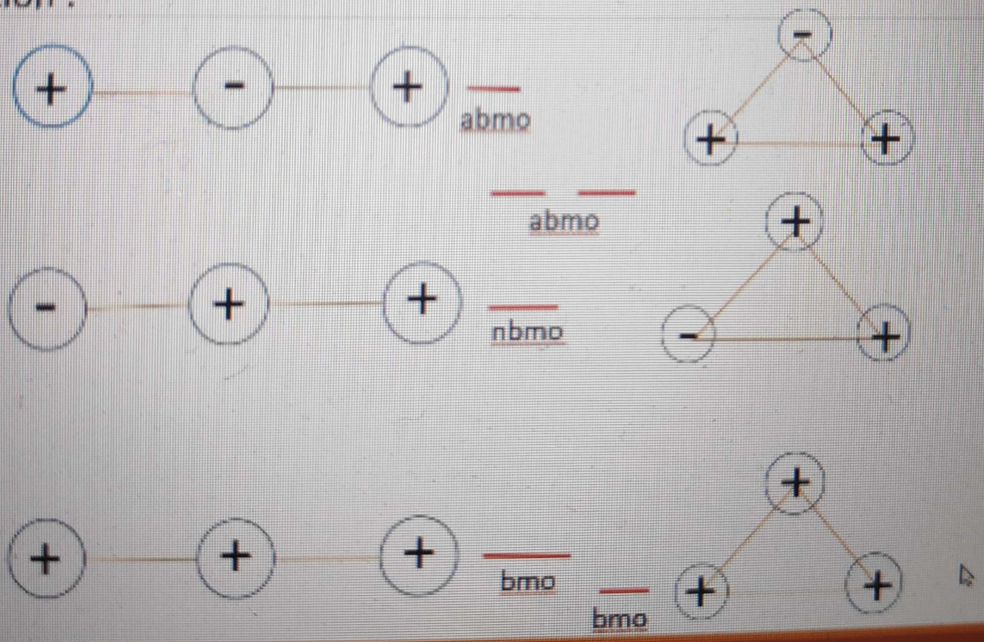
2x3 + 1x6 = 12 electrons

- Structure and bonding of boranes were tried to be understood in terms of octet theory of Kossel, Langmuir and Lewis.
- How to have the 7th bond in diborane
- Hence, di borane was not fitted in the octet theory and was labelled as an electron deficient molecule.



Linear and triangular ways of overlap for a triatomic system -

- The bridging B-H-B bonds in diborane having 2 electrons only should overlap in a triangular fashion rather than a linear one, as it is clear from the following illustration :



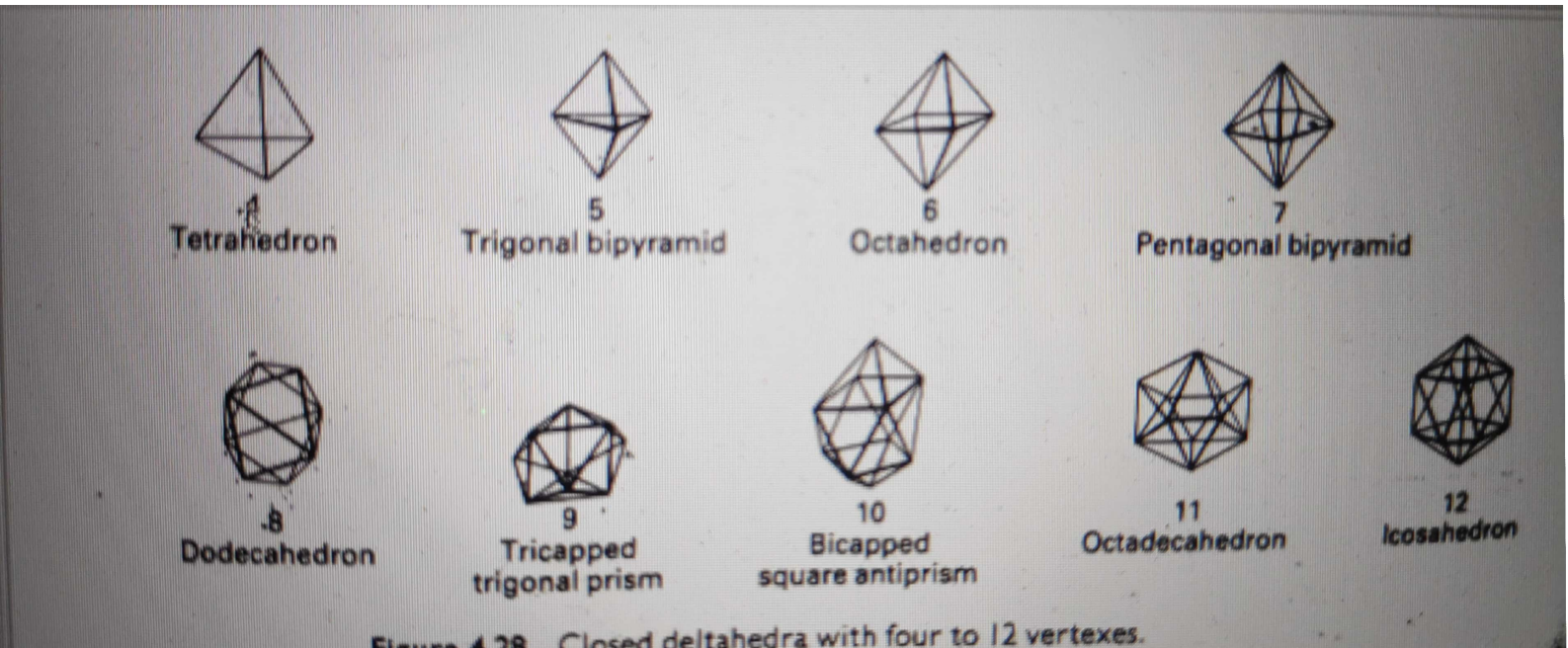
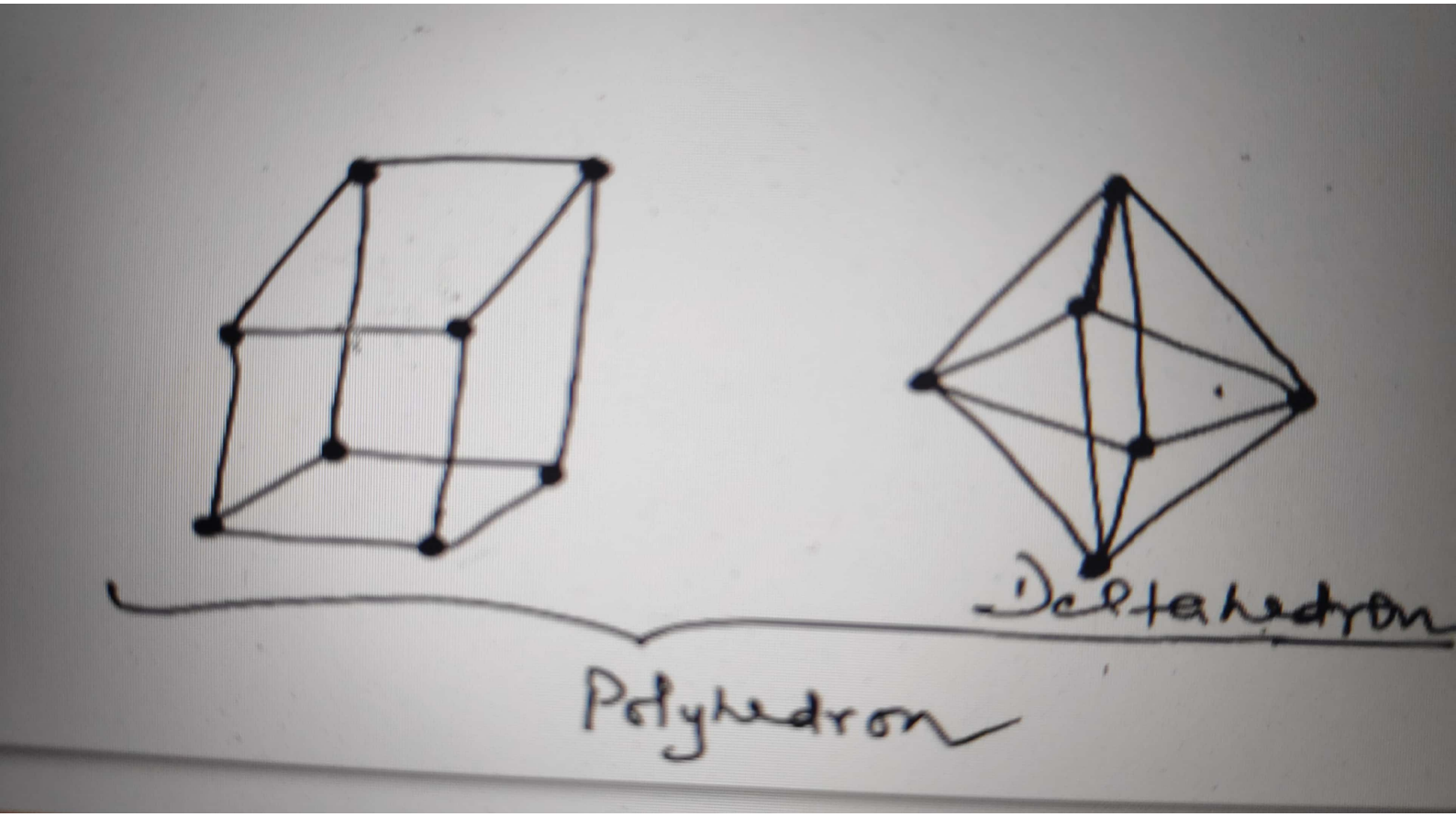
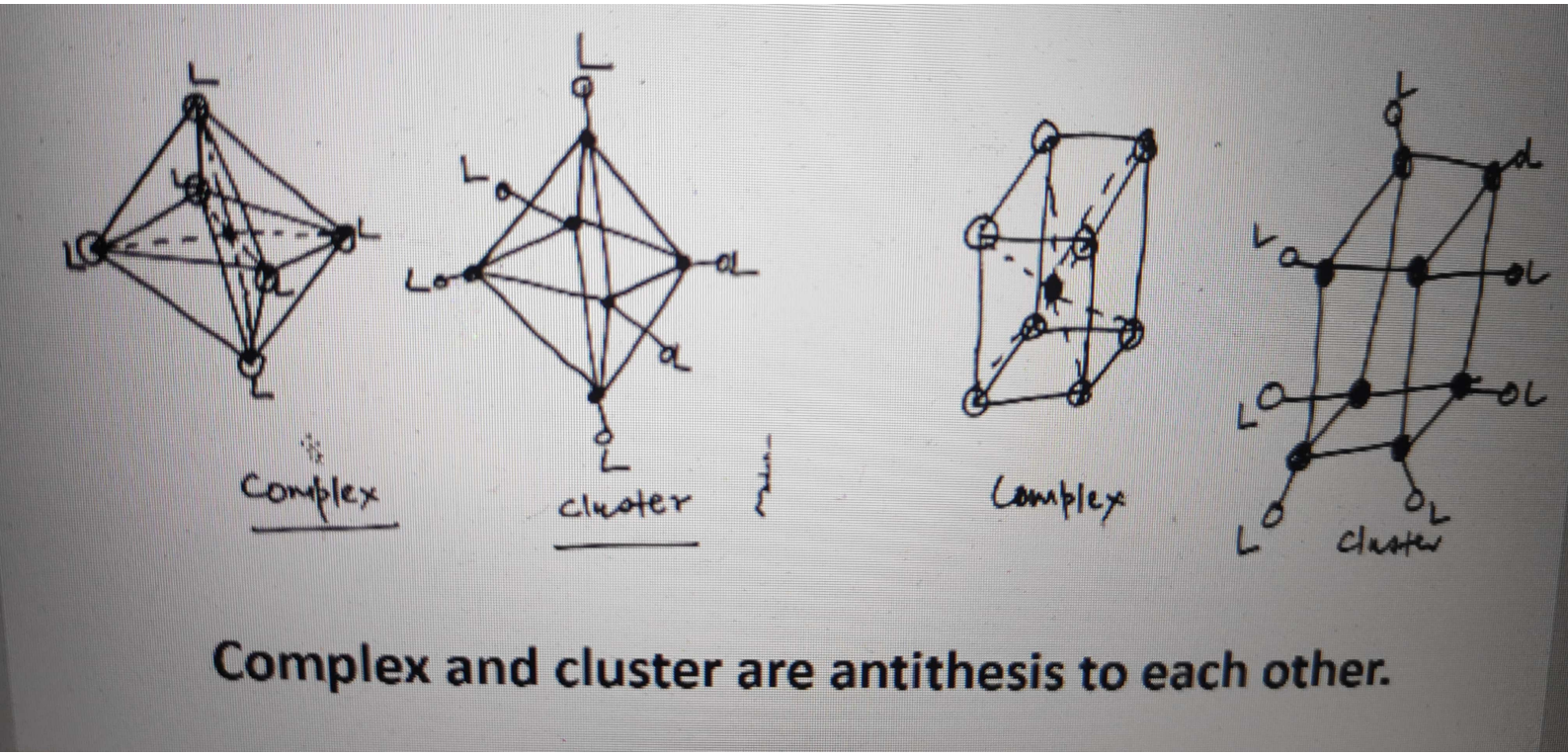


Figure 4.28 Closed deltahedra with four to 12 vertexes.

POCO ▪ **The higher boranes (where no. of boron atoms are four or more than four) adopt deltahedral structure i.e. a polyhedral structure where the faces are triangular.**





Complex and cluster are antithesis to each other.