

# Hemoglobin & Myoglobin

## - Objective

- . Structure-Function relationships in proteins
- . Hb - an allosteric protein
- . Hb - 4 chains and of two kinds
- . Why fetuses have distinctive Hb "HbF"
- . Concept of Molecular Diseases

1b

## - Globular Heme proteins

- Prosthetic group - HEME

- Apoprotein - provides an environment of three dimensional structure that dictate the role of heme

→ Reversible binding of  $O_2$   
as in Hb and Mb

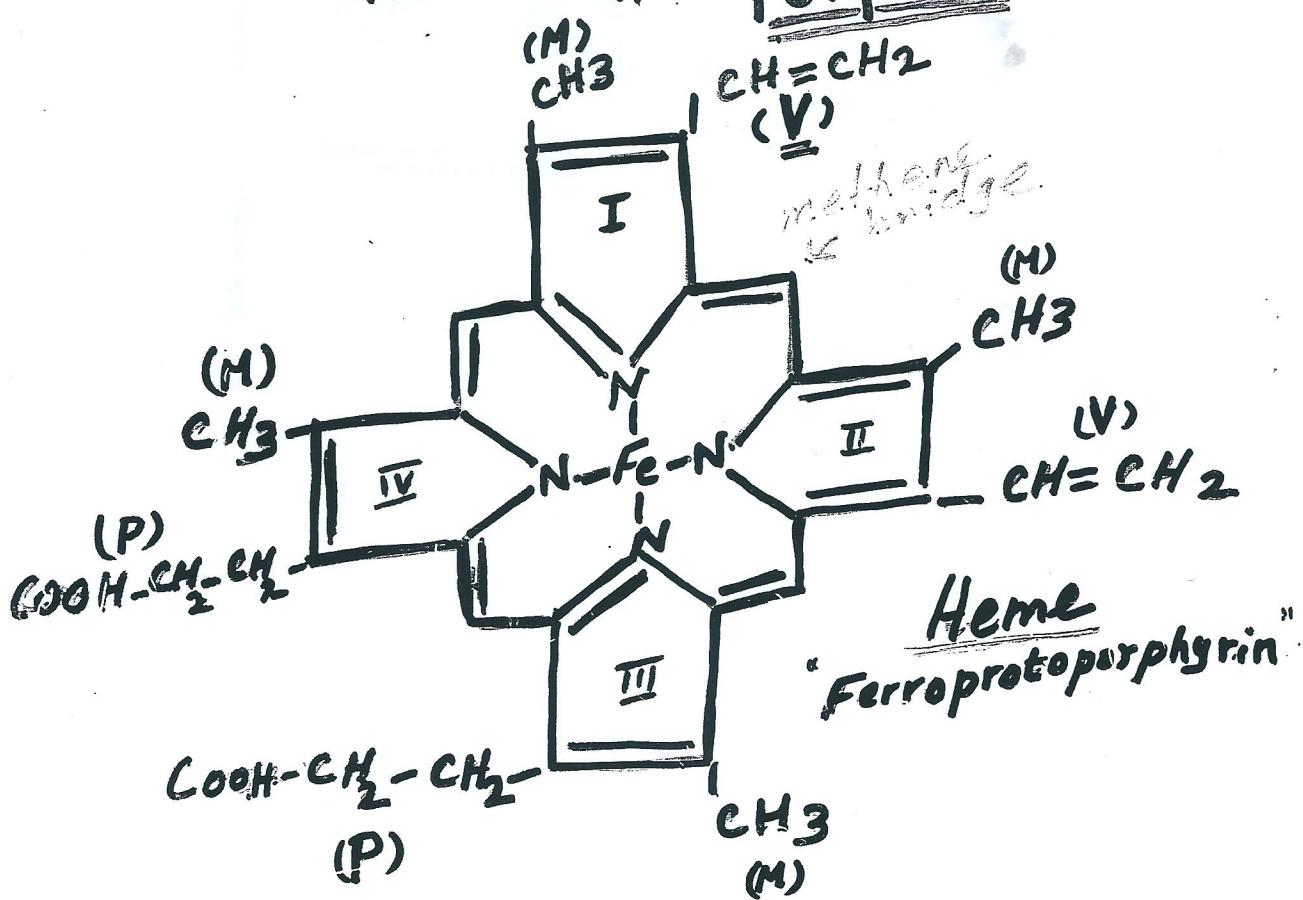
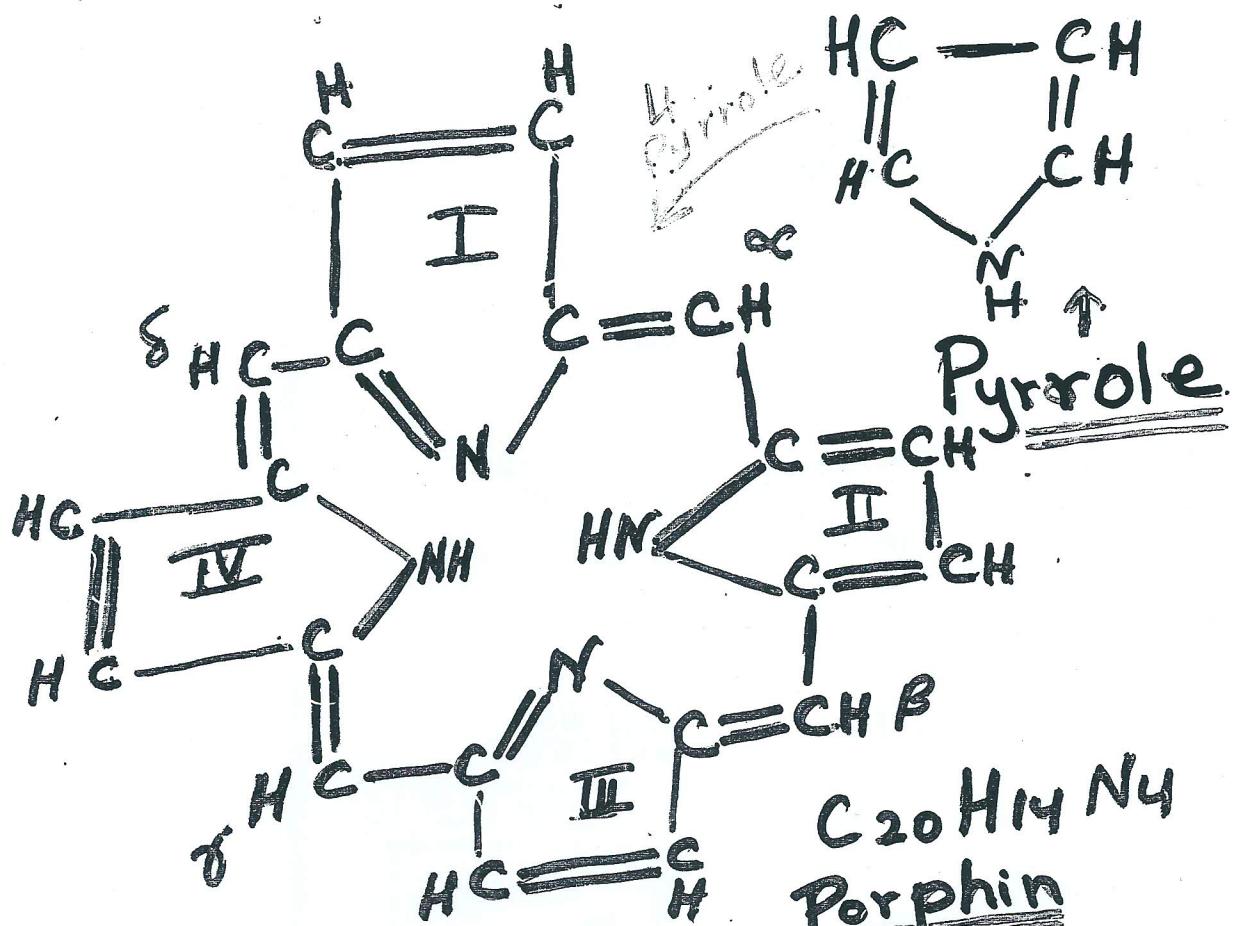
→ Electron carrier  
as in cytochromes

→ breakdown of  $H_2O_2$  as  
in catalase

→ others

# HEME STRUCTURE:

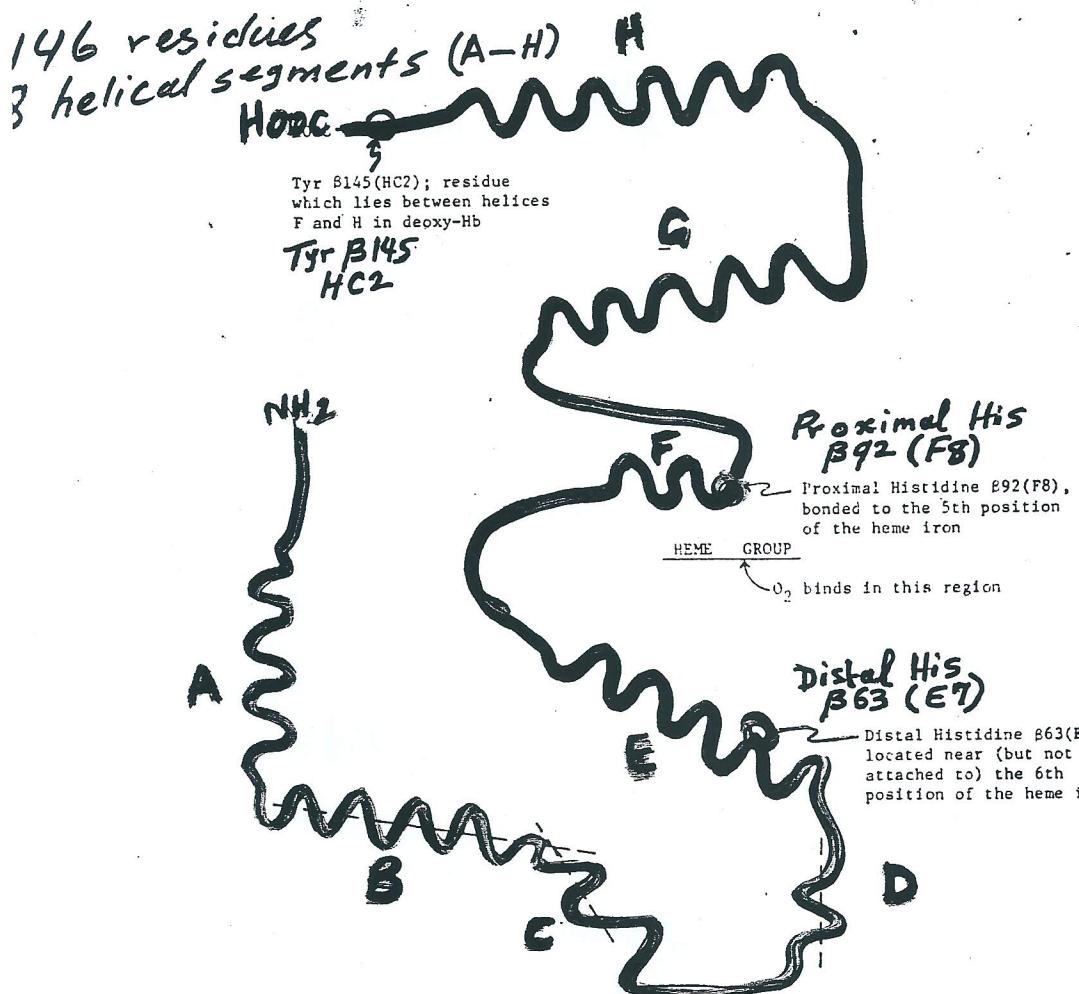
2a



3

# SEC. STRUCTURE OF $\beta$ -chain of Hb

Figure 81. Secondary Structure of the  $\beta$ -Chain of Human Hemoglobin

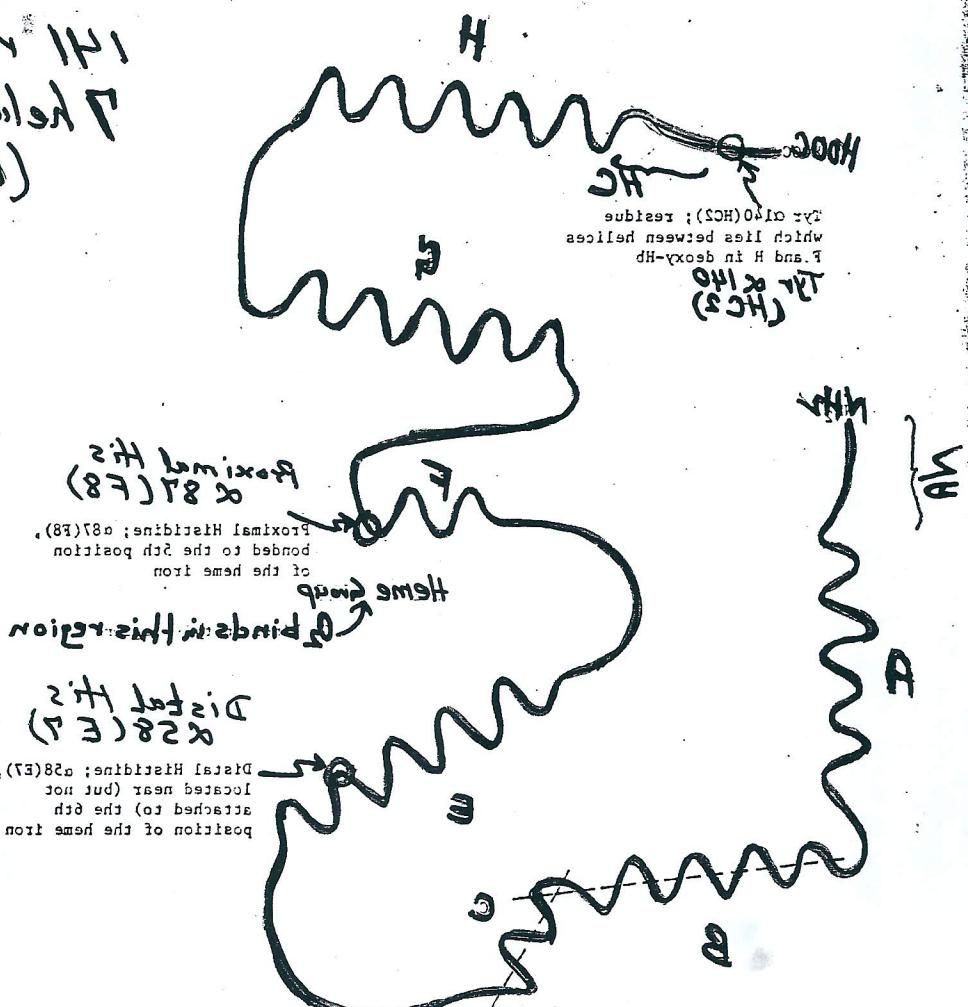


The helical regions (labeled A-H, after Kendrew), N- and C-termini, and the histidines located near the heme group are indicated. The axes of the B, C, and D helices are indicated by dashed lines.

# Sec. Structure of $\alpha$ -Chain of HP

Figure 80. Secondary Structures of the  $\alpha$ -Chain of Human Hemoglobin

III.  $\alpha$ -Chain  
Secondary Structure  
(H-A)

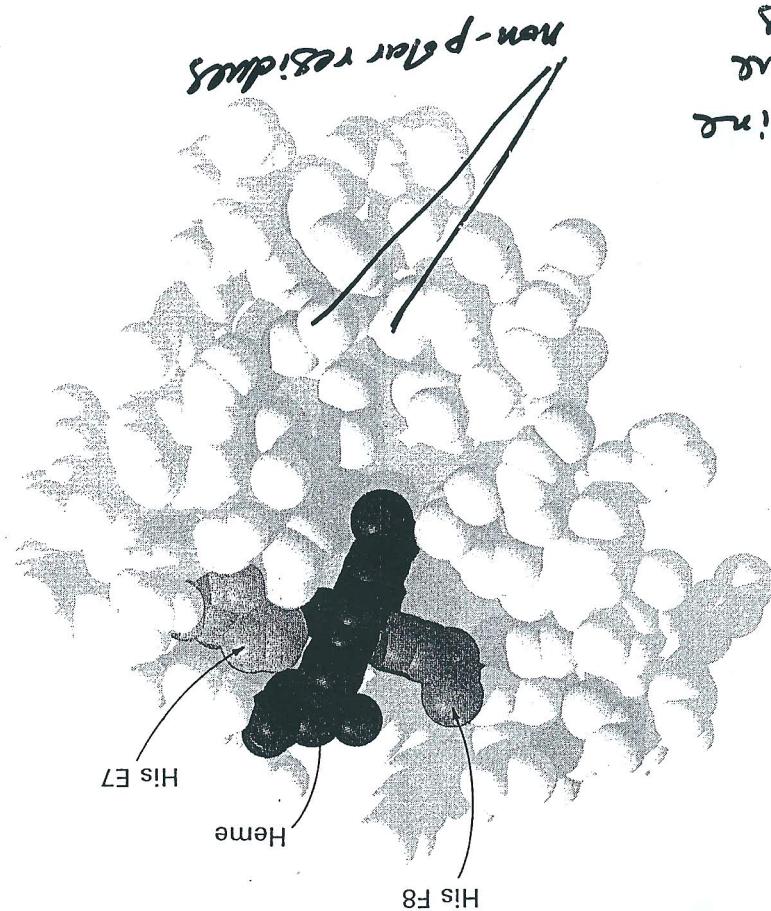


The peptide linkages (types A-H, see Kendrew), H- and C-terminal, and the histidine side chains near the same group are indicated. The axis of type B and C peptide side indicated by a dashed line.

5

## Ter-hairy Structure Myoglobin, Mb :-

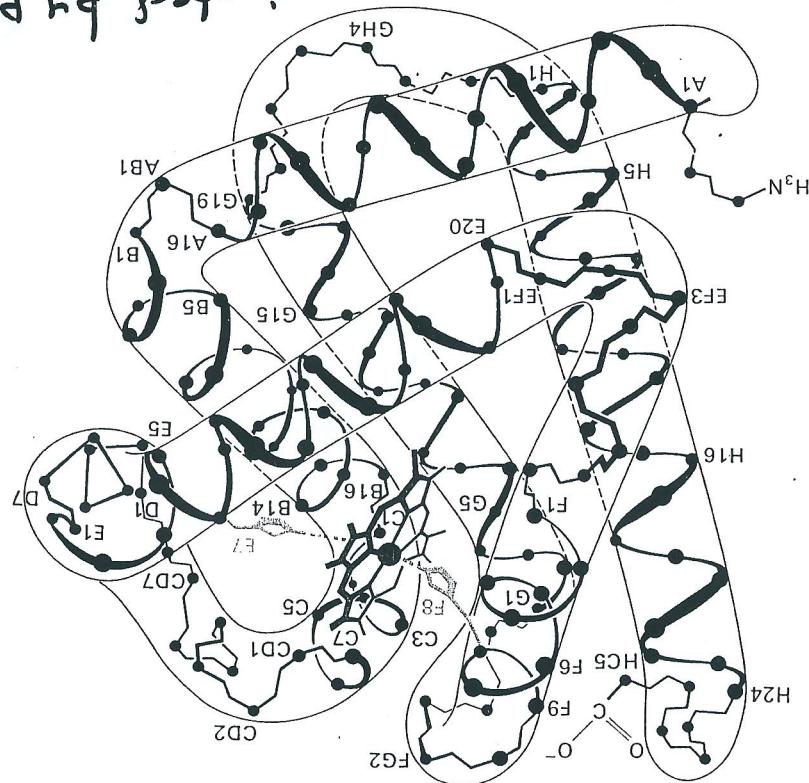
- Mb. is compact  $45 \times 35 \times 25$  Å  
- ~ 75% helical structure (8-helix segments)



- Helical termini defined by proline
- Interior consists of hydrophobic bic vesicles due to coil-coil for prox. of dis. hydro

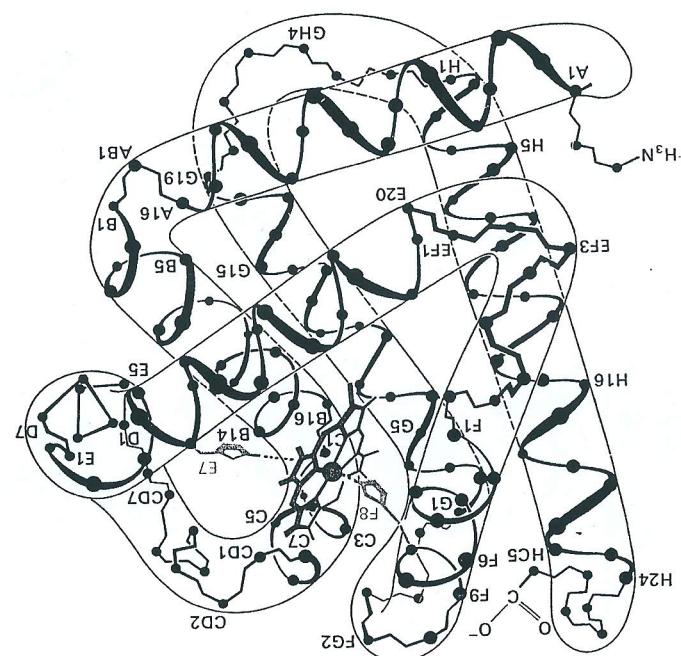
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Styer: Biochemistry, Fourth Edition

Figure 7-4, page 149; Figure 7-6, page 150



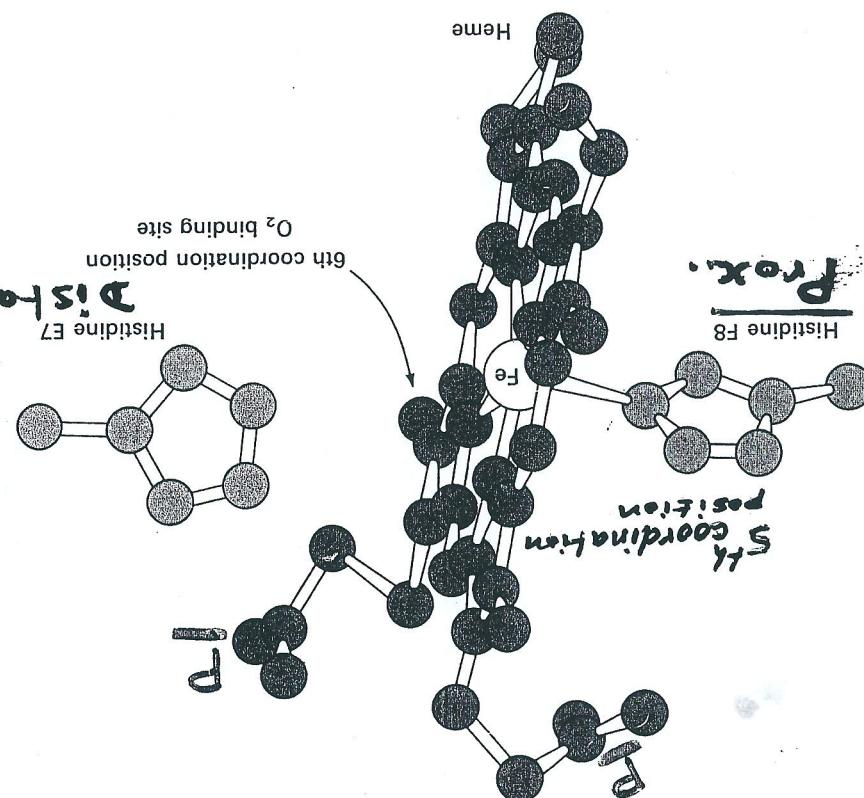
Figures 7-5 and 7-8

*Tertiary Structure*



The O<sub>2</sub>-binding site

**D**is-ha**I**



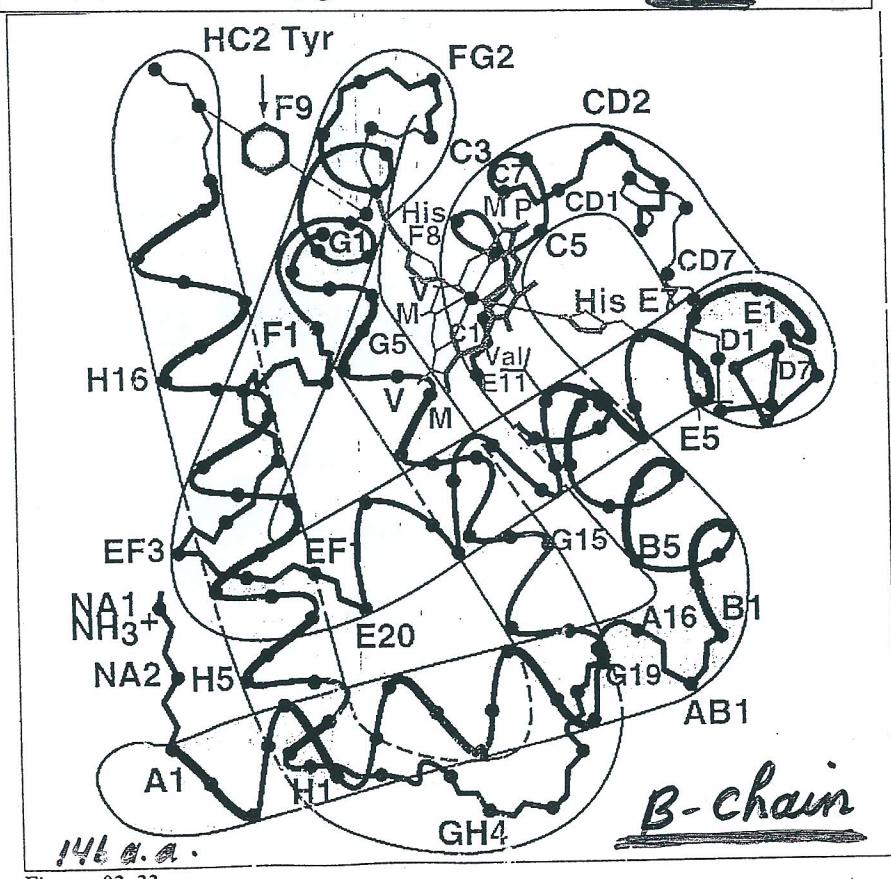
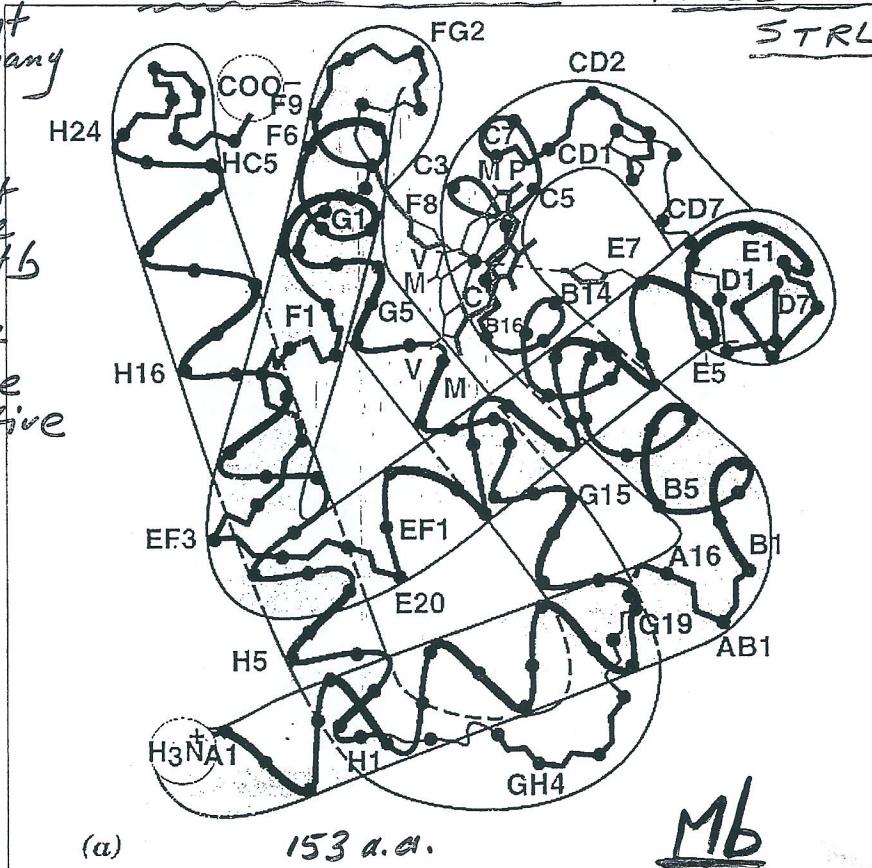
6

7) The Pri., Sec. & Ter. Structures of Mb & Hb chains  
 CLOSE RESEMBLANCE in THREE-DIMENSIONAL

- 83 invariant residues in many Mb

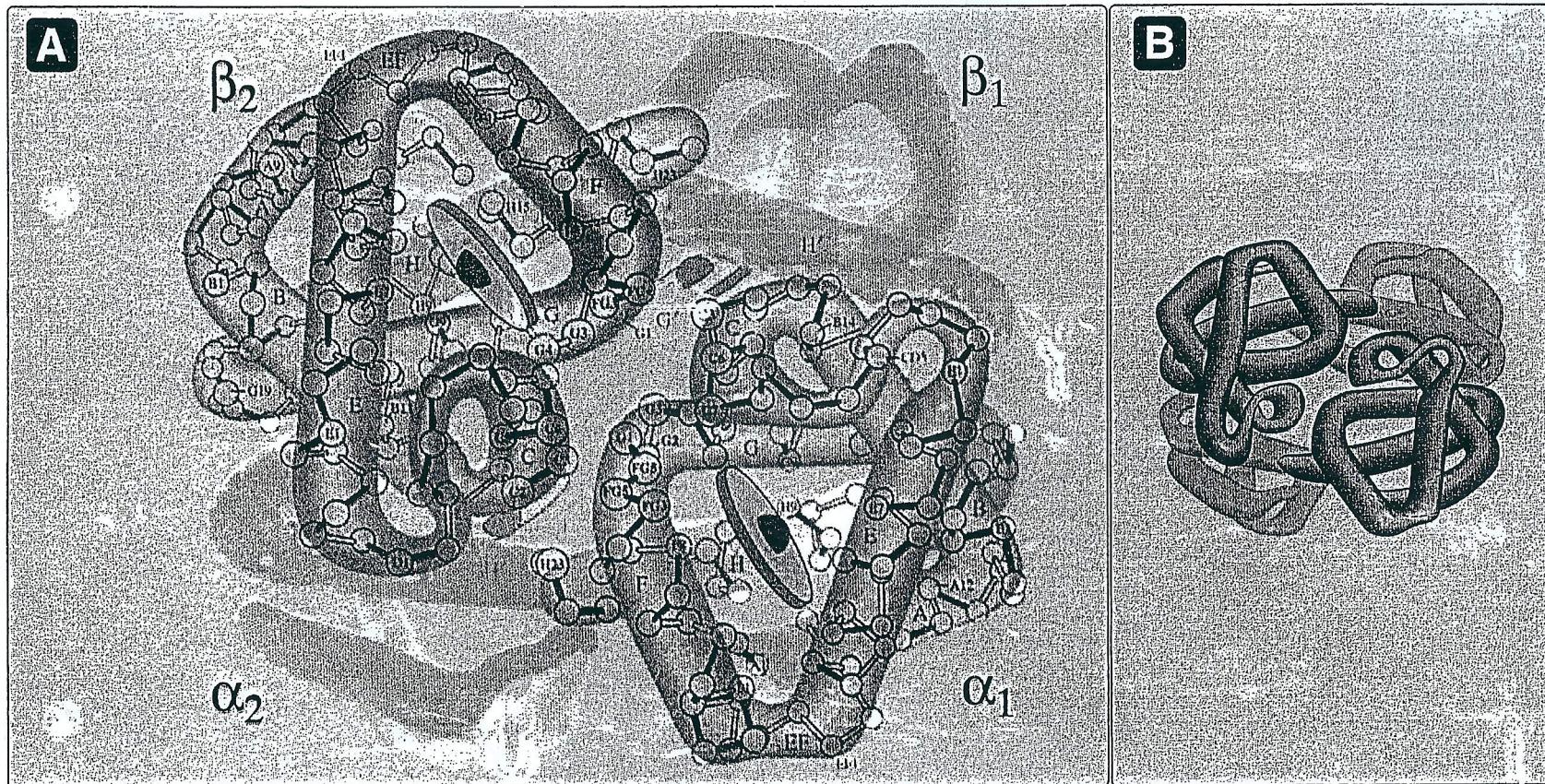
- 10 invariant residues are similar to Hb

- Many of the changes are conservative



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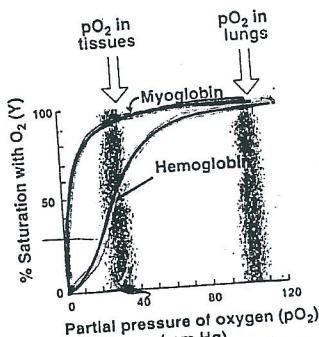
# Quaternary Structure



2

9

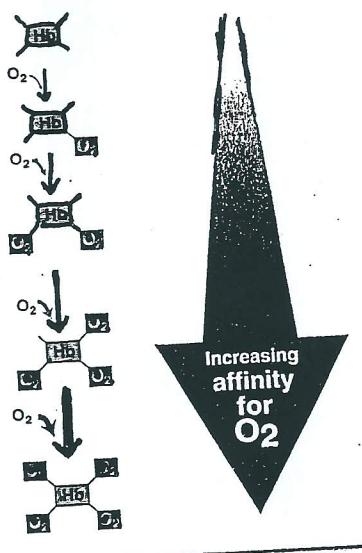
Binding of Oxygen to myoglobin and hemoglobin:-



$$P_{50} =$$

O<sub>2</sub>-dissociation curve for Hb & Mb

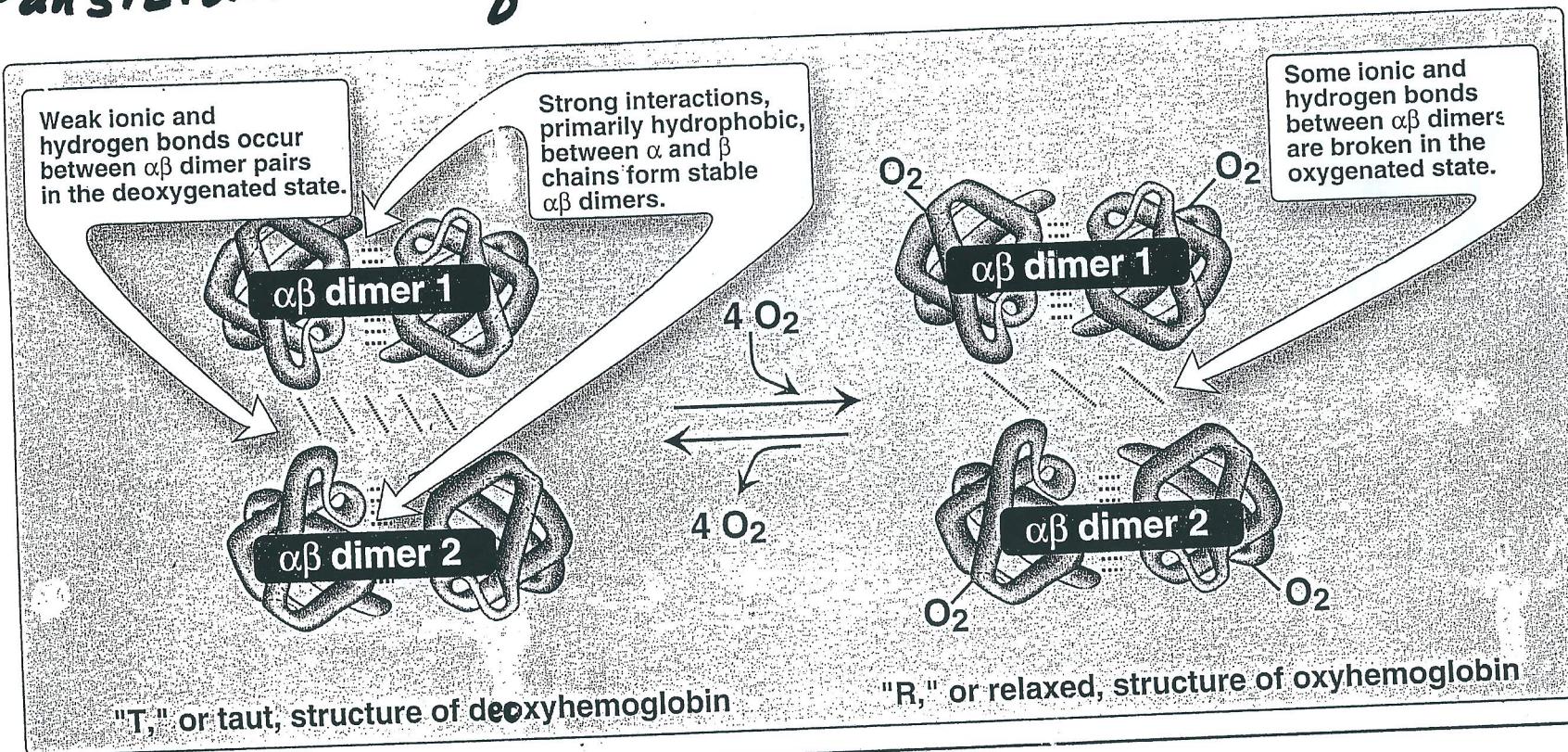
[53] - O<sub>2</sub> binds cooperatively to Hemoglobin :-



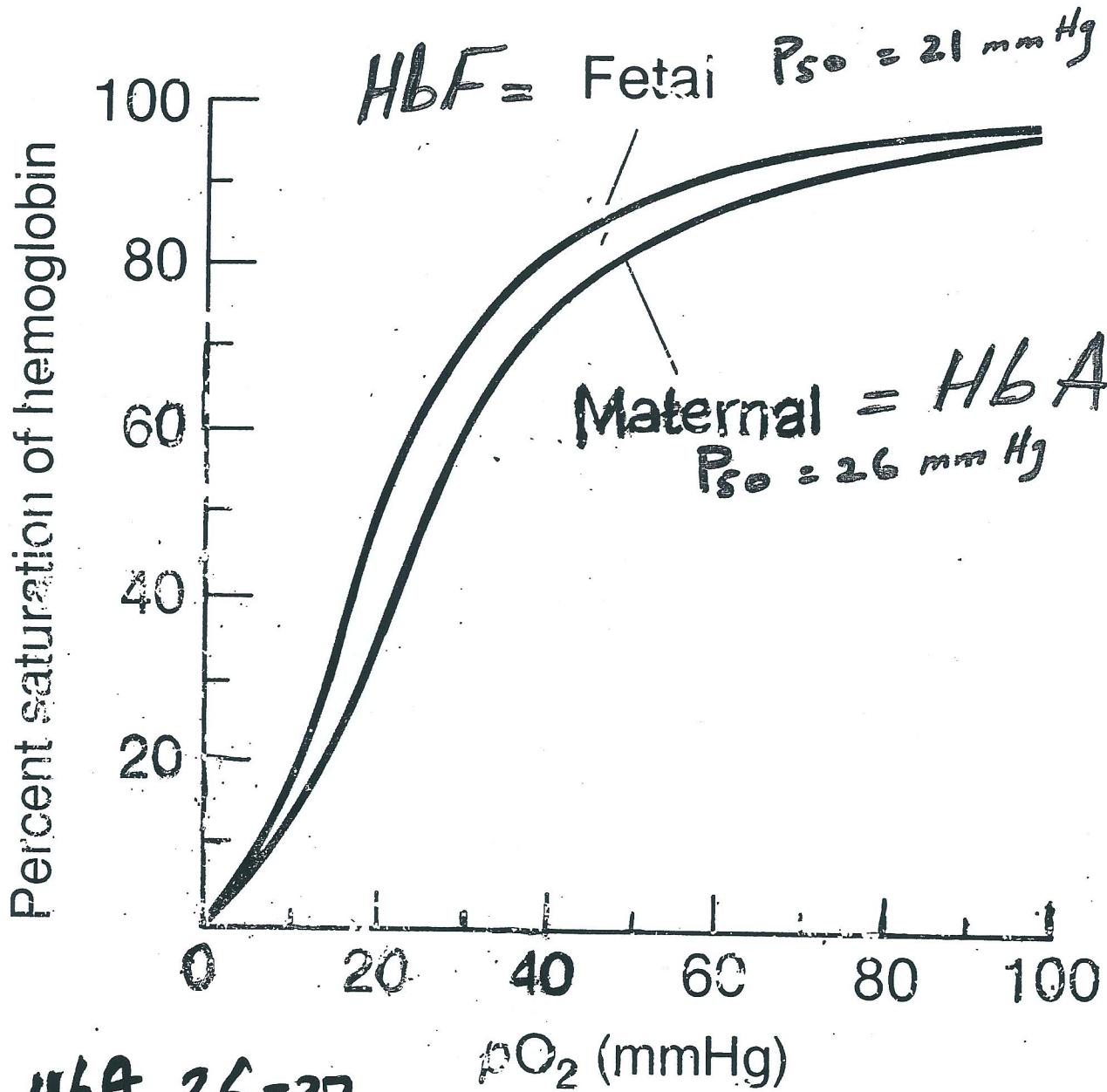
Hb. binds O<sub>2</sub> with increasing affinity

# Transitional or Conformational Change Upon Oxygenation

10



Fetal Hemoglobin has a Higher Affinity<sup>176</sup> for Oxygen than Adult Hemoglobin



$HbA 26-27$   
 $HbF 20 \text{ mm Hg}$

Oxygen-hemoglobin Dissociation Curve; Comparison of Fetal and Maternal Hemoglobin  
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