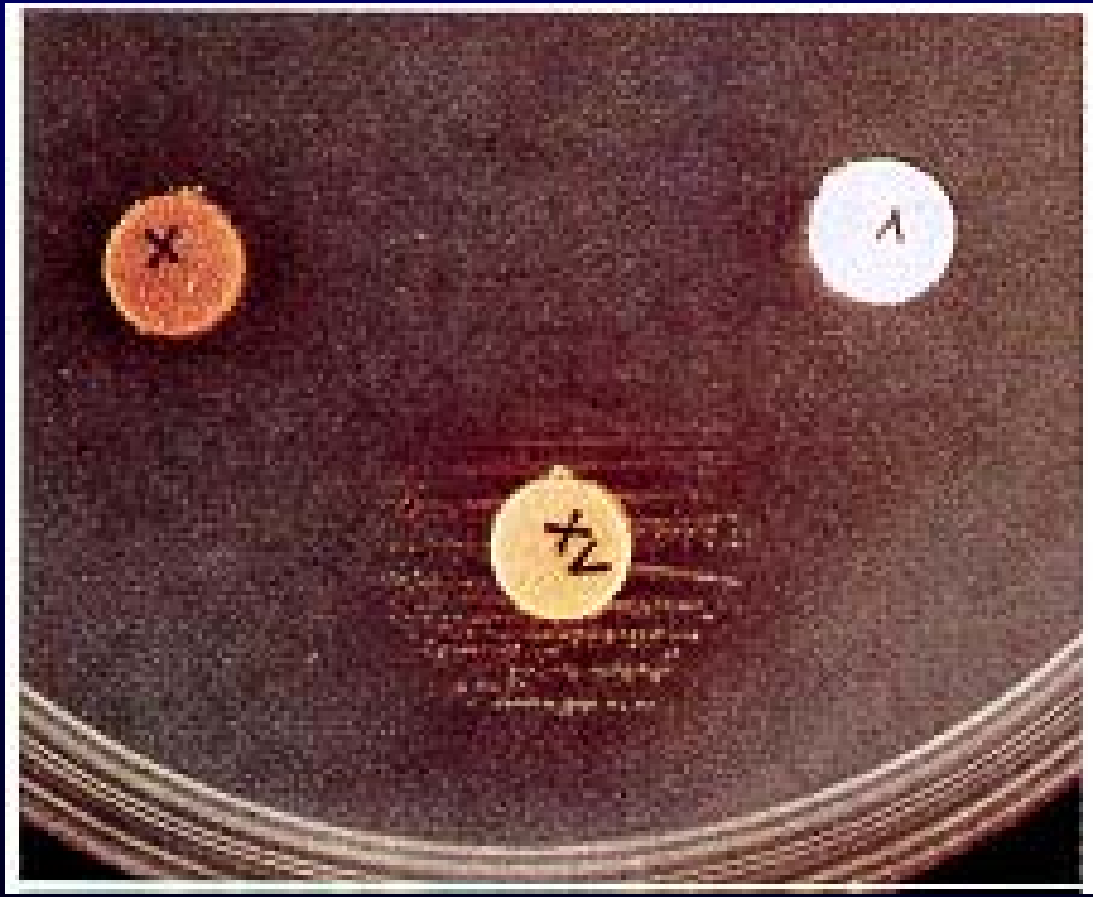
# *Haemophilus* and *Bordetella*

These two genera contain very small Gram-negative bacilli, *Haemophilus* causes a number of diseases and *Bordetella* is the agent of Whooping Cough

# Biology of *Haemophilus*

- Means “blood-loving”
  - culture requires blood in medium
- Found on mucus membranes
- *H. influenzae* composed of 6 serotypes (a to f)
  - most invasive infections are “b”
  - vaccine against b capsule **(Hib)**
  - Other spp, no capsule



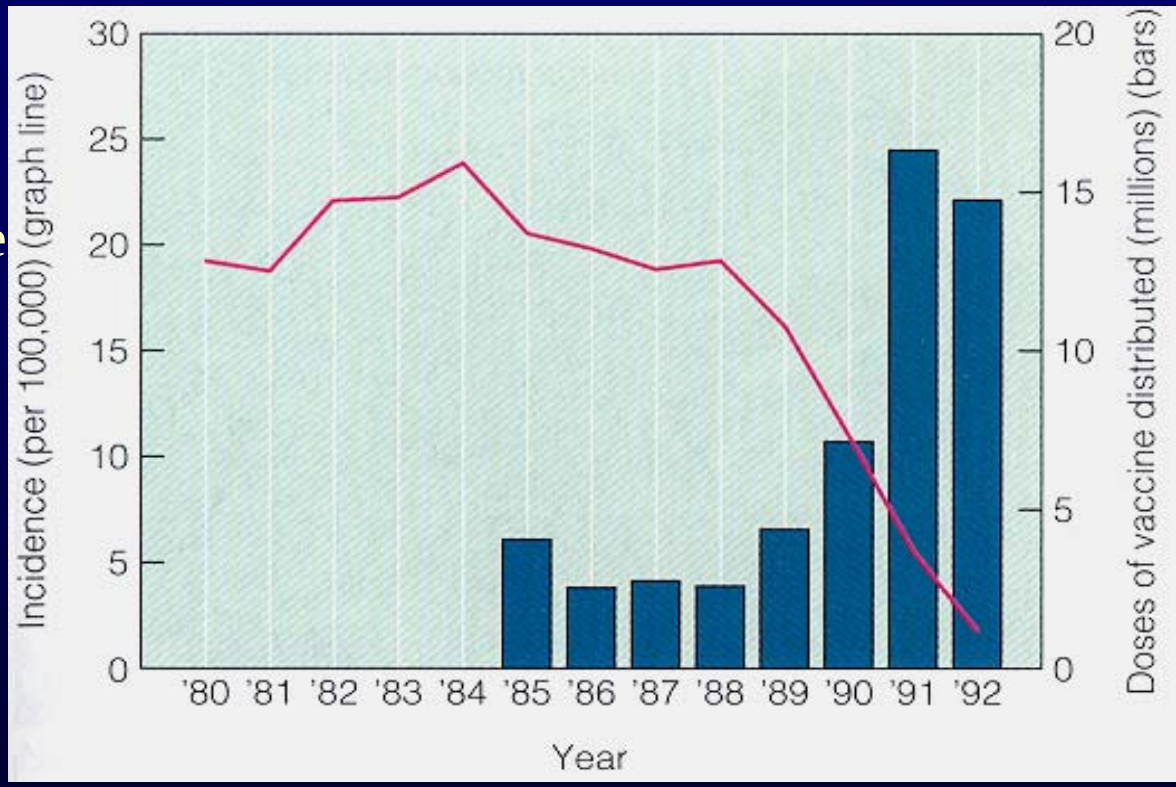

**Chocolate agar, with hemolyzed blood for culture of *Haemophilus* spp**

# Pathogenesis & Immunity

- Normal flora of upper respiratory tract
  - (except for *H. influenzae* type b, *Hib*)
  - Initially isolated in 1890 influenza pandemic, but 2ary invader, not cause
  - *Hib* infects children and immuno-compromised adults
- several infections are endogenous:
  - otitis media, sinusitis, bronchitis, pneumonia
- Encapsulated *Hib* is not normal flora, but the cause of:
  - meningitis, epiglottitis, cellulitis, arthritis, etc
- Virulence factors:
  - capsule=polyribitol $PO_4$ **PRP-b**=vaccine
  - LPS,
  - IgA-protease

# Epidemiology of *Haemophilus*

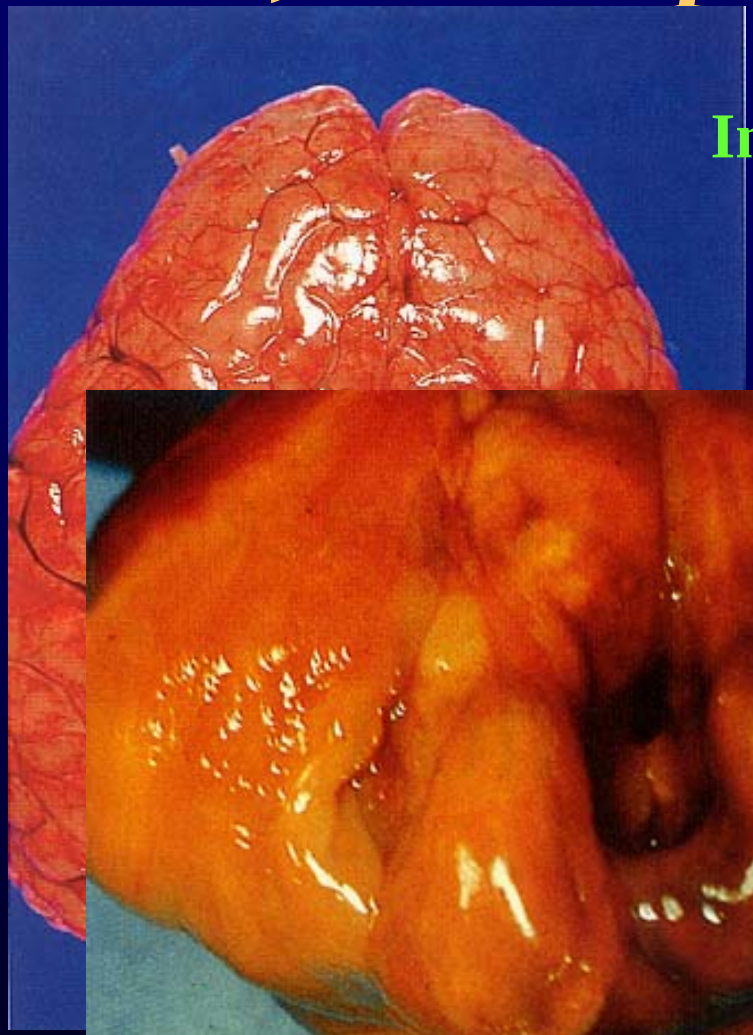
- Composes 10% bacteria in oral cavity
  - *H. parainfluenza* & non-capsulated *H.influ*.
  - Main pathogen, ***Hib*** is rare in healthy children
- Immunity=antibody to Hib-PRP
  - naturally acquired*
  - vaccine acquired*
    - PRP=carbohydrate
    - vaccine conjugated to give T-cell response
    - available since 1989
- Spread via aerosols
  - Older adults, chronic pneumonia




**Hib meningitis in USA, initial vaccine was not effective,**

# Clinical diseases, *Haemophilus*

- **Meningitis**=M.E.*
  - most common cause of pediatric meningitis*
  - clinically the same as *Neisseria* meningitis
  - follows 1-3 day mild upper respiratory disease
  - fatal w/o intervention
- **Epiglottitis**=M.E.*
  - inflammation of supraglottic tissues
  - pharyngitis, fevers, respiratory embarrassment
  - manipulations may induce laryngospasms & acute airway obstruction
  - may require tracheostomy
  - fatal w/o intervention



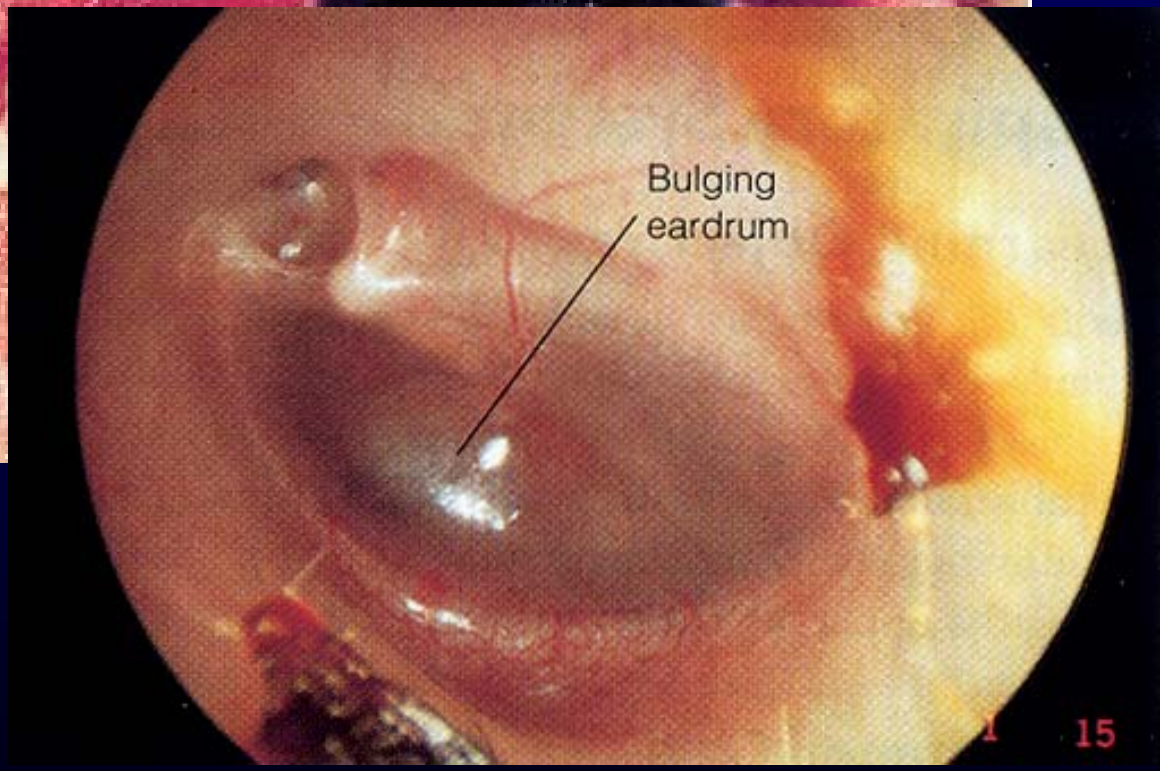
**Inflamed brain, meningitis**



**Supraglottic tissue inflammation fatal case 5 yr old child**

# Other diseases of *Haemophilus*

- **Cellulitis:**
  - reddish-blue cheeks & periorbital area
- **Arthritis:**
  - in young children
  - large joints, 2ary to *Hib* invasion
  - may be seen in immunocompromised adults
- **Conjunctivitis**:
  - "pink-eye"
  - highly contagious
  - *H. influenzae aegyptius*
- Unencapsulated strains:
  - otitis media, sinusitis, subacute endocarditis bronchitis & pneumonia




***Haemophilus* otitis media, along with *Strept. pneumoniae*, common cause**

# *Haemophilus ducreyi*

- **Chancroid:**
  - "soft chancre"
    - (hard chancre=syphilis)
  - tender papule becomes painful genital lesion, often with lymphadenopathy
  - non-indurated, marked margins
  - clinically more common in males
  - common in Africa & Asia, but some cases in USA
  - major enhancer of HIV, also in Africa & Asia
- Treatments, all infections
  - penicillin resistance, thus CSF-penetrating cephalosporins

**Chancroid lymphadenopathy**

# *Bordetella pertussis*

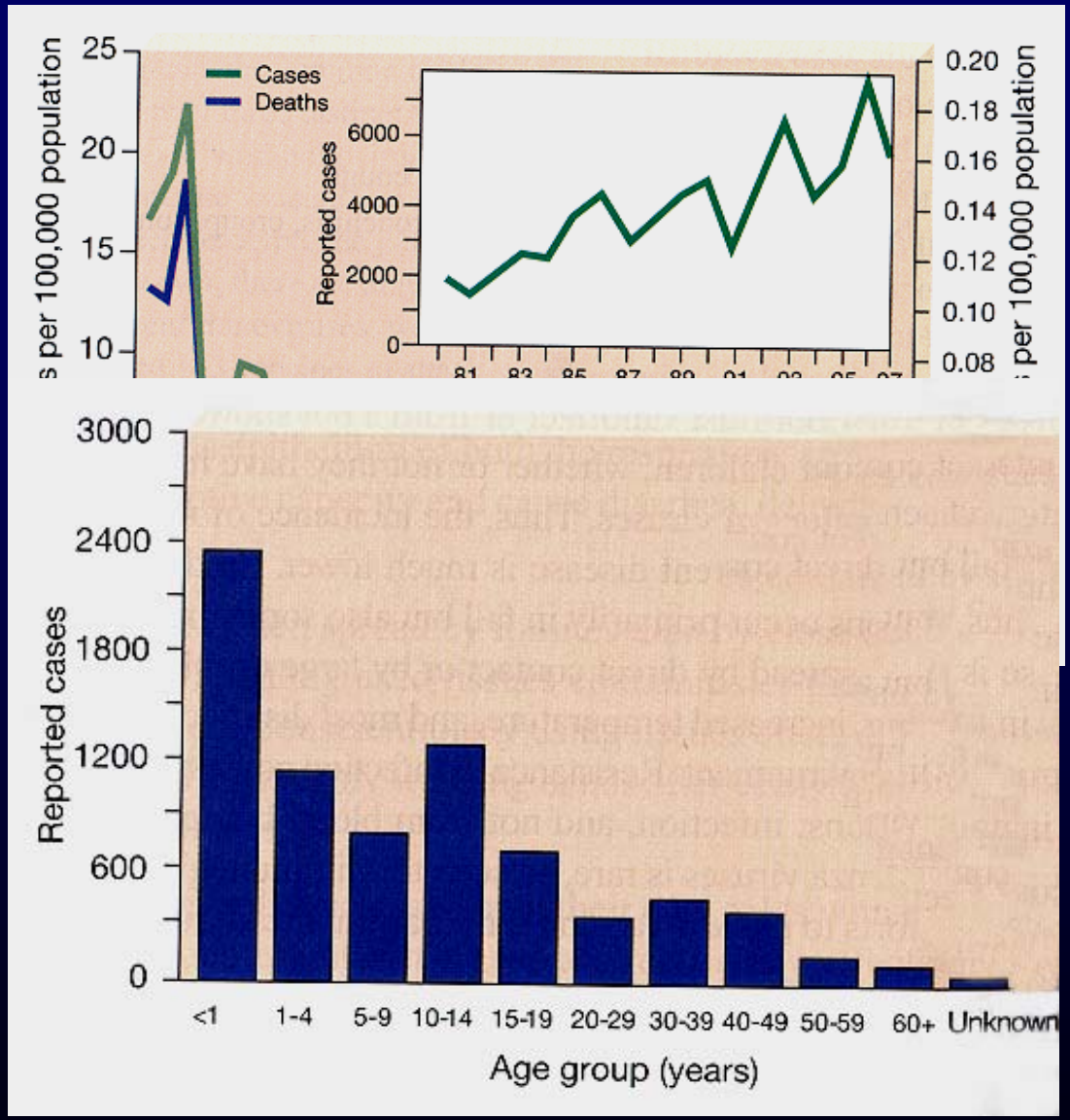
- Agent of whooping cough, very small Gram-negative coccobacillus
- Pertussis means “severe cough”
- *B. parapertussis* causes milder form
- DPT vaccine has reduced USA incidence, but still important globally with increasing cases in USA

# Pathogenesis of Whooping cough

- **Disease requires**: exposure, colonization attachment, growth= local tissue damage and systemic effects
- Virulence factors:
  - attachment to ciliated epithelial cells via filamentous hemagglutinin and pertussis toxin
  - **Pertussis toxin:**
    - classical A/B toxin
    - B=several cell types*
    - A=upregulation of adenylate cyclase
    - histamine sensitization
    - causes lymphocytosis
    - blocks immune cell functions, chemotaxis, phagocytosis, oxidative activity of alveolar macrophages, etc
    - ups insulin production
  - **Tracheal cytotoxin:**
    - peptidoglycan monomer
    - ciliostasis at low conc.
    - Extrusion of ciliated cells from bronchi & prevents regeneration
  - **Dermonecrotic toxin:**
    - vasoconstriction leading to localized tissue destruction
  - **LPS:**
    - you know this one

# *Epidemiology of whooping cough*

- Recognized for centuries
- Global endemicity
- Most infections due to inadequately immunized children
- Strict human pathogen
- Vaccine problems
  - DPT vaccine
  - toxicity reports
  - immunity unstable
- On the increase in USA, Sweden, Japan, etc.




**Whooping cough by age**

# Clinical syndromes of pertussis

- Aerosolization, attachment, etc. 7-10 days:
- **Catarrhal Stage:**
  - resembles cold, fever, sneezing, rhinorrhea
  - highly contagious
- **Paroxysmal Stage:**
  - extrusion of ciliated cells
  - increased mucus secretion
  - classic cough with whooping inspiration, vomiting and exhaustion
  - 40-50 paroxysms/day
  - lymphocytosis (40k/mm3)
  - Severe apnea = death
  - supportive therapy

**Cough-induced conjunctival hemorrhage**

# Whooping Cough continued

- **Convalescent Stage**:
  - Occurs over 2 to 4 wks with supportive therapy during lessening of paroxysms
  - antibiotics do not help because convalescence is correlated with re-generation of ciliated cells, etc.
- Erythromycin may be used as prophylactic for other family members

**Whooping cough is often fatal without supportive therapy with respirator**