

# Prokaryotic Biology

## **VIROIDS & PRIONS**

# Viroids and Prions

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## Viroids

### A. STRUCTURE & SEQUENCE

1. NUCLEOTIDE SEQUENCE -- 246N (CCCVd) TO 375N (CEVd)

a. NUMBERING SYSTEM

b. ROD SHAPE (20:1 AXIAL RATIO)

c.

NUCLEOTIDE SEQUENCES DETERMINED BY SEQUENCING

2. SECONDARY STRUCTURE

a. SECONDARY STRUCTURE NEAR NATURAL pH

b. EFFECT OF pH ON SECONDARY STRUCTURE AND LOOPS

c. EFFECT OF pH ON SECONDARY STRUCTURE CHANGES WITH DENATURATION



### Potato Spindle Tuber Viroid

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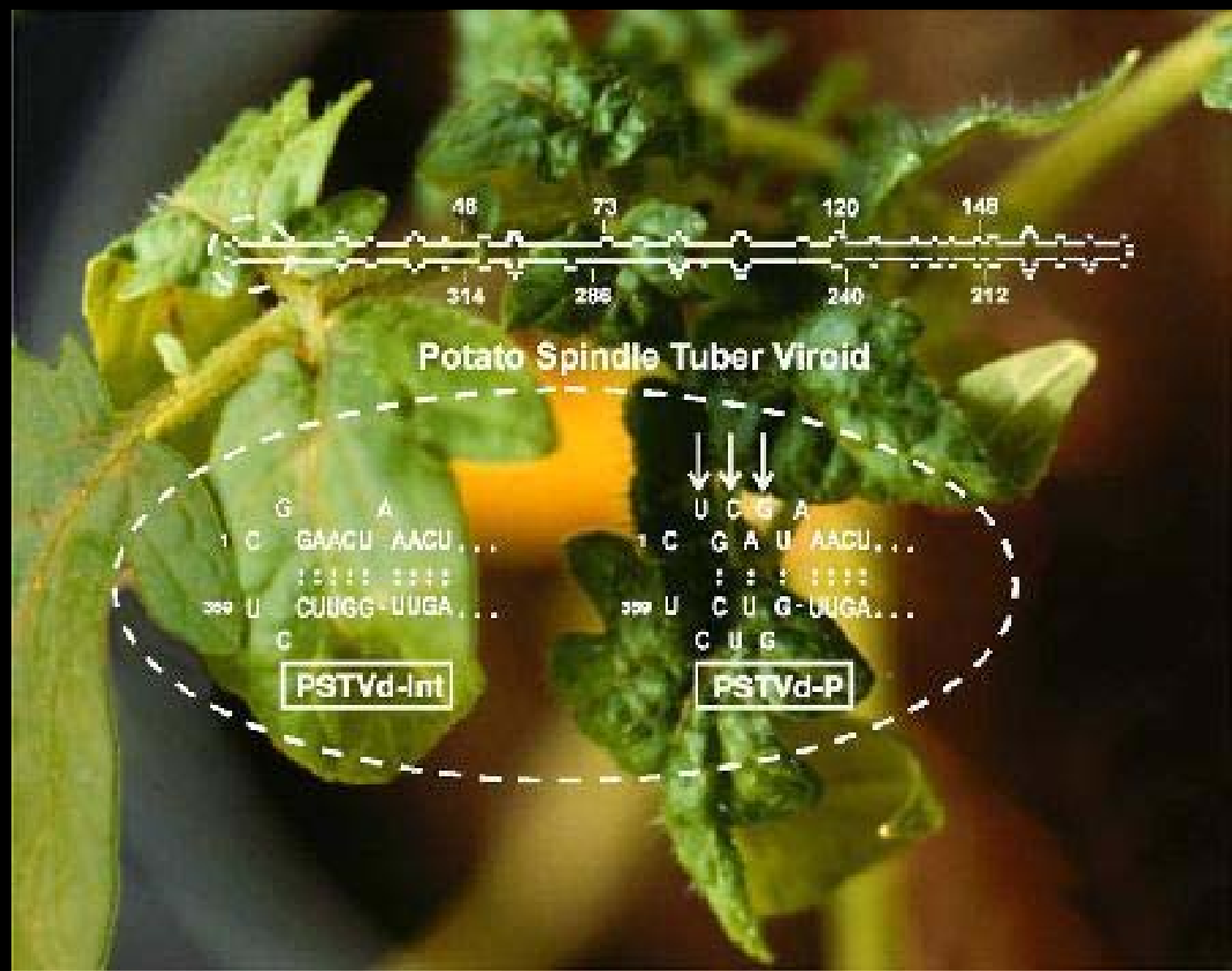
      G       A
1  C  GAACU AACU...
      : : : : :
399 U  CUBGG-UUGA...
  
```

**PSTVd-Int**

```

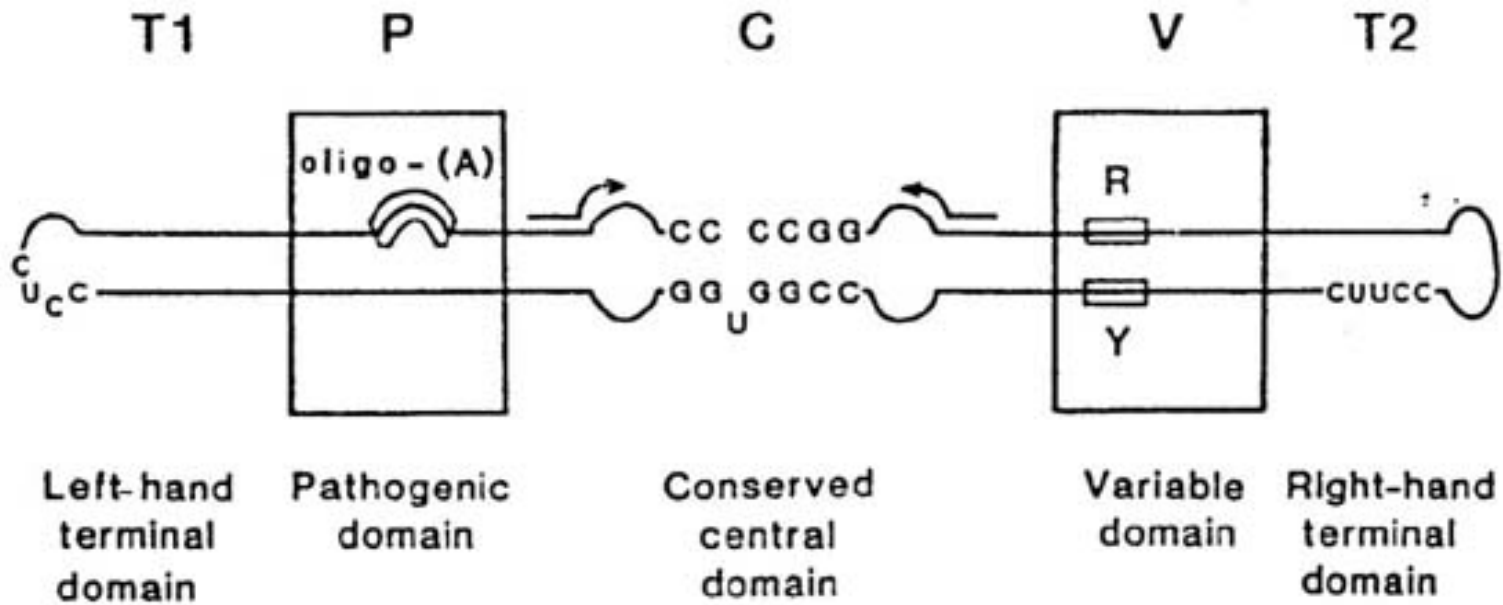
      U C G A
1  C  G A U AACU...
      : : : : :
399 U  C U G-UUGA...
  
```

**PSTVd-P**



# Viroids and Prions

## Viroid structure



# Viroids and Prions

## Viroids

### B. CLASSIFICATION -- BASED ON SEQUENCE AND SELF-CLEAVAGE

#### 1. POSPIVIROIDAE - PSTVd FAMILY (24 MEMBERS)

a. POSPIVIROID - PSTVd GROUP (8 MEMBERS)

b. COCADVIROID - CCCVd GROUP (4 MEMBERS)

c. APSCAVIROID - ASSVd GROUP (8

MEMBERS)

d. COLEVIROID - CbVd-1 (3 MEMBER)

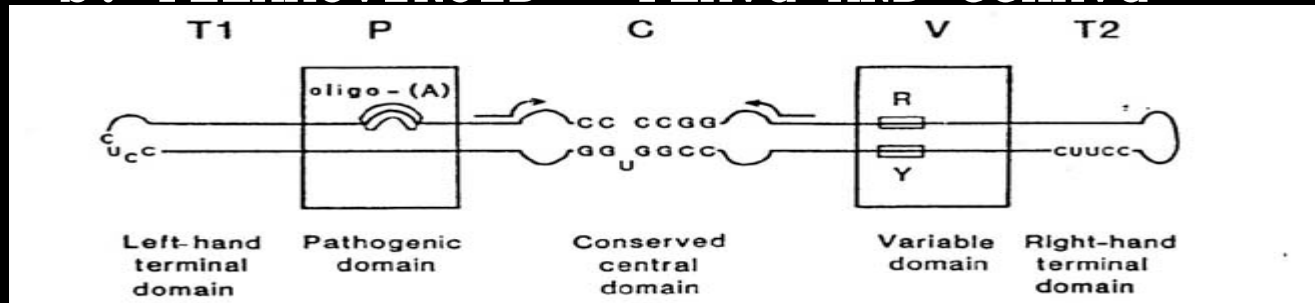
e. HOSTUVIROID - HSVd (1 MEMBER)

#### 2. AVSUNVIROIDAE - ASBVd FAMILY (3 MEMBERS)

##### SELF-CLEAVAGE HAMMERHEAD

a. AVSUNVIROID - ASBVd

b. PELAMOVIROID - PLMVd AND CChMVd



# Viroids and Prions

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## Viroids

### C. REPLICATION

1. NO CODING SEQUENCES --
- 2 + STRANDS ---> - STRAND
3. RNAP II THE PROBABLE EN

STRANDS

### D. PATHOGENESIS

1. INFECTIVITY OF CLONES
2. DISEASE
  - a. LIKE VIRUS INFECTION

1. WILTS, STUNTING,

IONS,

NECROSIS

2. MANY ARE SYMPTOML

VIROIDS

b. PROTEIN CHANGES (LI

ES)

c. CELL TO CELL MOVEMEN

d. SEED, POLLEN & AGRIC

MISSION



# **Viroids and Prions**

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## **Viroid pathogenesis**



***Chrysanthemum stunt viroid (CSVd)***

# **Viroids and Prions**

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## **Viroid pathology**

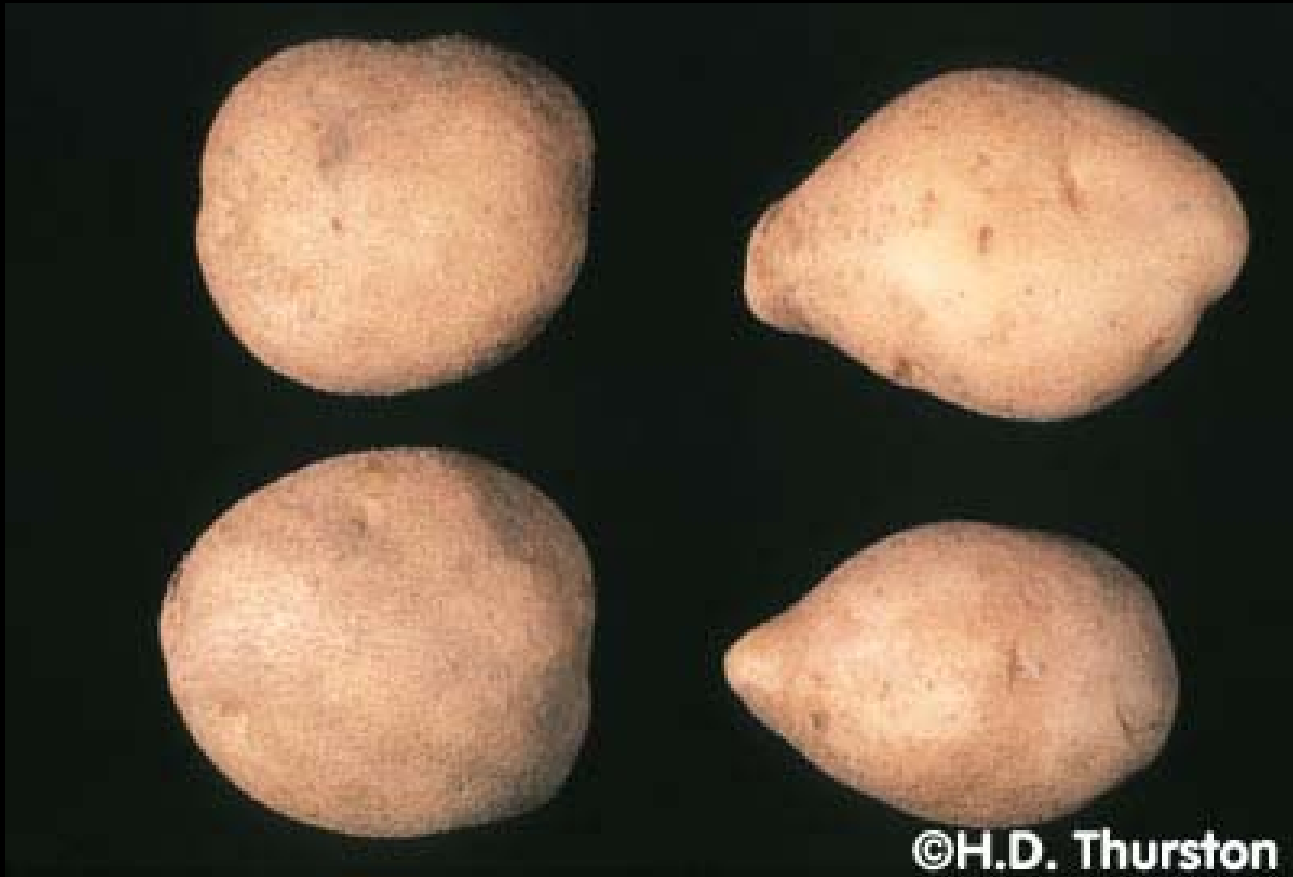


**PLUM DAPPLE : Hop stunt viroid (HSVd)**

# **Viroids and Prions**

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## **Viroid pathology**



©H.D. Thurston

**Potato spindle tuber viroid (PSTVd)**

# Viroids and Prions

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## Viroid pathology



**Citrus Exocortis viroid (CEVd)**

# Viroids and Prions

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## Prions

### KURU, AN UNUSUAL HUMAN DISEASE

- A. EPIDEMIC IN PAPUA, NEW GUINEA 1920-1970
- B. WOMEN AND CHILDREN AFFECTED
- C. LOSS OF MOTOR SKILLS AND DEMENTIA
- D. DEATH USUALLY WITHIN ONE YEAR
- E. DISEASE STUDIED BY CARLETON GAJDUSEK
  - 1. TRANSMITTED BY RITUALISTIC CANNIBALISM – MOURNING
  - 2. PROPERTIES LIKE OTHER RARE HUMAN DISEASES, EG. [REDACTED] AND SCRAPIE
  - 3. RECENTLY IN ENGL [REDACTED]

# Viroids and Prions

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## Prions

**KURU, AN UNUSUAL HUMAN DISEASE**

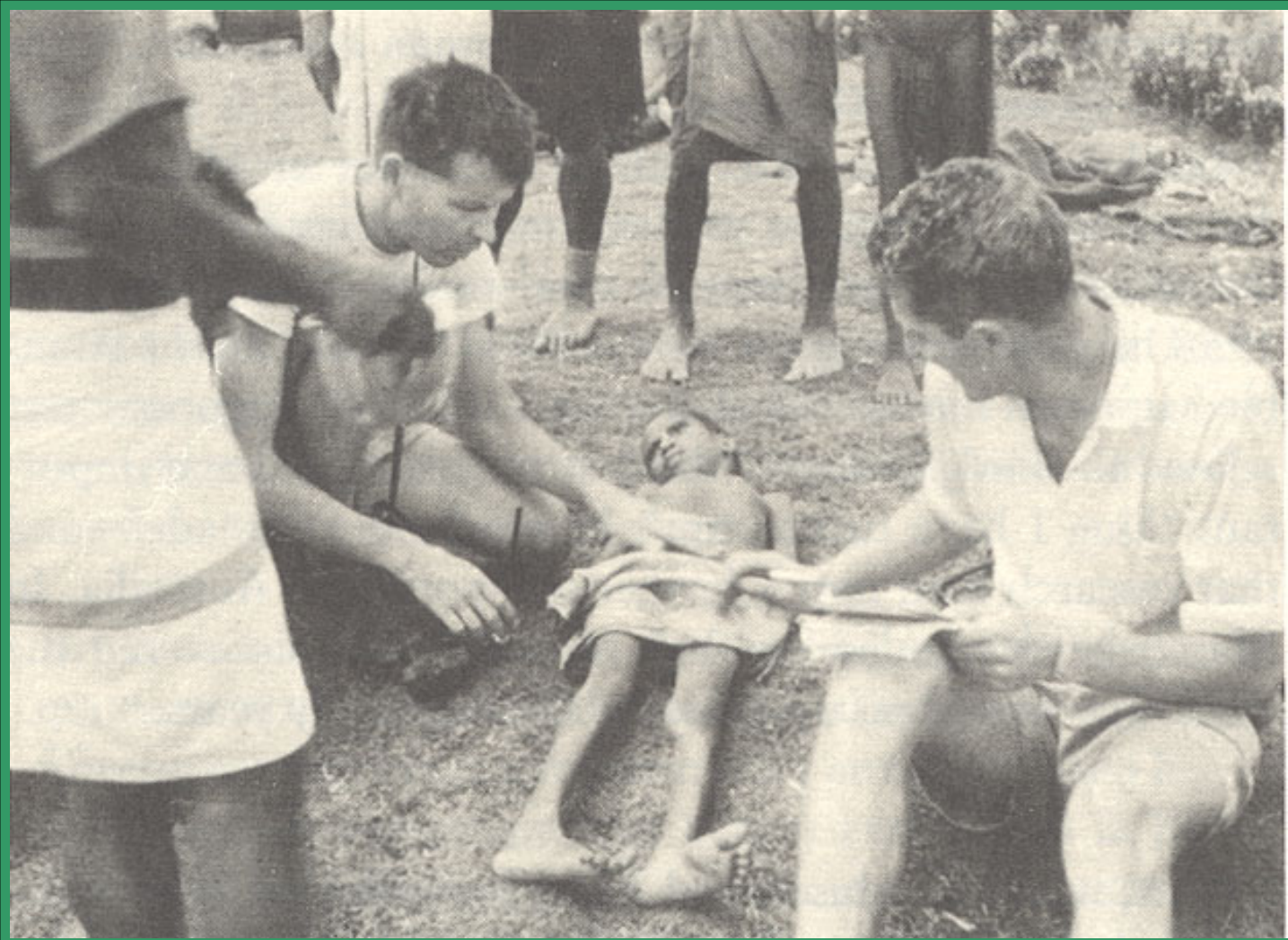


# A little history and mystery... Kuru

Kuru- affected the Fore tribe of New Guinea



Kuru means shivering or shaking



Gajdesuk and Zigas examine a boy in the late stages of Kuru- The child is nearly incapacitated

- ◆ For all prion diseases, it looks like they all arose initially by genetic mutations or spontaneous conformational changes = CJD, GSS, FFI, Scrapie
- ◆ These diseases were and are found at low levels everywhere
- ◆ But humans have caused epidemics by (1) importing infected species = scrapie (2) Being cannibals = Kuru (3) Feeding other animal species to themselves = BSE & vCJD (4) Iatrogenic transmission (medical procedures), corneal transplants, cadaver human growth hormone etc.

# Signs and Symptoms of Scrapie

- ◆ Intense itching alleviated by rubbing against walls, trees etc.
- ◆ Rubbed off wool
- ◆ Tremors, staggers, blindness
- ◆ Always fatal



A sheep with scrapie...

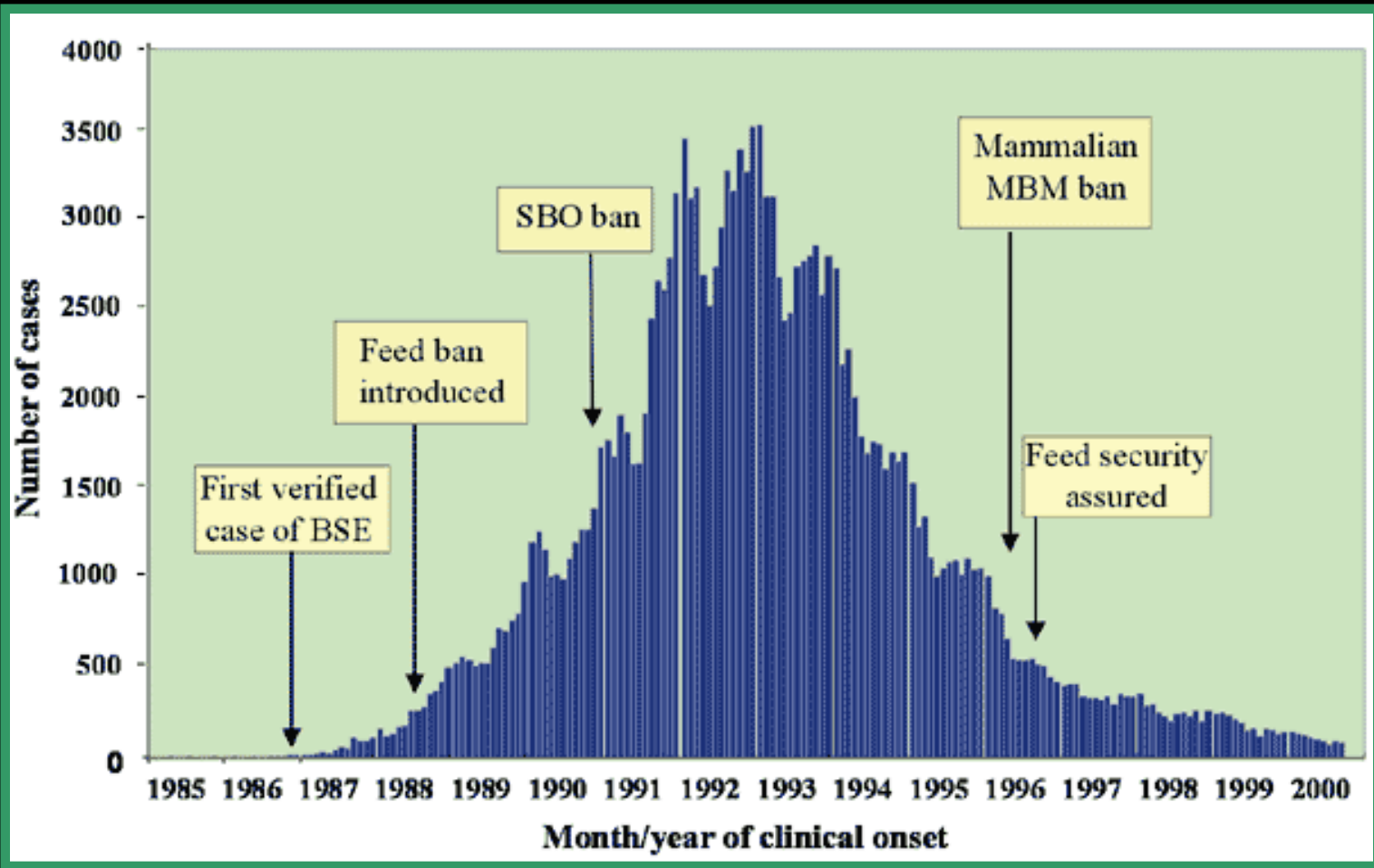
# Viroids and Prions

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## Prions

Mad cow disease – BSE (bovine spongiform encephalopathy)





First verified BSE case in 1986. First case of vCJD in 1994. Shorter incubation means that we are seeing the maximum number of cases at this time. A long incubation means that people who ate beef during the peak of the BSE epidemic will not show signs of infection until  $\sim 2004$  or so

# Viroids and Prions

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## Prions

F. RECENT WORK ON SCRAPIE, CJD AND KURU --

1. RAPID ASSAY WITH HAMSTERS

2. THE "PARTICLE" IS A

3. A DNA PROBE

ENCE -

4. THE HAMSTER

USING

ROBE

5. THE PRION G

6. THE "INFECT

A HOST

IN

7. HETERODIMER

TEIN

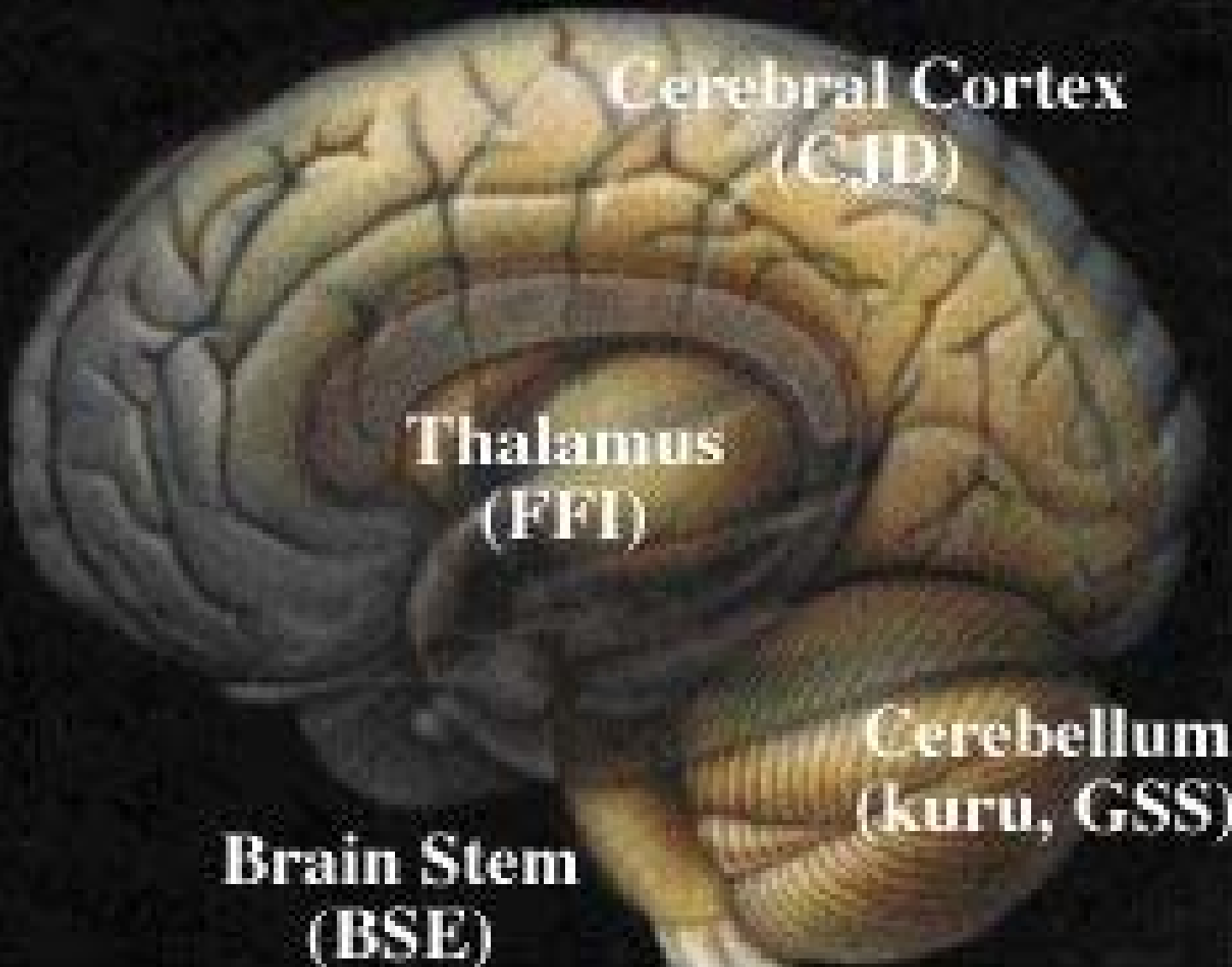
G. IS THERE A CUR

SEASE

H. BEEF, GREAT BR

AD COW

SE

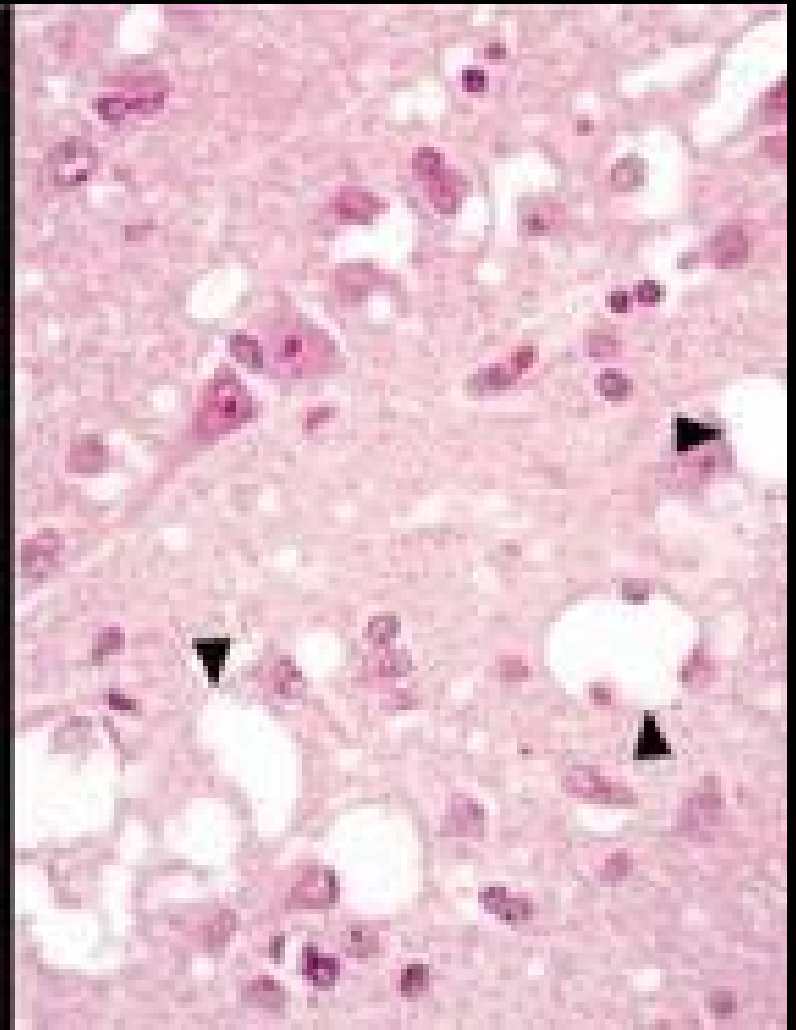
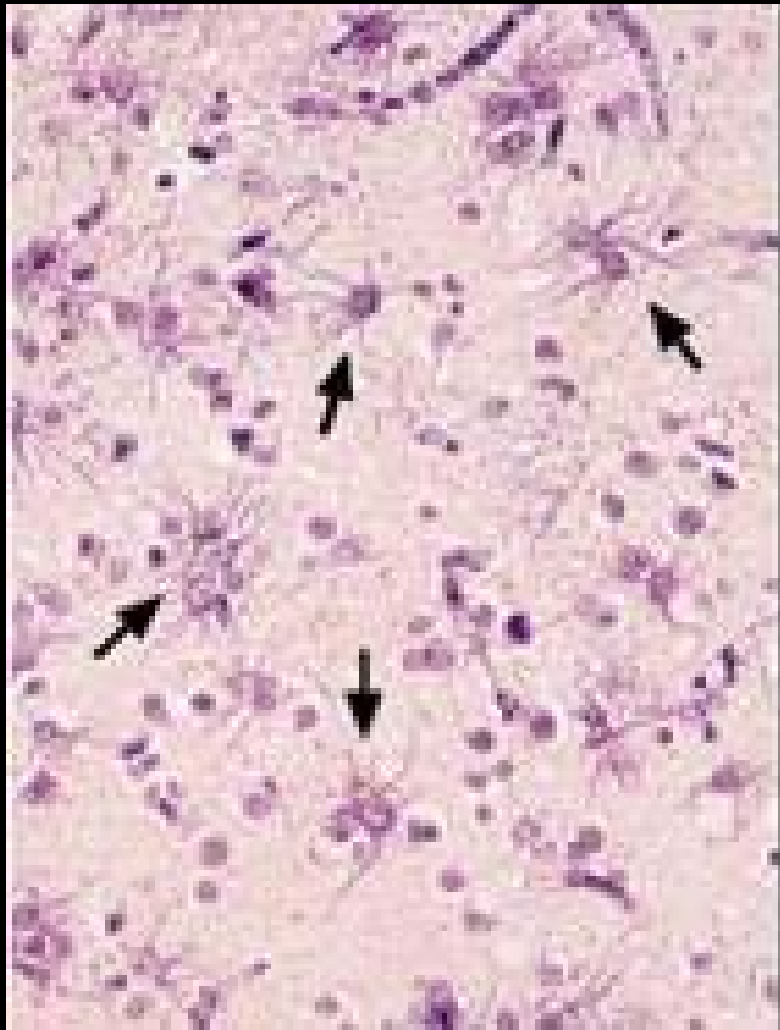


Cerebral Cortex  
(CJD)

Thalamus  
(FFI)

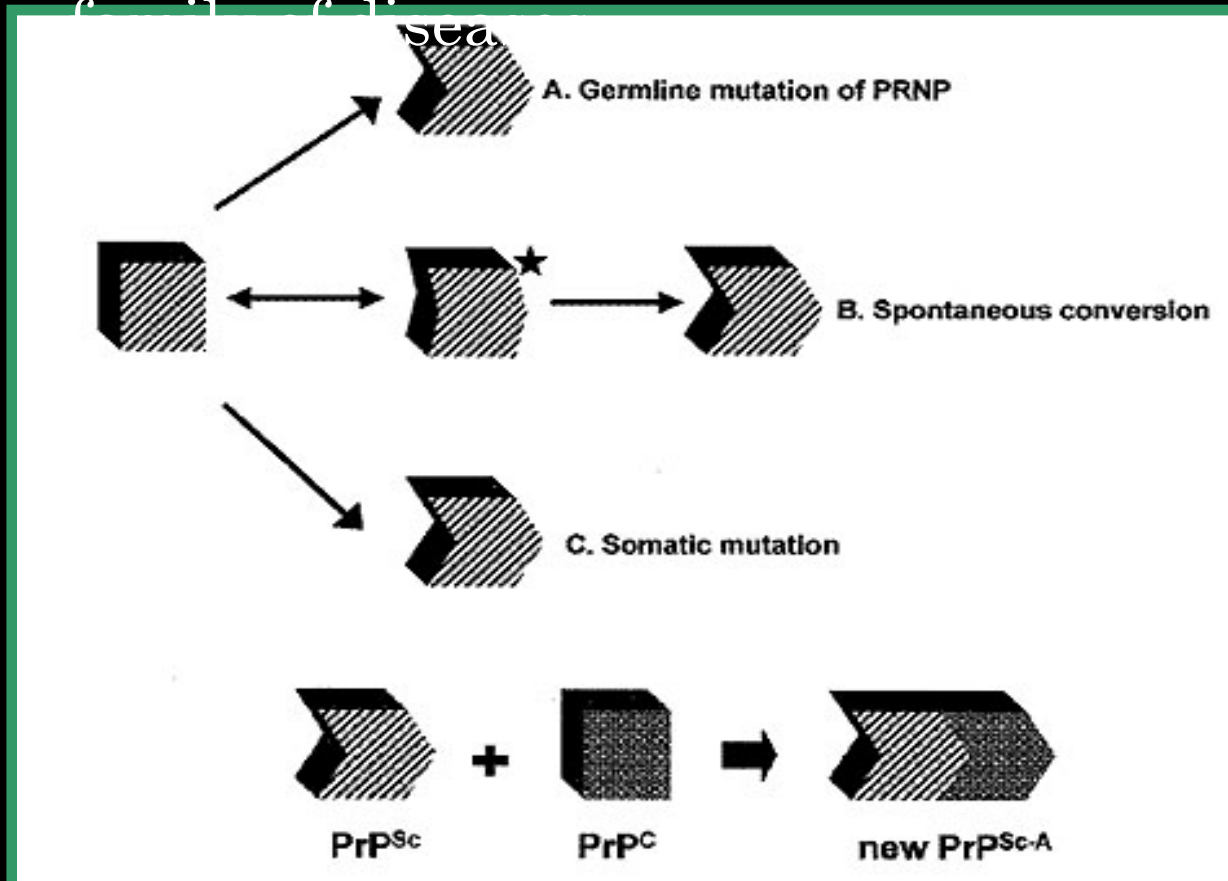
Cerebellum  
(kuru, GSS)

Brain Stem  
(BSE)

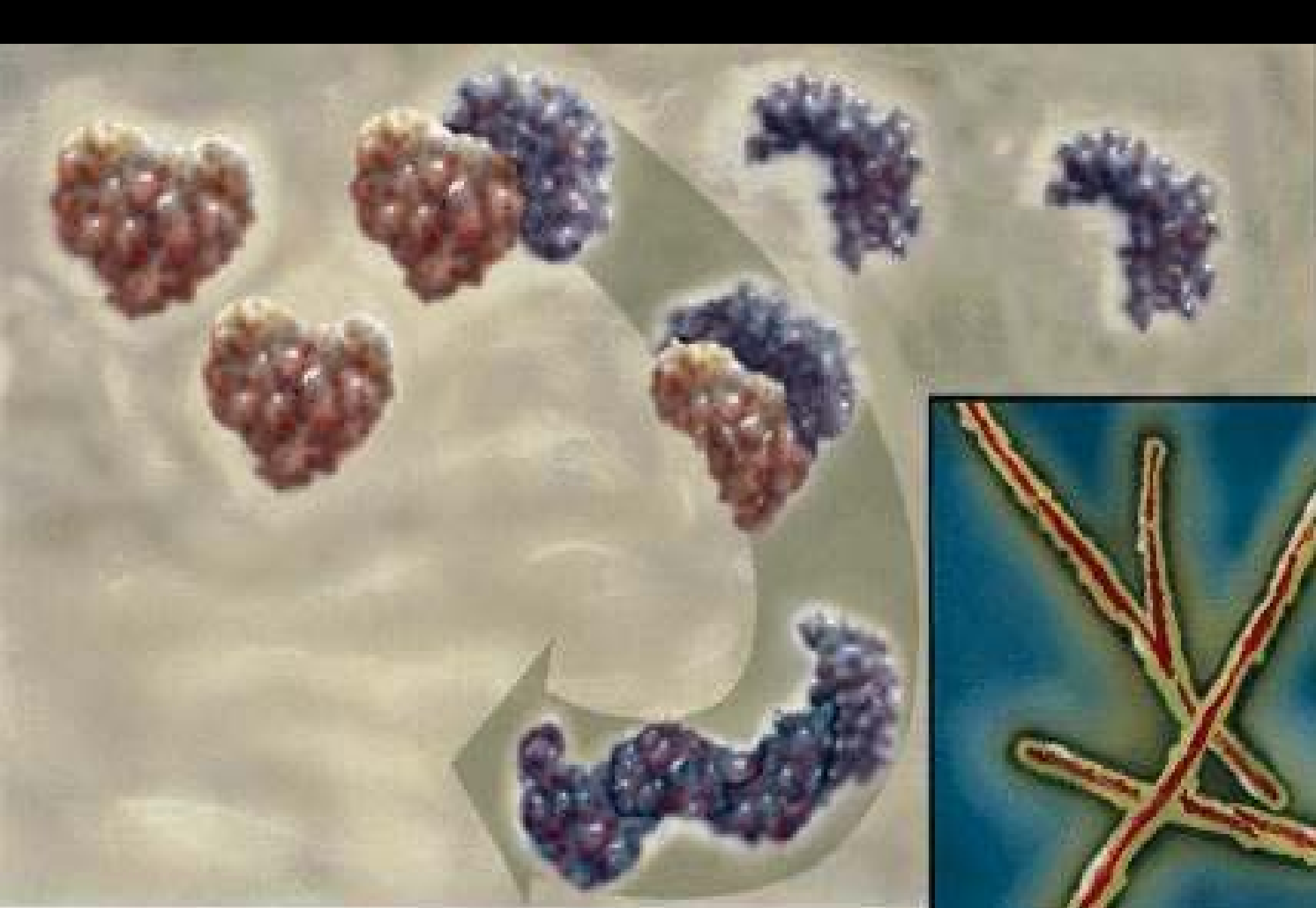


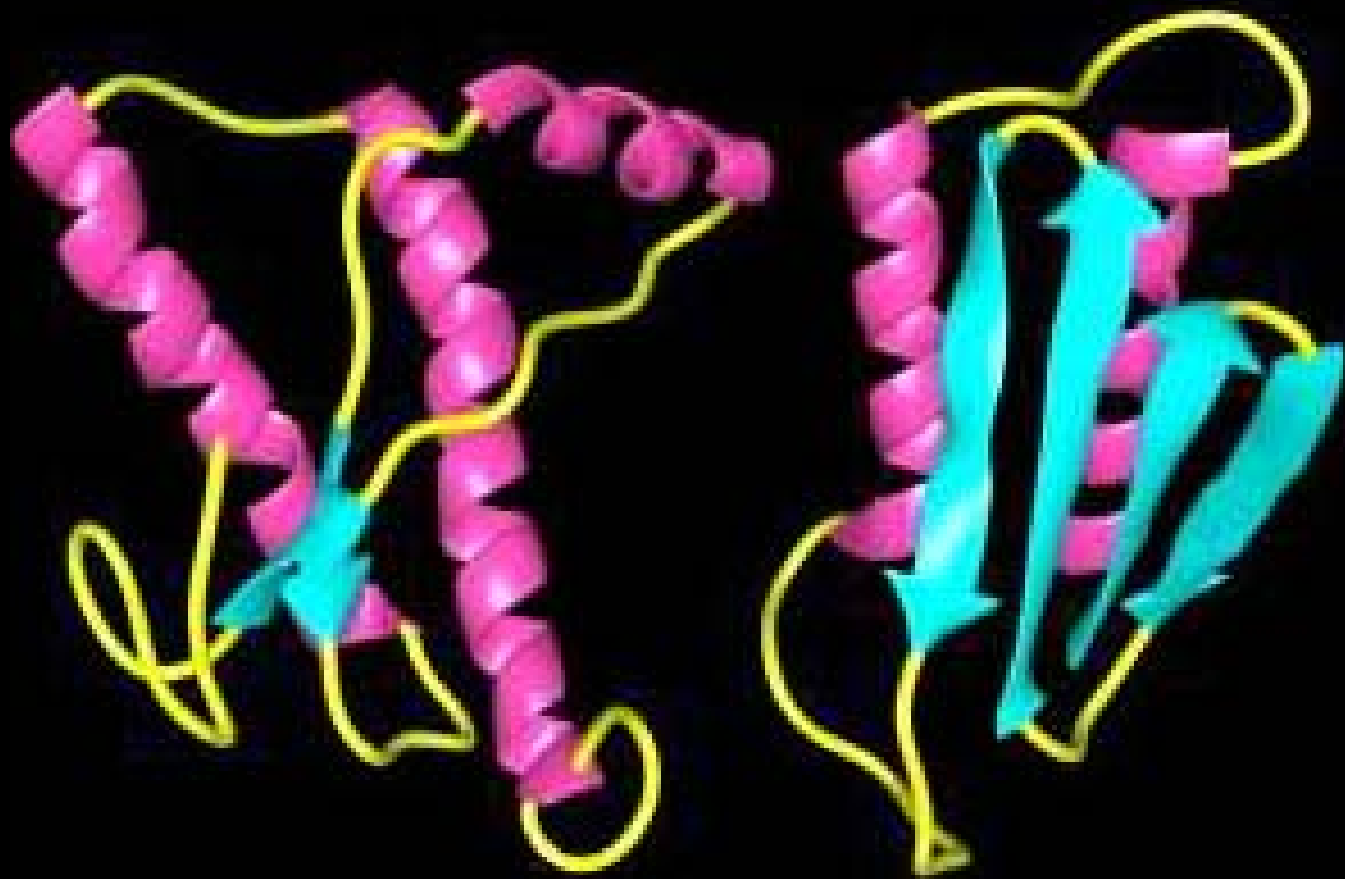
Once an abnormal form of the protein is either produced, consumed, or spontaneously changed, it acts as a template and causes other normal PrP<sup>c</sup> protein to change conformation into PrP<sup>sc</sup>

The PrP<sup>sc</sup> clumps together and causes holes and plaques in the brain = neurodegenerative symptoms of this



Conversion of PrP<sup>c</sup> to PrP<sup>sc</sup>





# Human Prion Gene Chromosome 20 not well localized

