| Virus Name: California encephalitis | Abbreviation: CEV |
|---|---|

Status
**Arbovirus**

Select Agent
**No**

SALS Level
**2**

SALS Basis
**Results of SALS surveys and information from the Catalogue.**

Other Information

Antigenic Group
**California**

## SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation
**BFS-283**

Accession Number

Original Date Submitted
7/20/1984

Family
**Bunyaviridae**

Genus
**Bunyavirus**

Information From
**Dr. W.C. Reeves**

Address
**School of Public Health, University of California, Berkeley, California**

Information Footnote
**Revised**

## Section II - Original Source

Isolated By (name)
**Hammon and Reeves (1)**

Isolated at Institute
**Hooper Foundation, Univ. of California**

Host Genus
**Aedes melanimon (dorsalis)**

Species

Host Age/Stage
**Imago**

Sex
**Female**

Isolated From

Isolation Details

Signs and Symptoms of Illness

Arthropod

Time Held Alive before Inoculation

Collection Method
**Principally aspiration from man-made shelters**

Collection Date
**6/12/1943**

Place Collected (Minimum of City, State, Country)
**Kern County, San Joaquin Valley, California,USA**

Latitude
**35° N**

Longitude
**119° W**

Macrohabitat

Microhabitat

Method of Storage until Inoculated
**Frozen on dry ice**

Footnotes

## Section III - Method of Isolation

Inoculation Date
**7/22/1943**

Animal (Details will be in Section 6)
**wn mice**

Route Inoculated
**Intracerebral**

Reisolation
**Yes**

Other Reasons

Homologous Antibody Formation by Source Animal

Test(s) Used

Footnotes

## Section IV - Virus Properties

Physicochemical
**RNA, Single Strand**

Pieces (number of genome segments)
**3**

Infectivity

Sedimentation Coefficients(s)
(S)

Percentage wt, of Virion Protein

Lipid

Carbohydrate

Virion Polypeptides: Number
**4 (20)**

Details
**Determined by polyacrylamide gel electrophoresis;designated VP-1, VP-2, VP-3, and VP-4,with MW of 17,500, 30,000,38,000, and 82,000 respectively. VP-2, VP-3 and VP-4 wereglycoproteins apparently associated with viral envelope (20).**

Non-virion Polypeptides: Number

Details

Virion Density
**1.18 gm/ml (21) in sucrose**

Sedimentation Coefficients(s)
**350 S (21)**(S)

Nucleocapsid Density
**1.26 gm/ml (21)**

Sedimentation Coefficients(s)
(S)

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**Stability of Infectivity (effects)**

pH (infective range)
**Reasonably stable pH 7-9 at 4dC (21)**

Lipid Solvent (ether - % used to test)
**50%**

After Treatment Titer
**<1.0 dex**

Control Titer
**5.3 dex (3)**

Lipid Solvent (chloroform)

After Treatment Titer

Control Titer

Lipid Solvent (deoxycholate)
**1:1000**

After Treatment Titer
**<1.0 dex**

Control Titer
**5.8 dex (3)**

Other (formalin, radiation)
**1:1000 after treatment titer reduced 2.1 dex (4)**

---

**Virion Morphology**

Shape
**Spherical**

Dimensions
**98 nm (2); 50 nm (5)**

Mean

Range

| | | |
|---|---|---|
| nm | nm | |
| Measurement Method<br>**Electron microscopy** | Surface Projections/Envelope | Nucleocapsid Dimensions, Symmetry |

**Morphogenesis**

| | | |
|---|---|---|
| Site of Constituent Formation in Cell | Site of Virion Assembly | Site of Virion Accumulation<br>**Found in cytoplasm in cell culture and mouse brain** |
| Inclusion Bodies | Other | |

**Hemagglutination**

| | | |
|---|---|---|
| Hemaggiutination<br>**Yes** | Antigen Source<br>**SMB ext. by sucrose-acetone** | Erythrocytes (species used)<br>**Goose** |
| pH Range<br>**5.8-6.6** | pH Optimum<br>**6.0, 6.2** | |
| Temperature Range<br>**24 - 37dC** | Temperature Optimum<br>**24 or 37dC** | |

Remarks
**Titer with virus strain BFS 283 usually 160 to 640. Some other strains produce poorer or no HA; enhanced by sonication.**

Serologic Methods Recommended
**CF, NT, HI**

Footnotes
**Titer with virus strain BFS 283 usually 160 to 640. Some other strains produce poorer or no HA; enhanced by sonication.**

## Section V - Antigenic Relationship and Lack of Relationship to Other Viruses

Originally determined to be new virus on the basis that there were no immunological relationships of any kind between CE virus and the following by the type of test or tests employed (NT, CF and/or vaccination challenge): WEE, EEE, SLE, JBE, WN, YF, ILH, RVF, CTF, ANA, ANB, WYO, BWA, Theiler's TO and GDVII, VSI, VSNJ, and herpes simplex [1] . The CAL group is indirectly related to the BUN group through GRO virus. GRO virus is related to the CAL group by HI (but not CF) and to the BUN group by CF (but not HI) [6] . Members of the CAL group also possess one-way relationships with BUT (SIM group) [7] and PAT (PAT group) viruses [8] . The relationship of members of the CAL group, BUT, and PAT to CE virus follows [6] - [11] .

| CE Antigen | | | | | | CE Antisera | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | HI | | CF | | NT | | HI | | CF | | NT |
| Immune Sera | Ht/Ho | Ratio | Ht/Ho | Ratio | Ht/Ho | Antigen | Ht/Ho | Ratio | Ht/Ho | Ratio | Ht/Ho |
| SH | 640/1280 | 1/2 | 32/256 | 1/8 | 2.0/5.5 | SH | 80/320 | 1/4 | 64/128 | 1/2 | 4.3/3.7 |
| LAC | 320/640 | 1/2 | 16/64 | 1/4 | 3.9/4.0 | LAC | 80/320 | 1/4 | 32/128 | 1/4 | 3.0/3.7 |
| TVT | | | 4/128 | 1/32 | 4.1/5.5 | TVT | | | 8/128 | 1/16 | 3.5/5.3 |
| KEY | | | 16/128 | 1/8 | | KEY | | | 64/128 | 1/2 | |
| SA | | | 32/64 | 1/2 | 4.4/5.0 | SA | | | 32/128 | 1/4 | 4.0/3.8 |
| JC | | | 8/64 | 1/8 | | JC | | | 32/128 | 1/4 | |
| TAH | 160/1280 | 1/8 | 32/256 | 1/8 | 2.4/4.2 | TAH | 640/640 | 1 | 32/128 | 1/4 | 3.6/4.1 |
| LUM | 320/320 | 1 | 64/128 | 1/2 | 2.8/4.4 | LUM | 160/640 | 1/4 | 32/128 | 1/4 | |
| MEL | | | 16/256 | 1/16 | 2.9/4.8 | MEL | | | 32/128 | 1/4 | 3.5/5.3 |
| INK | | | 256/512 | 1/2 | | INK | | | 8/128 | 1/16 | |
| GRO | 10/1280 | 1/128 | 0/256 | 0 | 1.6/4.3 | GRO | 10/320 | 1/32 | 0/128 | 0 | 1.6/5.3 |
| BUT | 40/320 | 1/8 | 0/128 | 0 | 2.0/>3.5 | BUT | <10/320 | >1/32 | 0/32 | 0 | 0.0/2.5 |
| PAT | <10/160 | >1/16 | <4/16 | >1/4 | 0.3/>5.4 | PAT | 10/80 | 1/8 | <4/>64 | >1/16 | |

SH=snowshoe hare, LAC=La Crosse, TVT=Trivittatus, KEY=Keystone, SA=San Angelo, JC=Jamestown Canyon, TAH=Tahyna, LUM=Lumbo, MEL=Melao, INK=Inkoo, GRO=Guaroa, BUT=Buttonwillow, PAT=Patois.

## Section VI - Biologic Characteristics

Virus Source (all VERTEBRATE isolates)

Lab Methods of Virus Recovery (ALL ISOLATIONS)
**Newborn mice, rabbit, ground squirrel, Vero cell cultures**

| Cell system (a) | Virus passage history (b) | Evidence of Infection | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | CPE | | | PLAQUES | | | Growth Without CPE |
| | | Day (c) | Extent (d) | Titer TCD50/ml (e) | Day (c) | Size (f) | Titer PFU/ml (e) | +/- (g) |
| Chick embryo (PC) | | | CPE | 4.0* | | No plaques (16) | | |
| Hamster kidney (PC) | | 3-4 | 4+ | 6.5 | | | | |
| KB (CL) | | | CPE | >4.0 | | | | |
| BS-C-1 (CL) | | | CPE | 4.0 | | | | |
| Vero (CL) | | 3-4 | 4+ | | 3-4 | | | |
| XC (CL) | | Supported viral growth although to a lesser extent than nucleated cells (22) | | | | | | |
| Ae dorsalis (CL) | SM 5 | | | | | | | + **(23) |
| Cx tarsalis (CL) | | | | | | | | + (24) |

* Expressed in dex

** CE virus produced temperature sensitive mutants after persistent infection of Ae dorsalis cell culture (28).

## Section VII - Natural Host Range (Additional text can be added below table)

| Vertebrate (species and organ) and arthropod | No. isolations/No. tested | No. with antibody/No. tested Test used | Country and region |
|---|---|---|---|
| Culex tarsalis | 1/* | | California, USA (1) |
| Aedes melanimon (dorsalis) | 2/* | | |
| Aedes vexans | 2/5,064 | | New Mexico, USA (12) |
| Aedes nigromaculis | 2 | | Texas, USA (12) |
| Psorophora signipennis | 3 | | |
| Culiseta inornata | 2/750 | | New Mexico, USA (12) |
| Aedes dorsalis | 9 | | Utah, USA (12) |
| Aedes melanimon | >1 | | Owen Valley, CA, USA (27) |
| Culiseta inornata | 1 | | Manitoba, Canada(29) |

* Hundreds of thousands 1943-1964

Neutralizing and HI antibodies reported from man and lower vertebrates of USA, Canada and Argentina but since extensive overlapping occurs with antibody to other group members, they cannot be attributed to CE virus.

## Section VIII - Susceptibility to Experimental Infection (include viremia)

| Experimental host and age | Passage history and strain | Inoculation Route-Dose | Evidence of infection | AST (days) | Titer log10/ml |
|---|---|---|---|---|---|
| Mice (nb) | BFS-283 | ic 0.1 | CNS signs and death(1) | 2-3 | 6.5-7.5 |
| Mice (nb) | mouse adapted; | ip 0.05 | CNS signs and death | 2-3 | 6.5-7.5 |
| Mice (nb) | terminal dilution | sc | | | |
| Mice (wn) | purified | ic 0.03 | CNS signs and death | 3-6 | 6.0-7.0 |
| Mice (wn) | purified | ip 0.25 | Fatal for about 2/3 | 6-10 | 1.0-2.0 |
| hamsters (3-4 wk) | BFS-283 | ic 0.1 | Death(1) | | Unk-6.0-7.0 |

| | | | | | |
|---|---|---|---|---|---|
| hamsters (3-4 wk) | BFS-283 | ic 0.1 | Death(1) | | Unk. 6.0-7.0 |
| hamsters(3-4 wk) | | ip,sc 0.3 | Irregular deaths(1) | | 1.0-2.0 |
| guinea pigs (ad) | | ic 0.1 | No illness but antibody (1) | | |
| cotton rats (ad) | | ic 0.1 | Death(1) | | >5.0 |
| rabbits(ad) | | ic,sc 0.2 | Viremia and antibody only(13) | | |
| rabbits(6 wk | | sc 0.1 | Viremia and antibody only(13) | | |
| ground squirrels (ad) | | sc 2.0 | Viremia and antibody only(1) | | |
| cow(immature) | | sc,in 4.0 | Antibody, no viremia(1) | | |
| chickens(immature) | BFS-283 and 91 | sc 0.2 | No viremia or antibody(1) | | |
| monkeys (immature) | | ic 0.5 | No illness but antibody (1) | | |
| monkeys(immature) | BFS-283 | im 4.0(x3) | No illness but antibody (14) | | |
| chick embryo(8-14 day) | | many | Multiplication, irreg. deaths(1) | | |
| dog | | iv | Antibody(15) | | |
| hog (4 mo) | | iv | No viremia(15) | | |
| A. nelsoni (ad) | | sc 1000PFU | 2/5 [a] viremia and antibody only | | 2.2 |
| C. beecheyi (ad) | | sc 1000PFU | 4/5 viremia and antibody only | | 3.3 |
| D. nitratoides (ad) | | sc 1000PFU | 7/10 viremia and antibody only | | 2.8 |
| L. californicus (ad) | | sc 1000PFU | 5/5 viremia and antibody only | | 5.1 |
| P. maniculatus (ad) | | sc 1000PFU | 1/10 viremia; 8/8 antibody | | 3.2 |
| S. auduboni (ad) | | sc 1000PFU | 10/10 viremia and antibody only | | 5.4 |

[a] Number infected/number inoculated

## Section IX - Experimental Arthropod Infection and Transmission

| Arthropod species & virus source(a) | Method of Infection log10/ml (b) | | Incubation period (c) | | Transmision by bite (d) | | Assay of arthropod, log10/ml (e) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Feeding | Injected | Days | °C | Host | Ratio | Whole | Organ | System |
| Aedes varipalpus, | | | | | | | | | |
| Cx tarsalis, Cs inornata | | | Susceptible to infection | | | | | | |
| Aedes melanimon | | | Susceptible to infection and capable of transmission(17) | | | | | | |
| Aedes dorsalis (Ft.Baker) | X | X | Transovarial transmission (TOT) demonstrated(26) * | | | | | | |
| Aedes dorsalis (Utah) | ND | X | Transovarial transmission (TOT) demonstrated(26) | | | | | | |
| Aedes melanimon (Sac.Val. CA) | X | X | Transovarial transmission (TOT) demonstrated(26) | | | | | | |
| Aedes melanimon (Kern Co.CA) | ND | X | Transovarial transmission (TOT) demonstrated(26) | | | | | | |

* Transmission by F4 TOT infected progeny to suckling mice demonstrated

Field collected or colony reared Ae dorsalis, Ae melanimon, Ae triseriatus and Cx tarsalis infected with CE by intrathoracic inoculation or ingestion did not recover from exposure to CO2 gas (25).

## Section X - Histopathology

Character of lesions (specify host)
**Monkey, ic: inflammatory lesions in thalamus, mesencephalon, pons, medulla, cerebellum, and spinal cord (14). Mouse, ic: neuronal necrosis in rhinencephalon, diencephalon, cerebral cortex, mesencephalon, and pons; perivascular cuffing, congestion and hemorrhage (18)**

Inclusion Bodies — Intranuclear

Organs/Tissues Affected

Category of tropism

## Section XI - Human Disease

In Nature — Residual — Death
**Reported**

Subclinical — Overt Disease

Clinical Manifestations
**Fever (R), headache (R), stiff neck (R), CNS signs (including encephalitis) (R), CNS pleocytosis (R), and vomiting (R)**

Number of Cases
**3 serologically diagnosed in 1945 (19)**

Category (i.e. febrile illness, etc.)
**Encephalitis**

## Section XII - Geographic Distribution

Known (Virus detected)
**California; Utah; New Mexico; Texas, USA, Manitoba, Canada**

Suspected (Antibody only detected)

## Section XIII - References


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## Remarks