

Status: Arbovirus

SALS Level: 2

Antigenic Group: A

Taxonomic status: *Alphavirus*

Other Information: None.

Select Agent:

SALS Basis: S

HEPA Filtration:

**Section I - Full Virus Name and Prototype Number****Full Virus Name:****Fort Morgan****Prototype Number:**

73V4009

**Information from:** D.B. Francy

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**Date:**

10/1/1984

**Address:** Vector-Borne Diseases Division, Center for Disease Control, Fort Collins, Colorado

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Reviewed by editor

**Section II - Original Source****Isolated by:** Vector-Borne Diseases Division (1)**at:** CDC, Fort Collins, Colorado**Genus and species:** Oeciacus vicarius Horvath (Hemiptera: Cimicidae), pool of 25 **Sentinel X****Age/Stage:** Adult**Sex:** ?

Isolated From	Isolation detail
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**Signs and symptoms of illness:**Arthropod engorged      depleted       gravid

Time held alive before inoculation: 2 weeks at 22 +- 2dC

Collection date: 9/26/1973      **Method:** Hand collection from cliff swallow nests

Place collected: Bijou Bridge, Morgan County, Colorado

Latitude: 40° 16' " N      **Longitude:** 103° 45' " W

Macrohabitat: Concrete bridge over cottonwood-lined stream in irrigated farmland, S. Platte River Basin

Microhabitat: Nest of cliff swallow occupied by house sparrows

Method of storage until inoculated: Held with nest material in plastic sack at room temperature.

Footnotes:

**Section III - Method of Isolation and Validity****Inoculation Date:** 9/1/1973**Animal:**      **Embryonated egg:**      **Tissue Culture:** X

(Details in Section VI - Biologic Char.)

**Route inoculated:**      **Reisolation:**

Other reasons: Different from all other alphaviruses in laboratory by serologic and physicochemical tests

Homologous antibody formation by source animal (See Section II):

Test used: HI      CF      NT

Other:

Footnotes:

## Section IV - Virus Properties

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### Physicochemical:

RNA: X DNA: Single Strand: X Double Strand:  
Pieces: Infectivity: Sedimentation coefficient(s): /strong>  
Percentage wt. of virion protein , lipid carbohydrate  
Virion polypeptides:  
Number: 3 (2) Details: E1 glycoprotein, MW 58,000, pI 7.8; E2 glycoprotein, MW 47,000, pI 9.2; C (nucleocapsid), MW 30,000  
Non-virion polypeptides:  
Number: Details:  
Virion density:  
Nucleocapsid density Sedimentation coefficient:  
Sedimentation coefficient:

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### Stability of infectivity (effects) pH 2.0-4.0 inactivates 5.0 dex Vero PFU infectivity

Lipid solvent:  
(ether) After treatment titer Control titer  
(chloroform) After treatment titer Control titer  
Detergent:  
(deoxycholate) 1:1000 After treatment titer <2.0 dex Control titer 5.4 dex  
Other (formalin, radiation):

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### Virion morphology:

Shape Spherical Dimensions  
Mean (nm) range (nm) 55-60 nm how measured Thin-section electron microscopy (3)  
Surface projections, envelope Spikes  
Nucleocapsid dimensions, symmetry Isometric

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### Morphogenesis:

Site of constituent formation in cell Cytoplasm (nucleocapsids accumulate in nucleus late in infection)  
Site of virion assembly Cytoplasmic and plasma membranes  
Inclusion bodies  
Other

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### Hemagglutination:

Hemagglutination Yes Antigen source Primary duck embryo, Vero cells, SMB  
Erthrocytes Goose pH range 5.9-6.4 pH optimum 6.0  
Temperature optimum 37dC range  
Remarks  
Serologic methods recommended HI, CF, NT  
Footnotes:

**Section V - Antigenic Relationship And Lack of Relationship To Other Viruses**

Antigen or Antibody of Indicated Virus	Fort Morgan Antigen*			Fort Morgan Antibody*		
	HI	CF	NT	HI	CF	NT
Fort Morgan	40	256	320	40	256	320
WEE (Fleming)	320/320	128/1024	/640	10/40	128/256	/320
Y62-33	320/640	128/512	80/640	/40	128/256	/320
HJ	20/80	8/64	/320	10/40	32/256	/320
Sindbis	320/640	128/512	/160	/40	64/256	/320
Whataroa	20/	/32	/160	ND	/256	/320
Aura	20/80	/64	20/160	/40	/256	/320
Chikungunya	40/160	/256	/>640	/40	/256	/320
Mayaro	/40	/32	/160	/40	/256	/320
Semliki Forest	/640	/64	/>640	/40	/256	/320
Una	/	/16	/40	ND	/256	/320
O'nyong nyong	/40	/32	/160	/40	/256	/320
Middleburg	/	/16	/320	ND	/256	/320
EEE	/80	/128	/>640	/40	/256	/320
VEE IA	/160	8/128	/>640	/40	/256	/320
IB	/80	/64	/320	/40	/256	/320
IC	/640	/64	/>640	/40	/256	/320
ID	40/80	16/128	/160	/40	/256	/320
IE	/80	/64	/160	/40	/256	/320
II	/640	/256	/>640	/40	64/256	/320
III	/160	/32	/160	/40	/256	/320
IV	/>640	/256	20/160	/40	/256	/320
Bijou Bridge (CM4-146)	10/640	/64	/640	/40	/256	/320

\* Ht/Ho; - = <10 HI, NT; <8 CF

## Section VI - Biologic Characteristics

**Virus source (all VERTEBRATE isolates):** Serum (LV), brain (LV)

**Lab Methods of Virus Recovery (ALL ISOLATIONS):** Plaque formation in primary duck embryo or Vero cell cultures; ic inoculation of newborn mice unsatisfactory for primary isolation

**Susceptibility of Cell Culture Systems:**

Cell system (a)	Virus passage history (b)	Evidence of Infection									
		CPE			PLAQUES						
		Day (c)	Extent (d)	Titer TCD50/ml (e)	Day (c)	Size (f)	Titer PFU/ml (e)				
Duck embryo (PC)	unpass.	2-3	4+		2-3	2-4 mm					
	DE 1 Vero 1, Vero 5						5.7**				
Vero (CL)		2-3	4+		2-3	2-4 mm	7.8				
Aedes albopictus (CL)						No plaques	<2.0	+ -			
L929 (CL)											

\*\* Expressed in dex

## Section VII - Natural Host Range

Vertebrate (species and organ) and arthropod	No. isolations/No. tested	No. with antibody/No. tested Test used	Country and region
Oeciacus vicarius	154/28,453 (1,201 pools)		NE Colorado, USA
Oeciacus vicarius	6/880 (18 pools)		South Dakota (Bon Home Co.), USA
Oeciacus vicarius	1/8,068 (100 pools)		West Texas, USA
Oeciacus vicarius	2/590 (14 pools)		Washington (Bent Co.), USA
P. pyrrhonota nestling (serum/brain)	14/291		NE Colorado, USA
P. pyrrhonota adult		43/296 NT	
P. domesticus nestling (serum/brain)	127/1,171		
P. domesticus adult		64/312 NT	
Dipodomys ordii		3/64 NT	
Peromyscus maniculatus		1/41 NT	
Perognathus flavus		0/7 NT	
Mus musculus		0/4 NT	
Sylvilagus sp.		0/7 NT	

## Section VIII - Susceptibility To Experimental Infection (Record Viremia)

Experimental host and age	Passage history and strain	Inoculation Route-Dose	Evidence of infection	AST (days)	Titer log10/ml		

Mice (nb)	Unpass.; Vero 1, or Vero 5	ic	Viral growth in CNS, other tissues *			
Mice (nb)		ip	Viral growth in CNS, other tissues *			
Mice (nb)		sc				
Mice (wn)		ic	Antibody			
Mice (wn)		ip	Antibody			
hamsters (nb)		ic	Death	4.0	7.1	
hamsters (nb)		ip	Death	4.0	6.4	
hamsters (wn)		ic	Paralysis, scattered deaths			
hamsters (wn)		ip	Antibody, paralysis, occasional death			
Passer domesticus						
nestling		sc	Viremia, occasional death (5)			
adult		sc	Viremia			
Petrochelidon						
pyrrhonota: nestling		sc	Viremia			
pyrrhonota: adult		sc	Viremia			

\* and variable mortality: 5-10% for unpassaged, 20-80% for Vero 5 passaged virus at all dilutions 5-7 days after inoculation.

## Section IX - Experimental Arthropod Infection And Transmission

Arthropod species & virus source(a)	Method of Infection log10/ml (b)		Incubation period (c) Days	Transmission by bite (d)		Assay of arthropod, log10/ml (e)		
	Feeding	Injected		°C	Host	Ratio	Whole	Organ

O. vicarius bugs fed on suspensions of Fort Morgan virus containing 4.5-6.9 logs were shown to contain virus after up to 312 days. Infected bugs transmitted the virus after 33 and 47 days incubation to nestling sparrows. Infection and transmission was demonstrated after 2 and 312 days incubation in bugs held at temperatures simulating hibernation.

Culex tarsalis and Cx pipiens pipiens fed on virus (suspensions and viremic hosts) and held for 9-23 days at 22-24°C contained no detectable virus. Minimal levels (1-1.3 dex PFU/ml) were detected in a small proportion of the mosquitoes after intrathoracic inoculation of virus.

Culiseta melanura and Cs inornata did not become infected after oral feeding (pledget suspensions, 6.3 dex/ml) but following intrathoracic inoculation apparent replication to higher levels than in Culex mosquitoes was observed.

## Section X - Histopathology

**Character of lesions:** Inflammation, necrosis in brain, spinal cord, skeletal muscle of infected infant mice.

**Inclusion bodies:**

**Cytoplasmic:**(M)

**(LV)**

**Intranuclear:** (M)

**(LV)**

**Organs-tissues affected:** Brain and cord: lymphocytic perivascular cuffing, endothelial cell swelling, diffuse gliosis, focal necrosis, neuronal degeneration Striated muscle: degeneration and necrosis of myofibers, calcification.

**Category of tropism:** Neuromuscular

## Section XI - Human Disease

<b>Human disease:</b>	<b>In nature:</b>	(S) (R)
	<b>Death:</b>	(S) (R)
	<b>Residua:</b>	(S) (R)
<b>Laboratory infections:</b>	<b>Subclinical:</b>	(S) (R)
	<b>Overt Disease:</b>	(S) (R)

**Clinical manifestations:**

**Category:** **No. of cases:**

## Section XII - Geographic Distribution

**Known (virus):**

Colorado; South Dakota; Texas; Washington, U.S.A.

## Section XIII - References

1. Hayes, R.O. et al. 1977.. J. Med. Ent. 14:257-262.
2. Trent, D.W. et al. 1980. J. Gen. Virol. 47:261-282.
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4. Calisher, C.H. et al. 1980. Am. J. Trop. Med. Hyg. 29:1428-1440.
5. Monath, T.P. et al. 1980. Am. J. Trop. Med. Hyg. 29:969-983.
6. Rush, W.A. et al. 1980. Ann. Ent. Soc. Am. 73:315-318.

## Section XIV - Remarks