Virus Name: **Eastern equine encephalomyelitis** **Abbreviation:** **EEEV**

Status: Arbovirus **Select Agent:** No
SALS Level: 2 **SALS Basis:** S **HEPA Filtration:**
Antigenic Group: A
Taxonomic status: *Alphavirus*
Other Information: USDA permit required, USDA high consequence agent, Department of Commerce permit required, vaccination recommended.

Section I - Full Virus Name and Prototype Number

Full Virus Name: **Prototype Number:**
Eastern equine encephalomyelitis
Information from: Roy W. Chamberlain **Date:**
* 4/5/1985
Address: Arbovirology Unit, Center for Disease Control, Atlanta, Georgia 30333, USA
*
Reviewed by editor

Section II - Original Source

Isolated by: Ten Broeck and Merrill (1) and / Giltner and Shahan (2) **at:** Rockfeller Ins., Princeton, NJ / USDA, Bur. Animal Ind.
Genus and species: Horse **Sentinel** X
Age/Stage: Adult **Sex:**

Isolated From	Isolation detail

Signs and symptoms of illness: High fever, incoordination, hyperirritability, convulsions; death frequently
Arthropod engorged **depleted** **gravid**
Time held alive before inoculation: 24-48 hrs after onse
Collection date: 8/1/1933 **Method:** Autopsy
Place collected: Delaware; Virginia; Maryland, USA
Latitude: 40° ' " N **Longitude:** 75° ' " W
Macrohabitat: Coastal areas
Microhabitat:
Method of storage until inoculated: Not recorded
Footnotes:

Section III - Method of Isolation and Validity

Inoculation Date: 1/1/1933
Animal: gp **Embryonated egg:** **Tissue Culture:**
(Details in Section VI - Biologic Char.)
Route inoculated: Intracerebral **Reisolation:**
Other reasons: Isolations and identifications performed independently by Ten Broeck and Merrill; Giltner and Shahan
Homologous antibody formation by ***source animal*** **(See Section II):**
Test used: HI **CF** **NT**
Other:
Footnotes:

Section IV - Virus Properties

Physicochemical:
RNA: X **DNA:** **Single Strand:** X **Double Strand:**
Pieces: **Infectivity:** No **Sedimentation coefficient(s): /strong>**
Percentage wt. of virion protein 49%**, lipid** 54% **carbohydrate** 4.0%; 4.4% RNA (4)
Virion polypeptides:
Number: **Details:**
Non-virion polypeptides:
Number: **Details:**
Virion density:
Sedimentation coefficient:
Nucleocapsid density **Sedimentation coefficient:**

Stability of infectivity **(effects) pH**
Lipid solvent:
(ether) **After treatment titer** <3.0 dex **Control titer** 8.0 dex (5)
(chloroform) **After treatment titer** **Control titer**
Detergent:
(deoxycholate) **After treatment titer** 0 dex **Control titer** 4.5 dex (7)
Other (formalin, radiation): 1:1000 deoxycholate: 5.5 dex inactivation (6)

Virion morphology:
Shape **Dimensions** 40-47 nm; 55 nm (25)
Mean (nm) **range (nm)** **how meansured** Electron microscopy (3)
Surface projections, envelope Envelope present
Nucleocapsid dimensions, symmetry Virus nucleoids = 28 nm diameter (25)

Morphogenesis:
Site of constituent formation in cell
Site of virion assembly Budding through plasma membranes (25)
Inclusion bodies
Other

Hemaggiutination:
HemaggiutinationYes **Antigen source** SMB ext. by acetone-ether or sucrose-acetone
Erthrocytes Goose **pH range** 5.9-6.5 **pH optimum** 6.2
Temperature optimum 37dC **range** 4dC- 37dC
Remarks
Serologic methods recommended HI, CF, NT
Footnotes:

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

The following information was extracted from Casals [9] :

Immune Sera*	Antigen of registered Virus		Antigens	Immune serum of registered virus*	
	HI			HI	
	Ht/Ho	Ind		Ht/Ho	Ind
Chikungunya	N.D./1280+		Chikungunya	40/10,240	1/256
Mayaro	40/1280	1/32	Mayaro	20/10,240	1/512
Semliki	40/2560	1/64	Semliki	20/10,240	1/512
Sindbis	80/1280	1/16	Sindbis	20/10,240	1/512
WEE	80/10,240	1/128	WEE	160/10,240	1/64
VEE	160/640+	1/4+	VEE	80/10,240	1/128

* Hyperimmune mouse sera

The above data demonstrate the antigenic relationship of EEE with representative members of the group, using hyperimmune sera. There is generally less crossing by CF: the NT is most specific. For antigenic relationship to other members of Group A, consult their respective catalogue cards and see References [9] , [26] - [29] .

EEE virus has been antigenically classified as a distinct virus type and is considered not to be closely related to any of the other alphaviruses [30] .

North American and South American antigenic varieties of EEE virus exist in nature; and they usually are distinguished by specialized serological techniques [21] , [22] .

Section VI - Biologic Characteristics

Virus source (all VERTEBRATE isolates): Blood (M)(LV), CNS (M)(LV), heart (LV), liver (LV), spleen (LV); can be isolated from many tissues of exp. infected birds and small mammals
Lab Methods of Virus Recovery (ALL ISOLATIONS): Newborn and weanling mice, baby chicks (<1-day old), chick embryos, hamsters, guinea pigs; primary avian andhamster kidney cell cultures
Susceptibility of Cell Culture Systems:

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)		1-2	CPE	9.0-10.0**		Plaques	9.0-10.0**			
Hamster kidney (PC)		1-2	CPE	9.0-10.0						
Duck embryo (PC)					3-5	Plaques	10.5-11.5			
BHK-21 (CL)	P-471	1	4+	10.5 (31)						
Vero (CL)	P-22				2	11 mm	10.1 (32)			
LLC-MK2 (CL)					3	3 mm	9.7 (32)			

** 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
Man: About 25 isolations in Massachusetts, New Jersey, Louisana, Gulf Coast States (brain). One from blood (10). Antibody in 8-9% in endemic areas of US and Panama; up to 29% in Brazil; 17% in Dominican Republic, 1948-49. One death in Czechoslavakia (18).			
Horses: Several hundred isol.(brain); Antibody in >0% in some enzootic areas.			
Pheasants (Eastern US): Over 100, mostly from brain.			
Wild birds: Many isol. (blood, also liver and spleen). Antibody rate high in residents of enzootic areas. At least 86 species susceptible; none known not susc. (11).			
Wild rodents: 2 isol.: white-footed mice in N.J., Nov. 30 (blood) and Dec. 27, 1962 (brain); antibody in white-footed mouse and meadow vole (12). Several isol. in Brazil from Oryzomys, Proechimys, and Marmosa (13). From Apodemus in Czechoslavakia (18). Dog (puppy): Isolation (brain) NW Florida.			
Monkey: one isol. (brain), Philippine Is. (14).			
Goat: 2/14 immune, Dominican Republic, 1949.			
Cows: 6/17 immune, Dominican Republic 1949.			
Arthropods *: Numerous isol. from mosquitoes in endemic areas; few from other arthropods. U.S. Main vector for birds, Culiseta melanura. Also from An crucians, Cq pertubans, Cx restuans, Cx salinarius, Cx quinque-salinarius, Ae vexans, Cx nigripalpus, Ae mitchellae, Ae fulvus pallens, Ae sticticus, Ae atlanticus; Culicoides sp., Eomenocanthus stramineus, Dermanyssus gallinae, Eusimulium johannseni, Simulium meridionale.			
Other areas: Ae taeniorhynchus, Cx taeniopus (Brazil): Cx taeniopus, Cx nigripalpus (Trinidad); Cx pipiens quinquefasciatus (Bangkok, Thailand (16)). Aedes sollicitans 3/470 ** isolations, So. coastal areas, New Jersey, USA ().			

* Compiled from many sources; incomplete listing.

** Isolations during epizootic period in 1982.

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)	Ar 167 P-3	ic 0.02	Paralysis, death	2-3	10.5-11.0
Mice (nb)		ip 0.03	Paralysis, death	2-4	10.5
Mice (nb)		sc			
Mice (wn)		ic 0.03	Paralysis, death	2-4	9.5-10.5
Mice (wn)		ip 0.03	Paralysis, death	4-7	7.5-9.0
chicks (1/2 day)		sc 0.03	Weakness, prostration, death	20-36hr	11.0-11.5
chicks (7 day)		sc 0.03	Occasional death		
guinea pig (3-4 wk)		ic 0.1	Paralysis, death	2-5	
embryonated eggs (10 day)		al.c. 0.1	Death, gen.hem., necrosis	22-36hr	8.5-9.0
"" (7 day)		ys 0.1	Death, gen.hem., necrosis	22-36hr	8.5-9.0
"" (13 day)		am.s. 0.03	Death, gen.hem., necrosis	22-36hr	10.5-11.5
Many wild birds sp (all ages)		sc 0.03	Death or inapparent infection; viremia		
Misc. reptile species (all ages)	GA,CE 2-9	sc 0.03	Erratic viremias and antibody responses. Average viremias: 12 days, with titers of 2.0 to 10.5 dex/ml (15).		

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
Misc. arthropods of several orders, larvae and adults, successfully infected by parenteral inoculation; serial passage of virus achieved regularly. No ill effects observed in arthropods; virus yields obtained of up to >8.0 dex based on body weight.									
Many mosquito species susceptible, including Aedes, Psorophora, Culiseta, Mansonia, Culex, Wyeomyea, Orthopodomyia; some Culex refractory; Anopheles poor transmitters.									
-	-	-	-	-	-	-	-	-	-

Section X - Histopathology

Character of lesions: Path. of nat. occurring infections in man and horse confined mostly to CNS. Acute lesions: ill-defined foci of polymorphonuclear leucocytic infiltration, neuronal necrosis. Lesions most in frontal cortex, decrease caudally. Round cells replace polys in older lesions. Exp. infections similar except mice show lessened leukocytic response. Birds may show encephalitis or hepatic necrosis in absence of encephalitis.
Inclusion bodies:
Cytoplasmic:(M) **(LV)** **Intranuclear: (M)** **(LV)**
Organs-tissues affected: Brain (M)(LV)
Category of tropism: Neurotropic and/or viscerotropic

Section XI - Human Disease

Human disease:	**In nature:**	**(S)** X	
	Death:	**(S)** X	
	Residua:	**(S)** X	
Laboratory infections:	**Subclinical:**	**(S)**	**(R)** X
	Overt Disease:	**(S)**	**(R)**

Clinical manifestations: Fever (S), headache (S), prostration (S), stiff neck (S), myalgia(S), arthralgia (S), CNS signs (including encephalitis)(S), leukopenia (S); coma
Category: Encephalitis **No. of cases:** Approximately 100

Section XII - Geographic Distribution

Known (virus):

Eastern USA, Panama, Trinidad, Dominican Republic, Guyana, Brazil; Philippine Islands (14), Argentina (17), Thailand (16), and Czechoslovakia (18), eastern Canada (19), Colombia (23)

Suspected (antibody):

Eastern Canada to Argentina; Surinam (33)

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Section XIV - Remarks

A good general account of EEE and other group A viruses is found in reference No. 20. The important work of Casals (21) suggests that antigenic variants of EEE virus occur in nature, and that South American types differ from North American types. The work of Calisher, et al. (22) tends to confirm this suggestion.