

|                              |                           |                          |
|------------------------------|---------------------------|--------------------------|
| <b>Virus Name: West Nile</b> |                           | <b>Abbreviation: WNV</b> |
| Status<br><b>Arbovirus</b>   | Select Agent<br><b>No</b> | SALS Level<br><b>3</b>   |
| SALS Basis                   |                           |                          |
| Other Information            |                           |                          |
| Antigenic Group<br><b>B</b>  |                           |                          |

**SECTION I - Full Virus Name and Prototype Number**

|   |                            |   |
|---|----------------------------|---|
| Prototype Strain Number / Designation<br><b>B 956</b> | Accession Number           | Original Date Submitted<br><b>7/16/1985</b> |
| Family<br><b>Flaviviridae</b>                         | Genus<br><b>Flavivirus</b> |   |
| Information From                                      | Address                    |   |
| Information Footnote<br><b>Reviewed by editor</b>     |                            |   |

**Section II - Original Source**

|   |  |  |
|---|--|--|
| Isolated By (name)<br><b>Smithburn, et.al. (1)</b>  | Isolated at Institute<br><b>Yellow Fever Res. Inst., Entebbe, Uganda</b> |  |
| Host Genus<br><b>Man</b>  | Species  | Host Age/Stage<br><b>Adult</b>   |
| Sex<br><b>Female</b>  |  |  |
| <u>Isolated From</u>  | <u>Isolation Details</u>   |  |
| <b>Serum/Plasma</b>   |  |  |
| Signs and Symptoms of Illness<br><b>Fever only (100.6d F). Patient denied feeling ill.</b>    | Arthropod  |  |
| Time Held Alive before Inoculation  |  |  |
| Collection Method<br><b>Vacuum syringe</b>  | Collection Date<br><b>12/1/1937</b>                                      |  |
| Place Collected (Minimum of City, State, Country)<br><b>Omogo, West Nile District, Uganda</b> |  |  |
| Latitude<br><b>3° 17' N</b>   | Longitude<br><b>31° 7' E</b>   |  |
| Macrohabitat<br><b>Tropical plateau savannah</b>  | Microhabitat   | Method of Storage until Inoculated<br><b>In syringe, air temperature</b> |
| Footnotes   |  |  |

**Section III - Method of Isolation**

Inoculation Date  
**12/1/1937**

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

|  |                                 |
|--|---------------------------------|
| Route Inoculated<br><b>Intracerebral</b> | Reisolation<br><b>Not tried</b> |
|--|---------------------------------|

Other Reasons

Homologous Antibody Formation by Source Animal  
**Yes**

Test(s) Used  
**NT**

Footnotes

**Section IV - Virus Properties**

Physicochemical  
**RNA**

|                                    |                                   |                                   |
|------------------------------------|-----------------------------------|-----------------------------------|
| Pieces (number of genome segments) | Infectivity                       | Sedimentation Coefficients(s) (S) |
| Percentage wt, of Virion Protein   | Lipid                             | Carbohydrate                      |
| Virion Polypeptides: Number        | Details                           |                                   |
| Non-virion Polypeptides: Number    | Details                           |                                   |
| Virion Density                     | Sedimentation Coefficients(s) (S) |                                   |
| Nucleocapsid Density               | Sedimentation Coefficients(s) (S) |                                   |

**Stability of Infectivity (effects)**

pH (infective range)

|  |   |                                     |
|--|---|-------------------------------------|
| Lipid Solvent (ether - % used to test)<br><b>1:1</b> | After Treatment Titer<br><b>&lt;1.0 dex</b> | Control Titer<br><b>3.5 dex (2)</b> |
| Lipid Solvent (chloroform)                           | After Treatment Titer                       | Control Titer                       |
| Lipid Solvent (deoxycholate)<br><b>1:2000</b>        | After Treatment Titer<br><b>&lt;1.0 dex</b> | Control Titer<br><b>3.5 dex (2)</b> |

Other (formalin, radiation)  
**Sensitive to formalin, heat; inact. by trypsin, papain**

**Virion Morphology**

|   |                              |                                   |
|---|------------------------------|-----------------------------------|
| Shape   | Dimensions<br><b>21-35nm</b> |                                   |
| Mean nm   | Range nm                     |                                   |
| Measurement Method<br><b>Filtration (1); EM (3)</b> | Surface Projections/Envelope | Nucleocapsid Dimensions, Symmetry |

### Morphogenesis

|                                       |                         |                             |
|---------------------------------------|-------------------------|-----------------------------|
| Site of Constituent Formation in Cell | Site of Virion Assembly | Site of Virion Accumulation |
| Inclusion Bodies                      | Other                   |                             |

### Hemagglutination

|  |   |                             |
|--|---|-----------------------------|
| Hemagglutination<br><b>Yes</b>                     | Antigen Source<br><b>SMB; cell culture; ext. by alk. Aqueous; sucrose-acetone; fluorocarbon</b> | Erythrocytes (species used) |
| pH Range<br><b>6.0-7.3</b>                         | pH Optimum<br><b>6.6</b>  |                             |
| Temperature Range<br><b>4-37dC</b>                 | Temperature Optimum<br><b>37dC</b>  |                             |
| Remarks<br><b>Lypholizes well (1)</b>              |   |                             |
| Serologic Methods Recommended<br><b>CF, HI, NT</b> |   |                             |
| Footnotes<br><b>Lypholizes well (1)</b>            |   |                             |

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

Member of Casal's Group B [9] . As far as is known, WN is not antigenically related to any viruses not in Group B.

Cross-reactive to a certain extent also in CF, NT and protection challenge with Japanese B and St. Louis viruses, but differentiable from them [5] ; however, cross-absorption studies have shown that WN is no more different from JBW and MVE than are African and American strains of yellow fever. Strains of WN from Africa and India can only be distinguished by very sensitive modification of HI test.

Spider monkeys inoculated with 17D are protected against West Nile challenge. Rhesus monkey inoculated with SLE followed by Ilheus produced high titered antibodies against WN [11] . Mice immunized with JBE are protected against WN challenge. 2/6 WN convalescent human sera also protected against yellow fever virus [15] .

Two independent cross-neutralization studies, employing 42 and 65 flaviviruses, respectively, have confirmed that West Nile is a member of the JBE-MVE-SLE complex within serogroup B [3] , [4] .

**Section VI - Biologic Characteristics**

Virus Source (all VERTEBRATE isolates)  
**Blood (LV)**

Lab Methods of Virus Recovery (ALL ISOLATIONS)  
**Newborn mice**

| Cell system<br>(a)  | Virus passage<br>history (b) | Evidence of Infection |               |                       |            |             |                     |                                  |
|---|------------------------------|-----------------------|---------------|-----------------------|------------|-------------|---------------------|----------------------------------|
|   |                              | CPE                   |               |                       | PLAQUES    |             |                     | Growth<br>Without CPE<br>+/- (g) |
|   |                              | Day<br>(c)            | Extent<br>(d) | Titer TCD50/ml<br>(e) | Day<br>(c) | Size<br>(f) | Titer<br>PFU/ml (e) |                                  |
| <p>Infects wide variety of human and primate tissues, rodents and wvine kidney, chick embryo (23). Multiplies in <i>Ae aegypti</i> cells, CPE in <i>Ae albopictus</i> line (30,31).</p> |                              |                       |               |                       |            |             |                     |                                  |

| Vertebrate (species and organ) and arthropod | No. isolations/No. tested | No. with antibody/No. tested<br>Test used | Country and region |
|--|---------------------------|---|--------------------|
| Arvicanthis niloticus (grass mouse)          | 2                         |   | Nigeria (32)       |
| Camel  | 2                         |   |                    |
| Bats   | 1                         |   | India              |
| Bats   |                           | 4/48 NT                                   | Egypt              |
| Sentinal chickens                            | 51                        | 25/120 HI                                 | S. Africa          |
| Sentinal mice                                | 12                        |   | Nigeria (32)       |
| Horses                                       | 2                         | 183/375 NT                                | Egypt              |
| Horses                                       | 1                         |   | France             |
| Horses                                       |                           | 163/1,019 NT                              | S. Africa          |
| Chimpanzee                                   |                           | up to 53% NT                              | Congo (Leo)        |
| Monkeys (Cercopithecus)                      |                           | 57/189 NT                                 | S. Africa          |

Man ISOLATIONS: 1 to many from Uganda (1), S. Africa, Congo (Leo), Egypt (24), Israel, France, India, and Nigeria (36).  
ANTIBODIES: By NT, Africa up to 70% (24), Albania 2/112, Philippines 62/208; Malaya, Thailand 62/150 (14), Israel 81/246 (27), India 134/751 (12).

Wild Birds ISOLATIONS: Many in Egypt, 3 in Israel, 1 S. Africa, 1 Borneo, 1 Cyprus (20), 2 Nigeria (28), 3 W. Slovakia (23).

Mosquitoes: *Culex univittatus* 5 Israel, 12 Egypt, 20 S. Africa. *Cx antennatus* 5 Egypt. *Cx modestus* 2 France. *Cx vishnui* 5. *Cx quinquefasciatus* 2 India (8). *Cx weschei* 1 Cent. Afr. Rep. (29). *Cx molestus* 1. *Anopheles coustani* Israel. *Cq metallica* 1 Uganda. *An subpictus* 1 India (8). *Aedes cantans* 1 W. Slovakia (23). *An maculopennis* 1 Portugal (35).

Ticks: *Argas hermanni* 3 Egypt. *Hyalomma plumbeum*\* 2 USSR.

Rodent antibodies: By HI, *Rattus r. frugivorus* 2/80, *R. norvegicus* 6/124, *Acomys cahirinus* 1/36 (all in Egypt) (33).

\* *Hyalomma plumbeum* = *Hyaloma m. marginatum* of Hoogstraal.

| Experimental host and age   | Passage history and strain | Inoculation Route-Dose | Evidence of infection  | AST (days) | Titer log <sub>10</sub> /ml |
|-----------------------------|----------------------------|------------------------|--|------------|-----------------------------|
| mice (nb)                   | P 36                       | ic 0.02                | Death  | 2-5        | 11.0                        |
| mice (nb)                   |                            | ip 0.03                | Death  | 4-5        | 10.0                        |
| mice (nb)                   |                            | sc                     |  |            |                             |
| mice (wn)                   | P<36                       | ic 0.03                | Death (1)  | 3-5        | 9.8                         |
| mice (wn)                   |                            | ip 0.06                | Death (1)  | 3-10       | 3.2                         |
| rabbits (ad)                | P 29                       | ic, corneal            | Antibody (1)   |            |                             |
| guinea pigs (ad, juv)       |                            | ic, ip, in             | Antibody (1)   |            |                             |
| hamsters (ad)               |                            | ic, ip                 | Death (transmit to young in milk)  |            |                             |
| wild rodents                |                            |                        | Fatal to gerbils after 1 blind passage; viremia and anti-body in Arvicanthus |            |                             |
| rhesus monkey (ad)          | P 29+                      | ic, iv, in             | Fever, encephalitis, occ. death (1)  |            |                             |
| Cercopithecus monkey (ad)   | P 20+                      | ic 0.2                 | Fever (1)  |            |                             |
| man                         |                            | im, iv, ip             | Fever, occ. encephalitis (18)  |            |                             |
| man, monkey, mouse, hamster |                            |                        | Have been infected by aerosol  |            |                             |
| chicks, pigeons, wild birds |                            | peripheral             | Viremia, paralysis, occ. death   |            |                             |
| chick embryo (6-12 day)     | P 134                      | various                | Death (13)   |            |                             |
| domestic animals            |                            |                        | Viremia, antibody; horse: encephalitis                                       |            |                             |

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

Arthropods: Can infect various spp. of Aedes, Anopheles, Culex, and ornithodoros and be transmitted by many. Bird-mosquito cycles succesful. Larvae pf Ae aegypti and various insects, and adult Argas ticks, can be infected but do not transmit.

Ornithodoros moubata orally infected on viremic nb mice; trans. virus through tick bite and via coxal fluids (10).

|  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|

Section X - Histopathology

Character of lesions (specify host)

**Man: post-mortem, diffuse encephalitis. Monkeys, mice guinea pigs, gerbils and chicks: lesions, typical of viral encephalitis (1); Horse: posterior spinal cord ventral horn poliomyelitis, menigieal edema.**

Inclusion Bodies

Intranuclear

**Lower Vertabrates**

**Lower Vertabrates**

Organs/Tissues Affected

**Brain (LV), spinal cord (LV), heart (LV), blood vessel (LV), marrow (LV), skeletal muscle (LV) secretory glands (LV), (adrenal cortex).**

Category of tropism

**Neurotropic (1), but blood vessel wall could be a primary site.**

Section XI - Human Disease

In Nature  
**Significant**

Residual  
**Reported**

Death  
**Reported**

Subclinical

Overt Disease  
**Reported**

Clinical Manifestations

**Fever (S), headache (S), conjunctival inflammation (R), myalgia (R), arthralgia (R), CNS signs (including encephalitis)(R), respiratory involvement (R), CNS pleocytosis (R), rash (S), lymphadenopathy (S), and myocarditis.**

Number of Cases  
**hundreds**

Category (i.e. febrile illness, etc.)  
**Febrile illness with rash**

Section XII - Geographic Distribution

Known (Virus detected)

**Egypt, Uganda, Congo (Leo), Central African Republic, Mozambique (34), Nigeria, India, Malaysia (Borneo), USSR, Israel, France, Cyprus, Portugal (36).**

Suspected (Antibody only detected)

**Africa; throughout Asia, Malaysia, Thailand, Philippines, Turkey, Albania, Corsica**

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**Remarks**

**The prototype strain is in the American Type Culture Collection. Enhances action of carcinogens in mice (19). Causes regression or oncolysis of various tumors (21).**