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DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control

June 1, 1986

From: B.R. Miller

Subject: Attached "Arthropod-Borne Virus Information Exchange"

Your copy of the most recent "Arthropod-Borne Virus Information Exchange" is attached.

The next deadline for submission of contributions is March 1, 1987.

Please address all communications to the undersigned.

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IMPORTANT NOTICE: This exchange is issued for the sole purpose of timely exchange of information among investigators of arthropodborne viruses. It contains reports, summaries, observations, and comments submitted voluntarily by qualified agencies and investigators. The appearance of any information, data, opinions, or views in this exchange does not constitute formal publication. Any reference to or quotation of any part of this exchange must be authorized directly by the person or agency which submitted the text.

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GUIDE FOR CONTRIBUTORS

The Arthropod-Borne Virus Information Exchange is issued for the purpose of timely exchange of information among investigators of arthropod-borne viruses. It contains reports, summaries, observations, and comments submitted voluntarily by qualified investigators. The appearance of any information, data, opinions, or views in this exchange does not constitute formal publication. Any reference to or quotation of any part of the "Information Exchange" must be authorized directly by person or agency submitting the article. The editor of the "Information Exchange" cannot authorize references and quotations.

Deadlines for contributions are March 1 and September 1.

1. Heading

The heading should be typed with capital letters, including name of laboratory and address. For example:

REPORT FROM THE BIOLOGICAL PRODUCTS PRODUCTION BRANCH, CENTER FOR INFECTIOUS DISEASES, CENTERS FOR DISEASE CONTROL, ATLANTA, GA 30333

2. Body of Report

The text of the report should be as brief as possible to convey the intended message and should make reference to tables and figures included in the report. The text should be single spaced with double spacing between paragraphs.

3. Authors' Names

The names of authors should be in parentheses following the text.

4. Tables and Figures

Tables and figures should be numbered and titled if appropriate. Tables and figures should not be submitted without some description or explanation.

5. Size of Pages

Since there are specific space limitations, the typed material on each page should not exceed 7-1/8" x 9-1/4". The same dimensions apply to tables and figures. If tables and figures are larger than these dimensions, they have to be reduced before being printed. The block shown on this page represents the maximum space available for each page of your report.

Reports should be typed only on one side of each page since they have to be photographed for reproduction. Each page should be numbered. Only the original typed report should be submitted.

First Announcement

Symposium
The Ecology of Arboviruses

Smolenice near Bratislava
September 7-11, 1987

Institute of Virology, Slovak Academy of Sciences
is organizing the Symposium: "The Ecology of Arboviruses".
The Symposium will be held in the Smolenice castle, Sep-
tember 7-11, 1987.

The scientific program of the Symposium will cover:

- 1/ Introduction
- 2/ Hybridomas to arbovirus antigens
- 3/ Antigenic variation of arboviruses
/molecular and biologic/
- 4/ Geographical distribution of arboviruses
- 5/ Haemorrhagic fever with renal syndrome
- 6/ Concluding remarks

The Symposium language will be English. Accomodation
for participans of the Symposium is reserved in the rooms
of the castle.

Applications forms regarding the symposium should be
adressed to: Dr.Milota Grešíková, ScD.,
Chief of the Department of
Ecology of Arboviruses
Institute of Virology,
Slovak Academy of Sciences
817 03 Bratislava, Mlynská
dolina 1, Czechoslovakia

R e g i s t r a t i o n f o r m

Forname and surname, title

.....

Adress:

.....

I wish to present the paper:

.....

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Date

.....
Signature

The William F. Scherer Award

The American Committee on Arthropod-borne Viruses established the William F. Scherer Memorial Fund in 1983 to honor the memory of one of the founding and more notable members of the Committee. The intent of the award is to recognize an outstanding advanced graduate student in the field of arbovirology by supporting his/her attendance and participation (presentation of research) at the annual meeting of the American Society of Tropical Medicine and Hygiene.

The first graduate student thus recognized was Rebecca Rico-Hesse from the Graduate School of Medical Science at Cornell University (1983, San Antonio) (Trop. Med. Hyg. News, 32(4):6, 1983, 33(1):7, 1984).

(prepared March 1985, T.H.G.A.)

The Nathaniel Young Memorial Award

The Nathaniel Young award was established in 1981 by the American Committee on Arthropod-borne Viruses (ACAV) to honor the memory of an outstanding young scientist, Dr. Nathaniel A. Young (1939 - 1979), whose promising life was cut short by a drowning accident. Nat Young was born in England but grew up in the United States. After obtaining his medical degree (1962), he worked in Panama (1964 - 1966) with the Middle America Research Unit studying Venezuelan equine encephalomyelitis virus (VEE). Subsequently he was associated primarily with the National Cancer Institute but also spent four years (1970 - 1974) at Harvard University. His studies with VEE virus resulted in a detailed classification of the natural antigenic variants of this virus species complex which he then related to the epidemiology of these agents (Trop. Med. Hyg. News, 30(1):8 - 10, 1981).

Action of the Executive Council of the ACAV provides for the Nat Young award to be presented every three years to the "person(s) less than 45 years of age deemed most worthy of recognition for work done in the field of arbovirology". The proposal received the approval of the Council of the American Society of Tropical Medicine and Hygiene (ASTMH) which agreed to manage funds raised to support the award. The first recipient was David Bishop (virologist), who was presented with the award at the 1981 ASTMH annual meeting in San Juan, Puerto Rico. The second awardee was Thomas Monath (virologist, 1984, Baltimore) (TMHN, 33(1):6, 1984, 34(1):5, 1985).

(prepared March 1985, T.H.G.A.)

The Richard Moreland Taylor Medal

The Richard Moreland Taylor award was established in 1966 by the American Committee on Arthropod-borne Viruses (ACAV) to honor the memory of Dr. Taylor (1887 - 1981) former Rockefeller Foundation (RF) staff member and later professor of epidemiology in the Department of Epidemiology and Public Health, Yale University School of Medicine. Arthropod-borne viruses, or arboviruses, are pathogens of man or lower animals which are transmitted by the bite of infected arthropods (ticks, mosquitoes, sandflies, etc.) and which usually involve a reservoir host.

The origins of the ACAV stem from the RF - sponsored Gould House Group which met at Ardsley-on-Hudson, NY in October 1959 to discuss and encourage research in the general field of arbovirology. By 1961 this informal group of investigators with kindred interests elected to meet annually under the aegis of the American Society of Tropical Medicine and Hygiene (ASTMH). Dr. Taylor was the catalytic force behind this group of eager workers by enthusiastically guiding the destiny of the infant organization, issuing a newsletter (the Arbovirus Information Exchange), initiating and assembling the Catalogue of the Arthropod-borne Viruses as well as maintaining a card file of the literature on arboviruses. The number of registered viruses has grown from 43 in 1960 to 189 as of 10 July 1984. (Taylor, R. "Cat. Arthropod-borne Viruses of the World", USPHS Pub. No. 1760, 1st ed., 1967; Downs, W. "The Rock. Found. Virus Program", Ann. Rev. Med., 33:1-29, 1982)

As indicated above, the Taylor award was created in 1966 to acknowledge Dr. Taylor's profound contribution to our understanding of this field of microbiology and as an appropriate token of this recognition, the first award was made to Dr. Taylor at the 1966 ASTMH annual meetings held in San Juan, Puerto Rico. (Work, T. "Richard Moreland Taylor", Trop. Med. Hyg. News, 30(4):18-21, 1981) Since 1966, the ACAV governing council has awarded the medal "for achievement in arbovirology" approximately every two years. Besides Dr. Taylor, the medal recipients over the years have been Jordi Casals (virologist, 1968, Atlanta), William Hammon (virologist, 1970, San Francisco), William Reeves (entomologist, 1972, Houston), Roy Chamberlain (entomologist, 1975, New Orleans), Wilbur Downs and Pedro Galindo (virologist and entomologists, 1977, Denver), Ottis and Calista Causey (entomologist and virologist, 1980, Atlanta), Telford Work (virologist, 1981, San Juan) and Harry Hoogstraal and Thomas Aitken (entomologists, 1984, Baltimore).

(prepared April 1985, T.H.G.A.)
Revised

Aedes albopictus introduced into the United States

On August 2, 1985, the Harris County Mosquito Control District in Houston, Texas, discovered that Aedes albopictus, a mosquito of Asian origin, was established in Harris County. This is the first time this species is known to have become established in the hemisphere. Results of a preliminary survey of Harris County conducted in September 1985, indicated that Ae. albopictus was present in a wide variety of habitats. It was found in flower pots in cemeteries, plastic pails, tin cans, and assorted rubbish containers within urban and rural environments. Of special interest is its presence in used tires. Used tires may constitute the most abundant larval habitat within the Houston area. Over 3,000 tire dumps were estimated to occur in Harris County alone, based upon a 1980 census. Aedes albopictus was found to occur in 55.8% of 163 sites inspected.

Since March, infestations have been found in 10 Texas counties, extending as far north as Dallas and as far south as Galveston. Aedes albopictus has also been found in six parishes in Louisiana and in Jackson, Mississippi, and Memphis, Tennessee.

Aedes albopictus is primarily a forest species that has become adapted to the urban environment. It breeds in tree holes and other water-holding containers of natural or human origin. Individual females lay their eggs--a few at a time--in several containers, which may contribute to rapid local spread of the species. It is also readily transported over larger distances by man, as eggs, larvae, or adults. Autogeny (production of viable eggs without a blood meal) has been reported in the Houston strain.

Ae. albopictus differs from the related Ae. aegypti in several important respects: (1) It extends much farther northward than aegypti, extending into Japan, Korea, northern China, and Siberia; (2) It is not restricted to the domestic or peridomestic environment as Ae. aegypti, a fact that has major implications for the control of the species as well as for disease transmission; and (3) It is, in many respects, more similar in its habits to the New World species, Ae. triseriatus and Ae. mediovittatus.

The establishment of new infestations in distant locations appears to have been facilitated by transport of actively breeding containers such as tires. Modern transportation technology has a tremendous potential impact on the worldwide dispersal of vector species such as Ae. albopictus.

Preliminary insecticide studies conducted by the DVBVD indicate the Houston population is partially resistant to malathion and is susceptible to resmethrin. These studies are continuing.

The introduction and establishment of Ae. albopictus into the United States has potentially serious public health implications. It has been associated with many epidemics of dengue over the years. A review of both

experimental and natural transmission data clearly documents that Ae. albopictus is a very efficient vector of epidemic dengue and its hemorrhagic complications. It has a higher susceptibility to oral infection with these viruses than Ae. aegypti, the principal epidemic vector in Asia. Moreover, Ae. albopictus has been shown to transmit all four dengue serotypes transovarially and transstadially. In addition, female Ae. albopictus has a wide host range, feeding predominantly on mammals but including birds in its host range. This, plus the high susceptibility makes it likely that it could play an important role in the maintenance cycle of dengue viruses, providing a mechanism for the viruses to exist in an area during interepidemic periods. One additional arbovirus, Chikungunya, has been isolated from field-collected albopictus.

Aedes albopictus has also been evaluated in laboratory studies for susceptibility to a number of arboviruses known to infect man. The list includes Japanese and St. Louis encephalitis, West Nile, and Kunjin viruses, all flaviviruses; Ross River, an alphavirus (as is Chikungunya); and Batai, La Crosse, and San Angelo viruses, all Bunyaviruses (the latter two belong to the California serogroup and are endemic in the U.S.). Of these viruses, vertical or transovarial transmission has been demonstrated for dengue, Japanese encephalitis, Kunjin, San Angelo, and La Crosse.

Because Ae. albopictus has been shown to be an efficient laboratory host for many different viruses and because of its wide host range, the possibility exists that this species may also become involved in the transmission cycles of other local viruses in the United States. The fact that Ae. albopictus so readily feeds on humans may provide an opportunity for increased infection of man. For example, Ae. albopictus is susceptible to La Crosse virus (California encephalitis) and transmits this virus transovarially. If Ae. albopictus became involved in the La Crosse virus transmission cycle, it would provide an additional vector for virus transmission to man.

While it is difficult to predict exactly how this species will affect the epidemiology of domestic viruses, it is clear that the presence of Ae. albopictus in the United States increases the risk that secondary transmission of dengue viruses will occur.

The presence of an established population of Ae. albopictus in the Americas has serious implications in the region south of the United States. Dengue fever is highly active in this zone. Currently, Ae. aegypti is the primary and possibly sole dengue vector in the Americas. If Ae. albopictus is introduced and established in Latin America, it will represent the second Stegomyia mosquito to be introduced that is a proven effective dengue vector. It is not known if the presence of a second vector species will significantly increase dengue transmission or the proportion of cases that develop serious hemorrhagic complications. It is believed it would be better to minimize the spread of Ae. albopictus than to study the effect of its having become established in Latin America.

(C. G. Moore, D. B. Francly, and D. A. Eliason)



The AMERICAN COMMITTEE ON ARTHROPOD-BORNE VIRUSES

1985 ANNUAL REPORT ON THE CATALOGUE OF ARTHROPOD-BORNE
AND SELECTED VERTEBRATE VIRUSES OF THE WORLD*

By
THE SUBCOMMITTEE ON ARTHROPOD-BORNE VIRUS
INFORMATION EXCHANGE

SUBCOMMITTEE ON INFORMATION EXCHANGE

I. Objectives:

The objectives of the Catalogue are to register data concerning occurrence and characteristics of newly recognized arthropod-borne viruses and other viruses of vertebrates of demonstrated or potential zoonotic importance and to disseminate this information at quarterly intervals to participating scientists in all parts of the world; to collect, reproduce, collate, and distribute current information regarding registered viruses from published materials, laboratory reports and personal communications; and to prepare and distribute an annual summary of data extracted from catalogued virus registrations.

II. Materials and Methods:

Viruses are registered and information supplied on a voluntary basis, usually by scientists responsible for their isolation and identification. New registration cards, information concerning registered viruses and pertinent abstracts of published literature are distributed at quarterly intervals to participating laboratories. Abstracts of published articles dealing with catalogued viruses are reproduced by special arrangements with the editors of Biological Abstracts, Abstracts on Hygiene, and the Tropical Disease Bulletin.

Distribution of Catalogue Materials: At the start of 1985, 176 mailings of Catalogue material were being made. During the year, two addresses were dropped and four new participants were added to the mailing list. At the end of the year, 178 mailings of Catalogue material were being made, including 57 within the U.S.A. and 121 to foreign addresses. Distribution by continent was: Africa 19, Asia 24, Australasia 8, Europe 40, North America 70, and South America 17.

Abstracts and Current Information: A total of 522 abstracts or references were coded by subject matter and distributed to participants during 1985. Of this total, 334 were obtained from Biosciences Information Service, 186 from Abstracts on Hygiene and the Tropical Diseases Bulletin, and two from current journals, personal communications, or other sources. A total of 15,677 references or units of information have been issued since the start of the program.

*The Catalogue is supported by the Centers for Disease Control, Atlanta, Georgia.

Note: This report is not a publication and should not be used as a reference source in published bibliographies.

Registration of new viruses. A total of 14 viruses was accepted for registration during the period January 1985 to December 1985. As of December 1984, the Catalogue contained 490 viruses. With the acceptance of 14 virus registrations, the total number of registered viruses is 504 as of December 1985. The 14 viruses registered between January 1985 and December 1985 are listed below.

<u>Virus Name</u>	<u>Recommended Abbreviation</u>	<u>Country</u>	<u>Source</u>	<u>Antigenic Group</u>
Resistencia	RTA	Argentina	Mosquitoes	RTA
Antequera	ANT	Argentina	Mosquitoes	RTA
Barranqueras	BQS	Argentina	Mosquitoes	RTA
Adelaide River	AR	Australia	Sentinel bovine	BEF
Berrimah	BRM	Australia	Sentinel bovine	BEF
Kimberley	KIM	Australia	Sentinel bovine	BEF
Meaban	MEA	France	Ticks	B
Tindhølmur	TDM	Denmark	Ticks	KEM
Mykines	MYK	Denmark	Ticks	KEM
Gadgets Gully	GGY	Australia	Ticks	B
Precarious Point	PP	Australia	Ticks	UUK
Lake Clarendon	LC	Australia	Ticks	
Seoul	SEO	S. Korea	Rat	HTN
Puumala	PUU	Finland	Bank vole	HTN

These viruses were isolated between 1961 and 1982. MYK and TDM were isolated in 1974, PP in 1976, GGY in 1977, ANT, BQS, KIM, RTA, and SEO in 1980, and MEA, PUU, and LC, AR and BRM in 1981. PH, PUU, and SEO were evaluated by SEAS as Probably Not Arbovirus and the rest as Possible Arbovirus.

None of these viruses has been isolated from humans, although PUU and SEO viruses are implicated epidemiologically and serologically in human disease.

Antigenic grouping. Two new serogroups were formed recently. Three viruses (Resistencia, Antequera and Barranqueras) isolated from mosquitoes collected in Argentina were shown to be identical by cross-complement-fixation (CF) tests. However, they readily were distinguished by cross-neutralization tests (NT). Barranqueras virus was shown to be morphologically identical to typical bunyaviruses. Barranqueras viral antigen and antibody did not cross-react by CF with more than 300 arboviruses and other viruses. In addition, antibody to Barranqueras virus did not inhibit hemagglutination (HA) of viruses of groups C, Bunyamwera, Turlock, California, and Phlebotomus fever (1). Because of their demonstrated serological relationship, these three viruses now comprise the Resistencia serogroup.

Adelaide River, Berrimah, and Kimberley, three recently registered Australian viruses were shown to be related to bovine ephemeral fever virus by IFA. In addition, Kimberley virus was related to bovine ephemeral fever virus

by CF, and Berrimah virus was related to bovine ephemeral fever virus by NT. These viruses plus bovine ephemeral fever virus now comprise the bovine ephemeral fever serogroup.

There are now 63 serogroups represented among viruses registered in the Catalogue, excluding viruses placed in the Bunyamwera Supergroup but unassigned (SBU).

Recent serologic studies have shown that Toure virus is related to Lassa virus (2). A preliminary cross-reaction was noted by IFA between Toure and Lassa and LCM viruses (2). Toure virus provisionally is being listed with members of the Tacaribe serogroup.

Taxonomic status of registered viruses. Reported changes in the taxonomic classification of registered arboviruses are of a provisional nature, and in some instances, new taxonomic placements are based on very slight evidence.

A formal proposal has been put forth which would create a fifth genus in the family Bunyaviridae (3). In addition to the Bunyavirus, Nairovirus, Phlebovirus, and Uukuvirus genera, the newly proposed taxon would be named the Hantavirus genus and initially would consist of Hantaan and Prospect Hill viruses and other Hantaan virus-related viruses. This proposal has not been acted upon by the International Committee on Taxonomy of Viruses (ICTV).

Previously, the family Filoviridae was proposed as "a taxonomic home" for Marburg and Ebola viruses (4). This proposal was not accepted by the ICTV. It is planned that, following some alteration and the addition of some information, the proposal will be resubmitted to the ICTV.

Finally, the ICTV has approved the proposal of the ICTV Togavirus Study Group which recommended the creation of a new family, Flaviviridae, and placement of the Flavivirus genus in this new taxon (5,6). Obviously, this was intended to separate the genus Alphavirus from the genus Flavivirus by removal of the flaviviruses from the family Togaviridae. Viruses of the two genera differ in size, morphology, morphogenesis and mode of replication. In addition, the flavivirus virion usually contains a single major envelope glycoprotein, a smaller membrane protein, and the core protein. On the other hand alphavirus virions contain at least two envelope proteins, one or more which are glycosylated, and a core protein. In the case of alphaviruses, genes for structural proteins are located at the 3' end of the genome, whereas for flaviviruses, genes for structural proteins are located at the 5' terminus (5).

SYNOPSIS OF INFORMATION IN THE CATALOGUE

This synopsis has been compiled primarily to provide a short review of the viruses included in the Catalogue. The following tabulations are designed to draw together groups of viruses showing certain common characteristics including taxonomic status, serological relationships, and, where appropriate, principal arthropod vector. Isolations from arthropod and animal hosts, continental distribution, involvement in human disease, and arthropod-borne status are indicated.

The recommended levels of laboratory practice and containment and the basis for assignment to these levels are shown. Most of this information was published previously by SALS (7). Several registered viruses listed in Tables 5.1 through 13.2.2 have not been rated by SALS. Appendices I and II, following Table 18.1, provide a description of recommended levels and an explanation of symbols used to define basis.

Other tables summarize the taxonomic status of registered viruses; the antigenic groups comprising a given taxon to which registered viruses have been assigned; the numbers of registered viruses assigned to presently recognized antigenic groups; chronology and areas of isolations of registered viruses; continental distribution by groups; numbers of viruses recovered from naturally infected arthropods and vertebrates; association with human disease; and evaluation of arthropod-borne status of members in various serogroups.

Appendices I and II are followed by a vector index and a host index. The vector index mostly shows registered viruses isolated from individual arthropod species collected in nature. The host index shows registered viruses isolated from vertebrate hosts collected in nature. Both Linnean taxonomic designations and common names of hosts are used depending upon information available from original sources. These indices were compiled primarily from information on virus registration cards. Other sources of information were employed as well, although these listings should not be considered as exhaustive. Because of the large number of virus names involved, official abbreviations for registered viruses were used. Please refer to Table 1.1 for the corresponding virus name.

1. Alphabetical and taxonomic listing of registered viruses. Table 1.1 presents a listing of the 504 viruses registered in the Catalogue as of December 1985. An official or provisional taxonomic classification is shown for each registered virus. If taxonomic status is not indicated, the registered virus is presently unclassified. Also, for each virus a recommended abbreviation is given, formulated according to the guidelines established by the ACAV (8). All too often, abbreviations of the author's choosing are employed in publications and do not conform to the recommended abbreviations. The use of unofficial abbreviations is confusing, is contrary to established guidelines, and erodes a portion of the effort of the Arbovirus Information Exchange program. All arbovirologists who plan to employ abbreviations in print should make every effort to use the recommended abbreviations.

Antigenic groups to which viruses have been assigned also are shown in Table 1.1. If no antigenic group is given, the virus is ungrouped and indicates that it has not been demonstrated to be related serologically to any other virus.

2. Antigenic groups of registered viruses. The originally described antigenic groups of arboviruses were designated by letters, A, B, and C; but in present practice, the first discovered virus of a newly recognized serogroup lends its name to the antigenic cluster. Before a virus can be assigned to any antigenic group, it must be shown to be serologically related to, but clearly distinguishable from a previously isolated virus.

Table 2.1 lists the serogroups comprising the various taxa to which registered viruses have been assigned. Sixty-three antigenic groups have been designated for viruses registered in the Catalogue, including the previously established rabies serogroup (9). The rabies serogroup is represented in the Catalogue because two members of that serogroup were registered in the Catalogue. Lagos bat virus was registered in 1961 and was described in the first published edition of the Catalogue (10). Kotonkan virus was registered more recently (in 1982); and had greater potential of being arthropod-borne since it was isolated from Culicoides insects. There are several instances in which only a single virus is shown in an antigenic group. That is so because one or more antigenic relatives of that virus are known but have not yet been registered.

The Bunyavirus genus comprises the Bunyamwera Supergroup to which several additional serogroups have been added. The most recent additions are the Anopheles B and Turlock serogroups (11). The Bunyamwera Supergroup originally was formulated to reflect low-level but reproducible intergroup relationships, usually by CF and/or HI reactions (12). A large number of these viruses were subsequently found to be identical morphologically and morphogenetically. The Bunyamwera Supergroup designation was thus replaced by the Bunyavirus genus in the Family Bunyaviridae (13,14). In a somewhat analogous situation, the Nairovirus genus was constructed to include six distinct serogroups which share low-level intergroup relationships among themselves (15,16). Registered viruses belonging in the Bunyavirus genus constitute slightly more than 25% of all registered viruses.

3. Initial isolations by decade and country of origin. Table 3.1 lists the initial isolation of registered viruses by the decade of discovery and according to the continent or zoogeographic region and country in which each was discovered. Because of the large number of virus names involved, abbreviations are employed. These abbreviations and the associated complete names of the respective viruses may be found in Table 1.1.

4. Initial isolation of viruses by continent, country, and chronological period. Periods or locations which show large numbers of virus isolations undoubtedly reflect the net effect of a number of contributing factors such as the change in emphasis of field programs from a search for viruses causing

specific diseases to a systematic search for viruses, new or known, in their natural ecological niche in a given geographical area; refinements in isolation and identification techniques; improved communication between arbovirus laboratories; more rapid dissemination of new information; or the presence in a given area of an arbovirus laboratory with highly active and effective field programs.

Tables 5.1 through 18.1 list registered viruses by serogroup; by recorded isolations from arthropod vectors and vertebrates; and by geographic distribution based on virus isolation. Data also are presented regarding human disease in nature or by laboratory infection, evaluation of arbovirus status, and proved or provisional taxonomic status. These tables also show the recommended laboratory practice and containment level assigned to each registered virus, and the basis for assignment to a level. Where possible, sets of viruses also were grouped according to their actual or suspected principal arthropod vector.

5. Alphaviruses. Alphaviruses clearly are mosquito associated, although a few have been isolated from other arthropods (Table 5.1). About half the alphaviruses are associated with avian hosts, whereas some, particularly those of the Venezuelan equine encephalitis complex, are associated with rodents. Sindbis virus has been recovered from the organs of insectivorous bats collected in Zimbabwe. Cabassou, chikungunya, eastern equine encephalitis, Highlands J, and Venezuelan equine encephalitis viruses represent the other alphaviruses which have been isolated from bats.

Eleven alphaviruses have been isolated from humans while 12 have been implicated in human disease either by infections acquired in nature or in the laboratory. Both Bebaru and Ross River viruses have been associated with clinically inapparent laboratory-acquired infections, although Ross River virus infections in nature have resulted in human disease. At least eight of these 13 alphaviruses have been responsible for epidemics: chikungunya, eastern equine encephalitis, Mayaro, o'nyong-nyong, Ross River, Sindbis, Venezuelan equine encephalitis, and western equine encephalitis. All of the 13 alphaviruses either are rated as Arbovirus (11 viruses), Probable Arbovirus (one virus) or Possible Arbovirus (1 virus).

6. Flaviviruses. Of the 66 registered flaviviruses, 47% have been placed in the mosquito-borne category (Table 6.1), 26% are considered to be tick-borne (Table 6.2), and 27% are categorized as not being associated with a proven arthropod vector (Table 6.3). Only St. Louis encephalitis, West Nile and yellow fever viruses in the mosquito-borne category (Table 6.1) and Powassan virus in the tick-borne category (Table 6.2) have been isolated from both mosquitoes and ticks. Israel turkey meningoencephalitis (IT) virus provisionally has been placed in the mosquito-associated category. Previously, it had been listed in the "no arthropod vector demonstrated" category (Table 6.3). Isolations of IT virus have been reported from Culicoides, mosquitoes (species not specified) and engorged Culex pipiens mosquitoes. Furthermore, experimentally infected Cx. molestus and Aedes aegypti mosquitoes have transmitted the virus by bite to suckling mice.

Twenty-seven of the 31 registered flaviviruses which are mosquito-borne (Table 6.1) are rated as Probable Arbovirus or Arbovirus. The tick-borne flaviviruses (Table 6.2) contain four registered viruses, Absettarov, Hanzalova, Hypr, and Kumlinge, which are very closely related or indistinguishable by conventional serological techniques, though they are purported to be clearly differentiated on the basis of clinical, epidemiological, and ecological markers from Russian spring-summer encephalitis virus and other members of that complex.

Twenty-nine (44%) registered flaviviruses have been isolated from humans; 19 of 31 (61%) mosquito-borne flaviviruses and nine of 17 (53%) tick-borne flaviviruses have been implicated in human disease. By contrast, only five of 18 (28%) flaviviruses not associated with a vector have been implicated in human disease. Modoc virus, listed in Table 6.3, was implicated in a clinically inapparent laboratory infection. Thus, a total of 33 flaviviruses have been associated with disease in humans.

With the exception of Koutango virus, none of the registered flaviviruses placed in the "no arthropod vector demonstrated" category are rated above Possible Arbovirus by SEAS. Seven members are rated as Probably Not or Not Arbovirus. Most of the flaviviruses listed in Table 6.3 have been isolated from rodents or bats. Cacipacore virus has been isolated from a wild bird and Aroa virus from a sentinel hamster. Only Dakar bat and Negishi viruses have been isolated from humans; Negishi virus has been recovered only from that source. While only 2 flaviviruses of this category have been isolated from humans, five have been implicated in human disease. These include Apoi, Dakar Bat, Koutango, Negishi, and Rio Bravo viruses.

Meaban and Gadgets Gully viruses represent two recently registered flaviviruses. Meaban virus was isolated from argasid ticks collected on Meaban Island, France, while Gadgets Gully virus was isolated from ixodid ticks collected in Australia. Thus far, neither virus has been associated with infections in humans.

7. Antigenically ungrouped viruses of families Togaviridae and Flaviviridae. Triniti virus was recovered in Trinidad from Trichoprosopon species mosquitoes. It was rated as Probable Arbovirus by SEAS (Table 7.1). This virus was shown to possess a ribonucleic acid (RNA) genome and morphologically it resembled viruses of the family Togaviridae (17).

Simian hemorrhagic fever virus has produced severe disease in rhesus monkeys imported from India. Other monkey species developed disease following contact with the recently imported sick rhesus monkeys. Simian hemorrhagic fever virus has been classified as Not Arbovirus by SEAS. This virus has been shown to resemble the flaviviruses morphologically and structurally, although an antigenic relationship has not been demonstrated.

8. Family Bunyaviridae.

8.1 Bunyaviruses. Sixteen antigenic sets of viruses plus Kaeng Khoi virus (SBU) comprise the bunyaviruses. A total of 123 registered viruses have been placed within the Bunyavirus genus.

8.1.1 Anopheles A and Anopheles B serogroup viruses. Members of the Anopheles A serogroup have been isolated either from anopheline or both culicine and anopheline mosquitoes. Of the five members of this serogroup, only Tacaiuma virus has been isolated from and reported to cause a febrile illness in humans. In addition, this virus has been isolated from a sentinel monkey. Members of this serogroup and of the ANB serogroup appear to be geographically localized.

Viruses of the Anopheles B serogroup have been isolated only from mosquitoes collected in South America. Neither virus has been associated with infections in humans.

8.1.2 Bunyamwera serogroup viruses. All members of the Bunyamwera serogroup have been isolated from culicine or anopheline mosquitoes or both. In addition, Lokern and Main Drain viruses have been isolated from Culicoides species. Anhembi, Germiston, Kairi, Macaua, Northway, Tensaw, and Shokwe viruses have been recovered from rodents, and Lokern, Main Drain, and Tensaw viruses from lagomorphs. Northway virus also was isolated from sentinel rabbits, Kairi virus from a monkey, Macaua virus from a bird, and Tensaw virus from a fox.

Bunyamwera, Germiston, Ilesha, Shokwe, and Wyeomyia viruses have been isolated from humans. These viruses plus Calovo and Tensaw viruses have been associated with human disease, either through infections acquired in nature or in the laboratory, or both. Furthermore, Maguari virus has been isolated from horses with encephalitis, Cache Valley from a caribou that died, a sick sheep, a cow and from an asymptomatic horse, and Main Drain virus has been isolated from brain tissue of a horse that died of encephalitis.

Fifteen of the 22 viruses registered in the Bunyamwera serogroup have been rated as Arbovirus or Probable Arbovirus. None are rated below Possible Arbovirus.

Members have been found most frequently in North America (8 viruses), South America (8 viruses) and Africa (5 viruses). Thus far, only one virus has been recovered in Asia, two in Europe, and none in Australasia.

8.1.3 Bwamba serogroup and group C viruses. The Group C viruses have been closely associated with mosquito vectors and small animals, particularly rodents. Eight group C viruses have been isolated from rodents, and three of these eight additionally have been isolated from marsupials. Two other viruses have been isolated from marsupials but not rodents. Ten of the twelve viruses have been isolated from humans. Only Gumbo Limbo and Vinces

viruses have not been isolated from humans and, with the exception of those two viruses, all members have been associated with cases of human febrile illness. In addition, Apeu, Caraparu, Marituba, Murutucu, Oriboca and Ossa viruses have been reported to infect humans as a result of laboratory mishaps. Ten of these viruses have been classified as Arboviruses and two as Probable Arboviruses.

Both Bwamba and Pongola viruses (Bwamba serogroup) are mosquito-borne, and Bwamba virus has been isolated from humans. Bwamba virus has been reported to produce a febrile illness in humans as a result of infections acquired in nature. Thus far, these two viruses have been found in Africa only. Pongola virus has been rated as Arbovirus while Bwamba virus has been rated as Probable Arbovirus.

8.1.4 California and Capim serogroup viruses. All California serogroup viruses are associated with mosquito vectors and four members have been recovered from rodents (Table 8.1.4). La Crosse, Guaroa, and Tahyna viruses have been isolated from humans and, along with California encephalitis, Jamestown Canyon, snowshoe hare and Inkoo viruses, have been associated with disease as a result of infections acquired in nature. In addition, Keystone virus has been implicated in an inapparent infection in a laboratory worker. Antibody to trivittatus virus has been demonstrated in humans although the virus has not been associated with the production of disease in humans. California group infections in humans have been documented serologically in China (18). Only Inkoo and Tahyna viruses have been isolated on continents other than North and South America. On the basis of virus isolation, the geographic distribution of Tahyna now includes Asia as well as Africa and Europe. Ten of the California serogroup viruses have been rated as Arbovirus, one other as Probable Arbovirus, and the remaining two as Possible Arbovirus.

Viruses of the Capim serogroup are associated with mosquito vectors, and four of the members have been isolated from rodents. None of these eight viruses have been associated with disease in humans. Capim serogroup members have been recovered only in North and South America. Six of the eight Capim serogroup viruses have been rated as Arbovirus (four viruses) or Probable Arbovirus (two viruses).

8.1.5 Gamboa, Guama and Koongol serogroup viruses. In addition to Gamboa virus, the serogroup contains Pueblo Viejo and San Juan viruses (Table 8.1.5). All virus members have been isolated exclusively from Aedeomyia squamipennis mosquitoes. The viruses appear to have a limited geographic distribution, and they have not been implicated in human infections.

Guama serogroup viruses have been found only in the western hemisphere. Catu and Guama viruses have been isolated from humans and have been associated with disease in humans. Nine of the 12 Guama group viruses have been rated as Arbovirus or Probable Arbovirus. Viruses of this serogroup clearly are mosquito-borne and most appear to be associated with rodents. Ten viruses have been isolated from sentinel animals, primarily mice.

Both Koongol group viruses were isolated in Australia and very little is known about them. These two viruses were rated as Probable Arbovirus.

8.1.6 Minatitlan, Olifantsvlei and Patois serogroup viruses. The Minatitlan serogroup listed in Table 8.1.6 now contains two registered members (Minatitlan and Palestina viruses). Several isolations of Palestina virus have been made from Culex sp. mosquitoes collected in Ecuador, and from sentinel hamsters. Minatitlan virus was isolated from a sentinel hamster exposed near Minatitlan, Mexico.

The Olifantsvlei group consists of three members, and all three were isolated in Africa from mosquitoes. Little information on the properties of these viruses is extant.

Viruses of the Patois group now have been isolated in North and South America, and most appear to be associated with mosquito vectors and some with rodent hosts. Babahoyo, Patois, Shark River, and Zegla viruses also were isolated from sentinel hamsters.

None of the viruses from these three serogroups have been isolated from humans, nor have they been associated with disease.

8.1.7 Simbu serogroup viruses. Table 8.1.7 shows that essentially equal numbers of Simbu serogroup viruses have been isolated from Culicoides flies and from mosquitoes. None have been recovered from rodents. Eight Simbu serogroup viruses have been isolated from livestock. These include Sabo, Sango, Shamonda and Shuni viruses (Nigeria); Douglas and Peaton viruses (Australia); Akabane virus (Japan, Kenya and Australia); and Sathuperi virus (India and Africa). In addition, four viruses have been isolated from birds, and Manzanilla virus has been isolated from a monkey. Oropouche and Shuni viruses are the only members that have been isolated from humans. Oropouche virus has caused frequent large outbreaks of disease in humans in Brazil.

Simbu serogroup viruses have wide distributions. Approximately 50% have been found in Africa or Africa and Asia, while others have been isolated in Asia; Asia and Australasia; Asia, Australasia and Africa; and North or South America. Only eight of the 21 members of this serogroup have been rated as Probable Arbovirus or Arbovirus. The remainder have been rated as Possible Arbovirus.

8.1.8 Tete and Turlock serogroups and unassigned (SBU) viruses. Refer to Table 8.1.6. All Tete serogroup viruses have been recovered from birds; only two of them (Bahig and Matruh viruses) have been recovered from an arthropod vector (ixodid ticks). None of these viruses have been associated with human infections. Only Bahig virus is rated above Possible Arbovirus.

All viruses of the Turlock serogroup are associated with mosquito vectors. In addition, Turlock and Umbre viruses appear to be associated with birds. Turlock virus has been found in both North and South America. All the

other members have been found in single continents (Africa, Asia, and Europe). Barmah Forest virus has been deleted from the listing of those viruses that belong in the Turlock serogroup.

Only Kaeng Khoi virus remains as a serologically unassigned bunyavirus. Kaeng Khoi virus was isolated from bats, sentinel mice and rats, and cimicid bugs.

8.2 Phleboviruses: Phlebotomus fever serogroup viruses. At present, the Phlebotomus fever serogroup consists of 35 members, and the entire serogroup comprises the Phlebovirus genus within the family Bunyaviridae (Table 8.2). Sicilian sandfly fever virus is the type virus for this genus.

Most of the members are associated with phlebotomine flies; only Arumowot, Chagres, Icoaraci, Itaporanga, Rift Valley fever and Zinga viruses have been isolated from mosquitoes. Nine of the phleboviruses have been isolated from humans or have been implicated in the production of disease in humans.

Gabek Forest virus has not been recovered from arthropods but has been isolated from a variety of rodents and a hedgehog collected in various areas of Africa. Gabek Forest virus has been rated as Probable Arbovirus.

Rift Valley fever (RVF) virus causes serious and extensive disease in domestic animals such as sheep and cattle, and may cause disease in veterinary personnel, field and laboratory workers, and persons who handle infected animals. Serological studies indicated that Zinga virus is closely related or identical to Rift Valley fever virus. Consequently Zinga virus has been placed in the Phlebotomus fever serogroup although it may be another strain of RVF virus. Previously it was listed as an antigenically ungrouped virus.

8.3 Nairoviruses. Members of the six antigenic groups shown in Tables 8.3.1 and 8.3.2 constitute the Nairovirus genus in the family Bunyaviridae (16). CHF-Congo virus was designated the type virus for this genus. Furthermore, reproducible intergroup antigenic relationships have been demonstrated for the six sets of viruses (15). Only members of the CHF-Congo and Nairobi sheep disease (NSD) serogroups have been associated with disease in humans.

8.3.1 CHF-Congo, Dera Ghazi Khan, and Hughes serogroups. Both Congo and Crimean hemorrhagic fever viruses are registered in the Catalogue. It must be reiterated that the agent of Crimean hemorrhagic fever (CHF) is antigenically indistinguishable from Congo virus. CHF virus has been implicated in more than two thousand cases of human disease in the USSR. Congo virus also has been associated with the production of disease in humans, either as a result of infections acquired in nature or in the laboratory. Thus far, Hazara virus has not been known to be involved in infections of humans, and little is known of this antigenic relative of CHF-Congo virus. All members of this serogroup appear to be associated with ixodid ticks although CHF virus was isolated from both ixodid and argasid ticks.

Members of the Dera Ghazi Khan (DGK) serogroup have not been isolated from vertebrate hosts, or from arthropod vectors other than ticks. Most of the viruses appear to be associated with argasid ticks. These viruses have been found in Africa, Asia and Australasia.

Only Hughes virus of the Hughes serogroup has been isolated from birds. It has been found in both North and South America while Soldado virus has been isolated in Africa, Europe and South America. All Hughes serogroup members have been associated with argasid ticks.

8.3.2 Nairobi Sheep Disease, Qalyub and Sakhalin serogroups. Nairobi sheep disease virus is an important cause of veterinary disease, while both Dugbe and Ganjam viruses have been isolated repeatedly from ticks removed from domestic animals. Dugbe and Ganjam viruses have caused febrile illnesses in humans. In the case of NSD virus, one infection in a person resulted in a febrile illness, while three others resulted in serologic conversions only. Thus, all three viruses have been isolated from humans and have been associated with laboratory infections. Pending further clarification of antigenic relationships, SIRACA considers Ganjam virus to be a variety of NSD virus.

Both Qalyub group viruses were found only in Africa, and both have been isolated from ticks. In addition, Bandia virus has been isolated from rodents.

Except for Avalon virus, members of the Sakhalin serogroup were isolated only from ixodid ticks. Avalon virus also was recovered from a bird. Sakhalin serogroup viruses are distributed in Asia (Paramushir, Sakhalin), Australasia (Taggart), Europe (Clo Mor), and North America (Avalon). Antigenic studies have indicated that Avalon and Paramushir viruses are strains of the same virus.

8.4 Uukuviruses: Uukuniemi serogroup viruses. Except for Uukuniemi virus, all members of the Uukuniemi serogroup have been isolated only from ticks (Table 8.4). Uukuniemi virus also has been recovered from both rodents and birds. Two of the viruses in this serogroup were found in Asia while three others were discovered in Europe. The sixth member, Precarious Point virus, was found on Australasia. HI antibodies to Uukuniemi virus have been detected in the sera of humans residing in Europe. Grand Arbaud virus has been evaluated as Arbovirus and Uukuniemi as Probable Arbovirus. The rest of the members have been evaluated as Possible Arbovirus.

The recently registered Precarious Point virus represents a new addition to the Uukuniemi serogroup. It was isolated from ixodid ticks collected at a penguin rookery on Macquarie Island, South Pacific Ocean.

8.5 Hantaviruses and bunyavirus-like viruses.

8.5.1 Hantaan, Bhanja, Kaisodi and Upolu serogroups. At present, the Hantavirus genus is only a proposed taxon (3). If approved, this genus will contain the four registered viruses listed in the Hantaan serogroup shown in Table 8.5.1. In addition to hantaan and Prospect Hill viruses, the

serogroup contains the recently registered Seoul and Puumala viruses. Seoul virus is the prototype virus for a group of Hantaan-related viruses isolated from rats, while Puumala virus is the etiologic agent of Nephropathia Epidemica. All four viruses have been isolated from rodents, while Hantaan virus has also been isolated from humans. Hantaan virus is the etiologic agent of hemorrhagic fever with renal syndrome (HFRS) or Korean hemorrhagic fever (KHF), and either is responsible for or is antigenically closely related to the agent(s) responsible for clinically similar diseases in the USSR, Japan, Manchuria, and Eastern and Northern Europe. More than 10,000 cases have occurred in Korea since the disease was first recognized in that country in 1951. Only Prospect Hill virus has not been shown to produce disease in humans. However, neutralizing antibodies to Prospect Hill virus were detected in the sera of four American mammalogists (19).

Bhanja virus is the sole registered virus member of the new Bhanja serogroup. Kismayo virus, an unregistered member, has been demonstrated to share an antigenic relationship with Bhanja virus (20). Bhanja virus has been isolated from humans and has been implicated in a laboratory-acquired human infection.

Two of the Kaisodi serogroup viruses were isolated from ticks collected in Asia while the third was isolated in North America. None of these viruses have been found to infect humans. Unpublished studies suggest that the RNA species and polypeptides of Silverwater virus resemble those of uukuviruses. Kaisodi and Silverwater viruses had been evaluated as Probable Arbovirus while Lanjan virus had been rated as Possible Arbovirus.

The Upolu serogroup consists of Upolu and Aransas Bay viruses. Both viruses were isolated only from argasid ticks. Neither virus has been associated with infections in humans. One virus has been found in Australia (UPO), and the other in North America (AB).

8.5.2 Bakau, Mapputta, Matariya, Nyando and Resistencia serogroups. All the viruses listed in Table 8.5.2 are members of minor serogroups, and provisionally are classified taxonomically as bunyavirus-like members of the family Bunyaviridae. Most viruses in these minor serogroups have been primarily associated with mosquito vectors. Viruses of the Matariya serogroups have not been recovered from mosquitoes.

Bakau serogroup viruses have been recovered only in Asia. Bakau virus has been isolated from mosquitoes, ticks and rodents.

Thus far, all four viruses of the Mapputta group have been found only in Australia. Maprik virus was rated as a Probable Arbovirus while the other three virus members were classified as Possible Arbovirus.

All three Matariya group viruses have been recovered from birds collected in Africa. Nothing is known concerning their possible vector association.

Nyando virus has been isolated from humans and from mosquitoes collected in Africa. The Nyando virus human infection resulted in a febrile illness.

The Resistencia antigenic group was recently formed and consists of three virus members isolated in Argentina from culicine mosquitoes. Electron microscopic investigations conducted with Barranqueras virus have shown that it resembles typical bunyaviruses morphologically and morphogenetically (see Barranqueras virus registration card).

8.5.3 Antigenically ungrouped bunyavirus-like viruses. The viruses shown in Table 8.5.3 have been subdivided according to their vector association. Those viruses in the upper part of the table have been listed together as mosquito-borne viruses. Those in the middle section have been associated with tick vectors, while the last two viruses have not been associated with any vector.

Tataguine, Tamdy and Bangui viruses have been isolated from humans and have been implicated in human disease.

9. Orbiviruses, family Reoviridae: Colorado tick fever and Kemerovo serogroups. While the viruses listed in Table 9.1 are tick-borne agents, they differ taxonomically from those in Tables 8.3.1-8.5.3 in that they have been classified as orbiviruses in the family Reoviridae. The orbiviruses are relatively resistant to lipid solvents, are inactivated at acid pH, and possess multiple segments of a double-stranded RNA genome. It is likely that members of the genus Orbivirus, and that the criteria used to define this genus, will be reevaluated in the near future.

Only Colorado tick fever (CTF) virus of the CTF serogroup and Kemerovo (KEM) and Lipovnik viruses of the KEM serogroup have produced disease in humans or have been isolated from humans.

Members of the KEM serogroup are widely distributed with at least one virus being found in each of the listed continents. Kemerovo and Chenuda viruses have been found in both Africa and Asia while Wad Medani virus has been discovered in Africa, Asia, and North America. Even though all members of this serogroup have been isolated from ticks, only three viruses were rated above Possible Arbovirus. All three were rated as Probable Arbovirus.

Mykines and Tindhølmur viruses, registered recently, were shown to be members of the KEM serogroup. Both viruses were isolated from ixodid ticks collected from a common puffin colony on the Faeroe Islands.

9.2 Other antigenic groups of orbiviruses. Several of the viruses in these serogroups cause significant diseases in large animals (Tables 9.2.1, 9.2.2). Bluetongue (BLU) virus causes disease in both wild and domestic ruminants; African horsesickness (AHS) virus in mules, donkeys and horses; epizootic hemorrhagic disease (EHD) virus in deer; and Ibaraki virus in cattle. Both BLU and AHS viruses have wide geographic distributions. The first isolation of BLU virus from a tick (Amblyomma variegatum) has been described (see BLU virus registration card).

Changuinola virus is the only member of these serogroups that has been isolated from humans; it has been reported to produce disease in humans. Of the present twelve serogroup members, only Irituia, Jari, and Monte Dourado viruses have not been isolated from an arthropod. All others, including Changuinola virus, appear to be associated with phlebotomine insects. Registered viruses of the Changuinola serogroup appear to have a limited distribution. Eleven members were recovered only in South America, while Changuinola virus was isolated in Central America.

Between 1960 and 1980, a total of 178 Changuinola serogroup viruses were isolated in Brazil, Colombia, and Panama. In a recent study, 24 of those viruses were selected as representative specimens and their antigenic, biological, and chemical properties were examined. Twelve of the viruses were distinct by neutralization tests and polyacrylamide gel electrophoresis (PAGE) (21). This study clearly showed that "a great many more Changuinola serotypes may exist" (21).

The three viruses of the Corriparta serogroup appear to be associated with mosquitoes. In addition, Corriparta virus was recovered from wild birds. All three viruses are widely separated in their distribution.

Thus far, Ibaraki and EHD viruses have not been associated with any known vector. The EHD virus has been found in Africa and North America, while Ibaraki virus has been recovered only in Asia.

Virus members of the Corriparta, Eubenangee, and Palyam serogroups appear to be primarily mosquito-associated, while members of the Wallal and Warrego (WAR) serogroups appear to be associated with Culicoides flies. Vector associations appear to be less clear for Eubenangee (EUB) virus of the EUB serogroup, and for WAR virus of the WAR serogroup.

9.3 Antigenically ungrouped Orbiviruses. The viruses in Table 9.3 are serologically ungrouped, though they have been clustered together on the basis of their association with mosquito or tick vectors.

Of the ungrouped orbiviruses associated with mosquito vectors, two viruses have been found in Africa (LEB, ORU), two in Australasia (JAP, PR) and three in North America (IERI, LLS, UMA). Llano Seco virus is antigenically related to Umatilla virus but its relationship to other established orbivirus groups has not been resolved. Thus it and Umatilla virus have been placed with the ungrouped viruses pending a clarification of their antigenic relationships.

Orungo virus has caused human disease as a result of laboratory infections and those acquired in nature. Lebombo virus, or a closely related virus, has been isolated from human plasma, although it has not been associated with the production of disease in humans thus far.

Chobar Gorge virus provisionally has been placed in the Orbivirus genus as a result of information originally present on the registration card but which previously had been overlooked.

Ife virus has not been associated with a vector and has been isolated from bats collected in Nigeria and Cameroun.

10. Family Rhabdoviridae. Members of the serogroups listed in Tables 10.1 and 10.2 or the antigenically ungrouped viruses listed in Table 10.3 possess a "bullet-shaped" morphology and are classified as members of the family Rhabdoviridae.

The rabies serogroup listed in Table 10.1 consists of kotonkan virus and Lagos bat virus. Kotonkan virus was isolated from Culicoides species collected in Nigeria. It was rated as Probable Arbovirus by SEAS. Lagos bat virus has been isolated only from bats and SEAS has evaluated it as Not Arbovirus.

All three viruses of the Sawgrass serogroup were isolated from ticks collected in North America. The viruses of the Timbo serogroup were isolated from lizards, and none of these viruses have been isolated from arthropods.

VSV group members have been recovered from phlebotomine flies, mosquitoes, ticks, Culicoides, mites, Simulium flies and a variety of other arthropods including house flies, face flies, Chloropidae, and Anthomyidae. Piry and VS-Alagoas viruses have not been recovered from arthropods. Of the serogroups listed in this and Table 10.2, only members of the VSV serogroup and Le Dantec virus have been shown to infect humans. In the VSV serogroup, Chandipura, Piry, VS-Indiana and VS-New Jersey viruses have been isolated from man. These viruses, plus VS-Alagoas virus, have been found to produce disease in humans during infections acquired in nature or in the laboratory. Both VS-Indiana and VS-New Jersey viruses readily infect livestock, while Cocal virus has been recovered from a horse and VS-Alagoas virus from a mule.

Table 10.2 contains the newly formed bovine ephemeral fever (BEF) serogroup, the Hart Park serogroup viruses, a Kwatta serogroup virus, the recently formed Le Dantec serogroup, and an expanded Mossuril serogroup consisting of eight members.

The newly formed BEF serogroup consists of three recently registered Australian viruses (AR, BRM, KIM) and bovine ephemeral fever virus. Only BEF and KIM viruses have been isolated from vectors. Kimberley virus has been isolated from Culicoides sp. and culicine mosquitoes, while bovine ephemeral fever virus has been isolated from Culicoides sp., anopheline mosquitoes and a mixed pool of mosquito species. All four viruses have been isolated from cattle. Thus far, only BEF virus has been recovered outside of Australia.

All of the Hart Park serogroup members are associated with a mosquito vector and two of the viruses (Hart Park and Flanders) have been isolated from birds. None of these viruses have been associated with disease in humans. Thus far their distribution includes only North and South America.

Kwatta virus was isolated only once from mosquitoes collected in Surinam. An antigenic relative of Kwatta virus remains unregistered. This unregistered virus was recovered from a bird collected in Brazil.

The new Le Dantec serogroup consists of Le Dantec and Keuraliba viruses. Prior to the discovery of an antigenic relationship between these two rhabdoviruses, Keuraliba virus was listed as a member of the VSV serogroup. However, this relationship was not reproducible and Keuraliba virus was withdrawn from the VSV serogroup when it was demonstrated to be related to Le Dantec virus. Neither virus has been isolated from an arthropod. Le Dantec virus has been isolated from humans and Keuraliba virus was isolated from rodents.

Three of the members of the Mossuril serogroup have not been isolated from arthropods. These include Cuiaba, Kern Canyon, and Marco viruses. Kern Canyon virus has been rated as Probably Not Arbovirus by SEAS. Previous studies have demonstrated that Kern Canyon virus could be propagated in an Aedes dorsalis cell culture line.

All the viruses listed in Table 10.3 are antigenically ungrouped rhabdoviruses. The first six viruses shown in the table have been associated with mosquito vectors. Inhangapi and Sripur viruses have been associated with phlebotomine flies and Tibrogargan virus with Culicoides flies. The latter five viruses have been isolated from vertebrates only.

Only Aruac and Almpiwar viruses have been rated as Probable Arbovirus. The rest have been rated as Possible Arbovirus or Probably Not Arbovirus.

None of the viruses listed in this table have been isolated from humans or have been implicated in human disease.

Recently, Gossas virus was shown to possess rhabdovirus morphology (22). The possibility that Gossas virus is antigenically related to other rhabdoviruses is being actively investigated.

11. Arenaviruses: Tacaribe serogroup viruses. Tacaribe group viruses in Table 11.1 are serologically related to lymphocytic choriomeningitis virus, and they are classified taxonomically in the Arenavirus genus. They are primarily rodent viruses, and there is little or no evidence that suggests that they are associated with an arthropod vector in nature. SEAS has judged most members to be Not Arbovirus or Probably Not Arbovirus.

Ippy and Toure viruses represent provisional additions to this serogroup. Previously, Ippy virus was found to be related to Lassa virus. Its antigenic relationship to other members of the Tacaribe serogroup has yet to be determined. Characteristically, Ippy virus has been isolated from Mastomys rodents and from rodents of other species. Toure virus was isolated from gerbils.

Three members of this group have been shown to cause severe, often fatal, human disease. These include Junin (Argentine hemorrhagic fever), Machupo (Bolivian hemorrhagic fever), and Lassa (Lassa disease). In addition to causing clinically frank laboratory-acquired infections, Junin virus also has

been reported to cause subclinical laboratory-acquired infections. A subclinical seroconversion to Tacaribe virus has been documented in a laboratory worker handling large quantities of Tacaribe virus. In addition, Pichinde virus has produced subclinical infections in laboratory workers. Finally, Flexal virus has produced a febrile illness in a laboratory worker following a laboratory accident. Flexal virus was recovered from rodents trapped in Brazil.

12. Thogoto serogroup viruses and antigenically ungrouped viruses of various taxa. See Table 12.1. Thogoto virus has been isolated from humans and has been involved in human disease. An unregistered antigenic relative of Thogoto virus has been isolated in Sicily (SiAr 126). Molecular analysis of a Thogoto serogroup virus has indicated that its virion RNA species and structural polypeptides resemble those of members of the family Orthomyxoviridae (23).

Formerly, the Bunyaviridae study group of the ICTV had classified Dhori virus as a member of the then newly defined Nairovirus genus. Subsequently, molecular studies indicated that Dhori virus possessed seven virion polypeptides and seven single-stranded RNA segments, comparable to those of viruses of the family Orthomyxoviridae (23).

Tettnang virus was shown to cross-react in CF tests with mouse hepatitis virus (MHV). Subsequently, three isolates of Tettnang virus were compared to prototype strains of MHV by neutralization tests (24). The relationship of Tettnang virus to MHV was confirmed; however, the precise relationship of the Tettnang virus isolates to MHV strains remained unclear because of the past passage history of the Tettnang isolates. Further, whether the Tettnang

isolates were, in fact, arthropod-borne remains unlikely but unanswered. Bocas virus was formerly included in the CAL serogroup until it was demonstrated that it was identical to or closely related to mouse hepatitis virus. Although both Tettnang and Bocas viruses are closely related to or identical to mouse hepatitis virus, they were not compared to each other.

Nodamura virus was isolated from wild-caught mosquitoes in Japan, and it has been demonstrated to produce disease in moths and honey bees. It also has been shown that it replicates in mosquitoes and is experimentally transmitted by mosquitoes. Nodamura virus is the type species for the Nodavirus genus within the family Nodaviridae. Both the family and the genus Nodavirus were established by ICTV during meetings held at the time of the Fifth International Congress of Virology in 1981 (25).

Cotia virus, a poxvirus, has been reported to produce disease in humans. However, very little information is available concerning Oubangui and Salanga viruses.

13. Taxonomically unclassified viruses.

13.1 Minor antigenic groups. Both Boteke group viruses listed in Table 13.1 have been isolated in Africa only. Zingilamo virus was recovered from a bird and Boteke virus was isolated from mosquitoes. Previously published studies have indicated that Zingilamo virus resembles viruses of the family Togaviridae (17). Pending further information, both viruses of this serogroup will be listed as unclassified in this report.

Malakal and Puchong viruses (Malakal serogroup) have been isolated from mosquitoes only. Malakal virus was recovered from mosquitoes collected in Africa, while Puchong virus was found in Asia.

Nyamanini virus and the unregistered Midway virus (26) now constitute the Nyamanini serogroup. Nyamanini virus was isolated from argasid ticks and birds. It has not been associated with human disease.

Quaranfil virus has been isolated from both humans and birds and has been associated with human disease as the result of natural infections. Preliminary molecular studies conducted with Quaranfil virus indicated that this virus may resemble viruses of the family Orthomyxoviridae. At this point, further verification is required. Little is known concerning the behavior of Johnston Atoll virus in nature.

Both Marburg and Ebola viruses have caused human disease as a result of infections acquired in nature and have been associated with laboratory-acquired infections. Ebola virus was found to possess a single-stranded RNA that was noninfectious upon extraction. Recent evidence indicates that there might be different serotypes of Ebola virus (27). Marburg and Ebola viruses have been isolated from humans only.

The two viruses of the Tanjong Rabok serogroup have been isolated in Malaysia but neither has been associated with a vector. Telok Forest virus was isolated from a wild monkey and Tanjong Rabok virus from a sentinel monkey.

13.2 Antigenically ungrouped viruses. The serologically ungrouped viruses in the upper part of Table 13.2.1 have been associated with mosquito vectors, and all remain taxonomically unclassified. Gomoka and Para viruses also have been recovered from sources other than mosquitoes. Gomoka virus was isolated twice from birds collected in the Central African Republic and Para virus was isolated from sentinel mice.

With one exception, viruses shown in the lower portion of Table 13.2.1 have been associated with tick vectors or both tick and mosquito vectors. Ngaingan virus has been associated with Culicoides flies.

Issyk-Kul and Keterah viruses have been shown to be closely related or identical by complement-fixation. Cross-neutralization testing will determine whether they are the same virus or antigenic relatives. Pending the results of that testing, these viruses are being listed in the ungrouped category.

Issyk-Kul virus has been isolated on more than 20 occasions from the blood of humans infected in nature. The infections were classified as febrile illnesses. Issyk-Kul virus also has been implicated in a laboratory infection.

Wanowrie virus has been isolated from the brain of a fatal human case.

Lake Clarendon virus represents a new addition to Table 13.2.1. This virus was recovered from argasid ticks collected in Australia.

Only Termeil, Issyk-kul and Keterah viruses were rated above Possible Arbovirus. Termeil and Keterah viruses were rated as Probable Arbovirus and Issyk-Kul virus as Arbovirus.

None of the viruses listed in Table 13.2.2 have been isolated from an arthropod vector, and none has been rated higher than Possible Arbovirus. More than half were isolated from birds. Three other viruses have been recovered from rodents, three from bats, and two others from other vertebrates. Twelve of these viruses were recovered in Africa and Asia. The remaining five viruses were found in South America.

Table 14.1 gives continental distribution of viruses in different antigenic groups on the basis of virus isolation. Most of the registered viruses are very limited in their distribution. Approximately 86% have been isolated on a single continent only, while 23 (4.6%) have been found on three or more continents. The largest number of viruses have been isolated in South America and Africa, probably reflecting research emphasis as well as biological limitations.

Table 15.1 shows the number of viruses, according to antigenic group, isolated from various classes of arthropods. About 49% have been recovered from mosquitoes, 22% from ticks, and 17% from all other classes. One hundred and eight registered viruses (21%) have never been recovered from any arthropod vector. The largest number of viruses which have been isolated from any arthropod, have been recovered from a single class only (351 of 396, 88.6%).

Table 16.1 presents a similar type of analysis in terms of virus isolations from various classes of vertebrates. Humans and rodents have provided the largest number of virus isolations. Most of the viruses isolated from vertebrates have been recovered from a single class only (198 of 283, 70.0%).

Table 17.1 lists the viruses by antigenic group that cause disease in humans. Approximately 25% of all registered viruses have been associated with human disease, either as a result of infections acquired in nature, from laboratory accidents, or both. Members of serogroups A and B and those in the Bunyamwera Supergroup constitute 42.7% of all registered viruses but about 61% of the instances in which registered viruses are associated with disease production in humans.

An analysis of the SEAS ratings for all registered viruses is presented in Table 18.1. It shows that 264 registrations (52.3%) are rated as Possible Arbovirus. Clearly, additional data are required if we are to have a more precise rating of the arthropod-borne status of these viruses. Sufficient data are available for about 47% of all registered viruses so that 41% are rated Probable Arbovirus or Arbovirus, while 6% are rated Probably Not Arbovirus or Not Arbovirus.

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Table 1.1

ALPHABETICAL AND TAXONOMIC LISTING OF 504 VIRUSES REGISTERED
AS OF DECEMBER 1985 WITH RECOMMENDED ABBREVIATIONS
AND ANTIGENIC GROUPINGS

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
ABRAS	ABR	Bunyaviridae	<u>Bunyavirus</u>	PAT
ABSETTAROV	ABS	Flaviviridae	<u>Flavivirus</u>	B
ABU HAMMAD	AH	Bunyaviridae	<u>Nairovirus</u>	DGK
ACADO	ACD	Reoviridae	<u>Orbivirus</u>	COR
ACARA	ACA	Bunyaviridae	<u>Bunyavirus</u>	CAP
ADELAIDE RIVER	AR	Rhabdoviridae		BEF
AFRICAN HORSESICKNESS	AHS	Reoviridae	<u>Orbivirus</u>	AHS
AFRICAN SWINE FEVER	ASF	Iridoviridae		
AGUACATE	AGU	Bunyaviridae	<u>Phlebovirus</u>	PHL
AGUA PRETA	AP	Herpesviridae		
AINO	AINO	Bunyaviridae	<u>Bunyavirus</u>	SIM
AKABANE	AKA	Bunyaviridae	<u>Bunyavirus</u>	SIM
ALENQUER	ALE	Bunyaviridae	<u>Phlebovirus</u>	PHL
ALFUJ	ALF	Flaviviridae	<u>Flavivirus</u>	B
ALMEIRIM	AMR	Reoviridae	<u>Orbivirus</u>	CGL
ALMPIWAR	ALM	Rhabdoviridae		
ALTAMIRA	ALT	Reoviridae	<u>Orbivirus</u>	CGL
AMAPARI	AMA	Arenaviridae	<u>Arenavirus</u>	TCR
AMANINDEUA	ANU	Bunyaviridae	<u>Bunyavirus</u>	GMA
ANHANGA	ANH	Bunyaviridae	<u>Phlebovirus</u>	PHL
ANHEMBI	AMB	Bunyaviridae	<u>Bunyavirus</u>	BUN

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
ANOPHELES A	ANA	Bunyaviridae	<u>Bunyavirus</u>	ANA
ANOPHELES B	ANB	Bunyaviridae	<u>Bunyavirus</u>	ANB
ANTEQUERA	ANT	Bunyaviridae	Bunyavirus-like	RTA
APEU	APEU	Bunyaviridae	<u>Bunyavirus</u>	C
APOI	APOI	Flaviviridae	<u>Flavivirus</u>	B
ARAGUARI	ARA			
ARANSAS BAY	AB	Bunyaviridae	Bunyavirus-like	UPO
ARBIA	ARB	Bunyaviridae	<u>Phlebovirus</u>	PHL
ARIDE	ARI			
ARKONAM	ARK			
AROA	AROA	Flaviviridae	<u>Flavivirus</u>	B
ARUAC	ARU	Rhabdoviridae		
ARUMOWOT	AMT	Bunyaviridae	<u>Phlebovirus</u>	PHL
AURA	AUFA	Togaviridae	<u>Alphavirus</u>	A
AVALON	AVA	Bunyaviridae	<u>Nairovirus</u>	SAK
BABAHOYO	BAP	Bunyaviridae	<u>Bunyavirus</u>	PAT
BAGAZA	BAG	Flaviviridae	<u>Flavivirus</u>	B
BAHIG	BAH	Bunyaviridae	<u>Bunyavirus</u>	TETE
BAKAU	BAK	Bunyaviridae	Bunyavirus-like	BAK
BAKU	BAKU	Reoviridae	<u>Orbivirus</u>	KEM
BANDIA	BDA	Bunyaviridae	<u>Nairovirus</u>	QYB
BANGORAN	BGN	Rhabdoviridae		MOS
BANGUI	BGI	Bunyaviridae	Bunyavirus-like	
BANZI	BAN	Flaviviridae	<u>Flavivirus</u>	B

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
BARMAH FOREST	BF	Togaviridae	<u>Alphavirus</u>	A
BARRANQUERAS	BQS	Bunyaviridae	Bunyavirus-like	RTA
BARUR	BAR	Rhabdoviridae		MOS
BATAI	BAT	Bunyaviridae	<u>Bunyavirus</u>	BUN
BATAMA	BMA	Bunyaviridae	<u>Bunyavirus</u>	TETE
BATKEN	BKN			
BAULINE	BAU	Reoviridae	<u>Orbivirus</u>	KEM
BEBARU	BEB	Togaviridae	<u>Alphavirus</u>	A
BELEM	BLM			
BELMONT	BEL	Bunyaviridae	Bunyavirus-like	
BENEVIDES	BVS	Bunyaviridae	<u>Bunyavirus</u>	CAP
BENFICA	BEN	Bunyaviridae	<u>Bunyavirus</u>	CAP
BERRIMAH	BRM	Rhabdoviridae		BEF
BERTIOGA	BER	Bunyaviridae	<u>Bunyavirus</u>	GMA
BHANJA	BHA	Bunyaviridae	Bunyavirus-like	BHA
BIMBO	BBO			
BIMITI	BIM	Bunyaviridae	<u>Bunyavirus</u>	GMA
BIRAO	BIR	Bunyaviridae	<u>Bunyavirus</u>	BUN
BLUETONGUE	BLU	Reoviridae	<u>Orbivirus</u>	BLU
BOBAYA	BOB	Bunyaviridae	Bunyavirus-like	
BOBIA	BIA	Bunyaviridae	<u>Bunyavirus</u>	OLI
BOCAS	BOC	Coronaviridae	<u>Coronavirus</u>	
BORACEIA	BOR	Bunyaviridae	<u>Bunyavirus</u>	ANB
BOTAMBI	BOT	Bunyaviridae	<u>Bunyavirus</u>	OLI

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
BOTEKE	BTK			BTK
BOUPOUI	BOU	Flaviviridae	<u>Flavivirus</u>	B
BOVINE EPHEMERAL FEVER	BEF	Rhabdoviridae		BEF
BUENAVENTURA	BUE	Bunyaviridae	<u>Phlebovirus</u>	PHL
BUJARU	BUJ	Bunyaviridae	<u>Phlebovirus</u>	PHL
BUNYAMWERA	BUN	Bunyaviridae	<u>Bunyavirus</u>	BUN
BUNYIP CREEK	BC	Reoviridae	<u>Orbivirus</u>	PAL
BURG EL ARAB	BEA	Bunyaviridae	Bunyavirus-like	MTY
BUSHBUSH	BSB	Bunyaviridae	<u>Bunyavirus</u>	CAP
BUSSUQUARA	BSQ	Flaviviridae	<u>Flavivirus</u>	B
BUTTONWILLOW	BUT	Bunyaviridae	<u>Bunyavirus</u>	SIM
BWAMBA	BWA	Bunyaviridae	<u>Bunyavirus</u>	BWA
CABASSOU	CAB	Togaviridae	<u>Alphavirus</u>	A
CACAO	CAC	Bunyaviridae	<u>Phlebovirus</u>	PHL
CACHE VALLEY	CV	Bunyaviridae	<u>Bunyavirus</u>	BUN
CACIPACORE	CPC	Flaviviridae	<u>Flavivirus</u>	B
CAIMITO	CAI	Bunyaviridae	<u>Phlebovirus</u>	PHL
CALIFORNIA ENC.	CE	Bunyaviridae	<u>Bunyavirus</u>	CAL
CALOVO	CVO	Bunyaviridae	<u>Bunyavirus</u>	BUN
CANANEIA	CNA	Bunyaviridae	<u>Bunyavirus</u>	GMA
CANDIRU	CDU	Bunyaviridae	<u>Phlebovirus</u>	PHL
CANINDE	CAN	Reoviridae	<u>Orbivirus</u>	CGL
CAPE WRATH	CW	Reoviridae	<u>Orbivirus</u>	KEM
CAPIM	CAP	Bunyaviridae	<u>Bunyavirus</u>	CAP

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
CARAPARU	CAR	Bunyaviridae	<u>Bunyavirus</u>	C
CAREY ISLAND	CI	Flaviviridae	<u>Flavivirus</u>	B
CATU	CATU	Bunyaviridae	<u>Bunyavirus</u>	GMA
CHACO	CHO	Rhabdoviridae		TIM
CHAGRES	CHG	Bunyaviridae	<u>Phlebovirus</u>	PHL
CHANDIPURA	CHP	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
CHANGUINOLA	CGL	Reoviridae	<u>Orbivirus</u>	CGL
CHARLEVILLE	CHV	Rhabdoviridae		MOS
CHENUDA	CNU	Reoviridae	<u>Orbivirus</u>	KEM
CHIKUNGUNYA	CHIK	Togaviridae	<u>Alphavirus</u>	A
CHILIBRE	CHI	Bunyaviridae	<u>Phlebovirus</u>	PHL
CHIM	CHIM			
CHOBAR GORGE	CG	Reoviridae	<u>Orbivirus</u>	
CLO MOR	CM	Bunyaviridae	<u>Nairovirus</u>	SAK
COCAL	COC	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
COLORADO TICK FEVER	CTF	Reoviridae	<u>Orbivirus</u>	CTF
CONGO	CON	Bunyaviridae	<u>Nairovirus</u>	CHF-CON
CONNECTICUT	CNT	Rhabdoviridae		SAW
CORRIPARTA	COR	Reoviridae	<u>Orbivirus</u>	COR
COTIA	COT	Poxviridae		
COWBONE RIDGE	CR	Flaviviridae	<u>Flavivirus</u>	B
CRIMEAN HEM. FEVER	CHF	Bunyaviridae	<u>Nairovirus</u>	CHF-CON
CSIRO VILLAGE	CVG	Reoviridae	<u>Orbivirus</u>	PAL
CUIABA	CUI	Rhabdoviridae		MOS

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
D'AGUILAR	DAG	Reoviridae	<u>Orbivirus</u>	PAL
DAKAR BAT	DB	Flaviviridae	<u>Flavivirus</u>	B
DENGUE-1	DEN-1	Flaviviridae	<u>Flavivirus</u>	B
DENGUE-2	DEN-2	Flaviviridae	<u>Flavivirus</u>	B
DENGUE-3	DEN-3	Flaviviridae	<u>Flavivirus</u>	B
DENGUE-4	DEN-4	Flaviviridae	<u>Flavivirus</u>	B
DERA GHAZI KHAN	DGK	Bunyaviridae	<u>Nairovirus</u>	DGK
DHORI	DHO	Orthomyxoviridae		
DOUGLAS	DGU	Bunyaviridae	<u>Bunyavirus</u>	SIM
DUGBE	DUG	Bunyaviridae	<u>Nairovirus</u>	NSD
EAST. EQUINE ENC.	EEE	Togaviridae	<u>Alphavirus</u>	A
EBOLA	EBO			MBG
EDGE HILL	EH	Flaviviridae	<u>Flavivirus</u>	B
ENSEADA	ENS	Bunyaviridae	Bunyavirus-like	
ENTEBBE BAT	ENT	Flaviviridae	<u>Flavivirus</u>	B
EP. HEM. DIS.	EHD	Reoviridae	<u>Orbivirus</u>	EHD
ESTERO REAL	ER			
EUBENANGEE	EUB	Reoviridae	<u>Orbivirus</u>	EUB
EVERGLADES	EVE	Togaviridae	<u>Alphavirus</u>	A
EYACH	EYA	Reoviridae	<u>Orbivirus</u>	CTF
FLANDERS	FLA	Rhabdoviridae		HP
FLEXAL	FLE	Arenaviridae	<u>Arenavirus</u>	TCR
FORT MORGAN	FM	Togaviridae	<u>Alphavirus</u>	A
FRIJOLES	FRI	Bunyaviridae	<u>Phlebovirus</u>	PHL

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
GABEK FOREST	GF	Bunyaviridae	<u>Phlebovirus</u>	PHL
GADGETS GULLY	GGY	Flaviviridae	<u>Flavivirus</u>	B
GAMBOA	GAM	Bunyaviridae	<u>Bunyavirus</u>	GAM
GAN GAN	GG	Bunyaviridae	Bunyavirus-like	MAP
GANJAM	GAN	Bunyaviridae	<u>Nairovirus</u>	NSD
GARBA	GAR	Bunyaviridae	Bunyavirus-like	MTY
GERMISTON	GER	Bunyaviridae	<u>Bunyavirus</u>	BUN
GETAH	GET	Togaviridae	<u>Alphavirus</u>	A
GOMOKA	GOM			
GORDIL	GOR	Bunyaviridae	<u>Phlebovirus</u>	PHL
GOSSAS	GOS	Rhabdoviridae		
GRAND ARBAUD	GA	Bunyaviridae	<u>Uukuvirus</u>	UUK
GRAY LODGE	GLO	Rhabdoviridae		
GREAT ISLAND	GI	Reoviridae	<u>Orbivirus</u>	KEM
GUAJARA	GJA	Bunyaviridae	<u>Bunyavirus</u>	CAP
GUAMA	GMA	Bunyaviridae	<u>Bunyavirus</u>	GMA
GUARATUBA	GTB	Bunyaviridae	<u>Bunyavirus</u>	GMA
GUAROA	GRO	Bunyaviridae	<u>Bunyavirus</u>	CAL
GUMBO LIMBO	GL	Bunyaviridae	<u>Bunyavirus</u>	C
GURUPI	GUR	Reoviridae	<u>Orbivirus</u>	CGL
HANTAAN	HTN	Bunyaviridae	<u>Hantavirus*</u>	HTN
HANZALOVA	HAN	Flaviviridae	<u>Flavivirus</u>	B
HART PARK	HP	Rhabdoviridae		HP

*Proposed genus designation

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
HAZARA	HAZ	Bunyaviridae	<u>Nairovirus</u>	CHF-CON
HIGHLANDS J	HJ	Togaviridae	<u>Alphavirus</u>	A
HUACHO	HUA	Reoviridae	<u>Orbivirus</u>	KEM
HUGHES	HUG	Bunyaviridae	<u>Nairovirus</u>	HUG
HYPR	HYPR	Flaviviridae	<u>Flavivirus</u>	B
IACO	IACO	Bunyaviridae	<u>Bunyavirus</u>	BUN
IBARAKI	IBA	Reoviridae	<u>Orbivirus</u>	EHD
ICOARACI	ICO	Bunyaviridae	<u>Phlebovirus</u>	PHL
IERI	IERI	Reoviridae	<u>Orbivirus</u>	
IFE	IFE	Reoviridae	<u>Orbivirus</u>	
ILESHA	ILE	Bunyaviridae	<u>Bunyavirus</u>	BUN
ILHEUS	ILH	Flaviviridae	<u>Flavivirus</u>	B
INGWAVUMA	ING	Bunyaviridae	<u>Bunyavirus</u>	SIM
INHANGAPI	INH	Rhabdoviridae		
ININI	INI	Bunyaviridae	<u>Bunyavirus</u>	SIM
INKOO	INK	Bunyaviridae	<u>Bunyavirus</u>	CAL
IPPY	IPPY	Arenaviridae	<u>Arenavirus</u>	TCR
IRITUIA	IRI	Reoviridae	<u>Orbivirus</u>	CGL
ISFAHAN	ISF	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
ISRAEL TURKEY MEN.	IT	Flaviviridae	<u>Flavivirus</u>	B
ISSYK-KUL	IK			
ITAITUBA	ITA	Bunyaviridae	<u>Phlebovirus</u>	PHL
ITAPORANGA	ITP	Bunyaviridae	<u>Phlebovirus</u>	PHL
ITAQUI	ITQ	Bunyaviridae	<u>Bunyavirus</u>	C

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
ITIMIRIM	ITI	Bunyaviridae	<u>Bunyavirus</u>	GMA
ITUPIRANGA	ITU			
JACAREACANGA	JAC	Reoviridae	<u>Orbivirus</u>	COR
JAMANXI	JAM	Reoviridae	<u>Orbivirus</u>	CGL
JAMESTOWN CANYON	JC	Bunyaviridae	<u>Bunyavirus</u>	CAL
JAPANAUT	JAP	Reoviridae	<u>Orbivirus</u>	
JAPANESE ENC.	JBE	Flaviviridae	<u>Flavivirus</u>	B
JARI	JARI	Reoviridae	<u>Orbivirus</u>	CGL
JERRY SLOUGH	JS	Bunyaviridae	<u>Bunyavirus</u>	CAL
JOHNSTON ATOLL	JA			QRF
JOINJAKAKA	JOI	Rhabdoviridae		
JUAN DIAZ	JD	Bunyaviridae	<u>Bunyavirus</u>	CAP
JUGRA	JUG	Flaviviridae	<u>Flavivirus</u>	B
JUNIN	JUN	Arenaviridae	<u>Arenavirus</u>	TCR
JURONA	JUR	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
JUTIAPA	JUT	Flaviviridae	<u>Flavivirus</u>	B
KADAM	KAD	Flaviviridae	<u>Flavivirus</u>	B
KAENG KHOI	KK	Bunyaviridae	<u>Bunyavirus</u>	SBU
KAIKALUR	KAI	Bunyaviridae	<u>Bunyavirus</u>	SIM
KAIRI	KRI	Bunyaviridae	<u>Bunyavirus</u>	BUN
KAISODI	KSO	Bunyaviridae	Bunyavirus-like	KSO
KAMESE	KAM	Rhabdoviridae		MOS
KAMMAVANPETTAI	KMP			
KANNAMANGALAM	KAN			

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
KAO SHUAN	KS	Bunyaviridae	<u>Nairovirus</u>	DGK
KARIMABAD	KAR	Bunyaviridae	<u>Phlebovirus</u>	PHL
KARSHI	KSI	Flaviviridae	<u>Flavivirus</u>	B
KASBA	KAS	Reoviridae	<u>Orbivirus</u>	PAL
KEMEROVO	KEM	Reoviridae	<u>Orbivirus</u>	KEM
KERN CANYON	KC	Rhabdoviridae		MOS
KETAPANG	KET	Bunyaviridae	Bunyavirus-like	BAK
KETERAH	KTR			
KEURALIBA	KEU	Rhabdoviridae		LD
KEYSTONE	KEY	Bunyaviridae	<u>Bunyavirus</u>	CAL
KHASAN	KHA	Bunyaviridae	<u>Nairovirus</u>	CHF-CON
KIMBERLEY	KIM	Rhabdoviridae		BEF
KLAMATH	KLA	Rhabdoviridae		
KOKOBERA	KOK	Flaviviridae	<u>Flavivirus</u>	B
KOLONGO	KOL			
KOONGOL	KOO	Bunyaviridae	<u>Bunyavirus</u>	KOO
KOTONKAN	KOT	Rhabdoviridae	<u>Lyssavirus</u>	RABIES
KOUTANGO	KOU	Flaviviridae	<u>Flavivirus</u>	B
KOWANYAMA	KOW	Bunyaviridae	Bunyavirus-like	
KUMLINGE	KUM	Flaviviridae	<u>Flavivirus</u>	B
KUNJIN	KUN	Flaviviridae	<u>Flavivirus</u>	B
KUNUNURRA	KNA	Rhabdoviridae		
KWATTA	KWA	Rhabdoviridae		KWA
KYASANUR FOR. DIS.	KFD	Flaviviridae	<u>Flavivirus</u>	B

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
KYZYLAGACH	KYZ	Togaviridae	<u>Alphavirus</u>	A
LA CROSSE	LAC	Bunyaviridae	<u>Bunyavirus</u>	CAL
LAGOS BAT	LB	Rhabdoviridae	<u>Lyssavirus</u>	RABIES
LA JOYA	LJ	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
LAKE CLARENDON	LC			
LANDJIA	LJA			
LANGAT	LGT	Flaviviridae	<u>Flavivirus</u>	B
LANJAN	LJN	Bunyaviridae	Bunyavirus-like	KSO
LAS MALOYAS	LM	Bunyaviridae	<u>Bunyavirus</u>	ANA
LASSA	LAS	Arenaviridae	<u>Arenavirus</u>	TCR
LATINO	LAT	Arenaviridae	<u>Arenavirus</u>	TCR
LEBOMBO	LEB	Reoviridae	<u>Orbivirus</u>	
LE DANTEC	LD	Rhabdoviridae		LD
LEDNICE	LED	Bunyaviridae	<u>Bunyavirus</u>	TUR
LIPOVNIK	LIP	Reoviridae	<u>Orbivirus</u>	KEM
LLANO SECO	LLS	Reoviridae	<u>Orbivirus</u>	*
LOKERN	LOK	Bunyaviridae	<u>Bunyavirus</u>	BUN
LONE STAR	LS	Bunyaviridae	Bunyavirus-like	
LOUPING ILL	LI	Flaviviridae	<u>Flavivirus</u>	B
LUKUNI	LUK	Bunyaviridae	<u>Bunyavirus</u>	ANA
MACAUA	MCA	Bunyaviridae	<u>Bunyavirus</u>	BUN
MACHUPO	MAC	Arenaviridae	<u>Arenavirus</u>	TCR

*Llano Seco virus is related to Umatilla virus. Its relationship to other orbivirus serogroups has not been determined.

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
MADRID	MAD	Bunyaviridae	<u>Bunyavirus</u>	C
MAGUARI	MAG	Bunyaviridae	<u>Bunyavirus</u>	BUN
MAHOGANY HAMMOCK	MH	Bunyaviridae	<u>Bunyavirus</u>	GMA
MAIN DRAIN	MD	Bunyaviridae	<u>Bunyavirus</u>	BUN
MALAKAL	MAL			MAL
MANAWA	MMA	Bunyaviridae	<u>Uukuvirus</u>	UUK
MANZANILLA	MAN	Bunyaviridae	<u>Bunyavirus</u>	SIM
MAPPUTTA	MAP	Bunyaviridae	Bunyavirus-like	MAP
MAPRIK	MPK	Bunyaviridae	Bunyavirus-like	MAP
MAPUERA	MPR			
MARBURG	MBC			MBG
MARCO	MCO	Rhabdoviridae		MOS
MARITUBA	MTB	Bunyaviridae	<u>Bunyavirus</u>	C
MARRAKAI	MAR	Reoviridae	<u>Orbivirus</u>	PAL
MATARIYA	MTY	Bunyaviridae	Bunyavirus-like	MTY
MATRUH	MTR	Bunyaviridae	<u>Bunyavirus</u>	TETE
MATUCARE	MAT			
MAYARO	MAY	Togaviridae	<u>Alphavirus</u>	A
MEABAN	MEA	Flaviviridae	<u>Flavivirus</u>	B
MELAO	MEL	Bunyaviridae	<u>Bunyavirus</u>	CAL
MERMET	MER	Bunyaviridae	<u>Bunyavirus</u>	SIM
MIDDELBURG	MID	Togaviridae	<u>Alphavirus</u>	A
MINATITLAN	MNT	Bunyaviridae	<u>Bunyavirus</u>	MNT
MINNAL	MIN			

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
MIRIM	MIR	Bunyaviridae	<u>Bunyavirus</u>	GMA
MITCHELL RIVER	MR	Reoviridae	<u>Orbivirus</u>	WAR
MODOC	MOD	Flaviviridae	<u>Flavivirus</u>	B
MOJU	MOJU	Bunyaviridae	<u>Bunyavirus</u>	GMA
MOJUI DOS CAMPOS	MDC			
MONO LAKE	ML	Reoviridae	<u>Orbivirus</u>	KEM
MONT. MYOTIS LEUK.	MML	Flaviviridae	<u>Flavivirus</u>	B
MONTE DOURADO	MDO	Reoviridae	<u>Orbivirus</u>	CGL
MORICHE	MOR	Bunyaviridae	<u>Bunyavirus</u>	CAP
MOSQUEIRO	MQO	Rhabdoviridae		HP
MOSSURIL	MOS	Rhabdoviridae		MOS
MOUNT ELGON BAT	MEB	Rhabdoviridae		
M'POKO	MPO	Bunyaviridae	<u>Bunyavirus</u>	TUR
MUCAMBO	MUC	Togaviridae	<u>Alphavirus</u>	A
MUNGUBA	MUN	Bunyaviridae	<u>Phlebovirus</u>	PHL
MURRAY VALLEY ENC.	MVE	Flaviviridae	<u>Flavivirus</u>	B
MURUTUCU	MUR	Bunyaviridae	<u>Bunyavirus</u>	C
MYKINES	MYK	Reoviridae	<u>Orbivirus</u>	KEM
NAIROBI SHEEP DIS.	NSD	Bunyaviridae	<u>Nairovirus</u>	NSD
NARANJAL	NJL	Flaviviridae	<u>Flavivirus</u>	B
NARIVA	NAR	Paramyxoviridae	<u>Paramyxovirus</u>	
NAVARRO	NAV	Rhabdoviridae		
NDUMU	NDU	Togaviridae	<u>Alphavirus</u>	A
NEGISHI	NEG	Flaviviridae	<u>Flavivirus</u>	B

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
NEPUYO	NEP	Bunyaviridae	<u>Bunyavirus</u>	C
NEW MINTO	NM	Rhabdoviridae		SAW
NGAINGAN	NGA			
NIQUE	NIQ	Bunyaviridae	<u>Phlebovirus</u>	PHL
NKOLBISSON	NKO			
NODAMURA	NOD	Nodaviridae	<u>Nodavirus</u>	
NOLA	NOLA	Bunyaviridae	<u>Bunyavirus</u>	SIM
NORHTWAY	NOR	Bunyaviridae	<u>Bunyavirus</u>	BUN
NTAYÄ	NFA	Flaviviridae	<u>Flavivirus</u>	B
NUGGET	NUG	Reoviridae	<u>Orbivirus</u>	KEM
NYAMANINI	NYM			NYM
NYANDO	NDO	Bunyaviridae	Bunyavirus-like	NDO
OKHOTSKIY	OKH	Reoviridae	<u>Orbivirus</u>	KEM
OKOLA	OKO			
OLIFANTSVLEI	OLI	Bunyaviridae	<u>Bunyavirus</u>	OLI
OMSK HEM. FEVER	OMSK	Flaviviridae	<u>Flavivirus</u>	B
O'NYONG-NYONG	ONN	Togaviridae	<u>Alphavirus</u>	A
ORIBOCA	ORI	Bunyaviridae	<u>Bunyavirus</u>	C
ORIXIMINA	ORX	Bunyaviridae	<u>Phlebovirus</u>	PHL
OROPOUCHE	ORO	Bunyaviridae	<u>Bunyavirus</u>	SIM
ORUNGO	ORU	Reoviridae	<u>Orbivirus</u>	
OSSA	OSSA	Bunyaviridae	<u>Bunyavirus</u>	C
OUANGO	OUA			
OUBANGUI	OUB	Poxviridae		

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
OUREM	OUR	Reoviridae	<u>Orbivirus</u>	CGL
PACORA	PCA	Bunyaviridae	Bunyavirus-like	
PACUI	PAC	Bunyaviridae	<u>Phlebovirus</u>	PHL
PAHAYOKEE	PAH	Bunyaviridae	<u>Bunyavirus</u>	PAT
PALESTINA	PLS	Bunyaviridae	<u>Bunyavirus</u>	MNT
PALYAM	PAL	Reoviridae	<u>Orbivirus</u>	PAL
PARA	PARA			
PARAMUSHIR	PMR	Bunyaviridae	<u>Nairovirus</u>	SAK
PARANA	PAR	Arenaviridae	<u>Arenavirus</u>	TCR
PAROO RIVER	PR	Reoviridae	<u>Orbivirus</u>	
PATA	PATA	Reoviridae	<u>Orbivirus</u>	EUB
PATHUM THANI	PTH	Bunyaviridae	<u>Nairovirus</u>	DGK
PATOIS	PAT	Bunyaviridae	<u>Bunyavirus</u>	PAT
PEATON	PEA	Bunyaviridae	<u>Bunyavirus</u>	SIM
PHNOM-PENH BAT	PPB	Flaviviridae	<u>Flavivirus</u>	B
PICHINDE	PIC	Arenaviridae	<u>Arenavirus</u>	TCR
PICOLA	PIA			
PIRY	PIRY	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
PIXUNA	PIX	Togaviridae	<u>Alphavirus</u>	A
PLAYAS	PLA	Bunyaviridae	<u>Bunyavirus</u>	BUN
PONGOLA	PGA	Bunyaviridae	<u>Bunyavirus</u>	BWA
PONTEVES	PTV	Bunyaviridae	<u>Uukuvirus</u>	UUK
POWASSAN	POW	Flaviviridae	<u>Flavivirus</u>	B
PRECARIOUS POINT	PP	Bunyaviridae	<u>Uukuvirus</u>	UUK

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
PRETORIA	PRE	Bunyaviridae	<u>Nairovirus</u>	DGK
PROSPECT HILL	PH	Bunyaviridae	<u>Hantavirus*</u>	HTN
PUCHONG	PUC			MAL
PUEBLO VIEJO	PV	Bunyaviridae	<u>Bunyavirus</u>	GAM
PUNTA SALINAS	PS	Bunyaviridae	<u>Nairovirus</u>	HUG
PUNTA TORO	PT	Bunyaviridae	<u>Phlebovirus</u>	PHL
PURUS	PUR	Reoviridae	<u>Orbivirus</u>	CGL
PUUMALA	PUU	Bunyaviridae	<u>Hantavirus*</u>	HTN
QALYUB	QYB	Bunyaviridae	<u>Nairovirus</u>	QYB
QUARANFIL	QRF			QRF
RAZDAN	RAZ	Bunyaviridae	Bunyavirus-like	
RESISTENCIA	RTA	Bunyaviridae	Bunyavirus-like	RTA
RESTAN	RES	Bunyaviridae	<u>Bunyavirus</u>	C
RIFT VALLEY FEVER	RVF	Bunyaviridae	<u>Phlebovirus</u>	PHL
RIO BRAVO	RB	Flaviviridae	<u>Flavivirus</u>	B
RIO GRANDE	RG	Bunyaviridae	<u>Phlebovirus</u>	PHL
ROCHAMBEAU	RBU			
ROCIO	ROC	Flaviviridae	<u>Flavivirus</u>	B
ROSS RIVER	RR	Togaviridae	<u>Alphavirus</u>	A
ROYAL FARM	RF	Flaviviridae	<u>Flavivirus</u>	B
RUSS. SPR. SUM. ENC.	RSSE	Flaviviridae	<u>Flavivirus</u>	B
SABO	SABO	Bunyaviridae	<u>Bunyavirus</u>	SIM
SABOYA	SAB	Flaviviridae	<u>Flavivirus</u>	B

*Proposed genus designation

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
SAGIYAMA	SAG	Togaviridae	<u>Alphavirus</u>	A
SAINT-FLORIS	SAF	Bunyaviridae	<u>Phlebovirus</u>	PHL
SAKHALIN	SAK	Bunyaviridae	<u>Nairovirus</u>	SAK
SAKPA	SPA			
SALANGA	SGA	Poxviridae		
SALEHABAD	SAL	Bunyaviridae	<u>Phlebovirus</u>	PHL
SAL VIEJA	SV	Flaviviridae	<u>Flavivirus</u>	B
SAN ANGELO	SA	Bunyaviridae	<u>Bunyavirus</u>	CAL
SANDFLY F. (NAPLES)	SFN	Bunyaviridae	<u>Phlebovirus</u>	PHL
SANDFLY F. (SICILIAN)	SFS	Bunyaviridae	<u>Phlebovirus</u>	PHL
SANDJIMBA	SJA			
SANGO	SAN	Bunyaviridae	<u>Bunyavirus</u>	SIM
SAN JUAN	SJ	Bunyaviridae	<u>Bunyavirus</u>	GAM
SAN PERLITA	SP	Flaviviridae	<u>Flavivirus</u>	B
SANTAREM	STM			
SANTA ROSA	SAR	Bunyaviridae	<u>Bunyavirus</u>	BUN
SARACA	SRA	Reoviridae	<u>Orbivirus</u>	CGL
SATHUPERI	SAT	Bunyaviridae	<u>Bunyavirus</u>	SIM
SAUMAREZ REEF	SRE	Flaviviridae	<u>Flavivirus</u>	B
SAWGRASS	SAW	Rhabdoviridae		SAW
SEPOKELE	SEB			
SELETAR	SEL	Reoviridae	<u>Orbivirus</u>	KEM
SEMBALAM	SEM			
SEMLIKI FOREST	SF	Togaviridae	<u>Alphavirus</u>	A

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
SENA MADUREIRA	SM	Rhabdoviridae		TIM
SEOUL	SEO	Bunyaviridae	<u>Hantavirus*</u>	HTN
SEPIK	SEP	Flaviviridae	<u>Flavivirus</u>	B
SERRA DO NAVIO	SDN	Bunyaviridae	<u>Bunyavirus</u>	CAL
SHAMONDA	SHA	Bunyaviridae	<u>Bunyavirus</u>	SIM
SHARK RIVER	SR	Bunyaviridae	<u>Bunyavirus</u>	PAT
SHOKWE	SHO	Bunyaviridae	<u>Bunyavirus</u>	BUN
SHUNI	SHU	Bunyaviridae	<u>Bunyavirus</u>	SIM
SILVERWATER	SIL	Bunyaviridae	Bunyavirus-like	KSO
SIMBU	SIM	Bunyaviridae	<u>Bunyavirus</u>	SIM
SIMIEN HEM. FEVER	SHF	Flaviviridae		
SINDBIS	SIN	Togaviridae	<u>Alphavirus</u>	A
SIXGUN CITY	SC	Reoviridae	<u>Orbivirus</u>	KEM
SLOVAKIA	SLO			
SNOWSHOE HARE	SSH	Bunyaviridae	<u>Bunyavirus</u>	CAL
SOKULUK	SOK	Flaviviridae	<u>Flavivirus</u>	B
SOLDADO	SOL	Bunyaviridae	<u>Nairovirus</u>	HUG
SOROROCA	SOR	Bunyaviridae	<u>Bunyavirus</u>	BUN
SPONDWENI	SPO	Flaviviridae	<u>Flavivirus</u>	B
SRIPUR	SRI	Rhabdoviridae		
ST. LOUIS ENC.	SLE	Flaviviridae	<u>Flavivirus</u>	B
STRATFORD	STR	Flaviviridae	<u>Flavivirus</u>	B
SUNDAY CANYON	SCA	Bunyaviridae	Bunyavirus-like	

*Proposed genus designation

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
TACAIUMA	TCM	Bunyaviridae	<u>Bunyavirus</u>	ANA
TACARIBE	TCR	Arenaviridae	<u>Arenavirus</u>	TCR
TAGGERT	TAG	Bunyaviridae	<u>Nairovirus</u>	SAK
TAHYNA	TAH	Bunyaviridae	<u>Bunyavirus</u>	CAL
TAMDY	TDY	Bunyaviridae	Bunyavirus-like	
TAMIAMI	TAM	Arenaviridae	<u>Arenavirus</u>	TCR
TANGA	TAN			
TANJONG RABOK	TR			TR
TATAGUINE	TAT	Bunyaviridae	Bunyavirus-like	
TEHRAN	TEH	Bunyaviridae	<u>Phlebovirus</u>	PHL
TELOK FOREST	TF			TR
TEMBE	TME			
TEMBUSU	TMU	Flaviviridae	<u>Flavivirus</u>	B
TENSAW	TEN	Bunyaviridae	<u>Bunyavirus</u>	BUN
TERMEIL	TER			
TETE	TETE	Bunyaviridae	<u>Bunyavirus</u>	TETE
TETTNANG	TET	Coronaviridae		
THIMIRI	THI	Bunyaviridae	<u>Bunyavirus</u>	SIM
THOGOTO	THO	Orthomyxoviridae		THO
THOTTAPALAYAM	TPM			
TIBROGARGAN	TIB	Rhabdoviridae		
TILLIGERRY	TIL	Reoviridae	<u>Orbivirus</u>	EUB
TIMBO	TIM	Rhabdoviridae		TIM
TIMBOTEUA	TBT	Bunyaviridae	<u>Bunyavirus</u>	GMA

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
TINAROO	TIN	Bunyaviridae	<u>Bunyavirus</u>	SIM
TINDHOLMUR	TDM	Reoviridae	<u>Orbivirus</u>	KEM
TLACOTALPAN	TLA	Bunyaviridae	<u>Bunyavirus</u>	BUN
TONATE	TON	Togaviridae	<u>Alphavirus</u>	A
TOSCANA	TOS	Bunyaviridae	<u>Phlebovirus</u>	PHL
TOURE	TOU	Arenaviridae	<u>Arenavirus</u>	TCR
TRIBEC	TRB	Reoviridae	<u>Orbivirus</u>	KEM
TRINITI	TNT	Togaviridae		
TRIVITTATUS	TVT	Bunyaviridae	<u>Bunyavirus</u>	CAL
TRUBANAMAN	TRU	Bunyaviridae	Bunyavirus-like	MAP
TSURUSE	TSU	Bunyaviridae	<u>Bunyavirus</u>	TETE
TURLOCK	TUR	Bunyaviridae	<u>Bunyavirus</u>	TUR
TURUNA	TUA	Bunyaviridae	<u>Phlebovirus</u>	PHL
TYULEMIY	TYU	Flaviviridae	<u>Flavivirus</u>	B
UGANDA S	UGS	Flaviviridae	<u>Flavivirus</u>	B
UMATILLA	UMA	Reoviridae	<u>Orbivirus</u>	*
UMBRE	UMB	Bunyaviridae	<u>Bunyavirus</u>	TUR
UNA	UNA	Togaviridae	<u>Alphavirus</u>	A
UPOLU	UPO	Bunyaviridae	Bunyavirus-like	UPO
URUCURI	URU	Bunyaviridae	<u>Phlebovirus</u>	PHL
USUTU	USU	Flaviviridae	<u>Flavivirus</u>	B
UTINGA	UTI	Bunyaviridae	<u>Bunyavirus</u>	SIM
UUKUNIEMI	UUK	Bunyaviridae	<u>Uukuvirus</u>	UUK

*See footnote for Llano Seco virus

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
VELLORE	VEL	Reoviridae	<u>Orbivirus</u>	PAL
VEN. EQUINE ENC.	VEE	Togaviridae	<u>Alphavirus</u>	A
VENKATAPURAM	VKT			
VINCES	VIN	Bunyaviridae	<u>Bunyavirus</u>	C
VIRGIN RIVER	VR	Bunyaviridae	<u>Bunyavirus</u>	ANA
VS-ALAGOAS	VSA	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
VS-INDIANA	VSI	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
VS-NEW JERSEY	VSNJ	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
WAD MEDANI	WM	Reoviridae	<u>Orbivirus</u>	KEM
WALLAL	WAL	Reoviridae	<u>Orbivirus</u>	WAL
WANOWRIE	WAN			
WARREGO	WAR	Reoviridae	<u>Orbivirus</u>	WAR
WESSELSBRON	WSL	Flaviviridae	<u>Flavivirus</u>	B
WEST. EQUINE ENC.	WEE	Togaviridae	<u>Alphavirus</u>	A
WEST NILE	WN	Flaviviridae	<u>Flavivirus</u>	B
WHATAROA	WHA	Togaviridae	<u>Alphavirus</u>	A
WITWATERSRAND	WIT	Bunyaviridae	Bunyavirus-like	
WONGAL	WON	Bunyaviridae	<u>Bunyavirus</u>	KOO
WONGORR	WGR			
WYEOMYIA	WYO	Bunyaviridae	<u>Bunyavirus</u>	BUN
XIBUREMA	XIB	Rhabdoviridae		
YACAABA	YAC			
YAQUINA HEAD	YH	Reoviridae	<u>Orbivirus</u>	KEM
YATA	YATA	Rhabdoviridae		

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
YELLOW FEVER	YF	Flaviviridae	<u>Flavivirus</u>	B
YOGUE	YOG			
YUG BOGDANOVAC	YB	Rhabdoviridae	<u>Vesiculovirus</u>	VSV
ZALIV TERPENIYA	ZT	Bunyaviridae	<u>Uukuvirus</u>	UUK
ZEGLA	ZEG	Bunyaviridae	<u>Bunyavirus</u>	PAT
ZIKA	ZIKA	Flaviviridae	<u>Flavivirus</u>	B
ZINGA	ZGA	Bunyaviridae	<u>Phlebovirus</u>	PHL
ZINGILAMO	ZGO			BTK
ZIRQA	ZIR	Bunyaviridae	<u>Nairovirus</u>	HUG

Table 2.1 Antigenic Groups of 504 Viruses Registered in Catalogue

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
<u>ARENAVIRIDAE</u> <u>Arenavirus</u>	Tacaribe	TCR	12	2.4
<u>BUNYAVIRIDAE</u> <u>Bunyavirus</u> (Bunyamwera Supergroup)	Anopheles A	ANA	5	24.4
	Anopheles B	ANB	2	
	Bunyamwera	BUN	22	
	Bwamba	BWA	2	
	C	C	12	
	California	CAL	13	
	Capim	CAP	8	
	Gamboia	GAM	3	
	Guama	GMA	12	
	Koongol	KOO	2	
	Minatitlan	MNT	2	
	Olifantsvlei	OLI	3	
	Patois	PAT	6	
	Simbu	SIM	21	
	Tete	TETE	5	
	Turlock	TUR	4	
	Unassigned	SBU	1	
<u>Nairovirus</u>	CHF-Congo	CHF-CON	4	4.6
	Dera Ghazi Khan	DGK	5	
	Hughes	HUG	4	
	Nairobi sheep disease	NSD	3	
	Qalyub	QYB	2	
	Sakhalin	SAK	5	
<u>Phlebovirus</u>	Phlebotomus fever	PHL	35	6.9

Table 2.1 (Continued)

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
BUNYAVIRIDAE				
<u>Uukuvirus</u>	Uukuniemi	UUK	6	1.2
<u>Hantavirus*</u>	Hantaan	HTN	4	0.8
"Bunyavirus-like" (Unassigned, probable or possible members)	Bakau	BAK	2	0.4
	Bhanja	BHA	1	0.2
	Kaisodi	KSO	3	0.6
	Mapputta	MAP	4	0.8
	Matariya	MTY	3	0.6
	Nyando	NDO	1	0.2
	Resistencia	RTA	3	0.6
	Upolu	UPO	2	0.4
	Ungrouped		12	2.4
REOVIRIDAE				
<u>Orbivirus</u>	African horsesickness	AHS	1	0.2
	Bluetongue	BLU	1	0.2
	Changuinola	CGL	12	2.4
	Colorado tick fever	CTF	2	0.4
	Corriparta	COR	3	0.6
	Epizootic hemorrhagic dis.	EHD	2	0.4
	Eubenangee	EUB	3	0.6
	Kemerovo	KEM	18	3.6
	Palyam	PAL	7	1.4
	Wallal	WAL	1	0.2
	Warrego	WAR	2	0.4
	Ungrouped		9	1.8
RHABDOVIRIDAE				
<u>Vesiculovirus</u>	Vesicular stomatitis	VSV	10	2.0

*Proposed genus designation

Table 2.1 (Continued)

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
<u>Lyssavirus</u>	Rabies		2	0.4
Unassigned or possible members	Bovine ephemeral fever	BEF	4	0.8
	Hart Park	HP	3	0.6
	Kwatta	KWA	1	0.2
	Le Dantec	LD	2	0.4
	Mossuril	MOS	8	1.6
	Sawgrass	SAW	3	0.6
	Timbo	TIM	3	0.6
	Ungrouped		14	2.8
TOGAVIRIDAE				
<u>Alphavirus</u>	A		26	5.2
Possible members	Ungrouped		1	0.2
FLAVIVIRIDAE				
<u>Flavivirus</u>	B		66	13.1
Possible members	Ungrouped		1	0.2
CORONAVIRIDAE				
<u>Coronavirus</u>	Ungrouped		2	0.4
HERPESVIRIDAE	Ungrouped		1	0.2
IRIDOVIRIDAE	Ungrouped		1	0.2
NODAVIRIDAE				
<u>Nodavirus</u>	Ungrouped		1	0.2
ORTHOMYXOVIRIDAE				
	Thogoto	THO	1	0.2
	Ungrouped		1	0.2

Table 2.1 (Continued)

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
PARAMYXOVIRIDAE	Ungrouped		1	0.2
POXVIRIDAE	Ungrouped		3	0.6
UNCLASSIFIED	Boteke	BTK	2	0.4
	Malakal	MAL	2	0.4
	Marburg	MBG	2	0.4
	Nyamanini	NYM	1	0.2
	Tanjong Rabok	TR	2	0.4
	Quaranfil	QRF	2	0.4
	Ungrouped		<u>43</u>	8.5
TOTAL			504	

Table 3.1 Initial Isolations of Viruses by Decade and Country of Origin

Decade	Continent	Country	Virus	
1900-09	Africa	S. Africa	BLU	
1910-19	Africa	Kenya	ASF, MSD	
1920-29	Africa	Nigeria	YF	
	Europe	Scotland	LI	
	N. America	U.S.A	VSI	
1930-39	Africa	Kenya	RVF	
		S. Africa	AHS	
		Uganda	BWA, WN	
	Asia	Japan	JE	
		U.S.S.R.	RSSE	
	N. America	U.S.A.	EEE, SLE, WEE	
	S. America	Venezuela	VEE	
1940-49	Africa	Uganda	BUN, NTA, SF, UGS, ZIKA	
	Asia	Japan	NEG	
		U.S.S.R.	OMSK	
		Hawaii	DEN-1	
	Australasia	New Guinea	DEN-2	
		Czechoslovakia	HAN	
	Europe	Italy	SFN, SFS	
	N. America	U.S.A.	CE, CTF, TVT	
	S. America	Brazil	ILH	
		Colombia	ANA, ANB, WYO	
	1950-59	Africa	Egypt	CNU, ORF, QYB, SIN
			Nigeria	ILE, LB
S. Africa			BAN, GER, ING, LEB, MID, MOS, NDU, NYM, PGA, SIM, SPO, TETE, USU, WIT, WSL	
		Sudan	WM	
		Uganda	CHIK, CON, ENT, NDO, ONN, ORU	
Asia		India	ARK, BHA, GAN, KAS, KSO, KFD, MIN, PAL, SAT, VKT, UMB, WAN	
		Israel	IT	
		Japan	AKA, APOI, IRA, NOD, SAG, TSU	
		Malaya	BAK, BAT, BEB, GET, KET, LGT, TMU	
		Australia	MVE	
Europe		Philippines	DEN-3, DEN-4	
		Czechoslovakia	HYPR, TAH	
		Finland	KUM	
N. America		U.S.S.R.	ABS	
		Canada	POW	
		Panama	BOC, LJ, PCA	
S. America		U.S.A.	CV, EHD, HP, MML, MOD, RB, SA, SSH, TUR, VSNJ	
		Argentina	JUN	
		Brazil	APEU, AURA, BSQ, CAP, CAR, CATU, GJA, GMA, ITQ, MAG, MIR, MOJU, MTB, MUC, MUR, ORI, TCM, UNA	
			Colombia	GRO, NAV
			Trinidad	ARU, BIM, BSB, IERT, KRI, LUK, MAN, MAY, MEL, NEP, ORO, TCR, TNT

Table 3.1 (Continued)

<u>Decade</u>	<u>Continent</u>	<u>Country</u>	<u>Virus</u>	
1960-69	Africa	Cameroun	NKO, OKO	
		Cent. Afr. Rep.	BAG, BGN, BIA, BIR, BOT, BOU, BTK, MPO, PATA, YATA, ZGA	
		Egypt	ACD, AMT, BAH, BEA, MTR, MTY, RF	
		Kenya	THO	
		Nigeria	DUG, KOT, LAS, SABO, SAN, SHA, SHU	
		Senegal	BDA, DB, GOS, KEU, KOU, LD, SAB, TAT, TOU, YOG	
		South Africa	OLI, SHO	
		Sudan	GF, MAL	
		Uganda	KAD, KAM, MEB, TAN	
		Asia	Cambodia	PPB
			India	BAR, CHP, DHO, KAN, KMP, SEM, THI, TPM, VEL
			Iran	KAR, SAL, TEH
			Japan	AINO
			Malaysia	JUG, KTR, LJO, PUC, TR
			Pakistan (West)	DGK, HAZ, MWA
			Persian Gulf	ZIR
	Singapore		SEL	
	Thailand		KK	
	U.S.S.R.		CHF, KYZ, OKH, SAK, TYU, ZT	
	Australasia	Australia	ALF, ALM, BEF, BEL, CHV, COR, DAG, EH, EUB, JAP, JOI, KOK, KOO, KOW, KUN, MAP, MPK, MR, RR, SEP, STR, TRU, UPO, WAR, WON	
		New Zealand	WHA	
		Pacific Island	JA	
		Czechoslovakia	CVO, KEM, LED, LIP, TRB	
	Europe	Finland	INK, UUK	
		France	GA, PTV	
		West Germany	MBG	
	N. America	Canada	SIL	
		Guatemala	JUT	
		Mexico	MNT, TLA	
		Panama	AGU, CHG, CHI, CGL, FRI, GAM, JD, LAT, MAD, MAT, OSSA, PAR, PAT, PT, ZEG	
	S. America	U.S.A.	BUT, CR, EVE, FLA, GL, HJ, HUG, JC, JS, KC, KEY, KLA, LAC, LOK, LS, MER, MD, MH, ML, PAH, SAW, SC, SHF, SR, TAM, TEN, UMA	
		Bolivia	MAC	
		Brazil	ACA, AMA, AMB, ANH, ANU, AP, ARA, BEN, BER, BLM, BOR, BUJ, BVS, CAN, CDU, CHO, COT, GTB, GUR, ICO, INH, IRI, ITP, JUR, MCC, OUR, PAC, PIRY, PIX, SDN, SOR, TBT, TIM, TME, URU, UTI, VSA	
		Colombia	BUE, PIC	
		French Guiana	CAB	

Table 3.1 (Continued)

Decade	Continent	Country	Virus	
1960-69	S. America	Peru	HUA,PS	
		Surinam	KWA	
		Trinidad	COC,MOR,NAR,RES,SOL	
1970-79	Africa	Cent. Afr. Rep.	BBO,BGI,BMA,BOB,GAR,GOM,GOR,IPPY,KOL, LJA,NOLA,OUA, OUB,SAF,SEB,SGA,SJA,SPA, ZGO	
		Egypt	AH,KS,PTH	
		Nigeria	IFE	
		Seychelles	ARI	
		S. Africa	PRE	
		Zaire	EBO	
		Asia	India	CG,KAI,SRI
			Iran	ISF
			Korea	HTN
			Malaysia	CI,TF
			U.S.S.R.	BKN,CHIM,IK,KHA,KSI,PMR,RAZ,SOK,TDY
	Australasia	Australia	BC,BF,CVG,DOU,GGY,GG,KNA,MAR,NGA,NUG, PEA,PIA,PR,PP,SRE,TAG,TER,TIB,TIL,TIN, WAL,WGR,YAC	
		Europe	Czechoslovakia	SLO
	Denmark		MYK,TDM	
	Germany		EYA,TET	
	Italy		TOS	
	Scotland		CM,CW	
	U.S.S.R.		BAKU	
	N. America	Yugoslavia	YB	
		Canada	AVA,BAU,GI	
		Mexico	SAR	
		Panama	CAC,CAI,MIQ	
	S. America	U.S.A.	AB,CNT,FM,GLO,LLS,MM,NOR,RG,SCA,SP, SV,VR,YH	
		Brazil	ALE,ALT,CNA,CPC,CUI,ENS,FLE,IACO,ITA, ITI,ITU,JAC,JAM,MCA,MDC,MPR,MQO,PARA, ROC,SM,STM,TUA	
		Ecuador	ABR,BAB,NJL,PLA,PLS,PV,SJ,VIN	
		French Guiana	INI,RBU,TON	
		Venezuela	AROA	
1980-85		Asia	Korea	SEO
	Australasia	Australia	AR,BRM,KIM,LC	
		Finland	PUU	
	Europe	France	MEA	
		Italy	ARB	
		Cuba	ER	
	N. America	USA	PH	
		S. America	Argentina	ANT,BQS,LM,RTA
	Brazil		AMR,JARI,MDO,MUN,ORX,PUR,SRA,XIB	

Table 4.1 Initial Isolation of 504 Registered Viruses by
Continent or Region, Country, and Chronological Period

Continent	Country or Area	Before 1930	1930 -39	1940 -49	1950 -59	1960 -69	1970 -79	1980 -85	Totals
AFRICA	Cameroon					2			2
	Cent. Afr. Rep.					11	19		30
	Egypt				5	7	3		15
	Kenya	2	1			1			4
	Nigeria	1			2	7	1		11
	Senegal					10			10
	Seychelles						1		1
	S. Africa	1	1		15	2	1		20
	Sudan					2			2
	Uganda		2	5	6	4			17
Zaire							1	1	
	Totals	4	4	5	28	46	26	0	113
ASIA	Cambodia					1			1
	India				12	9	3		24
	Iran					3	1		4
	Israel				1				1
	Japan		1	1	6	1			9
	Korea						1	1	2
	Malaysia				7	5	2		14
	W. Pakistan					3			3
	Persian Gulf					1			1
	Singapore					1			1
	Thailand					1			1
	U.S.S.R. (East)		1	1		6	9		17
	Totals	0	2	2	26	31	16	1	78
AUSTRAL- ASIA and PACIFIC ISLANDS	Australia				1	25	23	4	53
	Hawaii			1					1
	Johnston Island					1			1
	New Guinea			1					1
	New Zealand					1			1
	Philippines				2				2
	Totals	0	0	2	3	27	23	4	59
EUROPE	Czechoslovakia			1	2	5	1		9
	Denmark						2		2
	Finland				1	2		1	4
	France					2		1	3
	West Germany					1	2		3
	Italy			2			1	1	4
	Scotland	1					2		3
	U.S.S.R. (West)				1		1		2
	Yugoslavia						1		1
	Totals	1	0	3	4	10	10	3	31

Table 4.1 (Continued)

Continent	Country or Area	Before 1930	1930-39	1940-49	1950-59	1960-69	1970-79	1980-85	Totals
NORTH AMERICA	Canada				1	1	3		5
	Cuba							1	1
	Guatemala					1			1
	Mexico					2	1		3
	Panama				3	15	3		21
	U.S.A.	1	3	3	10	27	13	1	58
	Totals	1	3	3	14	46	20	2	89
SOUTH AMERICA	Argentina				1			4	5
	Bolivia					1			1
	Brazil			1	18	37	22	8	86
	Colombia			3	2	2			7
	Ecuador						8		8
	French Guiana					1	3		4
	Peru					2			2
	Surinam					1			1
	Trinidad				13	5			18
	Venezuela		1					1	2
Totals	0	1	4	34	49	34	12	134	
GRAND TOTALS		6	10	19	109	209	129	22	504

Table 5.1 Alphaviruses, Family Togaviridae

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING ¹		SEAS RATING**	TAXONOMIC STATUS					
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis				
	Mosq.	Ticks		Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds													Bats	Marsupials	Other	Sentinels
		Culicine	Anopheline																							
Aura	+																	2	S	22	Alphavirus "					
Barmah Forest	+																	2	A7	22						
Bebaru	+																	2	S	22						
Cabassou	+								+	+								3*	IE	21						
Chikungunya	+								+	+								3*	S	20						
Eastern equine enc.	+	+							+	+								2V	S	20						
Everglades	+	+							+	+								3*V	S	20						
Fort Morgan									+	+								2	S	20						
Getah	+	+																3	A1	20						
Highland J	+								+	+								2	S	20						
Kyzylgach	+																	3	IE	22						
Mayaro	+								+	+								3	S	20						
Middelburg	+																	3	A1	20						
Mucambo	+								+	+								3*V	S	20						
Ndumu	+																	3	A1	21						
O'nyong-nyong		+																2	S	20						
Pixuna	+	+							+	+								2	S	22						
Ross River	+																	2	S	20						
Sagiyana	+								+	+								3	A1	21						
Semliki Forest	+	+							+	+								3	A2	20						
Sindbis	+	+	+						+	+								2	S	20						
Tonate	+	+							+	+								3*V	IE	21						
Una	+	+																2	S	21						
Ven. equine enc.	+	+							+	+								3*V	S	20						
Western equine enc.	+	+							+	+								2V	S	20						
Whataroa	+																	2	S	20						

* Work with these viruses at containment level 3 requires HEPA filtration of all exhaust air prior to discharge to the outside.

** 20 = Arbovirus
21 = Probable Arbovirus
22 = Possible Arbovirus
23 = Probably not Arbovirus
24 = Not Arbovirus

V = Vaccination with demonstration of antibody development; without such vaccination, the next higher containment level is recommended.

Table 6.1 Mosquito-Borne Flaviviruses, Family Flaviviridae

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE	SALS RATING		SEAS RATING**	TAXONOMIC STATUS		
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection			Level	Basis
	Mosq. Cullicine	Amophelinae	Ticks Ixodid	Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Roentns												
Alfuy	+																	2	S	20	Flavivirus	
Bagaza	+																	2	S	20		
Banzi	+																	2	S	20		
Boubout	+	+					+											2	S	20		
Bussuquara	+						+		+									2	S	20		
Dengue 1	+						+	+	+									2	S	20		
Dengue 2	+						+	+	+									2	S	20		
Dengue 3	+						+	+	+									2	S	20		
Dengue 4	+						+	+	+									2	S	20		
Edge Hill	+	+																2	S	20		
Ilheus	+																	2	S	20		
Israel turkey men.	+				+													3	S	21		
Japanese enc.	+	+																2	S	20		
Jugra	+																	2	S	20		
Kokobera	+																	2	S	20		
Kunjin	+																	2	S	20		
Murray Valley enc.	+																	3	S	20		
Naranjal	+																	3	IE	21		
Ntaya	+																	2	S	21		
Rocio	+																	3*	S	21		
Sepik	+																	3	IE	21		
St. Louis enc.	+	+	+															3	S	20		
Spondweni	+																	3	S	20		
Stratford	+																	2	S	22		
Tembusu	+	+																2	S	21		
Uganda S	+																	2	S	20		
Usutu	+																	2	S	22		
Wesselsbron	+	+																3*X	S	20		
West Nile	+	+	+	+														3	S	20		
Yellow fever	+		+															3*V	S	20		
Zika	+																	2	S	20		

* See footnote Table 5.1
 ** See footnote Table 5.1

V: See footnote Table 5.1
 X: Arboviruses restricted by U.S. Department of Agriculture regulations or policy.

Table 6.2 Tick-Borne Flaviviruses, Family Flaviviridae

VIRUS	ISOLATED FROM											ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS				
	ARTHROPODS					VERTEBRATES						Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis			
	Mosq.	Ticks		Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats													Marsupials	Other	Sentinels
		Culicine	Anopheline																							
Absettarov						+												+	+	4	A4	20	Flavivirus " " " " " " " " " " " " " " "			
Gadgets Gully																						22				
Hanzalova						+														4	A4	20				
Hypr						+														4	S	20				
Kadam								+	+	+										2	S	21				
Karshi																				2	S	22				
Kumlinge						+		+	+											4	A4	20				
Kyasanur Forest dis.					+		+													4	S	20				
Langat								+	+											2	S	20				
Louping ill								+	+											3*	S	20				
Meaban								+														22				
Omsk hem. fever								+												4	S	20				
Powassan	+	+						+												3	S	20				
Royal Farm																				3	S	20				
Russ. spr. sum. enc.								+												2	S	22				
Saumarez Reef																				4	S	20				
Tyulenyi																				3	IE	22				
																				2	S	21				

* See footnote Table 5.1

** See footnote Table 5.1

X See footnote Table 6.1

Table 6.3 Flaviviruses, Family Flaviviridae:
No Arthropod Vector Demonstrated

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS		
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis	
	Mosq. Culicine	Anopheleline Ixodid	Arsasid	Plebotomine	Culicoides Other	Humans	Other Primates	Rodents	Birds	Bats													Marsupials Other
Apoi																		+	2	S	22	Flavivirus	
Aroa																			2	S	22		
Cacipacore																				2	S		22
Carey Island																				2	S		22
Cowbone Ridge																				2	S		23
Dakar bat																				2	S		24
Entebbe bat																				2	S		24
Jutiapa																				2	S		22
Koutango																				3	S		21
Hodoc																				2	S		24
Montana Myotis leuk.																				2	S		24
Negishi																				3	S		22
Phnom-Penh bat																				2	S		23
Rio Bravo																				2	S		24
Saboya																				2	S		22
Sal Vieja																				3	A7		22
San Perlita																				3	A7		22
Sokuluk																				2	S		22

** See footnote Table 5.1

Table 7.1 Families Togaviridae and Flaviviridae:
Antigenically Ungrouped Viruses

VIRUS	ISOLATED FROM		ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**		TAXONOMIC STATUS												
	ARTHROPODS		VERTEBRATES																								
	Mosq.	Ticks	Other	Culicoides	Phlebotomine	Humans	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis			Togaviridae	Flaviviridae
Trinit																											
Simian hem. fever							+																				

** See footnote Table 5.1

Table 8.1.1 Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, Anopheles A and Anopheles B Serogroup Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
<u>ANOPHELES A GR.</u>																						
Anopheles A																						
Las Maloyas																						
Lukuni	+																					
Tacaiuma	+																					
Virgin River	+																					
<u>ANOPHELES B GR.</u>																						
Anopheles B																						
Boraceia	+																					

** See footnote Table 5.1

Table 8.1.3 Bunyaviruses, Family Bunyviridae:
Bunyamwera Supergroup, Bwamba Serogroup and Serogroup C Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culiicine	Anophelinae	Ticks Ixodid	Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents												
<u>BWAMBA GR.</u>																						
Bwamba							+										+		2	S		
Pongoia	+	+																2	S			
<u>GROUP C</u>																						
Apeu	+						+					+					+	2	S			
Caraparu	+						+		+								+	2	S			
Gumbo Limbo	+						+		+								+	2	S			
Itaqui	+						+		+			+					+	2	S			
Madrid	+						+		+								+	2	S			
Marituba	+						+		+								+	2	S			
Murutucu	+						+		+								+	2	S			
Nepuyo	+						+		+		+						+	2	S			
Oriboca	+						+		+			+					+	2	S			
Ossa	+						+		+								+	2	S			
Restan	+						+		+								+	2	S			
Vinces	+						+		+								+	2	A7			

** See footnote Table 5.1

Table B.1.4 Bunyaviruses, Family Bunyaviridae:
Bunyamvera Supergroup, California and Capim Serogroup Viruses

VIRUS	ISOLATED FROM											ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES						Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats	Marsupials												
CALIFORNIA GR.																							
California enc.	+																						
Guaroa		+																					
Inkoo	+																						
Jamestown Canyon	+				+																		
Jerry Slough	+																						
Keystone	+	+																					
La Crosse	+																						
Melao	+																						
San Angelo	+	+																					
Serra do Navio	+																						
Snowshoe hare	+											+											
Tahyna	+	+																					
Trivittatus	+																						
CAPIM GR.																							
Acara	+																						
Benevides	+																						
Benfica	+																						
Bushbush	+																						
Capim	+																						
Guajara	+																						
Juan Diaz	+																						
Moriche	+																						

** See footnote Table 5.1

Table 8.1.5 Bunyaviruses, Family Bunyaviridae:
 Bunyamwera Supergroup, Gamboa, Guama and Koongol Serogroup Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS						
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis					
	Mosq.	Ticks		Phlebotomine	Other	Humans	Other Primates	Rodents	Birds	Bats													Marsupials	Other	Sentinel's		
<u>GAMBOA GR.</u>																											
Gamboa	+																										
Pueblo Viejo	+																										
San Juan	+																										
<u>GUAMA GR.</u>																											
Ananindeua	+							+	+		+																
Bertioga																											
Bimiti	+							+	+		+																
Cananea	+							+	+		+																
Catu	+		+					+	+		+																
Guama	+						+	+	+		+																
Guaratuba	+								+		+																
Itimirim									+																		
Mahogany Hammock	+							+	+		+																
Mirim	+								+		+																
Moju	+								+		+																
Timboteua									+																		
<u>KOONGOL GR.</u>																											
Koongol	+	?																									
Wongal	+																										

** See footnote Table 5.1

Table 8.1.6 Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, Minatitlan, Olifantsvlei and Patois Serogroup Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING*		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
Culicine	Anopheleine	Ixodid	Argasid																			
<u>MINATITLAN GR.</u> Minatitlan Palestina	+											++				+			2 3	S IE	22 21	Bunyavirus "
<u>OLIFANTSVLEI GR.</u> Bobia Botambi Olifantsvlei	+												+++						3 2 2	IE S S	22 22 22	Bunyavirus " "
<u>PATOIS GR.</u> Abrás Babahoyo Pahayokee Patois Shark River Zegla	+											+							2 2 2 2 2 2	A7 A7 S S S S	22 21 22 20 21 22	Bunyavirus " " " " "

** See footnote Table 5.1

Table 8.1.7 Bunyaviruses, Family Bunyviridae:
Bunyamwera Supergroup, Simbu Serogroup Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHIPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks		Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
Culicine	Anopheline	Ixodid	Argasid	Phlebotomine																		
Aino	+																	3	S	22	Bunyavirus	
Akabane	+																	3	S	21	"	
Buttonwillow	+																	2	S	20	"	
Douglas															+			2	S	21	"	
Ingwavuma	+																	2	S	20	"	
Inini															+			3	IE	22	"	
Kaikalur	+																	2	S	22	"	
Manzanilla															+			2	S	22	"	
Mermet															+			2	S	22	"	
Nola	+																	2	S	20	"	
Oropouche	+															+	+	3*	S	21	"	
Peaton																		3	AI	21	"	
Sabo																		2	S	22	"	
Sango																		2	S	22	"	
Sathuperi	+																	2	S	22	"	
Shamonda																		2	S	22	"	
Shuni	+															+		2	S	22	"	
Simbu	+																	2	S	21	"	
Thimiri																		2	S	22	"	
Tinaroo																		3	IE	22	"	
Utinga																		3	IE	22	"	

* See footnote Table 5.1

** See footnote Table 5.1

Table 8.2 Phleboviruses, Family Bunyaviridae:
Phlebotomus Fever Serogroup Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culicine	Anophele	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents												
Aguate					+													2	S	21	Phlebovirus	
Alenquer							+											2	IE	22		
Anhanga																		2	S	22		
Arbia					+													3	IE	21		
Arunwot	+								+	+								2	S	22		
Buenaventura					+													3	IE	22		
Bujaru									+									2	S	22		
Cacao					+													2	S	21		
Caimito					+													2	S	22		
Candiru							+	+									+	2	S	22		
Chagres	+							+										2	S	21		
Chilibre																		2	S	21		
Frijoles																		2	S	22		
Gabek Forest									+	+								3	IE	21		
Gordil									+	+								2	S	21		
Icoaraci	+	+							+	+								3	IE	22		
Itaituba																		2	S	20		
Itaporanga	+									+								2	S	21		
Karimabad																		3	IE	22		
Munguba																		2	S	22		
Nique																		2	IE	22		
Oriximina																		2	S	21		
Pacu									+									2	S	21		
Punto Toro																		2	S	21		
Rift Valley fever	+																	3*VX	S	20		
Rio Grande																		2	S	21		

* See footnote Table 5.1

** See footnote Table 5.1

V: See footnote Table 5.1

X: See footnote Table 6.1

Table 8.2 Phleboviruses, Family Bunyviridae:
Phlebotomus Fever Serogroup Viruses
(Continued)

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING'		SEAS RATING**	TAXONOMIC STATUS					
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis				
	Mosq.	Ticks		Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds													Bats	Marsupials	Other	Sentinels
		Anopheles	Ixodid																							
Culicine																										
Saint-Floris								+										2	S	21	Phlebovirus " " " " " " "					
Salehabad																		2	S	22						
SF-Naples						+												2	S	20						
SF-Sicilian						+												2	S	20						
Tehran						+												2	A7	22						
Toscana						+												2	S	21						
Turuna						+												2	IE	22						
Urucuri						+												2	S	22						
Zinga	+																	3	S	22						

** See footnote Table 5.1

Table 8.3.1 Nairoviruses, Family Bunyaviridae:
CHF-Congo, Dera Ghazi Khan and Hughes Serogroups

VIRUS	ISOLATED FROM											ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS						VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats	Marsupials												
<u>CHF-CONGO GR.</u>																							
Congo																							
Crimean hem. fever																							
Hazara																							
Khasan																							
<u>DERA GHAZI KHAN GR.</u>																							
Abu Hammad																							
Dera Ghazi Khan																							
Kao Shuan																							
Pathum Thani																							
Pretoria																							
<u>HUGHES GR.</u>																							
Hughes																							
Punta Salinas																							
Soldado																							
Zirqa																							

** See footnote Table 5.1

Table 8.3.2 Nairoviruses, Family Bunyaviridae:
Nairobi Sheep Disease, Qalyub and Sakhalin Serogroups

VIRUS	ISOLATED FROM											ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS			
	ARTHROPODS					VERTEBRATES						Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis		
	Mosq.	Ticks		Phlebotomine	Cuticoides	Other	Humans	Other Primates	Rodents	Birds	Bats													Marsupials	Other
<u>NAIROBI SHEEP DIS.</u> Dugbe Ganjam Nairobi sheep dis.	+	+	+											+	+	+	+								
<u>QALYUB GR.</u> Bandia Qalyub				+				+														2 2	S S	22 20	Nairovirus "
<u>SAKHALIN GR.</u> Avalon Clo Mor Paramushir Sakhalin Taggart									+													2 2 3 2 2	S S IE S S	21 22 22 21 22	Nairovirus " " " "

** See footnote Table 5.1

X: See footnote Table 6.1

Table B.4 Uukuviruses, Family Bunyaviridae:
Uukuniemi Serogroup Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
UUKUNIEMI GR.																						
Grand Arbaud		+	+	+															2	S		
Manawa		+	+	+								+							2	S		
Ponteves		+	+	+															3	IE		
Precarious Point		+	+	+									+						2	S		
Uukuniemi		+	+	+				+											2	S		
Zaliv Terpeniya		+	+	+								+							2	S		

** See footnote Table 5.1

Table 8.5.1 Hantaviruses and Bunyavirus-like Viruses, Family Bunyaviridae:
Hantaan and Other Antigenic Groups

VIRUS	ISOLATED FROM													ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS		
	ARTHROPODS						VERTEBRATES							Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis	
	Mosq.	Ticks		Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats	Marsupials	Other													Sentinels
		Cuticine	Anopheleine																							
<u>HANTAAN GR.</u> Hantaan Prospect Hill Puumala Seoul						+		+	+	+								+	+	3 ^o	S	22 23 23 23	Hantavirus* " " "			
<u>BHANJA GR.</u> Bhanja						+		+					+					+		3	S	21	Bunyavirus-like			
<u>KAISODI GR.</u> Kaisodi Lanjan Silverwater									+													2 2 2	S S S	21 22 21	Bunyavirus-like " "	
<u>UPOLU GR.</u> Aransas Bay Upolu																						3 2	IE S	22 22	Bunyavirus-like "	

* Hantavirus: Proposed genus designation.

** See footnote Table 5.1

^o If virus is handled in very high concentrations or in animals, then level 4.

Table 8.5.2 Bunyavirus-Like Viruses, Family Bunyviridae:
Other Antigenic Groups

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culexine	Anopheleline	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Reptiles												
<u>BAKAU GR.</u> Bakau Ketapang	+	+		+				+										2	S	22	Bunyavirus-like	
	+																	2	S	21	"	
<u>MAPPUTTA GR.</u> Gan Gan Mapputta Maprik Trubanaman	+																	2	A7	22	Bunyavirus-like	
		+																2	S	22	"	
		+																2	S	21	"	
		+																2	S	22	"	
<u>MATARIYA GR.</u> Burg el Arab Garba Matariya																		2	S	22	Bunyavirus-like	
																		3	IE	22	"	
																		2	S	22	"	
<u>NYANDO GR.</u> Nyando	+	+						+										2	S	21	Bunyavirus-like	
<u>RESISTENCIA GR.</u> Antequera Barranqueras Resistencia	+																				22	Bunyavirus-like
	+																				22	"
	+																				22	"

** See footnote Table 5.1

Table 8.5.3 Bunyavirus-Like Viruses, Family Bunyaviridae:
Antigenically Ungrouped Viruses

VIRUS	ISOLATED FROM											ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES						Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats	Marsupials												
Belmont	+																		2	S	22	Bunyavirus-like	
Enseada	+																		3	IE	22	"	
Kowanyama		+																	2	S	22	"	
Pacora		+																	2	S	22	"	
Tataguine		+				+													2	S	21	"	
Witwatersrand		+					+					+							2	S	20	"	
Lone Star																			2	S	22	Bunyavirus-like	
Razdan																			3	IE	22	"	
Sunday Canyon																			2	S	22	"	
Tamdy							+												3	IE	22	"	
Bangui							+												2	S	22	Bunyavirus-like	
Bobaya								+											3	IE	22	"	

** See footnote Table 5.1

Table 9.1 Orbiviruses, Family Reoviridae:
Colorado Tick Fever and Kemerovo Serogroups

VIRUS	ISOLATED FROM							ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS				VERTEBRATES			Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culicine	Ticks Ixodid Argasid Anopheiline	Phlebotomine	Culicoides Other	Humans Other Primates	Rodents	Birds												
COL. TICK FEV. GR. Col. tick fever Eyach		+	+		+	+						+		+	2	S	20	Orbivirus	
		+													2	S	22	"	
KEMEROVO GR.															2	S	22	Orbivirus	
Baku			+												2	S	22	"	
Bauline		+													2	S	22	"	
Cape Wrath		+													2	S	22	"	
Chenuda		+	+												2	S	22	"	
Great Island		+													2	S	22	"	
Huacho			+									+			2	S	22	"	
Kemerovo		+			+									+	2	S	21	"	
Lipovnik		+				+								+	2	S	22	"	
Mono Lake			+												2	S	22	"	
Mykines		+													2	S	22	"	
Nugget		+													2	S	22	"	
Okhotskiy		+													2	S	22	"	
Seletar		+													2	S	22	"	
Sixgun City			+												2	S	22	"	
Tindholmur		+													2	S	22	"	
Tribec		+				+									2	S	21	"	
Wao Medani		+													2	S	21	"	
Yaquina Head		+													2	S	22	"	

** See footnote Table 5.1

Table 9.2.1 Orbiviruses, Family Reoviridae:
Bluetongue Group and Other Antigenic Groups

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culicine	Ticks Anophelinae Ixodid Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
<u>AFR. HORSESICKNESS</u> Afr. horsesickness				+							+							X		20	Orbivirus	
<u>BLUETONGUE GR.</u> Bluetongue		+		+							+			+	+		+	2	S	20	Orbivirus	
<u>CHANGUINOLA GR.</u>																						
Almeirim				+														3	IE	22	Orbivirus	
Altamira				+														3	IE	22	"	
Caninde				+														3	IE	22	"	
Changuinola				+		+											+	2	S	21	"	
Gurupi				+														3	IE	22	"	
Irituia				+			+											2	S	22	"	
Jamanxi				+														3	IE	22	"	
Jari											+							3	IE	22	"	
Monte Dourado											+							3	IE	22	"	
Ourem				+														3	IE	22	"	
Purus	+																	3	IE	22	"	
Saraca				+														3	IE	22	"	
<u>CORRIPARTA GR.</u>																						
Acado	+																	2	S	22	Orbivirus	
Corriparta	+																	2	S	21	"	
Jacareacanga	+							+						+				3	IE	22	"	
<u>EHD GR.</u>																						
Epizootic hem.dis.																		2	S	21	Orbivirus	
Ibaraki																		3	IE	22	"	

** See footnote Table 5.1

X: See footnote Table 6.1

Table 9.2.2 Orbiviruses, Family Reoviridae:
Other Antigenic Groups of Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Cullicine	Anopheleline	Ticks Ixodid	Argasid	Plebotomine	Culicoides	Other	Humans	Other Primates	Rodents												
<u>EUBENANGEE GR.</u> Eubenangee Pata Tilligerry	+	+	+															2 2 3	S S IE	22 22 22	Orbivirus " "	
<u>PALYAM GR.</u> Bunyip Creek CSIRO Village D'Aguilar Kasba Marrakai Palyam Vellore					+													2 2 2 2 2 2	S S S S S S	21 21 22 22 22 22	Orbivirus " " " " "	
<u>WALLAL GR.</u> Wallal					+													2	S	22	Orbivirus	
<u>WARREGO GR.</u> Mitchell River Warrego	+	+			+													2 2	S S	22 22	Orbivirus "	

** See footnote Table 5.1

Table 9.3 Orbiviruses, Family Reoviridae:
Antigenically Ungrouped Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culicine	Ticks Anophelinae Ixodid	Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds												
Ieri	+																	2	S	22	Orbivirus * * * * * *	
Japanaut	+																	2	S	21		
Lebombo	+					+												2	S	21		
Llano Secott	+																	3	IE	21		
Orungo	+	+					+										+	3	S	21		
Paroo River	+																	3	IE	22		
Umatilla	+								+									2	S	20		
Chobar Gorge				+														2	S	22	Orbivirus	
Ife										+								3	IE	22	Orbivirus	

** See footnote Table 5.1

++ Although it has been demonstrated that Llano Seco virus is antigenically related to Umatilla virus, its antigenic relationship to other established orbivirus serogroups is uncertain.

Table 10.1 Lyssaviruses and Vesiculoviruses, Family Rhabdoviridae; Family Rhabdoviridae: Vesicular Stomatitis and Other Antigenic Groups

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SENS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culexine	Anopheleline	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents												
<u>RABIES SEROGROUP</u>																						
Kotonkan																				2	S	
Lagos bat						+													2	S		
<u>SAWGRASS GR.</u>																						
Connecticut																				3	IE	
New Minto																			3	IE		
Sawgrass																			2	S		
<u>TIMBO GR.</u>																						
Chaco																	+		2	S		
Sena Madureira																	+		3	IE		
Tinbo																	+		2	S		
<u>VES. STOMATITIS GR.</u>																						
Chandipura																		+	2	S		
Cocal	+																	+	3	A1		
Isfahan	+																	+	2	S		
Jurona	+																	+	2	S		
La Joya	+																	+	2	S		
Piry																		+	2	S		
VS-Aragoas																		+	3	S		
VS-Indiana	+																	+	2	A3		
VS-New Jersey	+																	+	2	A3		
Yug Bogdanovac																		+	3	IE		

** See footnote Table 5.1

Table 10.2 Family Rhabdoviridae:
Bovine Ephemeral Fever and Other Antigenic Groups

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS				
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis			
	Mosq. Culicine	Anopheline	Ticks Ixodid	Argasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rocents													Birds	Bats	Marsupials
<u>BOVINE EPHEMERAL FEVER GR.</u> Aueiaide River Berrimah Bovine ephem. fev. Kimberley	+																		X		22 22 22 22	Rhabdovirida " " "			
<u>HART PARK GR.</u> Flanders Hart Park Mosqueiro																					2 2 3	S S IE	22 21 22	Rhabdovirida " "	
<u>KWATTA GR.</u> Kwatta																					2	S	22	Rhabdovirida	
<u>LE DANTEC GR.</u> Keuraliba Le Dantec																					2 2	S S	22 22	Rhabdovirida "	
<u>MOSSURIL GR.</u> Bangoran Barur Charleville Cuiaba Kanese Kern Canyon Marco Mossuril																						2 2 2 2 2 2 2 2	S S S S S S S S	22 22 22 22 22 23 22 22	Rhabdovirida " " " " " " " "

** See footnote Table 5.1
X See footnote Table 6.1

Table 10.3 Family Rhabdoviridae:
Antigenically Ungrouped Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
Aruac	+																	2	S	21	Rhabdoviridae	
Gray Lodge	+																	3	IE	22	"	
Joinjakaka	+																	2	S	22	"	
Kununurra	+																	2	S	22	"	
Xiburema	+																	2	S	22	"	
Yata	+																	2	S	22	"	
Inhangapi																		3	IE	22	Rhabdoviridae	
Sripur																		3	IE	22	"	
Tibrogargan					+													2	S	22	"	
Almpiwar																		2	S	21	Rhabdoviridae	
Gossas																		2	S	23	"	
Klamath																		2	S	22	"	
Mount Elgon bat								+										2	S	23	"	
Navarro									+									2	S	22	"	

** See footnote Table 5.1

Table 11.1 Arenaviruses, Family Arenaviridae:
Tacaribe (LCM) Serogroup Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
Amapari					+			+										2	A5	24	Arenavirus	
Flexal								+										3	S	23	"	
Junin					+			+										4	A6	24	"	
Ippy								+										2	S	22	"	
Lassa								+										4	S	24	"	
Latino								+										2	A5	24	"	
Machupo								+										4	S	24	"	
Parana					+			+										2	A5	24	"	
Pichinde			+					+										2	A5	24	"	
Tacaribe	?	?			+			+										2	A5	24	"	
Tamiami								+										2	A5	24	"	
Toure								+						+				2	S	22	"	

** See footnote Table 5.1

Table 12.1 Families Orthomyxoviridae, Coronaviridae, Herpesviridae
Iridoviridae, Nodaviridae, Paramyxoviridae and Poxviridae:
Thogoto Serogroup and Antigenically Ungrouped Viruses

VIRUS	ISOLATED FROM											ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS						VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culicine	Anopheleine	Ticks Ixodid	Argasid	Plebotomine	Culicoides	Other	Humans	Other Primates	Roentents	Birds												
THOGOTO GR. Thogoto			+				+								+				3	S	21	Orthomyxoviridae	
Dhori			+												+	+			3	S	22	Orthomyxoviridae	
Bocas Tettang	+		+							+							+		2	S	22 22	Coronavirus "	
Agua Preta											+						+		3	IE	22	Herpesviridae	
Afr. swine fever				+									+			+	+		X		20	Iridoviridae	
Nodamura	+																		3	IE	23	Nodavirus	
Nariva									+								+		3	IE	23	Paramyxoviridae	
Cotia Oubangui Salanga	+				+		+							+			+		2 3 3	S IE IE	24 22 22	Poxviridae " "	

** See footnote Table 5.1
X See footnote Table 6.1
§ Cuba
α Brazil

Table 13.1 Taxonomically Unclassified Viruses:
Quaranfil, Marburg and Other Antigenic Groups of Viruses

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq. Culicine	Anophele line	Ticks Ixodid	Araeasid	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents												
<u>BOTEKE GR.</u> Boteke Zingilamo	+									+								2 2	S S	22 22	Unclassified "	
<u>MALAKAL GR.</u> Malakal Puchong	+	+																2 2	S S	22 22	Unclassified "	
<u>NYAMANINI GR.</u> Nyamanini				+						+								2	S	21	Unclassified	
<u>QUARANFIL GR.</u> Johnston Atoll Quaranfil				+	+			+		+							+	2 2	S S	20 20	Unclassified "	
<u>MARBURG GR.</u> Ebola Marburg								+									+	4 4	S S	23 23	Unclassified "	
<u>TANJONG RABOK GR.</u> Tanjong Rabok Telok Forest									+									2 3	S IE	22 22	Unclassified "	

** See footnote Table 5.1

Table 13.2.1 Taxonomically Unclassified Viruses:
Antigenically Ungrouped Mosquito-, Tick-, or Culicoides-Associated Viruses

VIRUS	ISOLATED FROM											ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS				
	ARTHROPODS						VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis			
	Mosq. Culicine	Ticks		Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats													Marsupials	Other	Sentinels
		Anopheline	Ixodid																							
Arkonam	+	+																	2	S	22	Unclassified				
Gomoka	+	+							+										2	S	22					
Itupiranga	+																				22					
Minnal	+																		2	S	22					
Nkolbisson	+																		2	S	22					
Okola	+																		2	S	22					
Para	+												+								22					
Picola	+																		3	IE	22					
Rochambeau	+																		3	IE	22					
Tanga		+																	2	S	22					
Tembe		+																	2	S	22					
Termeil	+																		3	IE	21					
Venkatapuram	+																		2	S	22					
Wongorr	+																		2	S	22					
Yacaaba	+																		3	IE	22					
Aride			+																2	S	22	Unclassified				
Batken	+		+																3	IE	22					
Chim			+																3	IE	22					
Estero Real				+															3	IE	22					
Issyk-Kul	+	+		+			+			+									3	IE	20					
Keterah				+															2	S	21					
Lake Clarendon				+																	22					
Matucare				+															2	S	22					
Ngaingan																			2	S	22					
Slovakia				+															3	IE	24					
Wanowrie	+		+					+											2	S	22					

** See footnote Table 5.1

Table 13.2.2 Taxonomically Unclassified Viruses:
Antigenically Ungrouped Viruses - No Arthropod Vector Known

VIRUS	ISOLATED FROM										ISOLATED IN					HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS	
	ARTHROPODS					VERTEBRATES					Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level			Basis
	Mosq.	Ticks	Phlebotomine	Culicoides	Other	Humans	Other Primates	Rodents	Birds	Bats												
Araguari																			3	IE	22	Unclassified * * * * * * * * * * * * * * *
Belem																			3	IE	22	
Bimbo																			3	IE	22	
Kanmavanpettai																			2	S	22	
Kannamangalam																			2	S	22	
Kolongo																			2	S	22	
Landjia																			2	S	22	
Mapuera																			3	IE	23	
Mojui dos Campos																			3	IE	22	
Ouango																			3	IE	22	
Sakpa																			3	IE	22	
Sandjimba																			2	S	22	
Santarem																			3	IE	22	
Sebokele																			2	S	22	
Senbalam																			2	S	22	
Thottapalayam																			2	S	22	
Yogue																			2	S	22	

** See footnote Table 5.1

Table 14.1 Continental Distribution of Grouped and Ungrouped Viruses.

Antigenic Group	Total in Group	No. of Continents involved											
		Africa	Asia	Australia	Europe	North America	South America						
A	26	6	8	7	2	7	10	17	7	0	2	0	0
AHS	1	1	1	0	1	0	0	0	0	1	0	0	0
B	66	19	23	14	9	15	12	50	11	2	1	2	0
BAK	2	0	2	0	0	0	0	2	0	0	0	0	0
BEF	4	1	1	4	0	0	0	3	0	1	0	0	0
BHA	1	1	1	0	1	0	0	0	0	1	0	0	0
BLU	1	1	1	1	1	1	0	0	0	0	0	1	0
BTK	2	2	0	0	0	0	0	2	0	0	0	0	0
Bunyamvera Supergroup	ANA	5	0	0	0	0	1	4	5	0	0	0	0
	ANB	2	0	0	0	0	0	2	2	0	0	0	0
	BUN	22	5	1	0	2	8	8	20	2	0	0	0
	BWA	2	2	0	0	0	0	0	2	0	0	0	0
	C	12	0	0	0	0	5	9	10	2	0	0	0
	CAL	13	1	1	0	2	9	3	11	1	1	0	0
	CAP	8	0	0	0	0	3	7	6	2	0	0	0
	GAM	3	0	0	0	0	1	2	3	0	0	0	0
	GMA	12	0	0	0	0	2	11	11	1	0	0	0
	KOO	2	0	0	2	0	0	0	2	0	0	0	0
	MNT	2	0	0	0	0	1	1	2	0	0	0	0
	OLI	3	3	0	0	0	0	0	3	0	0	0	0
	PAT	6	0	0	0	0	4	2	6	0	0	0	0
	SIM	21	10	6	5	0	2	4	16	4	1	0	0
TETE	5	4	1	0	2	0	0	3	2	0	0	0	
TUR	4	1	1	0	1	1	1	3	1	0	0	0	
SBU	1	0	1	0	0	0	0	1	0	0	0	0	
CGL	12	0	0	0	0	1	11	12	0	0	0	0	
CTF	2	0	0	0	1	1	0	2	0	0	0	0	
COR	3	1	0	1	0	0	1	3	0	0	0	0	
EHD	2	1	1	0	0	1	0	1	1	0	0	0	
EUB	3	1	0	2	0	0	0	3	0	0	0	0	
HTN	4	0	2	0	1	2	1	3	0	1	0	0	
HP	3	0	0	0	0	2	1	3	0	0	0	0	
KSO	3	0	2	0	0	1	0	3	0	0	0	0	
KEM	18	3	5	1	6	6	1	15	2	1	0	0	
KWA	1	0	0	0	0	0	1	1	0	0	0	0	
LD	2	2	0	0	0	0	0	2	0	0	0	0	
MAL	2	1	1	0	0	0	0	2	0	0	0	0	
MAP	4	0	0	4	0	0	0	4	0	0	0	0	
MRG	2	?	0	0	1	0	0	1	1	0	0	0	
MOS	8	4	1	1	0	1	2	7	1	0	0	0	

Table 14.1 (Continued) Continental Distribution of Grouped and Ungrouped Viruses

Antigenic Group	Total in Group	Africa	Asia	Aus-tral- asia	Eur- ope	North Amer- ica	South Amer- ica	No. of Conti- nents involved						
								1	2	3	4	5	6	
MTY	3	3	0	0	0	0	0	3	0	0	0	0	0	0
Nairo- viruses	CHF-CON	4	2	4	0	2	0	2	0	2	0	0	0	0
	DGK	5	2	4	1	0	0	3	2	0	0	0	0	0
	HUG	4	1	1	0	1	1	3	2	1	1	0	0	0
	NSD	3	2	1	0	0	0	0	3	0	0	0	0	0
	QYB	2	2	0	0	0	0	0	2	0	0	0	0	0
	SAK	5	0	2	1	1	1	0	5	0	0	0	0	0
NDO	1	1	0	0	0	0	0	1	0	0	0	0	0	
NYM	1	1	0	0	0	0	0	1	0	0	0	0	0	
PAL	7	0	3	4	0	0	0	7	0	0	0	0	0	
PHL	35	8	5	0	4	10	14	31	2	2	0	0	0	
QRF	2	1	0	1	0	0	0	2	0	0	0	0	0	
RABIES	2	2	0	0	0	0	0	2	0	0	0	0	0	
RTA	3	0	0	0	0	0	3	3	0	0	0	0	0	
SAN	3	0	0	0	0	3	0	3	0	0	0	0	0	
TCR	12	3	0	0	0	1	8	12	0	0	0	0	0	
THO	1	1	1	0	1	0	0	0	0	1	0	0	0	
TIM	3	0	0	0	0	0	3	3	0	0	0	0	0	
TR	2	0	2	0	0	0	0	2	0	0	0	0	0	
UPO	2	0	0	1	0	1	0	2	0	0	0	0	0	
UUK	6	0	2	1	3	0	0	6	0	0	0	0	0	
VSV	10	1	2	0	1	3	6	7	3	0	0	0	0	
WAL	1	0	0	1	0	0	0	1	0	0	0	0	0	
WAR	2	0	0	2	0	0	0	2	0	0	0	0	0	
Ungrouped	90	28	18	14	4	12	21	86	2	1	1	0	0	
TOTAL	504	130	104	68	47	107	152	433	48	16	4	3	0	

Table 15.1 Number of Viruses Isolated From Classes of Wild Caught Arthropods

Antigenic Group	Total in Group	Isolated From:					No. of Classes Involved		
		Mosq.	Ticks	Phlebotomine Flies	Culicoides	Other	1	2	3
A	26	25	2	0	1	5	21	3	2
AHS	1	0	0	0	1	0	1	0	0
B	66	32	20	0	1	3	41	7	1
BAK	2	2	1	0	0	0	1	1	0
BEF	4	2	0	0	2	0	0	2	0
BHA	1	0	1	0	0	0	1	0	0
BLU	1	0	1	0	1	0	0	1	0
BTK	2	1	0	0	0	0	1	0	0
ANA	5	5	0	0	0	0	5	0	0
ANB	2	2	0	0	0	0	2	0	0
BUN	22	22	0	0	2	0	20	2	0
BWA	2	2	0	0	0	0	2	0	0
C	12	12	0	0	0	0	12	0	0
CAL	13	13	0	0	0	1	12	1	0
CAP	8	7	0	0	0	0	7	0	0
GAM	3	3	0	0	0	0	3	0	0
GMA	12	9	0	1	0	0	8	1	0
KOO	2	2	0	0	0	0	2	0	0
MNT	2	1	0	0	0	0	1	0	0
OLI	3	3	0	0	0	0	3	0	0
PAT	6	6	0	0	0	0	6	0	0
SIM	21	10	0	0	11	0	11	5	0
TETE	5	0	2	0	0	0	2	0	0
TUR	4	4	0	0	0	0	4	0	0
SBU	1	0	0	0	0	1	1	0	0
CGL	12	1	0	8	0	0	9	0	0
CTF	2	0	2	0	0	0	2	0	0
COR	3	3	0	0	0	0	3	0	0
EHD	2	0	0	0	0	0	0	0	0
EUB	3	3	0	0	1	0	2	1	0
HTN	4	0	0	0	0	0	0	0	0
HP	3	3	0	0	0	0	3	0	0
KSO	3	0	3	0	0	0	3	0	0
KEM	18	0	18	0	0	0	18	0	0
KWA	1	1	0	0	0	0	1	0	0
LD	2	0	0	0	0	0	0	0	0
MAL	2	2	0	0	0	0	2	0	0
MAP	4	4	0	0	0	0	4	0	0
MBG	2	0	0	0	0	0	0	0	0
MOS	8	4	1	1	0	0	4	1	0

Table 15.1 (Continued) Number of Viruses Isolated From Wild Caught Arthropods

Antigenic Group	Total in Group	Isolated From:					No. of Classes Involved			
		Mosq.	Ticks	Phlebotomine Flies	Culicoides	Other	1	2	3	
MTY	3	0	0	0	0	0	0	0		
Nairo-viruses	CHF-CON	4	0	4	0	1	0	3	1	0
	DGK	5	0	5	0	0	0	5	0	0
	HUG	4	0	4	0	0	0	4	0	0
	NSD	3	2	3	0	2	0	0	2	1
	QYB	2	0	2	0	0	0	2	0	0
	SAK	5	0	5	0	0	0	5	0	0
NDO	1	1	0	0	0	0	1	0	0	
NYM	1	0	1	0	0	0	1	0	0	
PAL	7	3	0	0	4	0	7	0	0	
PHL	35	6	0	21	0	0	23	2	0	
QRF	2	0	2	0	0	0	2	0	0	
RABIES	2	0	0	0	1	0	1	0	0	
RTA	3	3	0	0	0	0	3	0	0	
SAW	3	0	3	0	0	0	3	0	0	
TCR	12	1	1	0	0	3	3	1	0	
THO	1	0	1	0	0	0	1	0	0	
TIM	3	0	0	0	0	0	0	0	0	
TR	2	0	0	0	0	0	0	0	0	
UPO	2	0	2	0	0	0	2	0	0	
UUK	6	0	6	0	0	0	6	0	0	
VSV	10	6	1	4	1	2	4	2	2	
WAL	1	0	0	0	1	0	1	0	0	
WAR	2	1	0	0	2	0	1	1	0	
Ungrouped	90	42	18	3	2	1	55	5	0	
TOTAL	504	249	109	38	34	16	351	39	6	

Table 16.1 Number of Viruses Isolated From Classes of Naturally Infected Vertebrates

Anti-genic Group	Total in Group	Humans	Other Primates	Rodents	Birds	Bats	Marsupials	Livestock	All Others	No. of Classes Involved					
										1	2	3	4	5	6
A	26	11	2	6	12	4	6	6	3	7	3	4	3	1	1
AHS	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0
B	66	29	5	19	17	13	1	6	7	28	6	8	4	2	1
BAK	2	0	1	0	0	0	0	0	0	1	0	0	0	0	0
BEF	4	0	0	0	0	0	0	4	0	4	0	0	0	0	0
BHA	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0
BLU	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0
BTK	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Bunyamvera Supergroup	ANA	5	1	1	0	0	0	0	0	0	1	0	0	0	0
	ANB	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	BUN	22	5	1	7	1	0	0	2	4	7	5	0	0	0
	BWA	2	1	0	0	0	0	0	0	0	1	0	0	0	0
	C	12	10	0	2	0	1	5	0	1	2	5	3	1	0
	CAL	13	3	0	4	0	0	0	0	1	4	2	0	0	0
	CAP	8	0	0	4	0	0	1	0	0	3	1	0	0	0
	GAM	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	GMA	12	2	0	8	2	2	4	0	0	5	1	1	2	0
	KOO	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	MNT	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	OLI	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	PAT	6	0	0	3	0	0	0	0	0	3	0	0	0	0
SIM	21	2	1	0	4	0	0	8	4	13	3	0	0	0	
TETE	5	0	0	0	5	0	0	0	0	5	0	0	0	0	
TUR	4	0	0	0	2	0	0	0	1	1	1	0	0	0	
SBU	1	0	0	0	0	1	0	0	0	1	0	0	0	0	
CGL	12	1	0	1	0	0	0	0	2	4	0	0	0	0	
CTF	2	1	0	1	0	0	0	0	1	0	0	1	0	0	
COR	3	0	0	0	1	0	0	0	0	1	0	0	0	0	
EHD	2	0	0	0	0	0	0	1	1	2	0	0	0	0	
EUR	3	0	0	0	0	0	0	0	0	0	0	0	0	0	
HTM	4	1	0	4	0	0	0	0	0	3	1	0	0	0	
HP	3	0	0	0	2	0	0	0	0	2	0	0	0	0	
KSO	3	0	1	0	1	0	0	0	1	3	0	0	0	0	
KEM	18	1	0	1	1	0	0	1	0	0	2	0	0	0	
KWA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
LD	2	1	0	1	0	0	0	0	0	2	0	0	0	0	
MAL	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
MAP	4	0	0	0	0	0	0	0	0	0	0	0	0	0	
MPG	2	2	0	0	0	0	0	0	0	2	0	0	0	0	
MOS	8	0	0	1	2	1	0	0	3	7	0	0	0	0	

Table 16.1 (Continued) Number of Viruses Isolated From Naturally Infected Vertebrates

Anti- genic Group	Total in Group	Humans	Other Primates	Rodents	Birds	Bats	Marsu- pials	Live- stock	All Others	No. of Classes Involved					
										1	2	3	4	5	6
MTY	3	0	0	0	3	0	0	0	0	3	0	0	0	0	0
Nairo- viruses	CHF-CON	4	2	0	0	0	0	1	1	1	1	0	0	0	0
	DGK	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	HUG	4	0	0	0	1	0	0	0	1	0	0	0	0	0
	NSD	3	3	0	1	1	0	0	2	1	1	0	1	0	0
	QYB	2	0	0	1	1	0	0	0	0	1	0	0	0	0
	SAK	5	0	0	0	1	0	0	0	0	1	0	0	0	0
NDO	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0
NYM	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0
PAL	7	0	0	0	0	0	0	4	0	4	0	0	0	0	0
PHL	35	9	0	0	3	0	2	1	3	15	4	1	0	0	0
QRF	2	1	0	0	1	0	0	0	0	0	1	0	0	0	0
RABIES	2	0	0	0	0	1	0	0	0	1	0	0	0	0	0
RTA	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAW	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCP	12	3	0	11	0	1	0	0	1	9	2	1	0	0	0
THO	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0
TIM	3	0	0	0	0	0	0	0	3	3	0	0	0	0	0
TR	2	0	1	0	0	0	0	0	0	1	0	0	0	0	0
UPO	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UUK	6	0	0	1	1	0	0	0	0	0	1	0	0	0	0
VSV	10	4	0	1	0	0	1	3	2	1	5	0	0	0	0
WAL	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WAR	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ungrouped	90	8	2	7	13	11	1	1	3	40	2	0	0	0	0
TOTAL	504	104	15	100	76	35	21	44	44	198	49	19	12	3	2

Table 17.1 Number of Viruses Associated with Naturally or Laboratory Acquired Disease in Humans

Antigenic Group	Total in Group	In Nature	Lab. Infection	Either or Both		
				Number	Percent	
Group A	26	11	7	12	46.2	
Afr. horsesickness	1	0	0	0		
Group B	66	30	27	33	50.0	
Bakau	2	0	0	0		
Bhanja	1	0	1	1	100.0	
Bluetongue	1	0	1	1	100.0	
Boteke	2	0	0	0		
Bovine ephem. fever	4	0	0	0		
Bunyamwera Supergroup	Anopheles A	5	1	0	1	20.0
	Anopheles B	2	0	0	0	
	Bunyamwera	22	6	2	7	31.8
	Bwamba	2	1	0	1	50.0
	C	12	10	6	10	83.3
	California	13	7	0	7	53.8
	Capim	8	0	0	0	
	Gamboia	3	0	0	0	
	Guama	12	2	1	2	16.7
	Koongol	2	0	0	0	
	Minatitlan	2	0	0	0	
	Olifantsvlei	3	0	0	0	
	Patios	6	0	0	0	
	Simbu	21	2	1	2	9.5
	Tete	5	0	0	0	
Turlock	4	0	0	0		
SBU	1	0	0	0		
Changuinola	12	1	0	1	8.3	
Colorado tick fever	2	1	1	1	50.0	
Corriparta	3	0	0	0		
Epizoot. hem. dis.	2	0	0	0		
Eubenangee	3	0	0	0		
Hantaan	4	3	3	3	75.0	
Hart Park	3	0	0	0		
Kaisodi	3	0	0	0		
Kemerovo	18	2	2	2	11.1	
Kwatta	1	0	0	0		
Le Dantec	2	1	0	1	50.0	
Malakal	2	0	0	0		
Mapputta	4	0	0	0		
Marburg	2	2	2	2	100.0	
Matariya	3	0	0	0		

Table 17.1 (Continued) Number of Viruses Associated with Naturally or Laboratory Acquired Disease in Humans

Antigenic Group	Total in Group	In Mature	Lab. Infection	Either or Both	
				Number	Percent
Mossuril	8	0	0	0	
Nairo-viruses	CHF-Congo	4	2	2	50.0
	Dera Ghazi Khan	5	0	0	
	Hughes	4	0	0	
	Nairobi sheep dis.	3	3	3	100.0
	Qalyub	2	0	0	
	Sakhalin	5	0	0	
Nyando	1	1	0	1	100.0
Nyamanini	1	0	0	0	
Palyam	7	0	0	0	
Phlebotomus fever	35	9	1	9	25.7
Quaranfil	2	1	0	1	50.0
Rabies	2	0	0	0	
Resistencia	3	0	0	0	
Sawgrass	3	0	0	0	
Tacaribe	12	3	6	6	50.0
Tanjong Rabok	2	0	0	0	
Thogoto	1	1	0	1	100.0
Timbo	3	0	0	0	
Upolu	2	0	0	0	
Uukuniemi	6	0	0	0	
Vesicular stom.	10	4	3	5	50.0
Wallaal	1	0	0	0	
Warrego	2	0	0	0	
Ungrouped	90	7	2	7	7.8
TOTAL	504	111	71	122	24.2

Table 18.1 Evaluation of Arthropod-Borne Status of 504 Registered Viruses (SEAS)

Anti- genic Group	Total in Group	Arbo- virus	Prob- ably Arbo- virus	Pos- sible Arbo- virus	Prob- ably not Arbo- virus	Not Arbo- virus	Arbo or Probably Arbo		Not or Probably Not Arbo	
							No.	%	No.	%
A	26	16	5	5	0	0	21	80.8	0	
AHS	1	1	0	0	0	0	1	100.0	0	
B	66	34	8	17	2	5	42	63.6	7	10.6
BAK	2	0	1	1	0	0	1	50.0	0	
BEF	4	0	0	4	0	0	0		0	
BHA	1	0	1	0	0	0	1	100.0	0	
BLU	1	1	0	0	0	0	1	100.0	0	
BTK	2	0	0	2	0	0	0		0	
Bunyavirus Supergroup	ANA	5	0	2	3	0	2	40.0	0	
	ANB	2	0	0	2	0	0		0	
	BUN	22	8	7	7	0	0	15	68.2	0
	BWA	2	1	1	0	0	0	2	100.0	0
	C	12	10	2	0	0	0	12	100.0	0
	CAL	13	10	1	2	0	0	11	84.6	0
	CAP	8	4	2	2	0	0	6	75.0	0
	CAM	3	0	1	2	0	0	1	33.3	0
	GMA	12	5	4	3	0	0	9	75.0	0
	KOO	2	0	2	0	0	0	2	100.0	0
	MNT	2	0	1	1	0	0	1	50.0	0
	OLI	3	0	0	3	0	0	0		0
	PAT	6	1	2	3	0	0	3	50.0	0
	SIM	21	3	5	13	0	0	8	38.1	0
TETE	5	0	1	4	0	0	1	20.0	0	
TUR	4	1	2	1	0	0	3	75.0	0	
SBU	1	0	0	1	0	0	0		0	
CGL	12	0	1	11	0	0	1	8.3	0	
CTF	2	1	0	1	0	0	1	50.0	0	
COR	3	0	1	2	0	0	1	33.3	0	
EHD	2	0	1	1	0	0	1	50.0	0	
EUB	3	0	0	3	0	0	0		0	
HTN	4	0	0	1	3	0	0		3	75.0
HP	3	0	1	2	0	0	1	33.3	0	
KSO	3	0	2	1	0	0	2	66.7	0	
KEM	18	0	3	15	0	0	3	16.7	0	
KWA	1	0	0	1	0	0	0		0	
LD	2	0	0	2	0	0	0		0	
MAL	2	0	0	2	0	0	0		0	
MAP	4	0	1	3	0	0	1	25.0	0	
MBG	2	0	0	0	2	0	0		2	100.0
MOS	8	0	0	7	1	0	0		1	12.5

Table 18.1 Evaluation of Arthropod-Borne Status of 504 Registered Viruses (SEAS) (Cont.)

Anti- genic Group	Total in Group	Arbo- virus	Prob- ably Arbo- virus	Pos- sible Arbo- virus	Prob- ably not Arbo- virus	Not Arbo- virus	Arbo or Probably Arbo		Not or Probably Not Arbo	
							No.	%	No.	%
MTY	3	0	0	3	0	0	0		0	
Nairo- viruses	CHF-CON	4	2	0	2	0	0	2	50.0	0
	DGK	5	0	0	5	0	0	0		0
	HUG	4	1	1	2	0	0	2	50.0	0
	NSD	3	1	1	1	0	0	2	66.7	0
	OYB	2	1	0	1	0	0	1	50.0	0
	SAK	5	0	2	3	0	0	2	20.0	0
NDO	1	0	1	0	0	0	1	100.0	0	
NYM	1	0	1	0	0	0	1	100.0	0	
PAL	7	0	2	5	0	0	2	28.6	0	
PHL	35	4	13	18	0	0	17	48.6	0	
QRF	2	2	0	0	0	0	2	100.0	0	
RABIES	2	0	1	0	0	1	1	50.0	1	50.0
RTA	3	0	0	3	0	0	0		0	
SAW	3	0	0	3	0	0	0		0	
TCR	12	0	0	2	1	9	0		10	83.3
THO	1	0	1	0	0	0	1	100.0	0	
TIM	3	0	0	3	0	0	0		0	
TR	2	0	0	2	0	0	0		0	
UPO	2	0	0	2	0	0	0		0	
UUK	6	2	0	4	0	0	2	33.3	0	
VSV	10	3	1	6	0	0	4	40.0	0	
WAL	1	0	0	1	0	0	0		0	
WAR	2	0	0	2	0	0	0		0	
Ungrouped	90	4	10	68	5	3	14	15.6	8	8.9
TOTAL	504	116	92	264	14	18	208	41.3	32	6.3

APPENDIX I

Summary Description of Recommended Practice and Containment Levels for Arboviruses and Certain Other Viruses of Vertebrates^a (11).

Level	Laboratory Practices	Primary Containment	Secondary Containment
1	Standard microbiological practices are required.	None. Open bench.	None required.
2	Care required to limit aerosols and contamination. Limited access. ^c	Class I or II BSC ^b required for aerosol producing procedures.	Designed to facilitate cleaning and disinfection.
3	All virus materials contained. Special lab gowns required.	Class I or II BSC or equivalent required for all manipulations of infectious materials.	Restricted access, ^d air lock facility, controlled unidirectional air flow. Exhaust air discharged away from building. Work with certain viruses indicated by an * requires HEPA filtration of exhaust air.
4	Rigorous containment of all virus manipulations. Change of clothing and shower required.	Class I or II BSC adequate for work with infectious materials if all laboratory personnel are immune or insusceptible. Otherwise, Class III or one-piece positive pressure suits are required.	Facility equivalent to separate building. Includes shower facilities, heat-treated biowaste, HEPA filtration of all exhaust air, double-door autoclaves.

^aThere are also SALS recommendations concerning vector and vertebrate studies.

^bBSC = Biological Safety Cabinets.

^cAccess limited to persons with knowledge of the biohazard potential.

^dAccess restricted to persons with programmatic or support requirements for entry.

APPENDIX II

Explanation of Symbols Used to Define Basis for Assignment of Viruses to Levels of Practice and Containment (11).

- S = Results of SALS surveys and information from the Catalogue.
- IE = Insufficient experience with virus; i.e., experience factor from SALS surveys was less than 500 in laboratory facilities with low biocontainment.
- A = Additional criteria 1, 2, 3, 4, etc.
1. Disease in sheep, cattle or horses.
 2. Fatal human laboratory infection, 1978, probably aerosol (14). This is recognized to be a unique incident in a long history of work with SFV under minimal biocontainment conditions. However, since the virulence characteristics of the strain responsible in this case require further study and the prevalence of subclinical infections in laboratories working with SFV remains unknown, the committee recommends Level 3 until further information is available warranting reconsideration at a lower level.
 3. Extensive laboratory experience and mild nature of aerosol laboratory infections justifies Level 2.
 4. Placed in Level 4 based on the close antigenic relationship with a known Level 4 agent, Russian spring-summer encephalitis, plus insufficient laboratory experience.
 5. Level 2 arenaviruses are not known to cause serious acute disease in man and are not acutely pathogenic for laboratory animals, including primates. Survey experience is sufficient to conclude that laboratory aerosol infection does not occur in the course of routine work with cell cultures and animals not subject to chronic infection. In view of a reported high frequency of laboratory aerosol infection that occurred in workers manipulating high concentrations of Pichinde virus, it is strongly recommended that work with high concentrations of Level 2 arenaviruses be done at Level 3.
 6. Level assigned to prototype or wild-type virus. A lower level may be recommended for laboratory strains or geographic variants of the virus with well-defined reduced virulence characteristics, as mentioned in the text.

VECTOR INDEX

Aedeomyia catasticta: ALF, COR, KNA
Aedeomyia squamipennis: GAM, PV, SJ
Aedes abnormalis: BOU, MOS, NDU, MID, PGA, SF, SPO, WSL
Aedes alberratus: JC
Aedes aegypti: CHIK, DEN-1, DEN-2, DEN-3, DEN-4, DUG, ORU, USU, VEE, WN, YF, ZIKA
Aedes africanus: BOU, BUN, CHIK, DEN-2, MID, ORU, SAB, WSL, WN, YF, ZIKA
Aedes albocephalus: MID, WN
Aedes albopictus: DEN-2
Aedes albopictus: WN
Aedes and *Anopheles*: GET
Aedes and *Culiseta*, mixed pool: INK
Aedes and *Psorophora* mixed pool: ILH
Aedes angustivittatus: SAR, VEE
Aedes arborealis: APEU
Aedes argenteopunctatus: BUN, GOM, MID, PGA, SF, SHO, WSL
Aedes argenteopunctatus and *Ae. mutilis*: NKO
Aedes argyrorhox: WYO
Aedes atlanticus: EEE, LAC, TEN, TVT
*Aedes atlanticus/tormentor**: EVE, KEY, LAC, TEN, TVT
Aedes aurifer: KEY, SSH
Aedes bancroftianus: BF
Aedes butleri: BEB
Aedes caballus: MID, RVF, WSL
Aedes campestris: CV, WEE
Aedes camporhynchus: TER
Aedes canadensis: CV, EEE, JC, KEY, LAC, SSH
Aedes cantans: TET, WN
Aedes cantator: JC
Aedes capensis: BUN
Aedes caspius: IK, ISF, TAH
Aedes caspius caspius and *Culex hortensis*: BKN
Aedes cataphylla: SSH
Aedes cinereus: CV, SSH
Aedes circumluteolus: BUN, GER, ING, LEB, MID, NDU, PGA, RVF, SHO, SIM, SPO, WSL, WN
Aedes communis: CV, JC, LAC, SSH, TVT
Aedes communis/punctor: INK
Aedes cumminsii: DEN-2, MID, NKO, PGA, RVF, SHO, SIM, SPO, WSL
Aedes dalzieli: BUN, CHIK, MID, NDU, NDO, PGA, SHO, SIM, WSL, ZIKA, ZGA
Aedes dentatus: MID, ORU, PGA, SF, SHO, WSL, YF
Aedes dianiaetus: TAH
Aedes domesticus: NKO, WSL
Aedes dorsalis: CV, CE, LAC, MD, TVT, WEE
*Aedes eidsvoldensis** and *Ae. pseudonormanensis*: GG
Aedes excrucians: NOR, SSH
Aedes fitchii: SSH
Aedes flavescens: CV, WEE
Aedes fowleri: PGA, SIM
Aedes fryeri/fowleri: SPO
Aedes fulvus: MAG, SDN, WYO
Aedes fulvus pallens: EEE
Aedes funereus: MPK
Aedes furcifer: CHIK, DEN-2, RVF, YF
Aedes furcifer/taylori: BOU, DEN-2, ZIKA
Aedes hexodontus: NOR, SSH
Aedes infirmatus: KEY, TEN, TVT
Aedes intrudens: SSH
Aedes jamoti: SF, ZIKA
Aedes lineatopennis: MID, RVF, TMU, WAL, WSL, WGR
Aedes lineatopennis/Ae. albothorax pool: MID
Aedes luteocephalus: BOU, CHIK, DEN-2, NKO, PGA, YF, ZIKA
Aedes marshallii: MID
Aedes mediolineatus: WSL
Aedes melanimon: CE, JC, SLE, WEE

* Currently considered to be a subspecies of *Aedes theobaldi*.

Aedes melanimon-dorsalis: CE
Aedes minutus: NDU, WSL
Aedes mitchelliae: EEE, TEN
Aedes neoaffricanus: CHIK, YF, ZIKA
Aedes nigripes: SSH
Aedes nigromaculis: CV, CE, EEE, MD, WEE
*Aedes nocturnus**: BAT
Aedes normanensis: BF, EH, GG, MVE, RR, SIN
Aedes opok: BOU, BUN, CHIK, DEN-2, MID, ORU, YF, WSL, ZIKA
Aedes palpalis: MID, PATA, SF, SIM, ZGA
Aedes pempaensis: BUN, TAH
Aedes polynesiensis: DEN-1, RR
Aedes punctator: BAT, JC, NOR, SSH
Aedes scapularis: CV, CAR, ILH, KRI, LUK, MAG, MAN, MAY, MEL, SLE, VEE, WYO
Aedes septemstriatus: APEU, WYO
Aedes serratus: AURA, COT, GTB, ILH, IPU, MAG, MEL, MIR, ORO, SLE, UNA, VEE, WYO
Aedes sexlineatus: WYO
Aedes simpsoni: YF
Aedes simulans: MID, WSL
Aedes sollicitans: CV, JC, KEY, LAC, VEE
Aedes species: BUN, CHIK, GMA, ICO, JC, KEY, KOK, MAG, MUC, NOR, ORI, SSH, TVT, UGS, UNA, VSI, WSL, WEE, ZIKA
Aedes (Adm) species: MID
Aedes (Can) species: JUG
Aedes (Dic) species: ORU
Aedes (Neo) species: WSL
Aedes (Och) species: UNA, WYO
Aedes spencerii: CV, WEE
Aedes sticticus: EEE, TAH
Aedes stimulans: CV, JC, SSH
Aedes stokesi: NKO
Aedes taeniorhynchus: CV, EEE, EVE, GL, KRI, KEY, NOR, ORI, PLA, TEN, TLA, TVT, VEE, WYO
Aedes tarsalis: MID, PATA, PGA, SHO, WSL, ZIKA
Aedes taylori: DEN-2, YF
Aedes tuelcter: JC, VEE
Aedes togoi: POW
Aedes tremulus: KUN
Aedes triseriatus: CV, JC, KEY, LAC, SSH, TVT
Aedes trivittatus: BOC, CV, JC, LAC, SSH, TVT
Aedes vexans: BAT, CV, CE, EEE, GET, JC, KEY, LAC, MD, SAG, SLE, SF, SSH, TAH, TVT, WEE
Aedes vexans nipponii: AKA, GET
Aedes vigilax: BF, DEN-1, DEN-4, EH, GG, KOK, RR, SIN, STR, TER, YAC
Aedes vittatus: BUN, CHIK, MID, PGA, SAB, SF, SIM, WSL, YF, ZIKA
*Alectorobius capensis*** : SOL
Alectorobius sonrai† : CHIK, BDA, KOU
Alveonasmus lahorensis§ : CON, CHF
Amblyomma americanum: LS
Amblyomma cajennense: WM
Amblyomma cohaerens: DUG
Amblyomma loculosum: ARI
Amblyomma pomposum: DUG
Amblyomma species: DUG
Amblyomma variegatum: BHA, BLU, CON, DUG, KAS, THO, WN, YF
Anopheles albimanus: TLA
Anopheles albitarsis: LM
Anopheles amictus: GET, KOW, RR
Anopheles annulipes: KOW, MAP, TIL, TRU
Anopheles aquasalis: VEE
Anopheles bancroftii: BEF, KOO
Anopheles barbirostris: JBE
Anopheles boliviensis: ANA, ANB
Anopheles bradleyi-crucians: CV
Anopheles braziliensis: TON
Anopheles brohieri: SHO
Anopheles coustani: CHIK, PGA, WN

* Currently considered to be a subspecies of *Aedes vexans*.

**Considered by most to be *Ornithodoros (Alectorobius) capensis*.

† Considered by most to be *Ornithodoros (Alectorobius) sonrai*.

§ Considered by most to be *Ornithodoros (Alveonasmus) lahorensis*.

Anopheles crucians: CV, EEE, EVE,
 KEY, LAC, SR, SLE, TEN, TVT,
 VEE
Anopheles cruzii: BOR, GTB, ICO,
 TCM
Anopheles farauti: KOO
Anopheles flavicosta: MID
Anopheles franciscanus: MD
Anopheles freeborni: CV, MD, VR,
 WEE
Anopheles funestus: AKA, BWA,
 CHIK, NDO, ONN, ORU, PGA, SF,
 TAN, TAT, WSL
Anopheles gambiae: BWA, CHIK,
 ILE, MID, NDO, ONN, ORU, TAT,
 ZIKA
Anopheles gambiae and *An*
pharoensis: WSL
Anopheles grabhamii: CV
Anopheles hyrcanus: ARK, IK, JBE,
 POW, TAH
Anopheles maculipennis: BAT,
 CVO, WN
Anopheles mediopunctatus: TON
Anopheles meraukensis: EH, MAP,
 WAR
Anopheles neivai: ANA, ANB, GRO,
 YF
Anopheles neomaculipalpus: VEE
Anopheles nili: PGA, TAT
Anopheles nimbus: CATU, LUK, PIX,
 TME, WYO
Anopheles paludis: BOU, GOM
Anopheles pharoensis: BIR, SIN
Anopheles philippinensis: TMU
Anopheles pseudopunctipennis
pseudopunctipennis: CV, SA,
 VEE
Anopheles punctimacula: VEE
Anopheles punctipennis: CV, JC,
 LAC, SSH, TEN, VEE
Anopheles punctipennis and *An*
quadrinaculatus: CV
Anopheles quadrinaculatus: CV,
 JC, SLE, TEN
Anopheles species: CV, MAG, MPK,
 TLA, UNA, WN, WEE, WYO
Anopheles squamosus: BIR
Anopheles subpictus: ARK, BAT, WN
Anopheles tessellatus: BAT
Anopheles walkeri: CV
 Anophelines: GRO
 Anthomyidae: VSNJ
Argas africanus: PRE
Argas abdussalami: BAK, MWA
Argas arboreus: NYM, PS, QRF
Argas cooleyi: ML, SC, SCA
Argas hermanni: AH, CNU, GA, QRF,
 RF, UUK, WN
Argas peringueyi: CNU
Argas persicus: CHF, SLO
Argas pusillus: KTR
Argas reflexus: CNU, GA, NYM,
 PTV, QRF, UUK, WN
Argas robertsi: KS, PTH
Argas vespertilionis: IK
Argas vulgaris: QRF
Argas walkerae: NYM
Armigeres species: SEP
Bdellonyssus: WEE
Bdellonyssus bursa: SIN
Boophilus annulatus: BHA, CON,
 DUG, THO
Boophilus calcaratus: CHF
Boophilus decoloratus: BHA, CON,
 DUG, THO
Boophilus decoloratus, Rhipice-
phalus appendiculatus, R.
evertsi, R. simus: THO
Boophilus geigy: DUG
Boophilus microplus: SEL
Boophilus microplus and *Hyalomma*
a. anatolicum: WM
 Chloropidae: VSNJ
Chrysops cincticornis: JC
Chrysops obsoletus: KEY
Cimex insuetus: KK
Coquillettidia: ILH, UNA
Coquillettidia albicosta: RBU,
 TON
Coquillettidia arribalzagai: UNA,
 WYO

Coquillettidia aurites: TAT, USU
Coquillettidia crassipes: WON
Coquillettidia fraseri: SIM
Coquillettidia fuscopennata:
 SIN, YF
Coquillettidia linealis: RR
Coquillettidia linealis, *Culex*
molestus and *Cx cylindricus*:
 BF
Coquillettidia maculipennis: BTK
Coquillettidia metallica: MID, WN
Coquillettidia perturbans: CV,
 EEE, JC, TEN, TVT
Coquillettidia richiardii: CVO
Coquillettidia venezuelensis:
 ANU, BSQ, CAB, COT, ITP, MAY,
 MOJU, MUR, ORO, SLE, TON
Coquillettidia xanthogaster:
 DEN-4
Culex accelerans: BSB, NEP
Culex adamesi: ABR, NJL
*Culex aikenii**: APEU, MTB, MUR,
 VEE
Culex albinensis: SLE
Culex albiventris: MPO
Culex amazonensis: ACA, MOR, WYO
Culex annulirostris: BF, BEL,
 COR, DEN-4, EH, EUB, GG, KIM,
 KOK, KOO, KOW, KUN, MVE, PR,
 PIA, RR, SIN, TER, WAR, WON,
 WGR
Culex annulioris: KAM, MID
Culex antennatus: AMT, PGA, SIN,
 WN
Culex antennatus and *Cx*
univittatus neavi: ACD
Culex Belem complex No. 19: ANU
Culex Belem species No. 11: BEN
Culex (Mel) Belem species No. 1:
 BSQ, CAP
Culex (Mel) Belem species No.
 17: ACA
Culex (Mel) Belem species No.
 27: ANU
Culex bitaeniorhynchus: BAT, GET,
 MVE, SIN, UMB
Culex caudelli: ITP, SLE
Culex cinereus: MPO
Culex cinereus and *Cx albiventris*:
 MID
Culex corniger: VEE
Culex coronator: SLE
Culex crybda: BSQ
Culex (Cux) species: BUN, SLE,
 VEE
Culex decens: BAG, KAM, MOS, MPO
Culex declarator: SLE, TUR
Culex delpontei: ANT, BQS, RTA,
 VEE
Culex dunni: EEE, LJ, PCA, WEE
Culex eastor: ITP
Culex elevator: BOC
Culex epanatasis: ENS
Culex erraticus: SLE, WEE
Culex fuscocephala: JBE
Culex gelidus: BAT, GET, JBE, TMU
Culex gelidus, *Cx pseudovishnui*
 and *Cx tritaeniorhynchus*: TMU
Culex guiarti: BAG, BOT, ING,
 MID, NTA, OUB, WN
Culex ingrami and *Cx guiarti*:
 BAG
Culex iolambdis: PAT
Culex (Lop) species: BAK, BEB,
 KET
Culex Malaysia species No. 1: BAK
Culex Malaysia species No. 3: BAK
Culex (Mel) species: ANU, AURA,
 BSQ, EVE, GL, JAC, KEY, MH,
 MTB, MIR, MOJU, NJL, PAH, SR,
 VEE
Culex mixed: See *Culex* species
Culex modestus: KYZ, LED, WN
*Culex molestus*** : WN
Culex nakuruensis: BAN
Culex neavei: SPO
Culex nebulosus: MID, MPO, NTA
Culex nigripalpus: CAB, EEE,
 EVE, HP, KEY, PAH, SR, SLE,
 TEN, TVT, VEE, VSNJ, WYO

* *Culex (Mel) aikenii* is a synonym of *Cx ocosa*.

***Culex molestus* is considered to be a biotype of *Cx pipiens*.

Culex ocozza: BAB, PARA, VEE, WEE
Culex opisthopus: PAT
Culex panocossa: EEE
Culex paracrybda: ABK, PLS
Culex paracrybda and *Cx ocozza*: BAB
Culex periscus: BAG, BGN, GOM, KAM, MPO, MOS, NOLA, ORU, USU, WSL, WN
Culex pervigilans: WHA
Culex pipiens: CV, FLA, HP, IT, JBE, LAC, OLI, SF, SLE, TAH, TVT, TUR, UMA, WEE
Culex peus: SLE, TUR, WEE
*Culex pipiens quinquefasciatus**: BAN, EEE
Culex pipiens and *Cx pseudovishnui*: AINO
Culex poecilipes: OLI
Culex poriesi: ANU, BIM, CAB, CAR, CATU, CUC, COT, GJA, GMA, ITQ, MAG, MTB, MOJU, MQO, MUC, MUR, ORI, RES, SLE, TON, TUR
Culex pruina: BAG, KAM, MOS, SIN, WN
Culex pseudosinensis: UMB
Culex pseudovishnui: KUN, SIN, TMU, UMB
Culex pseudovishnui and *Culex India species No. 3*: VEL
Culex pullus: ALF
Culex quinquefasciatus: CHIK, EEE, KUN, MTB, MUR, ORO, RR, SLE, SIN, TUR, VEE, WAN, WEE, WN
Culex quinque-salinarius: EEE
Culex restuans: EEE, HP, SLE, WEE
Culex rubinotus: AMT, BAN, GER, UGS, WIT
Culex sacchettae: BER, EEE
Culex salinarius: EEE, FLA, SLE, TEN

Culex sitiens: MOS**, TMU
Culex species: ACA, ANU, APEU, ARU, BAG, BVS, BIM, BUN, BSB, BSQ, CAB, CAP, CAR, CATU, CHIK, COT, GER, GJA, GMA, ICO, ILH, ITP, ITQ, KWA, MAY, MPO, MUC, MUR, NEP, NTA, ORI, PAT, SLE, SIN, UNA, USU, WEE, WIT
Culex spissipes: BVS, BIM, KRI, SLE, TON
Culex squamosus: KUN
Culex taeniopus†: ANU, BIM, BSQ, CAP, EEE, ENS, MAG, MIR, OSSA, PAT, SLE
Culex tarsalis: CV, CE, FLA, GLO, HP, LLS, LOK, MD, SLE, TUR, UMA, VEE, WEE
Culex telesilla: BAG, MID, MOS, NKO, WSL
Culex territans: EEE, FLA, SLE
Culex thalassius: BAG, ILE, SIN
Culex theileri: RVF, SHU
Culex theileri and *Cx rubinotus*: GER
Culex thriambus: PAT
Culex tigripes: BIA, KAM, MOS, SIN
Culex tritaeniornynchus: AINO, AKA, ARK, DEN-3, GET, JBE, KAI, NOD, SAG, SIN, TMU, WN
Culex univittatus: BAG, ING, MOS, MPO, SIN, SPO, USU, WSL, WN
Culex virgultus‡: SLE, TUR
Culex vishnui: GAN, GET, ING, JBE, KAS, MIN, PAL, SAT, TMU, UMB, VKT, WN
Culex vomerifer: ANU, BSQ, CAR, GMA, ITQ, MAD, MOJU, OSSA, VIN
Culex weschei: BOU, MOS, MPO, WN
Culex zeteki: TON
Culex zombaensis: BUN, PGA
 Culicines: JAP, JOI, MPK, TAH

* Elevated to a full species (*Culex quinquefasciatus*).

**Recovered from a pool identified as *Cx sitiens*, but may also have contained *Cx thalassius* and *Cx tritaeniornynchus*.

Culex opisthopus is a synonym for *Cx taeniopus*.

‡ Nomen Dubium

Culicoides brevitarsis: AINO,
 AKA, BC, CVG, DAG, DOU, KIM,
 NGA, PEA, TIB, TIN, WAL
Culicoides dycei: WAL, WAR
Culicoides histris: SAT, THI
Culicoides Kenya species No. 23:
 BLU
Culicoides kingi, *C. nivosus*, *C.*
bedfordi, *C. pallidipennis*, *C.*
cornatus, mixed pool: BEF
Culicoides marksi: BEL, EUB,
 WAL, WAR
Culicoides milnei: BLU
Culicoides onsoletus: BLU
Culicoides imicola (= *C. pallidi-*
pennis): BLU, SABO, SHA
Culicoides pallidothorax: WGR
Culicoides paraensis: ANU, OKO
Culicoides species: AHS, AINO,
 AKA, BLU, BUT, CON, CVG, DAG,
 DUG, EEE, EHD, IT, KOT, LOK,
 MR, RVF, SABO, SAN, SAT, SHA,
 SHU, WAL, WAR
Culicoides schultzei: BEF, BC,
 DAG, EHD
Culicoides schultzei and *C.*
perigrinus: MAR
Culicoides tororensis: NSD
Culicoides variipennis: BLU, BUT,
 LOK, MD
Culiseta: WEE
Culiseta alaskaensis: NOR
Culiseta annulata: TAH
Culiseta impatiens: SSH
Culiseta inornata: CV, CE, JC,
 JS, MD, NOR, SLE, SSH, TVT,
 TUR, WEE
Culiseta melanura: EEE, FLA, HP,
 HJ
Culiseta tonnoiri: WHA
Deinocerites pseudus: SLE, VEE
Dermacentor albipictus: CTF
Dermacentor andersoni: CE, CTF,
 POW
Dermacentor auratus: KFD, LJJ

Dermacentor marginatus: BHA, CHF,
 DHO, HYPR, OMSK, RAZ, RSSE
Dermacentor occidentalis: CTF
Dermacentor parumapertus: CTF
Dermacentor reticulatus (= *D.*
pictus): HYPR, OMSK, RSSE, TET
Dermacentor silvarum: OMSK, RSSE
Dermacentor variabilis: SAW, SLE
Dermanyssus: WEE
Dermanyssus americanus: SLE
Dermanyssus gallinae: EEE, SLE
Echinolaelaps echidninus: JUN
Eomenocantnus stramineus: EEE
Eretmapodites chrysogaster: MID,
 NKO, OKO, RVF, SIM
Eretmapodites grahami: SF
Eretmapodites leucopous: NKO
Eretmapodites quinquevittatus:
 PGA
Eretmapodites semisimplicipes:
 OKO
Eretmapodites silvestris: SPO
Eretmapodites species: NKO, SPO
Eubrachilaelaps rotundus: JUN
Eusimulium johannseni: EEE
Ficalbia species: KOO, SEP
Gigantolaelaps inca: PIC
Gigantolaelaps species: COC, MAY,
 PIC, SLE
Haemagogus capricornii: YF
Haemagogus equinus: YF
Haemagogus janthinomys: MAY, YF
Haemagogus leucocelaenus: WYO, YF
Haemagogus lucifer: YF
Haemagogus mesodentatus: YF
Haemagogus species: ILH, MAY,
 MUC, TCM, YF
Haemagogus spegazzinii: JUR
Haemaphysalis bispinosa: KFD
Haemaphysalis concina: OMSK,
 RSSE, TDY
Haemaphysalis cuspidata: KFD
Haemaphysalis intermedia: BAR,
 BHA, GAN

Haemaphysalis inermis: HYPR
Haemaphysalis japonica douglasi:
 RSSE
Haemaphysalis kysanurensis: KFD
Haemaphysalis leporispalustris:
 NM, SAW, SIL
Haemaphysalis longicornis: KHA,
 RSSE
Haemaphysalis minuta: KFD
Haemaphysalis neumanii: POW
Haemaphysalis papuana: LGT
Haemaphysalis papuana kinneari:
 KFD
Haemaphysalis punctata: BHA, CHF,
 HYPR, TRB
Haemaphysalis semermis: LJJ
Haemaphysalis species: LJJ
Haemaphysalis spinigera: KSO, KFD
Haemaphysalis ticks: BHA
Haemaphysalis turturis: KSO, KFD
Haemaphysalis wellingtoni: GAN,
 KFD
Hyalomma asiaticum asiaticum:
 CNU, CHF, ISF, TDY, WM, WAN
Hyalomma anatolicum anatolicum:
 CHF, KEM, THO, WM
Hyalomma detritum: CHF
Hyalomma dromedarii: DGK, DHO,
 KAD
Hyalomma excavatum: CON
Hyalomma impeltatum: CON, DUG,
 WAN
Hyalomma impressum: CON
Hyalomma marginatum: BAH, CHF,
 DHO, MWA, MTR, SIN, TDY, WAN,
 WN
Hyalomma marginatum isaaci: WM
Hyalomma marginatum rufipes: BAH,
 BHA, CON, DUG
Hyalomma marginatum turanicum:
 CHF
Hyalomma nitidum: CON
*Hyalomma plumbeum plumbeum**: BKN,
 CHF, DHO, TDY, WN
Hyalomma rufipes: CON

Hyalomma species: CON, WM, WN
Hyalomma truncatum: BHA, CON,
 DUG, THO
Hyalomitra lasiophthalma: JC
Hyalomitra nuda: JC
Ixodes apronophorus: OMSK
Ixodes cookei: POW
Ixodes dentatus: CNT
Ixodes eudypitidis: SRE
Ixodes granulatus: LGT, LJJ
Ixodes lividus: RSSE
Ixodes marxi: POW
Ixodes persulcatus: ABS, KEM,
 LGT, OMSK, RSSE
Ixodes petauristae: KFD
Ixodes putus: OKH, PMR, SAK, TYU,
 ZT
Ixodes ricinus: ABS, CHF, EYA,
 HAN, HYPR, KUM, LIP, LI, RSSE,
 TET, TRB, UUK
Ixodes redikorzevi: HAZ
Ixodes ricinus and I. persulcatus:
 UUK
Ixodes signatus: GI, PMR
Ixodes spinipalpus: POW
Ixodes uriae (= I. putus): AVA,
 BAU, CW, CL, GI, MYK, NUG,
 SAK, TAG, TDM, TYU, UUK, YM
Ixodes species: KFD
Ixodes tropicalis: PIC
Ixodes vespertilionis: IK
 Ixodidae: DUG
 Laelapidae: AMA
 Laelapid ("Gamasoid") mites: RSSE
Lasiochelea taiwana: JBE
Limatus durhami: CAR, WYO
Limatus flavisetosus: GJA, WYO
Limatus pseudomethysticus: CAB,
 COT
Limatus species: GMA, WYO
Lutzomyia: GMA
Lutzomyia flaviscutellata: ICO,
 INH, PAC
Lutzomyia panamensis: NIQ

* *Hyalomma plumbeum* = *Hyalomma marginatum* of Hoogstraal.

Lutzomyia AGU, ALT, BUE,
CAC, CAN, CHG, CHI, COT, FRI,
GUR, JAM, OUR, PT, SRA, TUA,
VSI
Lutzomyia trapidoi: AGU, CAC,
CHG, PT, VSI
Lutzomyia umbratilis: AMR, MUN
Lutzomyia ylephilator: AGU, CAI,
CHG, PT
Mansonia africana: BAN, BUN,
CHIK, LEB, MID, PGA, SHO, SPO,
USU, WSL, ZGA
Mansonia africana/Ma uniformis:
PGA
Mansonia dyari: VEE
Mansonia indubitans: SLE, VSNJ
Mansonia (Man) species: MQO
Mansonia papuensis: MPK
Mansonia pseudotitillans: SLE,
TON
Mansonia septempunctata: SEP, SIN
Mansonia species: CHIK, GMA,
MOJU, MUC, ORI, VEE
Mansonia titillans: BSQ, CAB,
TLA, TON, VEE
Mansonia uniformis: BUN, MAL,
MID, NDU, OLI, PUC, RR, SAN,
SPO, WSL, YATA, ZIKA, ZGA
Mansonia uniformis, Anopheles
gambiae, and Culex
antennatus: BAR
Mimomyia flavens: SEP
Mimomyia flavens and Mi modesta:
MPK
Mosquitoes: IT, MAP, MID, NEP,
TAT
Mosquitoes, mixed species: BEF,
EUB, MAG, MAP, MEL, NTA, SEP,
TCR, TAH
Mosquitoes, other: BIM
Musca autumnalis: VSNJ
Musca domestica: VSNJ
Oeciacus vicarius: FM
Ornithodoros adult: KFD
Ornithodoros amblus: HUA, PS
Ornithodoros boliviensis: MAT
Ornithodoros capensis: AB, BAKU,
HUG, JA, QRF, SRE, SOL, UPO
Ornithodoros capensis and/or O.
denmarki: SOL
Ornithodoros denmarki: HUG
Ornithodoros erraticus: ASF, BDA,
QYB
Ornithodoros maritimus: MEA, SOL
Ornithodoros moubata porcinus:
ASF
Ornithodoros musebecki: ZIR
Ornithodoros papillipes: CHIM,
KSI
Ornithodoros sonrai: CHIK
Ornithodoros species: BDA, CG,
HUG, KFD
Ornithodoros tadaridae: ER
Ornithodoros tartakovskyi: CHIM
Ornithonyssus sylviarum: SLE
Otobius lagophilus: CTF
Phlebotomines: CGL
Phlebotomines species: ORX
Phlebotomus papatasi: ISF, SFN,
TEH
Phlebotomus perfiliewi: ARB, SFN,
YB
Phlebotomus perniciosus: ARB, TOS
Phlebotomus species: CHP, CHV,
KAR, SAL, SFN, SFS
Phoniomyia pilicauda: AMB, BOR
Phoniomyia species: ARU
Psorophora albipes: IERI, ILH,
ITU, PUR, UNA, WYO
Psorophora ciliata: VEE
Psorophora cilipes: VEE
Psorophora cingulata: WYO
Psorophora columbiae: CV, JC, SA,
TEN, WEE
Psorophora confinnis: VEE
Psorophora cyanescens: VEE
Psorophora discolor: JC, VEE
Psorophora ferox: ARU, CV, COT,
IERI, ILH, ITU, KRI, MEL, MIR,
ORI, ROC, SLE, UNA, WYO

Psorophora ferox and *Ps albipes*:
UNA
Psorophora howardii: LAC
Psorophora lutzii: UNA
Psorophora signipennis: CE, LOK,
MU, SA, TVT, WEE
Psorophora species: CV, GMA, ILH,
MAG, MAY, VEE, WEE, WYO
Rhipicephalus appendiculatus: NSD
Rhipicephalus bursa: CON, CHF,
THO
Rhipicephalus evertsi: THO, WM
Rhipicephalus guilhoni: WM
Rhipicephalus lunulatus: DUG, WN
Rhipicephalus munsamae: DUG, KOU,
WSL, WN
Rhipicephalus pravus: KAD
Rhipicephalus pulchellus: BAR,
DUG
Rhipicephalus pumilio: CHF
Rhipicephalus rossicus: CHF
Rhipicephalus sanguineus: CHF,
CON, WM
Rhipicephalus sanguineus
turanicus: MWA
Rhipicephalus species: KFD, LJN,
MWA, THO
Rhipicephalus sulcatus: DUG
Rhipicephalus turanicus: CHIM,
CHF, MWA, TDY
Sabethes belisarioi: SLE
Sabethes chloropterus: ARU, CHG,
SLE, YF
Sabethes intermedius: XIB

Sabethes soperi: MCA
Sabethes species: ILH, SLE
Sabethines: MUR
Sabethini species: ICO, KRI, MAY,
MOJU, MUC, ORI, SOR, WYO
Scipio aulacodi: LEB
Sergentomyia species: SRI
Simuliidae: VSNJ
Simulium bivittatum: LOK
Simulium black flies: VSNJ
Simulium malyscheri: SSH
Simulium meridionale: EEE
Stricticimex parvus: KK
Ticks: BHA
Triatoma: WEE
Trichoprosopon digitatum: PIX,
WYO
Trichoprosopon leucopus: WYO
Trichoprosopon longipes: SLE, WYO
Trichoprosopon pallidiventer: AMB
Trichoprosopon species: BSQ,
GMA, ILH, SLE, TNT, WYO
Trichoprosopon theobaldi: ARU
Uranotaenia species: JUG
Wyeomyia aporonoma: KRI, WYO
Wyeomyia complosa: WYO
Wyeomyia melanocephala: TON, WYO
Wyeomyia occulta: CAB, TON, WYO
Wyeomyia pseudopecten: TON
Wyeomyia species: ARU, CAR, IACO,
ILH, KRI, MCA, MAG, MQO, MUC,
SLE, UNA, WYO
Wyeomyia ypsipola: KRI

HOST INDEX

Ablepharus boutonii virgatus:
 ALM, KOW
Acomys cahirinus (= *A. albigena*):
 GF
Acrocephalus schoenobaenus: SJA
Aepcomys (= *Thomasomys*) *fuscatus*:
 PIC
Aethomys medicatus: SGA
Agelaius phoeniceus phoeniceus:
 MER
Agelaius tricolor: HP
Akodon arenicola: JUN
Akodon azarae: JUN
Akodon species: KRI, SLE
Alcedo atthis: IK
Alouatta seniculus insularis: MAN
Alouatta, sentinel: BSQ, GMA
Amevia ameiva: BOC
Amevia ameiva ameiva: CHO, MCO,
 MAY, SM, TIM
Andropodus virens: GOM, MOS, USU
 Antelope: RVF
Antichromus minutus: WN
Apodemus agrarius coreae: HTN
Apodemus argenteus hokkaidi: APOI
Apodemus flavicollis: HYPR, TET,
 UUK
Apodemus sylvaticus: HYPR, LI
Ardea cinerea: SEM
Ardeola grayii: ING, THI
Artibeus jamaicensis: NEP
Artibeus jamaicensis trinitatus:
 TCR
Artibeus lituratus: NEP
Artibeus lituratus palmarum: TCR
Arvicanthus niloticus: AMT, GF,
 UGS, WN, WIT
Arvicanthus species: BDA, GF,
 IPPY, SAB
Arvicola species: TBE
Auripasser: CHIK
Bandicota indica: HTN/SEO*
 Bats: CAB, GMA, MDC, RB, SLE, WN
 Blue jay: See *Cyanocitta cristata*
 Birds, wild: ANU, EEE, HJ, ICO,
 ILH, ING, JBE, MOS, ROC, SF,
 SIN, TDY, TETE, TON, TUR,
 UMB, UUK, WEE, WN
 Boar, wild: CVO
 Bobcat: EVE
Bolomys (= *Akodon*) *obscurus*: JUN
Bos taurus: See Cattle
 Bovine: See Cattle
Bradypus tridactylus: MUR, ORO,
 UTI
Bubulcus ibis: NYM, QRF
 Buffalo: RVF
Bufo marinus: CUI
Bycanistes sharpii: ZGO
Callithrix species: MAY
Calomys callosus: LAT, MAC
Calomys laucha: JUN
Calomys musculus: JUN
Caluromys species: CAP
Caluromys p. philander: ANU, APEU
 Calves - See Cattle
 Calves, fetal - See Cattle
 Camel: THO, WSL, WN
 Cardinal: See *Cardinalis*
cardinalis
Cardinalis cardinalis (= *Richmondia*
cardinalis): MER,
 SLE
Carduelis cannabina: MTR**
 Caribou: CV
Carollia subrufa: AP
Carpodacus mexicanus: HP, TUR
 Cat bird: SLE
Cathartes aura: NAV

* A single isolation of either a Hantaan or Seoul virus from *Bandicota indica*.

**Most of these isolates have not been serotyped; they may represent Bahig or Matruh viruses or other Tete group viruses.

Catharus ustulatus swainsoni (= *Hylocichla ustulata swainsoni*): MER
 Cattle: ADE, AKA, BHA, BLU, BEF, BC, BRM, CV, CON, CHF, CVG, DAG, DOU, DUG, IBA, KIM, LI, MAR, NDU, PEA, RVF, SABO, SAN, SAT, SHA, SHU, THO, VSI, VSNJ, WSL
 Cattle, sentinel: BC, CVG
Cavia pamparum: JUN
Cebus, sentinel: CAR, CATU, GMA, ILH, ITQ, MTB, MIR, MOJU, MUC, MUR, ORI
Cebus apella, sentinel: APEU, GMA, MTB, TCM
Centropus phasianus: ALF
Cercopithecus aethiops: CHIK, YF, ZIKA
Cercopithecus nictitans: BOU
Chaerephon pumila [= *Tadarida (Chaerephon) limbata*]: ENT
Charadrius melanops: COR
 Chickens, sentinel: ANU, MVE, TMU, TUR, WEE, WN
 Chimney swift: SLE
Chloris chloris: BAH*
Choloepus brasiliensis: ANH
Choloepus didactylus: JARI
Casticola chinana: TETE
Clethrionomys glareolus: KEM, LI, PUU, TBE, TET, TRB
Clethrionomys rufocanus: PUU
Clethrionomys rutilus: KEM, KLA, NOR
Clethrionomys species: POW
Clytospizza monteiri: ING
Coendou species: GMA
Colius passer macrourus: MOS
Columbigallina: MAY
Coracopsis vasa: WN
Corvus corone sardonius: SIN
Corvus splendens: KAN
Corythornis cristata: GAR
 Cotton rat: See *Sigmodon hispidus*
Coturnix coturnix: MTR*
 Cows: See Cattle
Cricetomys gambianus: BDA, DUG, GF, UGS
Crocidura species: AMT, BLU
Cyanocitta cristata: HJ, MER, SLE
Cyanopica cyanus: TSU
Cynopterus brachyotis: CI, JUG, PPB
Cynopterus brachyotis angulatus: PPB
Dasypus novemcinctus: MDO
 Deer: EHD, LI, WEE
 Deer, sentinel: JC
 Deer, red: See Deer
 Deer, white-tailed: See Deer
Desmodillus auricularis: WSL
Dicrostonyx rubricatus: SSH
Didelphis m. marsupialis: ANU, CAB, CATU, ITA, MTB, MOJU, MUR, ORI
 Dog: AHS, EEE, TEN, WN
 Donkey: See Horse
 Dove, mourning: SLE
 Dove, ruddy ground: SLE
 Dove, white tipped: SLE
Dryoscopus gambensis: DUG
 Egret: WN
 Egret, nestling: NYM
Eidolon helvum: IFE, LB
Emberiza citrinella: KUM
Eonycteris spelaea: PPB
Epomophorus species: YF
Epomophorus wahlbergi: LB
Eptesicus fuscus: RB
Eptesicus (= *Vespertilio*) *serotinus*: IK

* Most of these isolates have not been serotyped; they may represent Bahig or Matruh viruses or other Tete group viruses.

Erethizon dorsatum: CTF
Erinaceus albiventris (= *Atelerix spiculus*; *A. albiventris*): BHA, CHP, CON, GF, SF
Erinaceus concolor (= *E. roumanicus*): HYPR, RSSE
Erithacus luscinia (= *Luscinia luscinia*): BAH*, MTR*
Erithacus megarhynchos (= *Luscinia megarhynchos*): BAH*
Erythrocebus patas: CHIK, DEN-2, YF, ZIKA
Estrilda melpoda: ING, WN
Euplectes afra: BMA, BBO, KOL
Euplectes orix: ING, TETE
Flicker: SLE
Formicarius analis: CPC
Fox: POW, SLE
Fringilla coelebs: BAH*
Fringilla montifringilla: BAH*
Frogs: OMSK, WEE
Galago: WN
Galago senegalensis: GF
Gehyra australis: CHV
Goats: ABS, CON, CHF, NSD, SABO
Goats, sentinel: TRB
Goose: SLE
Gracula religiosa: SIN
Grallina cyanoleuca: RR
Grouse: LI
Halcyon senegalensis: SF
Hamster, sentinel: AROA, BAB, BAN, GER, GMA, GTB, ITQ, MAD, MNT, MIR, NJL, NEP, OSSA, PAT, PLS, SR, VEE, VIN, WIT, ZEG
Hares: See Rabbits
Heron, white-faced: MVE
Heteromys anomalus: BIM, CAR, COC, GMA, MUC, VEE
Hipposideridae: SIN**

Hipposideros caffer: ZGA
Hipposideros terasensis: JBE
Hirundo rustica: IK
Horse: AHS, CV, COC, EEE, GET, JBE, LI, MAG, MD, MID, UNA, VEE, VSA, VSI, VSNJ, WEE, WN
House finch: See *Carpodacus mexicanus*
House sparrow: See *Passer domesticus*
Humans: ABS, ALE, APEU, BGI, BAN, BHA, BUN, BSQ, BWA, CDU, CAR, CATU, CHG, CHP, CGL, CHIK, CTF, CON, COT, CHF, DB, DEN-1, DEN-2, DEN-3, DEN-4, DHO, DUG, EEE, EBO, EVE, GAN, GER, GMA, GRO, HTN, HAN, HYPR, ILE, ILH, IK, ITQ, JBE, JUN, KEM, KOU, KUM, KUN, KFD, LAC, LAS, LEB, LD, LI, MAC, MAD, MBG, MTB, MAY, MID, MUC, MVE, MUR, NSD, NEG, NEP, NDO, OMSK, ONN, ORI, ORO, ORU, OSSA, PIRY, POW, PT, QRF, RES, RVF, ROC, RR, RSSE, SFN, SFS, SF, SHO, SHU, SIN, SLE, SPO, TCM, TAH, TDY, TAN, TAT, TET, THO, TOS, (UGS)†, UMB, USU, VEE, VSI, VSNJ, WAN, WSL, WEE, WN, WYO, YF, ZIKA, ZGA
Hylocichla meinertzhageni: ASF
Hylomyscus species: SEB
Hylophylax naevioides: BLM
Hylophylax poecilonota: MCA
Hyphanturgus brachypterus: ING
Hyphanturgus nigricollis: BMA
Hyphanturgus ocularius: ING
Jynx torquilla: IK

* Most of these isolates have not been serotyped; they may represent Bahig or Matruh viruses or other Tete group viruses.

**Isolated from a pool of organs from bats of above family plus bats of Rhinolophidae family.

† () = questionable.

Kentropyx calcaratus: CHO
Lanius collurio: MTR*
Larus argentatus: AVA
Lemmyscomys barbarus: GF
Lemmyscomys species: KOU
Lemmyscomys striatus: AMT, GOR,
 IPPY, KOU
Lepus americanus: SIL, SSH
Lepus californicus: BUT, CTF,
 LOK, MD, TUR
Lepus europaeus: JUN
Lepus timidus: KUM
 Lizard: OMSK
Lophuromys flavopunctatus: WIT
Macaca fascicularis: BAK
Macaca mulatta: SHF
Macaca nemestrina: LJN, TR, TF
Macaca radiata: KFD
Macroglossus lagochilus: CI
Macropus (= Wallabia) agilis: RR
 Mammals, small: AMT
 Manakin, black and white: SLE
 Manakin, flame-headed: SLE
 Marmosa: EEE
Marmosa cinerea: APEU
Marmosa mitis: MUC
Marmosa murina: ITQ
Marmosa species: MUR
Marmota monax: POW
 Marsupials: GMA, MUC
Meleagris gallopavo: IT
Metachirus nudicaudatus: CAB, ITQ
Microeca fascians: RR
Micropteropus pusillus: LB
Microtus agrestis: KUM
Microtus montanus: KLA
Microtus oeconomus: KLA
Microtus pennsylvanicus: PH
Microtus gregalis (= M. stenocranius): OMSK
 Migratory finch: MTR
Miniopterus s. fuliginosus: JBE
 Mockingbird: SLE
Molossus obscurus: CATU
 Monkey: DEN-2, YF
 Monkey, sentinel: ANU, DEN-1,
 DEN-2, KRI, ORU, VEE, ZIKA
Motacilla alba: IK, SIN
Motacilla cinerea: IK
 Mouse, deer: CTF
 Mouse, sentinel: ACA, ANU, APEU,
 BVS, BEN, BER, BIM, BSB, BSQ,
 CAB, CNA, CAP, CAR, CATU,
 CHIK, COC, COT, GF, GJA, GMA,
 GTB, HJ, ICO, ITP, ITQ, JD,
 MAD, MAG, MTB, MIR, MOJU,
 MUC, MUR, NEP, ONN, ORI,
 PARA, PAT, ROC, SF, SIN, TBT,
 TON, TUR, UGS, UNA, VEE, WN,
 WYO, ZEG
 Mule: See Horse
Mus musculus: JUN, TBE
 Mus species: WEE
Muscicapa striata: BAH*
Myotis blythii (= M. oxygnathus):
 IK
Myotis lucifugus: BOC, MML
Myotis yumanensis: KC
Neacomys guianae: AMA, ICO
Nectarinia pulchella: GAR
Nectomys: NEP
Nectomys squamipes: ACA, CAR,
 CATU, GMA, ITQ, MOJU, MUC, MUR
Nectomys squamipes amazonicus:
 BEN
Neotoma micropus: RG
Numida meleagris: ING
Nyctalus noctula: IK
Nycticorax nycticorax: SEM
Odocoileus virginianus: See Deer
Ondatra zibethicus: OMSK
 Opossum: EVE

* Most of these isolates have not been serotyped; they may represent Bahig or Matruh viruses or other Tete group viruses.

Oriolus flavocinctus: KUN
Oriolus oriolus: BAH*
Oryzomys: EEE
Oryzomys albigularis: PIC
Oryzomys bicolor: FLE
Oryzomys (= *Oecomys*) *bicolor*:
 KRI, MOJU
Oryzomys buccinatus: PAR
Oryzomys capito: AMA, CAR, CATU,
 FLE, ITQ, MUC, ORI
Oryzomys capito goeldii: PAC
Oryzomys capito velutinus: PAC
Oryzomys flavescens: JUN
Oryzomys goeldii: AMA
Oryzomys laticeps: CAR, CATU, MUC
Oryzomys palustris: TAM
Oryzomys, sentinel: CAR, GMA, MUC
Oryzomys species: BIM, GMA, IRI,
 ITI, MOJU, MUR, STM
Otomys irroratus: BLU
 Ovine: See Sheep
Papio papio: BOU, CHIK
Passer domesticus: FM, HP, SLE,
 TUR, UMA
Passer hispaniolensis: IK
Peromyscus gossypinus: TEN
Peromyscus leucopus: SV
Peromyscus maniculatus: CTF, MOD
Peromyscus species: EEE, POW, WEE
Petrochelidon pyrrhonota: FM
Phacochoerus aethiopicus: ASF
 Pheasant: EEE
Philander opossum: ARA, PIRY
Phoenicurus phoenicurus: BAH,*
 IK, KEM, MTR*
Phylloscopus collybitus: BAH*
Phylloscopus trochilus: BAH,*
 MTR*
 Pigeon: QRF, SLE
 Pig: CNU, GET, ING, JBE, VSI,
 VSNJ, WEE
Pipistrellus (= *Vespertilio*)
pipistrellus: SOK, IK
Pipra erythrocephala: MUC
Pitmys subterraneanus: TRB
Platyrinchus coronatus: MCA
Plesiositagra cucullata: ING,
 KOL, TETE
 Ploceide: ING
Ploceus cucullatus: TETE
Ploceus melanocephalus: BMA, OUA
 Porcupine: CTF
Potamochoerus species: ASF
Praomys (= *Mastomys*) *femelle*: CON
Praomys (= *Mastomys*) *natalensis*:
 DUG, GF, LAS, UGS
Praomys (= *Mastomys*) species:
 BDA, BLU, IPPY, KEU, KOU,
 SAB, SPA, SEB
Presbytis entellus: KFD
 Primates: YF
Proechimys iheringi: AMB
Proechimys guyanensis: BIM, BSQ,
 CAP, CAR, CATU, GJA, GMA,
 ITQ, MOJU, MUC, MUR, ORI, URU
Proechimys oris (= *Proechimys g.*
oris): BUJ, ICO, PIX
Proechimys longicaudatus: URU
Proechimys semispinosus: MAD,
 OSSA
Proechimys species: EEE, MCA,
 NEP, TBT
Progne subis: MER
Psarocolius decumanus: TON
Pteroglossus aracari: INI
Puffinus pacificus chlorohynchus:
 UPO
Pycnonotus barbatus: ING
Pyriglena leucoptera: BLM
Quelea erythroptera: SF
Quelea quelea: ING

* Most of these isolates have not been serotyped; they may represent Bahig or Matruh viruses or other Tete group viruses.

Rabbits (and Hares): CON, CHF,
 LI, TEN
 Rabbit, sentinel: KEY, NOR, SSH,
 TAH, TVT
 Rat: KK
 Rat, laboratory: SEO
 Rat, sentinel: MUC
 Rat, Sprague-Dawley: SEO
 Rat, Wistar: SEO
Rattus blanfordi: KFD
Rattus nitidus: SEO
Rattus norvegicus: SEO, VEE
Rattus rattus: SEO, VEE
Rattus rattus wroughtoni: BAR,
 KFD
Rattus species: SEO
 Rhinolophidae: SIN**
Rhinolophus c. cornutus: JBE
Rhinolophus hildebrandti
eloquens: MEB
Rhinolophus rouxi: KFD
Riparia paludicola: LJA
 Robin: SLE
 Robin, pale vented: SLE
 Rodents: EEE, GER, ICO, RVF,
 RSSE, SHO, WEE
Rousettus aegyptiacus: YOG
Rousettus leschenaulti: WN
 Ruminants, domestic: BLU
 Ruminants, wild: BLU
 Saimiri: KRI
Saxicola rubetra: MTR*, UGS
Sciurus carolinensis: LAC
Sciurus carolinensis, sentinel:
 LAC
Sciurus griseus: WEE
Sciurus vulgaris: KUM
Scotophilus nigrita nigrita: DB
Scotophilus species: CHIK, DB
Scotophilus temmencki: KTR
Seiurus aurocapillus: FLA

Serinus canaria: MTR*
Serinus mozambicus: TETE
 Sheep: BHA, BLU, CV, GAN, LI,
 NSU, RVF, SABO, SHU, WSL
 Siberian polecat: TDY
Sigmodon hispidus: CR, EVE, GL,
 JUT, KEY, MH, PAT, SP, SR,
 TAM, TEN, TVT, VEE, WEE, ZEG
Sigmodon species: PAT, TAM, ZEG
 Skunk, spotted: POW
 Snake: WEE
Sorex araneus: HYPR, LI
Spermophilus (= *Citellus*)
beecneyi: WEE
Spermophilus (= *Citellus*)
columbianus: CTF
Spermophilus (= *Citellus*)
lateralis: CTF
Spermophilus (= *Citellus*)
richardsoni: WEE
 Squirrel: CTF
 Starling, immature: FLA
Sterna fuscata: HUG
Sturnira lilium: MPR
Sturnus pagodarum: KMP
Suncus murinus: HTN/SEO, KFD, TPM
Sus scrofa: ASF
Syconycteris crassa: JAP
Sylvia atricapilla: BAH*
Sylvia borin: BAH,* MTY, MTR*
Sylvia communis: BAH,* MTR,* THI
Sylvia curruca: BAH,* BEA, MTY,
 MTR,* THI
Sylvia hortensis: BAH*
Sylvia nisoria: BAH*
Sylvia ruppelli: BAH*
Sylvilagus aquaticus: TEN
Sylvilagus auduboni: BUT, LOK
Tadarida brasiliensis mexicana:
 RB, SLE, VEE

* Most of these isolates have not been serotyped; they may represent Bahig or Matruh viruses or other Tete group viruses.

**Isolated from a pool of organs from bats of above family plus bats of Hipposideridae family.

Tadarida condylura wonderi: DB
Tadarida plicata: KK
Tadarida species: DB, GOS
Talpa europaea: HYPR
Tamias striatus: LAC
Tamiasciurus hudsonicus: POW
 Tanager, silver beak: SLE
Taphozous theobaldi: KK
Tatera valida (= *T. kempi*): AMT,
 BDA, GF, KEU, KOU, SAB, TOU
Tatera species: GF, GOK, GOS, SAF
Taterillus gracilis: GF
Taterillus nigeriae: GF
Taterillus species: BDA, GF,
 KTR, KEU, KOU
Tchagra australis: WN
Thamnomys macmillani: AMT
Thamnophilus aethiops: ITP
Thryonomys swinderianus: LAT, LEB

Tolmomyias poliocephalus: CAB
Trichosurus vulpecula: WHA
Trionyx spinifer: CV
Tropidurus torquatus hispidis:
 MAY
Turdus libonyanus: AMT, BGN, BOB,
 MPO, USU
Turdus merula: KUM, UUK
Turdus nudigenis: CAB
Turdus philomelos: KUM
Urocyon cinereoargenteus: TEN
Xanthocephalus xanthocephalus: HP
Xanthomyias virescens: GTB
Xerus erythropus: BDA, BHA
Zoothera citrina: KSO
Zygodontomys brevicauda: BIM,
 BOC, CAR, GMA, MUC, NAR, PAC
Zygodontomys species: BIM, CAR,
 CATU, GMA, PAC, VEE

REPORT FROM THE
SUBCOMMITTEE ON EVALUATION OF ARTHROPOD-BORNE STATUS (SEAS)
FOR 1985

During 1985, ten newly registered viruses were evaluated by this subcommittee:

Virus	Genus	Source	Country	SEAS Rating
Meaban	<u>Flavivirus</u>	Argasidae	France	possible arbovirus
Gadgets Gully	<u>Flavivirus</u>	Ixodidae	Australia	possible arbovirus
Mykines	<u>Orbivirus</u>	Ixodidae	Faeroe Is.	possible arbovirus
Tindholmur	<u>Orbivirus</u>	Ixodidae	Faeroe Is.	possible arbovirus
Precarious Pt.	<u>Uukuvirus</u>	Ixodidae	Australia	possible arbovirus
Corfu	<u>Phlebovirus</u>	Psychodidae	Greece	possible arbovirus
Omo	<u>Nairovirus</u>	rodent	Ethiopia	possible arbovirus
Lake Clarendon	unclassified	Argasidae	Australia	possible arbovirus
Puumala	<u>Hantavirus</u>	rodent	Finland	probably not an arbovirus
Seoul	<u>Hantavirus</u>	rodent	Korea	probably not an arbovirus

Largely through the research efforts of Dr. T.H.G. Aitken, the status of seven additional previously registered viruses were upgraded:

Virus	Genus	Source	Country	New SEAS Rating
Uukuniemi	<u>Uukuvirus</u>	Ixodidae	Finland	arbovirus
Qalyub	<u>Nairovirus</u>	Argasidae	Egypt	arbovirus
Sakhalin	<u>Nairovirus</u>	Ixodidae	USSR	probable arbovirus
Rio Grande	<u>Phlebovirus</u>	Psychodidae	US	probable arbovirus
Karimabad	<u>Phlebovirus</u>	Psychodidae	Iran	probable arbovirus
Saint Floris	<u>Phlebovirus</u>	rodent	CAR	probable arbovirus
Gamboa	<u>Bunyavirus</u>	Culicidae	Panama	probable arbovirus

Only two of the ten new registrations had sufficient information to evaluate the arthropod-borne status of the virus. The Subcommittee would like to reemphasize the importance of vector studies in the descriptions of newly registered viruses.

December 15, 1985

Respectively submitted,

A.J. Main, Jr., Chairman
T.H.G. Aitken
Dr. E.W. Cupp
D.B. Francy
D.J. Gubler
J.L. Hardy
D.M. McLean
M.J. Turell

REPORT FROM THE STATE OF NEW YORK DEPARTMENT OF HEALTH, WADSWORTH CENTER FOR LABORATORIES AND RESEARCH, ALBANY, NEW YORK 12201

Humans: As of August 16, 1985, 149 sera from 119 CNS patients from New York State were screened for HI antibody to EEE, WEE, POW, SLE and California serogroup (LAC, JC) viruses; positive reactors were tested for evidence of neutralizing antibody. To date, no confirmed cases of arbovirus encephalitis have been diagnosed.

Mosquitoes: A total of 957 pools of 64,591 adult female mosquitoes collected from 4 counties (Oswego, Onondaga, Oneida, Madison) in upstate New York and from 1 county (Suffolk) on Long Island were tested for EEE virus with negative results. Over half of the specimens were identified as Culiseta melanura and Culiseta morsitans, which are established vectors of EEE virus in enzootic areas of New York State.

Avians and Equines: Blood and/or brain tissue from 5 sick birds and 3 ill horses from central New York were tested for evidence of infection with EEE and WEE viruses by HI technique and/or inoculation in Vero cell cultures, with negative results.

Margaret A. Grayson, Ph.D. and
Rudolf Deibel, M.D.

Wadsworth Center for Laboratories and Research

Summary of 1985 Arbovirus Activity

Humans: During the summer of 1985, 357 sera from 245 patients with diagnosis or signs of infection of the central nervous system were screened for HI antibody to the following arboviruses: Eastern equine encephalitis, Western equine encephalitis; St. Louis encephalitis, Powassan; La Crosse and Jamestown Canyon (California serogroup). Sera from 20 patients reacted with one or both of the California serogroup antigens. Results of plaque reduction neutralization tests indicated Jamestown Canyon (12 patients), Jamestown Canyon or South River (1), South River (1) and La Crosse (2). The subtype was undetermined in 4 patients. Findings for specific antibody in the IgM fraction suggested a recent infection in 4 patients (18, 24, 32, and 54 years of age), all subtyped as Jamestown Canyon infection. The diagnoses were encephalitis (2) or meningitis (2); three of these individuals lived in the southern counties of the state. Specific IgM antibody was not detected in the remaining 16 patients; their antibody findings are interpreted as reflecting an infection at an undetermined time in the past. High titers to St. Louis encephalitis and Powassan virus indicated a flavivirus infection in 1 patient who had recently returned from Africa with headache, fever and leukopenia. The observations suggested a dengue fever infection in this case.

Mosquitoes: A total of 149,584 adult mosquitoes collected between May 16 and September 26, 1985 from 10 counties in 4 regions of New York State were tested in 2,143 pools for the presence of arbovirus (Table 1). At least 17 species in 6 genera of Culicidae were included; in decreasing order of prevalence, Coquilletidia represented 48% of the collections followed by Culiseta (33%) and Aedes (16%) with Culex, Anopheles and Uranotaenia making up the remainder (3%). One California serogroup isolate, subtyped as Jamestown Canyon virus, was obtained from a pool of 92 Aedes stimulans mosquitoes collected on July 1, 1985 from Erie County in western New York. The failure to detect Eastern equine encephalitis virus in 1,857 pools of 130,899 mosquitoes examined from upstate New York, where an outbreak among equines occurred in 1983, is noteworthy.

Avians and Equines: No evidence of EEE or WEE complex virus infection was obtained from virologic or serologic tests of 15 blood and/or tissue specimens from 1 sick horse and 8 pheasants in the Syracuse Region.

(Margaret A. Grayson, Ph.D. and Rudolf Deibel, M.D.)

Table 1

Mosquitoes Examined for Arbovirus by Region and County of Collection,
New York State - 1985

Region	County	No. Tested		No. of Isolates
		Pools	Specimens	
Albany		5	153	
	Schenectady	5	153	
Buffalo		172	10,409	1 (CAL)
	Cattaraugus	19	453	
	Chautauqua	76	7,020	
	Erie	77	2,936	1 (CAL)
Syracuse		1,857	130,899	
	Madison	177	9,585	
	Oneida	259	13,967	
	Onondaga	633	51,463	
	Oswego	788	55,884	
Long Island		109	8,123	
	Ulster	9	338	
	Suffolk	100	7,785	
Totals		2,143	149,584	1 (CAL)

Report from the Biological Products Program, Center for Infectious Diseases, CDC, Atlanta, GA.

Evaluation of 15 Different Bovine Albumin Preparations for Use in Arbovirus Hemagglutination Test.

The techniques for hemagglutination (HA) and hemagglutination-inhibition (HAI) tests with arthropod-borne viruses were described by Clarke and Casals (1). They recommended a solution of Armour bovine albumin fraction V (BAV) in borate saline for diluting antigens and sera. By today's standards, this BAV product was a relatively crude preparation but nevertheless became the basic diluent for use in arbovirus HA testing. Since that time numerous manufacturers have developed bovine albumin (BA) products by different methods resulting in products with higher levels of purity. These materials are usually available in a powder or crystalline form, however, several companies also offer sterile aqueous solutions.

During recent years when problems have occurred in HAI testings, the BA diluent often has been suspected as the possible cause of error. In an attempt to clarify this problem, we evaluated 15 different BA preparations selected from 6 different manufacturers. These products are listed in Table 1. Stock solutions of 4% BA or BAV in borate saline, pH 9.0, were prepared and sterilized by filtration with a 0.22u Millipore filter. A working solution of 0.4% was prepared in borate saline.

HA antigens for LaCrosse (LAX), Eastern Equine Encephalomyelitis (EEE), St. Louis Encephalitis (SLE), and Yellow Fever (YF) viruses were used for evaluation of each of the diluents. These reagents were obtained from CDC, Biological Products Program Inventory (2). The LAX antigen was prepared from BHK-21/13s cell suspensions treated by the tween-80 ether procedure (2,3). The other antigens were prepared from suckling mouse brain material extracted by the tris-beta propiolactone (BPL) procedure (2,4). HA titrations by the micro procedure were carried out at 37 C with seven pH increments ranging from 5.8 to 7.0. Armour bovine albumin fraction V was used as the standard control diluent.

Diluents were prepared from each of the BA products and used in preparation of antigen HA titrations. The optimum HA titers were determined and compared. Eleven of the 15 BA products gave comparable HA titers which varied less than one 2-fold dilution from the optimum. The HA results obtained with the other 4 products varied greater than one 2-fold dilution from the average optimal titer. These results are presented in Table 2. Reduced titers were observed with the two 30% aqueous BA solutions, product numbers 4 and 5. Product #4 gave a reduced titer with the LAX and SLE antigens, while product #5 gave reduced HA titers with all 4 antigens. Two powder preparations (numbers 7 and 10) also showed reduced HA titers but only with 1 antigen, LAX and SLE respectively.

In preparation of the stock 4% solutions, all products except one were readily dissolved into an easily filterable solution. Product number 3, a purified albumin powder, made a very turbid and unfilterable solution. When used unfiltered, the HA titrations were satisfactory.

These results indicate that any bovine albumin powder regardless of the degree of purity, method of preparation, or source, when used as a 0.4% concentration, will function satisfactorily in the arbovirus HA titrations. Deviations from the optimal HA titer were more evident when the diluent was prepared from 30% commercial BA solutions.

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(L. A. White, M. B. Fears, A. Daugharty, and W. A. Chappell)

Table 1. Bovine Albumin Products

Manufacturer	Title, Description and Catalog Number	Lot No.	Preparation***
1. Calbiochem-Behring	Albumin, Bovine, Fraction V Microbiological Grade, #12660	305112	Prepared by Cohn cold ethanol fractionation procedures (5,6) Purity: $\geq 96\%$ by electrophoresis (Esis)* pH of a 1% isotonic solution: 5.2
2. Calbiochem-Behring	Albumin, Bovine, Crystalline #12657	405665	Prepared by Cohn procedures (5,6) Purity: $\geq 99\%$ Esis* pH of a 1% aqueous solution: 5.2**
3. Calbiochem-Behring	Albumin, Bovine, Purified #126615	405317	Purity: free of all other detectable protein by electrophoresis (including denatured albumin)
4. Calbiochem-Behring	Albumin, Bovine, 30% Aqueous Solution #126622	305242	Purity: $\geq 98\%$ Esis* sterile 30% aqueous solution pH of an isotonic solution: 7.3 Contains 0.1% sodium azide
5. Calbiochem-Behring	Albumin, Bovine, 30% Aqueous Solution, Preservative Free #126626	201096	Prepared by Cohn procedures (5,6) Purity: $\geq 96\%$ Esis* pH 7.2** Sterile 30% aqueous solution
6. Sigma Chemical Co.	Albumin, Bovine, Fraction V #A-7906	34F-0272	Prepared by low temperature solvent precipitation with charcoal treatment and dialysis. Purity: 98-99% albumin pH 7.0**
7. Sigma Chemical Co.	Albumin, Bovine, Fraction V #A-4503	112F-0707	Prepared by modified Cohn procedure (5,6) Purity: 96-99% albumin pH 5.2**
8. Sigma Chemical Co.	Albumin, Bovine, Fraction V #A-9647	64F-0669	Prepared from pasteurized bovine serum with procedures of #6 above followed by pH adjustment prior to drying Purity: 96-99% albumin, pH 7.0**
9. Sigma Chemical Co.	Albumin, Bovine, Fraction V #A-2153	122F-0776	Prepared by modified Cohn procedure (5,6) Purity: 96-99% albumin, pH 7.0**
10. Miles Labs., Inc.	Bovine Albumin Fraction V #81-003	385	Prepared from fresh bovine plasma by a modified Cohn procedure (5,6), Purity: $>98\%$ Esis*, pH 7.0

Table 1. Bovine Albumin Products (continued)

Manufacturer	Title, Description and Catalog Number	Lot No.	Preparation***
11. Miles Labs., Inc.	Bovine Albumin Sulphydral Modified #81-018	11M	Prepared from bovine albumin fraction V reagent grade (#81-066) by a modified procedure yielding a protein with low levels of heavy metals and interfering metabolites. Purity: >99% albumin Esis*, pH 7.0
12. Miles Labs., Inc.	Bovine Albumin Fraction V Fatty Acid Free #82-002	39	Prepared as above from #81-066 by a modification of Chan low pH charcoal method (7). Purity: >98% Esis* pH 7.0
13. Difco Laboratories	Bovine Plasma Fraction V #0497-12-6	7240-70	No data
14. Eastman-Kodak Co.	Albumin, Bovine, Fraction V #15402	C12B	No data
15. Armour Pharmaceutical Co.	Bovine Plasma Albumin #2266	D-71002	Prepared from fresh bovine plasma by Cohn method (5,6) Purity: \geq 98% albumin pH 5.2**
16. Armour Pharmaceutical Co.	Bovine Albumin Fraction V #0125-02	Y-89303	Prepared from bovine serum by Cohn method (5) pH 5.2**

*Esis - purity determined by electrophoresis

**pH determined of a 1% aqueous solution

***As described in manufacturers catalog

Table 2. Bovine Albumin Products Showing a Reduction in HA Titers

Arbovirus HA Antigens (Lot No's.)	Bovine Albumin Products*				
	<u>#16**</u>	<u>#4</u>	<u>#5</u>	<u>#7</u>	<u>#10</u>
LAX (83-0080)	160***	40	40	40	160
EEE (83-0110)	10,240	10,240	2,560	5,120	10,240
SLE (84-0038)	2,560	640	160	1,280	640
YF (80-0032)	10,240	10,240	320	10,240	10,240

*Refer to Table 1 for identification

**Armour BAV control

***Reciprocal of dilution in HA test

REPORT FROM THE N.E.R.C. INSTITUTE OF VIROLOGY, MANSFIELD ROAD,
OXFORD, U.K., OX1 3SR

Genetic studies on orbiviruses of the Kemerovo serogroup.

Broadhaven and GS80-9 are two serotypes of the Great Island antigenic complex in the Kemerovo serogroup. Both were originally isolated from ticks (Ixodes uriae) collected in seabird colonies.

Spontaneous temperature sensitive (ts) mutants of the two serotypes were isolated by screening plaques in Vero cells at permissive (36°C) and non-permissive (41°C) temperatures. Stocks were grown up and those having an efficiency of plating (EOP = titre 41°C/titre 36°C) of less than 0.002 were considered to be ts mutants. Eighteen stable ts mutants of Broadhaven virus and 9 ts mutants of GS80-9 virus were isolated from 2800 and 3200 plaques, respectively.

Recombination was carried out with pairs of ts mutants eg. A and B, and recombination frequencies calculated using the formula:

$$\%R = \frac{[(\text{Yield AB})_{41} - (\text{Yield A} + \text{Yield B})_{41}]}{(\text{Yield AB})_{36}} \times 100 \times 2$$

Percentage recombination values of less than 1 were taken to indicate that the 2 ts mutants in question belonged to the same recombination group, values greater than 1 were taken to indicate that they were of different groups.

High frequency pairwise recombination defined 5 recombination groups of Broadhaven virus and 2 groups of GS80-9 virus. Group II of GS80-9 virus appeared to be the same as group III of Broadhaven virus whereas members of group I of GS80-9 virus reassorted with all ts mutants of Broadhaven virus.

Recombinant viruses derived from pairwise crosses between ts mutants of Broadhaven and GS80-9 viruses were analysed by polyacrylamide gel electrophoresis of the 10 RNA segments. The RNA profiles of the parental viruses of Broadhaven and GS80-9 differ in the migration of each segment (except segment 8). By comparing the profiles of parental and recombinant viruses, the derivation of each RNA segment of the recombinant viruses was determined.

Recombinant viruses were also tested by plaque reduction neutralisation with hyperimmune ascitic fluid raised against the parental viruses. Comparison of the results of RNA analyses and neutralisation tests showed a correlation between segment 5 and neutralisation, ie. when segment 5 of the recombinant virus was derived from the Broadhaven parental ts mutant, the recombinant was neutralised by ascitic fluid to Broadhaven and not to GS80-9 virus, and vice versa. These results indicate that segment 5 codes for the neutralising epitopes of at least two serotypes of orbiviruses in the Kemerovo serogroup.

(P.A. NUTTALL, S.R. MOSS, C.M. AYRES, C.H. THOMAS).

Arbovirus serosurvey among seabirds and landbirds in Brittany, France.

Sera from 215 seabirds (mainly gulls) and 74 landbirds (mainly starlings) from Brittany were studied by hemagglutination inhibition (HI) and complement fixation (CF) tests for antibody against 9 arboviruses among them 8 were previously isolated from ticks associated with seabirds.

Among seabirds, 145 (or 65%) were found positive for flaviviruses and nairoviruses of the Hughes serogroup (Soldado, Puffin Island viruses). Unexpected high frequency of HI positive reactions for Tyuleniy virus indicate the possible circulation of this virus among seabird colonies of Brittany in addition to the recently isolated Meaban flavivirus (Chastel et al., 1985).

Among landbirds, only one positive HI reaction for Tyuleniy virus was detected in a house sparrow (*Passer domesticus*) and, from these results it seems that landbirds may not play an important role in the spreading of these arboviruses to man and to domestic animals.

MATERIAL AND METHODS

POINTS OF COLLECTION OF BLOOD

They are disseminated in four areas, from the Mont-Saint Michel Bay in the North to the Loire estuaire in the South (see map):

- Northern coastal area (I) points 1 to 5
- Western coastal area (II) points 6 to 12
- Southern coastal area (III) points 13 to 16
- Inland area (IV) points 17 to 19

SPECIES OF BIRDS SURVEYED; COLLECTION AND MANAGEMENT OF BLOOD

The 215 seabirds surveyed belonged in two families, Laridae and Phalacrocoracidae, and seven species: Herring gull (*Larus argentatus*), lesser black-backed gull (*L. fuscus graellsii*), great black-backed gull (*L. marinus*), kittiwakes (*Rissa tridactyla*), northern black-headed gull (*L. ridibundus*), shag (*Phalacrocorax aristotelis*) and common cormorant (*Ph. carbo*).

The 74 landbirds belonged in Sturnidae, Turdidae, Ploceidae, Hirundinidae and Rallidae, but starling (*Sturnus vulgaris*) was the more abundant species in captures.

Blood was collected either on blotting paper strips (209 samples) or by puncture of heart or wing vein (80 samples). In both cases, non specific inhibitors were removed by cold-aceton and heteroagglutinins were eliminated by absorption on 1-day old chick erythrocytes.

SEROLOGICAL METHODS

We used micromethods for both HI and CF tests, and 9 different antigens as follows:

- 3 HI antigens were obtained by sucrose-aceton extraction of suckling mice brains infected by Tyuleniy (TYU), Saumarez Reef (SRE) and Meaban viruses;
- 6 CF antigens were prepared by the same method for 2 strains of Soldado (SOL) virus, Brest/Ar T13 and Brest/Ar T101, and for Puffin Island (PI) virus (Gould et al, 1983), Avalon (AVA) virus (Brest/Ar T261), Zaliv Terpeniya (ZT) virus (Brest/Ar T260) and a not yet identified virus isolated in France from a shrew (Brest/An 219).

RESULTS

As a whole, we have found 142 sera positive, or 49%, for one or more antigens. However, there was a marked difference between results for seabirds and landbirds.

From 215 seabirds, 141 were positive (or 65%) and from 74 landbirds only one reacted (or 1.4%).

In addition, the distribution of positive reactions varied following the point of collection, the virus, the species of bird and, when available, following the degree of maturity of birds.

POINTS OF COLLECTION

There are only minor differences in the distribution of positive reactions in the four areas of the survey, from 41.6 to 58.8%. However, when taking in account only the seabirds, we found 88% of positive reactions in the western coastal area: this variation was highly significant ($p < 0.001$).

VIRUSES

No CF reaction was observed with the T101 strain of SOL virus, nor with AVA and ZT viruses. On the contrary, positive reactions were obtained in CF tests with the T13 strain of SOL virus, with PI virus and with the strain An 219.

In HI tests, positive reactions were detected for all the three flaviviruses: TYU, SRE and MEA.

In fact, the highest percentages of positivity for flaviviruses were found for TYU virus: 135 positive sera from 215 examined seabirds (or 62.7%) whereas only 7.9% and 5.1% were detected for MEA and SRE viruses respectively. Titers up to 2,560 were found in seabirds for TYU virus, a virus not yet identified in Brittany. Comparatively low titers were observed for MEA (up to 80) virus and SRE (up to 40) virus, only from the southern coastal area.

SPECIES OF BIRDS

All the species of landbirds so far surveyed were negative with the exception of an alone immature house sparrow (*Passer domesticus*) from the inland area and this bird reacted only with TYU virus.

All the species of seabirds were positive with the exception of common cormorant. However, only 3 sera from this species were studied. Herring gull (*Larus argentatus*) was the species exhibiting the highest titers in HI tests for TYU virus and it was the only species reacting with SOL, PI and An 219 viruses.

DEGREE OF MATURITY OF BIRDS

Percentages of positivity in seabirds were also compared following the degree of maturity of birds, when available. It was observed that 88.6% of chick were positive, whereas only 58.2% of adults reacted: the difference was highly significant ($p < 0.001$).

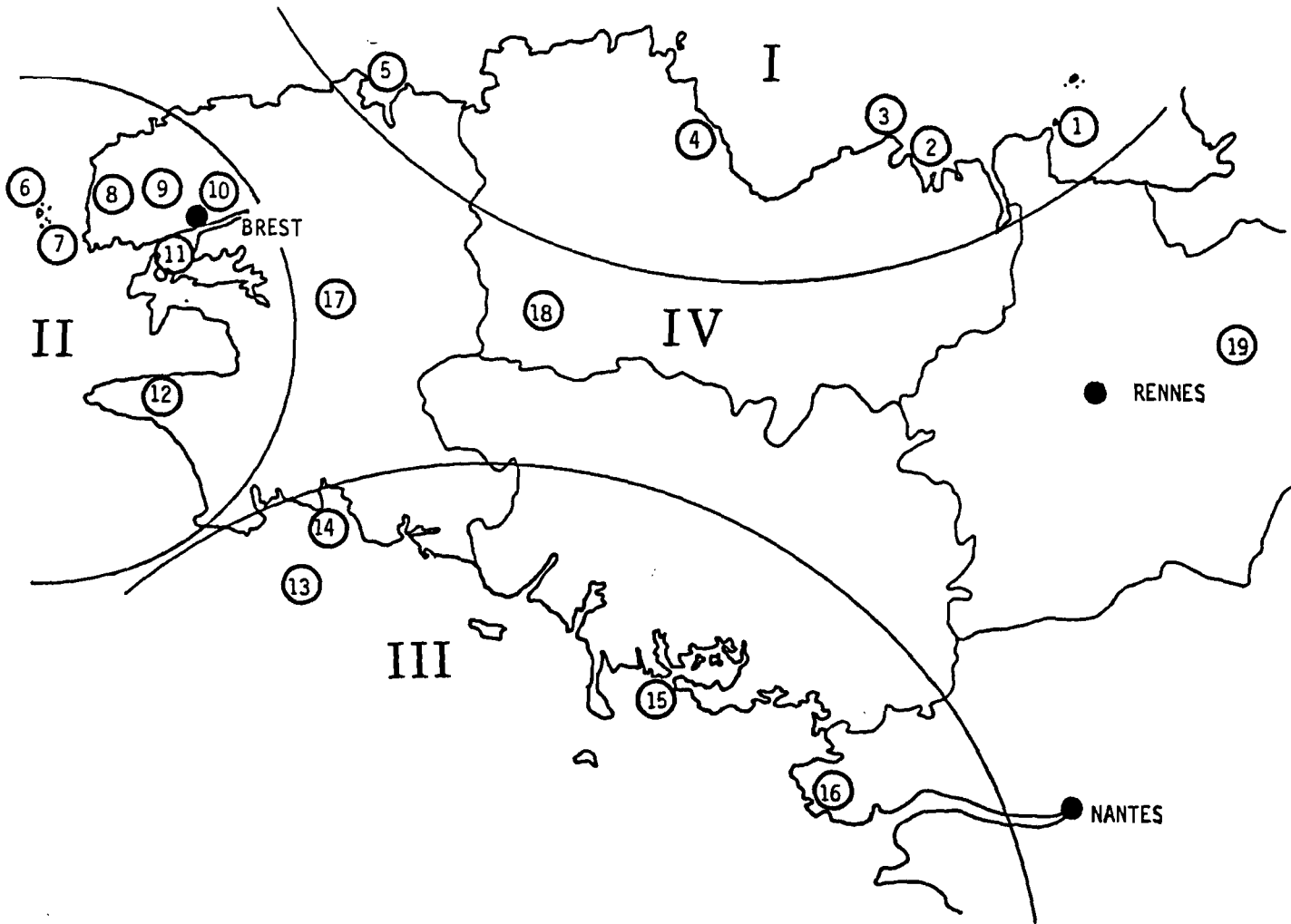
COMMENTS

The highest percentages of positivity and also the highest titers observed in HI tests concerned TYU virus, an tick-borne virus transmitted in nature by *Ixodes uriae* ticks among seabird colonies in the northern hemisphere. This agent was not yet identified in Brittany. Percentages of positivity and HI titers for MEA virus appeared comparatively low in despite the fact MEA virus was isolated recently from *Ornithodoros (A.) maritimus* ticks infesting seabirds in southern Brittany. These results were largely unexpected and deserve further investigations.

Another point of interest was the observation of highest percentages of positivity found in chicks with regard to those of adults. Similar results were previously reported in North American seabird colonies (Yunker, 1975) indicating the natural transovarial transmission of TYU antibody from female birds to their offsprings through the eggs. This observation may have important ecological consequences on the maintenance of tick-borne arboviruses in the colonies of seabirds.

To be published in details in "Bulletin de la Société de Pathologie Exotique", Paris, 1985.

[Chastel C., Le Lay G., Hardy E., Kerdraon G., Virus Laboratory, Brest, France.]
[Guiguen C. and Beaucournu J.C., Medical Entomology, Rennes, France.]
[Monnat J.Y., Zoology, Faculty of Sciences, Brest, France.]



MAP OF BRITTANY

TABLE 1.
Distribution of positive reactions following the geography and the species of birds studied.

Species of bird:	Northern area	Western area	Southern area	Inland	Total	%	Antigens concerned by positive reactions
SEABIRDS:							
<i>Larus argentatus</i>	16/36	50/55	47/71	0/1	113/161	69%	TYU, MEA, SRE, T13, PI, AN229
<i>L. f. graelsii</i>	0/2	6/6	4/13	-	10/21	47%	TYU, MEA, SRE
<i>L. marinus</i>	-	1/1	0/2	-	1/3	-	TYU
<i>L. ridibundus</i>	-	-	-	9/14	9/14	64%	TYU
<i>Rissa tridactyla</i>	-	2/4	2/2	-	4/6	-	TYU
<i>Phalacrocorax aristotelis</i>	4/4	0/1	-	-	4/5	-	TYU
<i>Ph. carbo</i>	0/3	-	-	-	0/3	-	
SUBTOTAL	20/45 44.4%	59/67 88.0%	53/88 60.2%	9/15 60.0%	141/215	65%	
LANDBIRDS:							
<i>Sturnus vulgaris</i>	-	0/66	-	-	0/66	-	
<i>Turdus philomelos</i>	-	-	-	0/1	0/1	-	
<i>T. merula</i>	-	0/1	-	-	0/1	-	
<i>Passer domesticus</i>	-	0/1	-	1/1	1/2	-	TYU
<i>Delichon urbica</i>	0/3	-	-	-	0/3	-	
<i>Rallus aquaticus</i>	-	0/1	-	-	0/1	-	
SUBTOTAL	0/3	0/69	-	1/2	1/74	1.4%	
TOTAL	20/48	59/136	53/88	10/17	142/289	49%	

REPORT FROM WHO COLLABORATING CENTER FOR ARBOVIRUS REFERENCE
AND RESEARCH, INSTITUTE OF VIROLOGY, BRATISLAVA, CZECHOSLOVAKIA

A survey for antibodies to some arboviruses from
the family Togaviridae in human population from
Vietnam

Altogether 240 human sera were tested by the haemagglutination-inhibition (HI) reaction for antibodies to Chikungunya, dengue type 1, type 2, type 3, type 4 and Japanese encephalitis (JE) viruses.

Human sera had antibodies to Chikungunya virus in 26.25 %; the HI titres reached the values ranging from 1:40 up to 1:5120 (Table 1). Haemagglutination-inhibiting antibodies to dengue viruses were found from 17.9 % to 35 %. HI antibodies to JE virus were found in 34.58 % in human population (Table 2). The HI titres reached the values ranging from 1:20 up to 1:1280 (Table 3). The highest positive reactions were found in adults (Table 4).

HI antibodies in human sera from Vietnam indicated possible infections with Chikungunya, dengue and Japanese encephalitis viruses.

(M. Grešíková, M. Sekeyová)

Table 1

Haemagglutination-inhibiting (HI) antibodies to Chikungunya virus in the population of Vietnam

HI antibody titre	No of reacting sera
20	177
40	6
80	9
160	11
320	17
640	11
1280	5
2560	3
5120	1
T o t a l	240

Table 2

Haemagglutination-inhibiting (HI) antibodies to dengue viruses and to Japanese encephalitis virus

HI antibody titre	D 1	D 2	D 3	D 4	JE
10	197	168	156	158	157
20	3	8	11	14	13
40	10	23	26	17	22
80	14	18	22	17	28
160	8	16	12	13	8
320	6	6	10	8	9
640	2	1	2	3	1
1280			1		2
2560					
5120					
% of reacting sera	17.9	30	35	30	34.58

D 1 = Dengue type 1
 D 2 = Dengue type 2
 D 3 = Dengue type 3
 D 4 = Dengue type 4
 JE = Japanese encephalitis

Table 3

Haemagglutination-inhibiting (HI)
titres to dengue viruses

HI antibody titre	Antigens			
	D 1	D 2	D 3	D 4
10	197	168	156	168
20	3	8	11	14
40	20	23	26	17
80	14	18	22	17
160	8	16	12	13
320	6	6	10	8
640	2	1	2	3
1280			1	
T o t a l	240			

Table 4

Prevalence of haemagglutination-inhibiting anti-
bodies to some arboviruses (family Togaviridae)
by age

Age group (years)	No of sera	HI positives				JE	Chikun- gunya
		D 1	D 2	D 3	D 4		
20	47	0	0	14.8	8.5	14.8	0
21-40	100	23	33	37	31	28	33
41-79	93	20	39.7	41.9	38.7	45.1	37.6

D 1 = Dengue type 1
D 2 = Dengue type 2
D 3 = Dengue type 3
D 4 = Dengue type 4
JE = Japanese encephalitis

REPORT FROM COLLABORATING CENTRE FOR ARBOVIRUS REFERENCE
AND RESEARCH BRATISLAVA, CZECHOSLOVAKIA

Serological survey with antigen of haemorrhagic fever
/HFRS/ virus with renal syndrome in small rodents in
Slovakia

Altogether 120 small rodent serum samples were examined for the presence of antibodies to the antigen of HFRS virus in CF and IF tests. Of them, 92 sera were coming from small rodents trapped in Eastern Slovakia, 28 sera from those trapped in Western Slovakia. In sera from Western Slovakia antibodies were detected in *Cl. glareolus*, *A. sylvaticus*, *M. arvalis* and *M. economus* species. Antibodies were detected also in sera from Eastern Slovakia in species of *Cl. glareolus*, *A. agrarius* and *P. subterraneus* /Table 1/. Overall infestation with HFRS virus of small rodents in the localities under study was 8.2 %. The results obtained with two tests, namely CF and IF are considered to be comparable, based on the finding of full correspondence of these two tests in our previous study.

/M. Grešíková, M. Sekeyová, M. Brummer-Korvenkontio,
O. Kožuch, M. Labuda, J. Rajčáni, J. Lysý; Acta virol.,
In press./.

Table 1

Detection of antibodies to HFRS virus antigen in sera
of small rodents trapped in Slovakia

Region investigated	Rodent species	Number of positive/ No of examined animals	Test used
Eastern Slovakia	<i>Cl. glareolus</i>	1/5	CF
	<i>A. agrarius</i>	1/34 ⁺	IF
	<i>M. arvalis</i>	0/5	CF, IF
	<i>P. subterraneus</i>	1/7	CF
	<i>A. flavicollis</i>	0/41 ⁺	IF
Western Slovakia	<i>Cl. glareolus</i>	2/6	IF
	<i>A. sylvaticus</i>	2/18	IF
	<i>M. arvalis</i>	2/2	IF
	<i>M. econemus</i>	1/2	IF
Examined in total		10/120	CF, IF

⁺Sera examined by Dr. Brummer-Korvenkontio

REPORT FROM THE NATIONAL INSTITUTE OF HEALTH, BOGOTA COLOMBIA
DENÇUE ACTIVITY IN COLOMBIA (JANUARY 1981 - MAY 1985)

During the period 1971 - 1982, all four strains of dengue virus have been active in Colombia at one time or another, causing serious epidemics. Conservative estimates show that no less than two million cases of dengue infections occurred during the aforementioned period...

A limited program for surveillance of the disease that started in 1982 has revealed persistence of dengue 1 and 4 during 1982, 1983 and 1984 as well as dengue 2 activity during 1982 and 1983. Table 1 shows the results of attempts at isolation of virus during the period 1981 - 1985, and figure 1 indicates the localities where the viruses were isolated. The results have to be considered only as qualitative, indicating merely that one or more strains were present in a given locality at a given year. However, these isolations, together with clinical and serological evidences indicate either small outbreaks or sporadic cases. For instance, there is evidence that dengue 1 caused small outbreaks in Yopal in 1981, in Palmira in 1983 and in Melgar in 1984; and that dengue 4 produced small epidemics in Valledupar in 1982 and in several localities in 1983 and 1984. On the other hand the sporadic appearance of dengue 2 seems to represent endemicity.

So far no cases of haemorrhagic dengue (DHF and DSS) have been reported but it must be stated that the search for there complications has not been particularly active.

Regarding the vector it should be mentioned that Aedes aegypti, after having reinvaded the country, has established itself not only in its former niches but in a number of new localities, for instance the Amazonian region the Eastern Plains and the Atrato Basin. Moreover, this mosquito which in years prior to 1950 was found only at altitudes lower than 1250 m above sea level, began to be recognized at higher altitudes up to 2200 m and in remote rural areas reached only by horseback. It is resistant to DDT and limited studies in one locality indicate some resistance to the organophosphate fenitrothion.

At present it is presumed that the infested area at altitudes below 1600 m is of 380.000 Km² with 3.2 million houses and a population of 15 million people.

The current funds for the control of Aedes aegypti are limited and allow only for the campaign against the mosquito in five important cities, Barranquilla, Cartagena, Santa Marta, Cucuta and Cali.

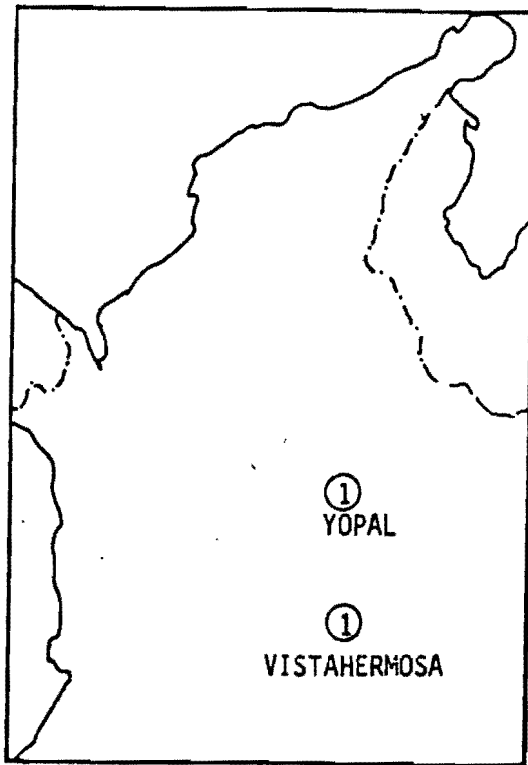
(Report from Hernando Groot and Jorge Boshell).

TABLE 1

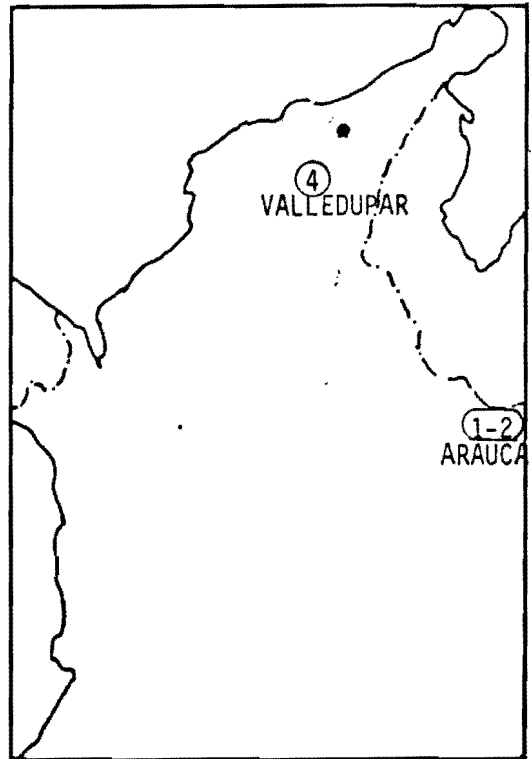
ATTEMPTS AT ISOLATION OF DENGUE VIRUS FROM HUMAN SERA. COLOMBIA 1981 - 1985					
YEAR	NO. OF SERA STUDIED	NUMBER OF DENGUE STRAINS ISOLATED			
		DEN 1	DEN 2	DEN 4	TOTAL
1981	63	4	0	0	4
1982	96	1	1	1	3
1983	95	9 **	3	7	19
1984	105	5	0	3	8
1985 *	61	1	0	0	1

* JANUARY - MAY.

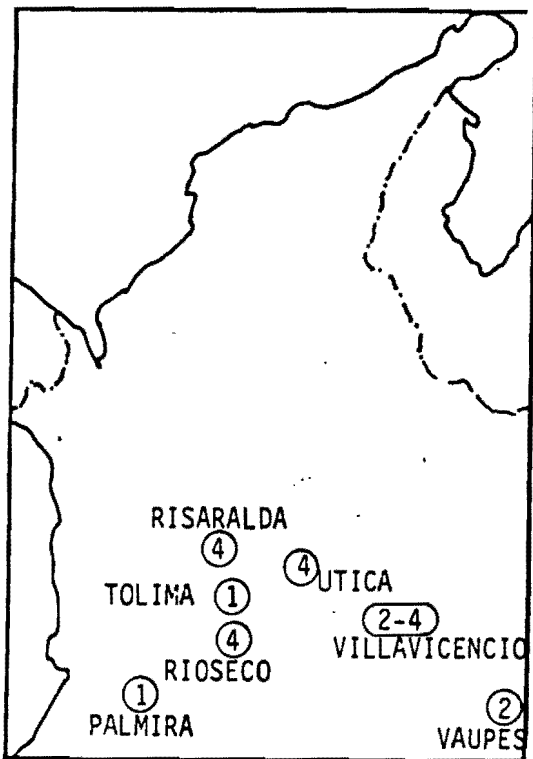
** INCLUDE 8 ISOLATIONS MADE AT THE UNIVERSIDAD DEL VALLE
FROM PATIENTS FROM THE CITY OF PALMIRA.



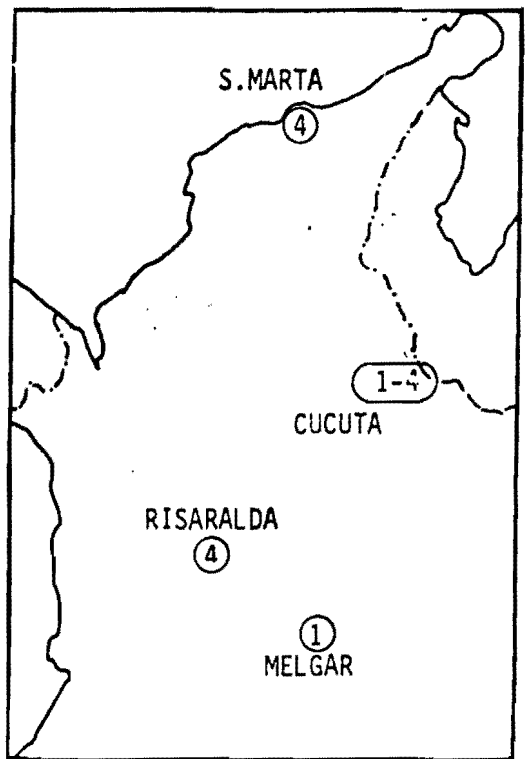
1981



1982



1983



1984

COLOMBIA: LOCALITIES WHERE DENGUE VIRUSES WERE ISOLATED DURING 1981-1984
(In circle: Dengue virus strain)

Figure 1

DETECTION OF GENETIC RELATIONSHIPS OF SOME FLAVIVIRUSES BY DOT BLOT HYBRIDIZATION ANALYSES.

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cDNA-RNA hybridization studies were carried out in order to determine the broad genetic relationship of the four dengue virus serotypes and three Australian flaviviruses (Edge Hill, Kunjin and Stratford). Initial studies were previously reported through the Arbovirus Information Exchange (1) and are published in detail (2,3). Results from these cDNA-RNA hybridization experiments revealed close genetic relationships between dengue serotypes 1 and 4 (about 70% hybridization), 3 and 4 (about 50% hybridization) and dengue type 2 and Edge Hill virus (about 70% hybridization). The genetic relationship between dengue-2 and Edge Hill was also detected by dot blot hybridization analysis with cloned dengue-2 specific DNA fragments. The results of these experiments are described below.

RNA from a dengue-2 virus (strain 16681; Bangkok, 1964) isolated from Thailand (provided by Dr Sutee Yoksan, Mahidol University) was converted to double-stranded DNA by oligo (dT) priming the first cDNA strand followed by synthesis of the second strand using RNase H and DNA polymerase I. This double-stranded DNA was then digested with the restriction enzyme *Sau* 3A and cloned into the *Bam* HI cleaved pUC plasmid vector in order to obtain small inserts suitable for use as specific primers in sequence studies.

About 100 dengue-2 specific clones with inserts ranging from 70 to 1500 bases were obtained. The nucleotide sequences of these clones are being determined and they are also being used to obtain information about the genetic relationships of several flaviviruses, in particular the dengue viruses and Edge Hill virus. The method used to detect the genetic relatedness of some flaviviruses with cloned dengue-2 specific DNA fragments was the dot blot hybridization technique.

About 10 ng of RNA (1 ul volume) from each of the four dengue virus serotypes (prototype strains), three Australian flaviviruses (Edge Hill, Kunjin, Stratford) as well as 100 ng of nucleic acid from the C6/36 cell-line were bound to nylon membranes for use in dot blot hybridization analyses. These dot blots were hybridized with ³²P-labelled (by nick translation) plasmid DNAs containing dengue-2 inserts at 65°C for 16 h. Results of 30 of these dot blots (Table 1) reveal that:

- (a) none of the clones hybridized to the mosquito cell-line C6/36 in which the viruses were grown,
- (b) some clones were dengue-2 specific only,
- (c) many of the clones cross-reacted with some or all of the other dengue virus serotypes, and several of them also hybridized with Edge Hill virus,
- (d) a few of the clones also hybridized weakly with Stratford virus,

(e) no clones hybridized well with Kunjin virus.

This dot blot hybridization technique can therefore be used to detect genetic relationships among flaviviruses with cloned DNA fragments. Sequence studies on the dengue clones which are cross-reactive or dengue-2 specific are underway and these sequences may be useful in understanding the detailed genetic relationship of the flaviviruses and may also prove useful as diagnostic probes for dengue virus infection.

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Table 1. Dot blot hybridization analyses.

DNA clone	Insert size (bp)	³² P-labelled DNA probes						
		RNA used in dot blots (10 ng)						
		Den-1	Den-2	Den-3	Den-4	Edge Hill	Kunjin	Stratford
DV2.1	ca.1000	++	++++	++	++	++	-	+
DV2.2	ca.750	++	++++	-	-	+	-	-
DV2.3	ca.440	+++	++++	++	+	++	-	+
DV2.4	ca.300	+	++++	-	+	+	-	+
DV2.5	ca.300	+	++++	-	++	+	-	-
DV2.6	ca.650	-	++++	-	+	+	-	-
DV2.7	ca.600	+++	++++	++	++	++	-	-
DV2.8	ca.1200	+	++++	+	++	+	-	-
DV2.9	ca.600	+++	++++	++	++	++	-	-
DV2.10	ca.750	-	++++	-	-	-	-	-
DV2.11	ca.400	-	++++	-	-	-	-	-
DV2.12	205	+	++++	+	+	++	-	++
DV2.13	ca.650	+	++++	++	+	+	-	-
DV2.14	ca.430	++	++++	-	-	-	-	-
DV2.15	224	+	++++	-	+	+	-	-
DV2.16	ca.400	+	++++	++	+	+	-	-
DV2.17	ca.600	+	++++	++	++	++	-	-
DV2.18	ca.400	+++	++++	+	+	-	-	-
DV2.19	ca.590	+++	++++	++	+	+	-	-
DV2.20	ca.450	-	++++	-	-	-	-	-
DV2.21	70	+	++++	-	-	-	-	-
DV2.22	127	+	++++	-	-	-	-	-
DV2.23	ca.350	-	++++	-	++	-	-	-
DV2.24	ca.300	-	++++	-	-	++	-	+
DV2.25	ca.320	+	++++	-	-	+	-	-
DV2.26	ca.300	+	++++	-	-	+	-	+
DV2.27	ca.600	+++	++++	++	++	++	-	+
DV2.28	ca.1100	+++	++++	++	++	++	-	++
DV2.29	ca.800	+++	++++	++	+	++	-	+
DV2.30	272	-	++++	-	-	-	-	-

++++ = homologous hybridization
 +++ = strong hybridization
 ++ = medium hybridization
 + = weak/very weak hybridization

Studies with the in vitro feeding of ticks on meals in glass capillaries:

Previously a glass capillary technique was developed in this laboratory for feeding mosquitoes artificially which permitted demonstrating virus transmission capability of infected mosquitoes (Aitken, Mosquito News, 37: 130, 1977).

It was hoped that the above method might be adapted for use with ticks as it was known that Burgdorfer had described a technique for infecting ticks with pathogens involving the use of glass capillaries (J. Infect. Dis., 100:212, 1957). Burgdorfer worked with hard (ixodid) ticks, immobilizing them in plasticine, after which the capillary tip could be inserted readily over the mouthparts, and the tick then proceeded to feed. The method worked in our hands with Amblyomma americanum because an unengorged hard tick is flat, but when it was tried with the soft tick, Ornithodoros moubata, it failed. The tick could not be immobilized because the body is more rounded (3-dimensionally) and mattress- or balloon-like; the tick continually inflated and deflated itself and quickly squirmed loose. The problem was finally resolved by applying the dorsum of the tick to a piece of masking tape which in turn was stuck to a glass slide. From the anterior position, the glass capillary tip was inserted more or less horizontally over the mouthparts (chelicerae and hypostome) of the ventrally-presenting tick; the capillary was then allowed to rest on (or firmed into) a small mound of plasticine. Care was taken to firmly press the capillary tip against the tick otherwise the tick was able to work the capitulum loose.

In this manner 4 female Ornithodoros were exposed to artificial meals. The meal for 2 of the ticks consisted solely of 10% fetal calf serum (FCS) and for the other ticks 10^{-3} adenosine triphosphate (ATP) was added. After one hour, the ticks feeding on the latter meal (ca. 0.02 ml) had almost exhausted it, whereas those ticks deprived of the ATP had barely taken any meal even by 2 hours; when ATP was added to this meal subsequently, the ticks fed more readily.

As in the case of the earlier mosquito studies, such meals exposed to feeding virus-infected ticks could subsequently be assayed for infectivity in a tissue culture system or else inoculated into clean mosquitoes and after a suitable incubation period, processed for infectivity by fluorescent microscopy.

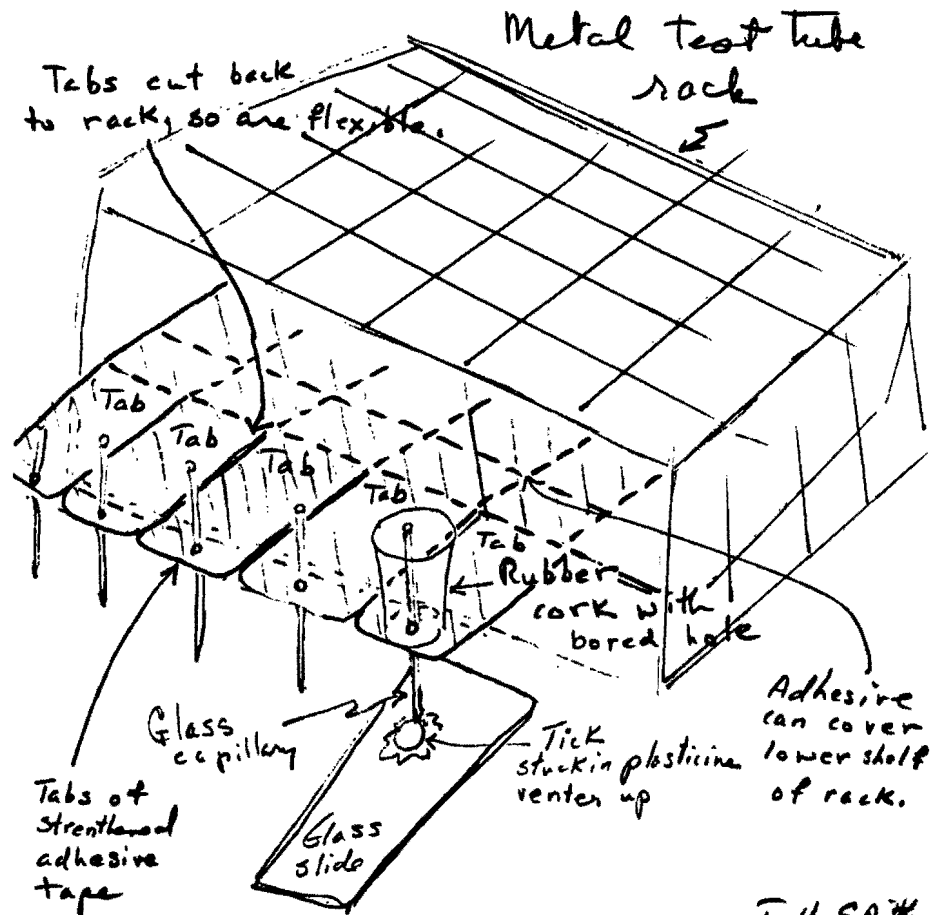
In the course of this study, additional work was done with Amblyomma americanum and the Burgdorfer technique modified. This flat tick was readily immobilized on its back in a small pyramid of plasticine affixed to a glass slide. Capillaries, charged with 0.02 ml of meal (10% FCS in PBS and antibiotics, penicillin and streptomycin), were introduced vertically over the mouthparts of the recumbent tick. Each capillary was held in position by a tab of strengthened adhesive tape projecting from a test tube rack and bearing a small hole which held the capillary in position. To avoid jiggling of the tabs (and thus disconnecting the capillary from the ticks), a small rubber cork (bored) was placed over the capillary and rested on the tab; the cork provided the necessary weight to prevent movement.

(see figure)

Using this technique, 17 Amblyomma females were successfully fed over a period of 2 1/2 hours. Nine ticks imbibed the full amount of the meal (0.02 ml), 4 ticks took 0.015 ml and 4 ticks took 0.01 ml.

It would thus seem that these techniques might well be used in laboratory studies of the transmission of tick-borne viruses.

(Thomas H.G. Aitken and Adam Messer)



Feeding device for hard ticks utilizing glass capillaries and "tabs" for keeping capillaries vertical.

Yellow fever virus studies with nectar meals and mosquitoes:

Female mosquitoes, when not taking blood meals, and males maintain themselves in nature by feeding on flower nectar. One of the spin-off ideas resulting from our 1978 yellow fever (YF) transovarial virus transmission studies was the possibility that infected mosquitoes could contaminate flower nectaries and a subsequent nectar feeder of either sex might acquire an infection. Previous observations covering several years in this laboratory indicated that male mosquitoes are readily infected by feeding on artificial meals containing YF virus; in fact males appear to be more susceptible than female mosquitoes. Furthermore, other studies by us (Beaty and Aitken, Mosq. News 39(2):232, 1979) demonstrate that infected female mosquitoes are capable of *in vitro* transmission of YF virus to artificial meals of 10% fetal calf serum (FCS) and 10% sucrose. Thus the stage was set to try and demonstrate the artificial up-take of virus by male and female mosquitoes feeding on an artificial nectar meal previously exposed to an infected mosquito.

Experiment #1:

Aedes aegypti (Amphur_{F23}) females were inoculated intrathoracically with 20% SMB YF virus (Asibi) titering $10.75 \log_{10}$ TCID₅₀/ml (C6/36 cells). After an incubation period of 17 days at ca. 28°C and 75-90% RH, "donor" females (starved 39 hours) were confined to 19 tubes (2 females per tube) provided with nylon netting on which was placed a drop (0.1 ml) of nectar (10% honey, 10% FCS and 80% buffered water pH 7.5). Exposure to the meal varied from 1 3/4 to 2 hours after which the mosquitoes were removed and subsequently tested for infectivity by direct fluorescent antibody microscopy; all were strongly positive for YF antigen by head squash examination. Most mosquitoes fed to repletion but at least one fed in each tube.

Following withdrawal of the "donor" females, clean "recipient" mosquitoes (2 of each sex) were immediately introduced into each tube and allowed to feed for 15-20 minutes on the contaminated nectar drop. Thereafter the engorged "recipients" were confined to cages to incubate "virus" for 14 days at which time they were harvested and head and abdomen squashes were prepared, stained with specific YF conjugate and examined by FA microscopy. In 13 successful feeding tests of one or more "recipient" mosquitoes, 21 males and 23 females were negative. That is, they failed to produce a demonstrable YF infection after feeding on virus-contaminated nectar.

Experiment #2:

Aedes aegypti (Amphur_{F23}) females were inoculated as above and allowed to incubate virus for 8 days. Thereafter 2 "donor" females each (starved 48 hours) were confined to tubes and allowed to engorge on a nectar droplet for 43 minutes to 1 1/2 hours. Most mosquitoes fed to repletion, but at least one fed in each tube. The "donors" were then removed and all subsequently shown to be infected by head squash. "Recipient"

mosquitoes (2 of each sex) were then introduced into each tube to feed on the nectar droplet for about 40 minutes (Note: about double the time in Exp. #1). Engorging "recipient" mosquitoes were then permitted to incubate "virus" for 21 days (rather than 14 days in the previous experiment) on the chance that small amounts of ingested virus might have a longer time to replicate and be demonstrable. In 33 successful feeding tests, 57 male and 54 female "recipients" proved negative.

An attempt was made to recover all test nectar meals which had not dried. These were inoculated into 6-day old clean Amphur females and held at 30°C for 21 days. Meal recipients varied from 2 to 11 females depending on the size of the inoculated meal. Eight meals were thus tested and 3 were shown to contain YF virus derived from feeding "donor" mosquitoes. The virus recovery rate could well have been greater had the meal-inoculated mosquitoes survived better. Mortality caused by the concentrated honey nectar was high. In any event, virus was surviving in the nectar meal for at least 4-5 hours in the 3 successful instances. There is, thus, still a tenuous possibility that besides transovarial transmission of virus, mosquitoes might acquire virus through nectar feeding and provide a means of virus survival through adverse climatic conditions. Perhaps nectar feeding of an infectious nature might be significant under certain rural epidemiological situations where the virus infection of mosquitoes is concentrated in a small area and there are few flowers as a source of nectar meals (supplemental in the case of haemophilic females).

(Thomas H. G. Aitken, YARU; Barry J. Beaty, Colorado State Univ., Fort Collins; and L. Lorenz, Univ. of Maryland, College Park)

ARBOVIRUS SURVEILLANCE IN CALIFORNIA, 1985 (PRELIMINARY REPORT)
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Following the unprecedented occurrence of epidemic St. Louis encephalitis (SLE) in urban and suburban areas of southern California during 1984, when 26 cases (1 fatal) were confirmed, expanded surveillance efforts and control measures are in effect in this region as well as in the traditional endemic areas of Sacramento, San Joaquin and Imperial Valleys.

Surveillance data include weekly adult mosquito population indices throughout the State, rainfall data; mosquito pools collected for virus isolation attempts; monthly bleedings of 53 chicken flocks for SLE and WEE antibody tests by indirect immunofluorescence; and laboratory tests to confirm suspect equine cases of WEE and human cases of SLE or WEE.

As of August 23, 100 suspect human cases of encephalitis have been screened, but only 1 case has been confirmed as SLE: a 17 year old male from Riverside County with onset July 24 and a complete recovery after hospitalization. However, the 1984 experience was that most cases had onset in September, so intensive surveillance must be continued. Of only 5 suspect cases of encephalitis in equines so far, none have been confirmed as having WEE. Of 2,767 mosquito pools tested, 21 have yielded WEE virus and 9 SLE virus, while 102 yielded other agents (Hart Park, Turlock and 6 CEV). As usual the CEV isolates have been from Aedes melanimon, and all other isolates have been from Culex tarsalis except for 1 SLE isolate from Culex peus in Los Angeles County. There is special interest in monitoring species such as C. peus and the Culex pipiens complex in addition to the traditional vector C. tarsalis, since less is known about their vector capacity and involvement in urban southern California and they might explain the unusual events of 1984. Researchers from the Arbovirus Research Unit, School of Public Health, University of California, Berkeley; the University of California at Los Angeles; local health departments; various local Mosquito Abatement Agencies; and the California Department of Health Services' Vector Surveillance and Control Branch are assisting in these expanded ecologic studies. As usual, rapid direct immunofluorescence staining of suckling mouse brain slip smears or BHK-0853 (hamster kidney line) cell culture preparations is used to identify viral isolates quickly. A comparative study of cell culture vs. suckling mice is being done to see if the former could be an adequate substitute in our routine surveillance program.

Of 3,442 chickens sampled from the 53 sentinel flocks since May, 33 have seroconverted for SLE antibody, and 10 for WEE antibody, all in traditionally endemic areas of Imperial and San Bernardino Counties.

The next 2 months of surveillance should help to show if the events of 1984 were unique or if a more permanent change in arbovirus ecology in urban and suburban southern California has occurred.

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ARBOVIRUS SURVEILLANCE

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The occurrence of epidemic St. Louis encephalitis (SLE), with 26 documented cases, 1 fatal, in heavily populated southern California urban and suburban areas during the summer and fall of 1984, added a new chapter to the long and continuing saga of mosquito-borne diseases in California. In prior years only rare, sporadic cases had been documented outside of the Sacramento, San Joaquin, and Imperial Valley regions. In 1985 expanded studies and programs to determine the specific mosquito vectors, to implement mosquito control, and to detect and prevent cases of SLE and western equine encephalomyelitis (WEE), the two commonest diseases transmitted to man by mosquito bite in California, were established for this newly recognized endemic area. Fortunately, during 1985 only 3 cases of SLE were documented: (1) a 17 year old boy from Lake Elsinore, Riverside County; (2) a 31 year old man from Needles, San Bernardino County; and (3) a 61 year old woman from the North Hollywood area of Los Angeles County. All 3 recovered. There were no laboratory-confirmed cases of WEE in humans or horses during the year.

Tests for viruses in mosquito pools and monthly bleedings of sentinel chicken flocks at 55 sites throughout the state again indicated significant SLE and WEE viral activity only in the Imperial Valley and southern California area, as occurred in 1984. A total of 4,417 mosquito pools were tested, 1,348 more than in 1984. The majority of these pools were comprised of Culex tarsalis, as usual (3,197 pools, 72.4% of the total), but attempts were also made to include Culex pipiens complex (15.5%), Aedes melanimon (5.5%) and Culex peus (3.6%) in greater numbers than in previous years. Viruses isolated from the pools included: 30 SLE, 28 WEE, 18 CE group, 48 Turlock, 122 Hart Park, and 2 Main Drain -- 248 isolates altogether. As usual, nearly all the isolates came from Culex tarsalis, except for 15 CE isolates from A. melanimon, 1 Turlock and 2 Hart Park from C. pipiens complex, 1 Turlock from C. erythrothorax, 2 Main Drain from Aedes taeniorhynchus, and 1 SLE isolate from a pool of C. peus in Encino, Los Angeles County -- a finding of special interest.

There were 5,819 serum samples taken from chickens in the 55 sentinel flocks (10 more flocks than in 1984) which were bled monthly from May through October. The only seroconversions for WEE or SLE antibodies occurred in 6 flocks at southern California sites.

In summary, the surveillance program in 1985, as in 1983 and 1984, confirmed the occurrence of SLE and WEE viral activity along the Colorado River and in southern California urban and suburban areas not previously known to be endemic areas, where the potential for a major outbreak in heavily populated areas exists.

Several mosquito species which are efficient vectors of SLE and WEE viruses can breed extensively in storm drains, gutters, neglected swimming pools, marshes, and other water sources in or near urban areas, as well as in the usual rural water sources. Control of mosquito breeding is more difficult in urban settings. It will be important again during the summer of 1986 to maintain a high index of suspicion for human SLE and WEE cases and for equine WEE cases. Continued surveillance and study of the ecology of viral persistence in these areas, and the means for mosquito control and encephalitis prevention, are essential.

MAC-ELISA FOR DIAGNOSIS OF ROCIO ENCEPHALITIS

Sera from 75 patients with clinical encephalitis in 1975 and 1976, during an epidemic in Ribeira Valley, State of São Paulo, Brazil, were tested with an immunoglobulin M (IgM) antibody capture enzyme immunoassay (MAC ELISA). Of the 75 patients 23 presented serological results indicative of acute infection by Rocio virus (haemagglutination inhibition and complement fixation tests of paired sera), 48 presented inconclusive serological results, most of them because only single serum sample was available, and 4 presented sera non reagent to Rocio, Ilhéus, St. Louis encephalitis and yellow fever flavivirus.

In the development of the immunoenzymatic test, polystyrene plates were coated with goat anti-human IgM and was incubated successively with sera from patients at 1/10 and 1/100 dilutions, with antigens of Rocio, Ilhéus and St. Louis encephalitis virus, prepared as sucrose acetone extracts of infected suckling mouse brains, obtained from Division of Vector-Borne Viral Diseases reference collection, with flavivirus group-reactive monoclonal antibody conjugated to alkaline phosphatase (gift from John Roehrig, Division of Vector-Borne Viral Diseases) and with p-nitrophenyl phosphate. The reaction, stopped by the addition of 3N NaOH, was evaluated espectrophotometrically at 410 nm on a Dynatech Minireader. Controls of negative and positive sera, PBS and conjugate were included in all the tests.

The results were standardized assuming as reference the mean absorbance value of positive control. A P/N ratio $\geq 2,0$ was considered positive (P = absorbance value of test serum, dilution 1/100; N = mean absorbance value of corresponding dilution of negative control).

To ascertain the possible presence of non specific IgM antibodies, 35 positive sera by ELISA were tested once more after absorbed with heat-aggregated gamma globulin, according to procedures by Camargo et al. (1972).

Positive results were obtained with MAC ELISA in the 23 patients with confirmed diagnosis (2 positive sera samples in 20 patients and one positive sample in 3) and 85,4% (41/48) of the patients with inconclusive results by IH and CF tests. In the 4 non reagent sera ELISA was negative.

The presence of false positives in MAC ELISA by interference of the rheumatoid factor was observed in only 2,9% (1/35) of the sera researched.

Significant variation in the ELISA value of paired serum samples, a critical ratio $\geq 1,3$ as described by Monath et al. (1984), was observed on 72% (18/25) with higher frequency for MAC ELISA than for IH and CF tests .

MAC ELISA seems very useful on Rocio encephalitis surveillance as only 11,25% (9/80) of patients from Ribeira Valley, during the period from 1978 to 1983, had available paired serum samples (Iversson & Lisieux, 1984).

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(IVERSSON, L.B.; COIMBRA, T.L.M.; NASSAR, E.S. & FERREIRA, I.B.)

Serological diagnosis of DHF in Thailand 1984

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To be published in the Bulletin of Department of Medical Sciences.

In 1984, the reported cases of DHF from division of epidemiology in the surveillance program were 63,037 cases with 392 deaths. The blood samples were sent to confirm the clinical diagnosis and evaluation for surveillance at VRI 69 provinces with 6,983 cases. Six thousand seven hundred and twenty seven cases of proper blood sample which were 10.7% of reported cases were examined by HI method followed by Clarke and Casals using Dengue type 2,4 and Chikungunya antigen and concluded with WHO guidelines.

The results were Dengue infection 69.2%, Chikungunya infection 2.2%, negative 21.3% and inconclusive 7.3%. Most of the patient cases were in the age group 5-9, 10-14 and 1-4 year old. The ratio of patients in male and female were 1:1.02. From DHF clinical diagnosis were confirmed real dengue infection 72.8% and Chikungunya infection 3.3%. In the cases of dengue infection confirmed were 4.4% of primary infection and less than one year age group. During June to July had highest reported and confirmed cases. North-east region found 73.1% of dengue infection. Next were Central, North and South region which showed 68.2%, 64.8% and 56.5% respectively.

JE surveillance in Thailand 1984

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To be published in the Bulletin of Department of Medical Sciences.

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During the year 1984, there were 1,576 cases with 169 deaths of encephalitis were reported by division of epidemiology, Ministry of Public Health. VRI received 407 serum specimens from JE suspected cases all over the country. For laboratory confirmation, all specimens were examined by HI test using microtiter technique against JaGAR#01, Den-2, Den-4 and were also tested by JE MAC ELISA follow by Donald S. Burke, AFRIM, Bangkok.

It was found that 25.4% of these specimens were positive and indicated that 97% of positive cases had been previously infected by flavivirus. The patients were children more than adult and the peak of age group was 5-9 years. The ratio of positive in male and female was 1.9 to 1. There were confirmed specimens all years round and showed the peak in June and July.

Comparison between Haemolysis in Gel (HIG) and Haemagglutination Inhibitor (HI) Test for Serodiagnosis of Dengue Haemorrhagic Fever (DHF).

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To be published in the Bulletin of Department of Medical Sciences.

Haemolysis in gel (HIG) is one of several techniques for serodiagnosis which has been recommended by the World Health Organization. This method was standardized in our laboratory and compared with the HI test for the determination of antibodies to dengue virus type 2,4 and Japanese encephalitis (JE) in 100 cases of suspected dengue patients. HIG could be used for the determination of antibodies for the diagnosis of DHF in a similar manner as HI test. 74% of positive cases including 5% primary and 69% secondary infections were found by HI test while 66% of the positive cases with 4% primary and 62% secondary infections were given by HIG method. Both HI and HIG methods had the result of dengue high cross reaction between dengue virus type 2 and 4. However, HIG technique could demonstrate a higher specificity than HI test to differentiate between dengue virus antibodies and those against JE according to 71% positive cases in JE by HI test but only 26% by HIG test in these dengue patients' sera. Other than this, HIG test seems to be a good step forward in untreated and undiluted sera before testing, unlike HI test. So this test should be suitable for sero-epidemiological study of arbovirus group.

APPLICATION OF FORMALINIZED GOOSE RED BLOOD CELLS
TO ARBOVIRUS HEMAGGLUTINATION (HA) AND
HEMAGGLUTINATION-INHIBITION (HI) TEST.

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Interim Report 4, Promotion of Provincial Health Services,
April 1983.

Arbovirus HA and HI test were effectively simplified by substitution of formalinized goose red blood cells (FGRBC) for fresh goose red blood cells. Compared to fresh goose red blood cells, FGRBC agglutinated with Japanese encephalitis (JE) and Dengue virus HA antigens over a wider range of pH and agglutinated with Dengue virus type 1 and type 4 HA antigen at double the titer. Comparative HI assay of human sera, using fresh and FGRBC with arbovirus antigens, showed that antibody titers were the same, or within one dilution of each other, that is, FGRBC could be used for routine diagnostic or epidemiological HI tests instead of fresh goose red blood cells which are rather troublesome to prepare and impossible to keep for a long time.

-
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 3. Japanese Expert in Virology, dispatched from Central Research Division, Takeda Chemical Industries, Ltd. Japan.

This study was supported partly by Japan International Cooperation Agency's fund.

Short report

The epidemic of DHF in Payao Province, Thailand.

The epidemic of Dengue Hemorrhagic Fever (DHF) occurred at Payao Province, northern part of Thailand in May 1985. The Virus Research Institute collected 24 sera from patients for virus isolation.

Seven sera were isolated in mosquito cell line C6/36 and identified by plaque reduction neutralization test which 3 of them were Dengue type-2, and 4 were Dengue type-4.

Thirteen sera were examined by hemagglutination inhibition test. Eight sera could be confirmed for dengue infection which 3 of them were primary, and 5 of them were secondary infection.

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Monoclonal antibodies to tick-borne encephalitis virus.

Two types of monoclonal antibodies (MA) of KEN and NEK series prepared to tick-borne encephalitis (TBE) virus differed in the spectrum of their reactivity in serological tests and ability to react with individual representatives of the TBE complex.

The KEN series of MA were induced to the 4072 strain of TBE virus isolated from the blood of a patient in the USSR. The NEK series of MA were directed to the Skalica strain isolated from bank vole in Czechoslovakia.

Different modes of immunization of BALB/c mice - donors of immune splenocytes - were employed to prepare KEN and NEK hybridoma secreting antibody to strain 4072 and Skalica respectively. The former were immunized with crude 10% suckling mice brain suspension, the latter by immunization with virus grown in chick embryo fibroblasts and purified by ultracentrifugation in sucrose density gradient. NSO lymphoblastoma cells were used for hybridization. Screening of antibody secreting hybridoma cells was carried out in IF.

Two clones of hybridomas producing MA to either virus strain were further studied: KEN-46-8 and KEN-6-4 to the 4072 strain; NEK-9-4 and NEK-12-4 to the Skalica strain.

Either hybridoma cells easily multiplied in peritoneal cavity of BALB/c mice, pretreated with Pristane (Sigma , U.S.A.). $1 - 2 \times 10^7$ hybridoma cells were injected via ip route . Ascitic fluid containing MA was tapped on 8 - 10 day.

Both groups of MA belonged to IgG class; they were highly reactive in IF and EIA, but they had no HI properties. MA of the NEK series reacted in CF test, but MA of the KEN series did not.

KEN MA neutralized TBE virus, whereas the neutralization with NEK antibodies was observed irregularly (Table 1) and was probably due to antibody related steric hindrance effect .

Neither KEN nor NEK monoclonal antibodies reacted with flaviviruses other than TBE complex. NEK antibodies reacted in IF and CF with TBE, OHF, Langat TP-21, KFD, Louping ill, and Negishi viruses, but did not with Powassan virus. KEN MA could differentiate Powassan, Langat TP-21 viruses and Skalica strain from the other members of the TBE complex (Table 2).

(S. Ya. Gaidamovich, M. Grešikova)

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Table 1. Reactivity of NEK and KEN MA with the TBE complex viruses in IF and CF tests .

Viruses, Strains	NEK-9-4		KEN-12-4		KEN-46-8	KEN-6-4	IAF
	IF	CF	IF	CF	IF	IF	CF
TBE Sofjin	2560	320	1280	320	2560	1280	320
TBE 4072	2560	640	1280	320	2560	1280	640
TBE Absettarov	5120	640	1280	320	1280	1280	320
TBE Skalica	1280	320	640	640	≤10	≤10	640
Negishi	640	640	320	320	160	160	640
OHF	320	640	320	ND	160	320	320
Langat TP-21	320	320	320	320	≤10	<10	160
KED	640	80	320	ND	80	ND	ND
Louping ill	640	320	640	640	320	320	160
Powassan	10	10	10	10	≤10	≤10	40

Note : IAF - polyclonal immune ascitic fluid to the homologous virus.

ND - not done.

Table 2 . Serological activity of MA in ascitic fluids in IF, CF, HI, EIA and virus neutralization test with to 4072 strain.

MA	IF	CF	IH	EIA	virus neutral. Index in log
NEK-9-4	2560*	640	≤ 10	500 000	2,0 - 2,5 **
NEK-12-4	1280	320	≤ 10	ND	2,0 - 2,5 **
KEN-46-8	2560	< 10	≤ 10	500 000	3,0 - 3,5
KEN-6-4	1280	< 10	≤ 10	ND	3,0

Notice : * - titres expressed as dilution reciprocals;

** - irregular results;

ND - not done .

ARBOVIRUS ISOLATIONS IN SWEDEN

Investigations on the ecology of Ockelbo disease, presumed to be caused by Sindbis virus, were carried out during 1983 in the Sassman area near Edsbyn, Sweden. A total of 266 pools of 11 154 female and 2 179 male mosquitoes, collected from March to October with animal-baited traps, UV-light traps, and from humans, cattle-sheds and overwintering sites, were processed for virus isolation attempts.

Sindbis virus was isolated from 2 pools of nonengorged females. One of the pools consisted of 50 Culex pipiens* L. and the other of 24 Culiseta morsitans (Theob.) collected between 20 July and 3 August. Sera from the sentinel bait animals (2 domestic rabbits, 2 guinea pigs, 2 bantam hens, 2 domestic doves) were drawn at 2-week intervals from May through September. Sindbis virus neutralizing antibodies were present in one of the doves from early or midAugust. These results strengthen the hypothesis that Sindbis virus circulates in a sylvatic cycle involving ornithophilous culicines and birds.

Inkoo virus (California serogroup), previously only known from Finland, was isolated from one pool of 100 nonengorged Aedes communis (DeGeer) females collected between 21 June and 5 July. The high prevalence of Inkoo virus neutralizing antibodies detected in human sera indicates that this virus is widely distributed in Sweden.

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*pipiens L./torrentium Martini

1. Titer Distribution Analysis of Chikungunya Virus in Aedes albopictus Mosquitoes

The growth of chikungunya virus was compared in strains of Aedes albopictus from Oahu, Hawaii, and Hyogo, Japan, after feeding on a blood-virus mixture with a titer of ca. 10^5 PFU per mosquito. Determination of virus quantities in individual Oahu mosquitoes indicated rapid virus multiplication and appearance of high-titered mosquitoes mainly in the early phase of infection, followed by separation into the unsusceptible ($<10^1$ PFU), moderately susceptible (10^3 - 10^4 PFU), and highly susceptible (10^6 - 10^7 PFU) groups 14 days after feeding. In contrast, only 2 of 58 Hyogo mosquitoes at day 14 showed virus titers over 10^4 PFU. A trimodal pattern of titer distribution was consistently observed at day 14 in Oahu mosquitoes, but not when these mosquitoes were maintained for 21 or 28 days. Despite a similar course of digestion and excretion for blood ingested by Oahu and Hyogo mosquitoes, the Hyogo strain was fundamentally different in virus retention. In this strain the infection rate decreased to 40-50% at day 2 and remained unchanged up to day 14, while all Oahu mosquitoes retained the virus up to day 7 and ca. 30% of the sample became uninfected between days 7 and 14.

(This study was performed by E. Konishi and H. Yamanishi)

2. Detection of Chikungunya Virus Antigen in Aedes albopictus Mosquitoes by Enzyme-linked Immunosorbent Assay

Double-antibody sandwich and modified sandwich systems of enzyme-linked immunosorbent assay for detecting chikungunya virus antigen present in female mosquitoes, Aedes albopictus (Oahu strain), were evaluated as simple and rapid methods of selection of a highly susceptible mosquito line. Both assays were capable of detecting 3.9×10^1 ng (4.0×10^6 PFU) or more of the purified antigen. An inhibition system was less sensitive, and a direct system with adsorption of test specimens on the solid phase was not useful. Positive reactions were observed in 16 (48.5%) of 33 infected mosquitoes with 10^6 to 10^7 PFU, which correspond to the highly susceptible group of this strain. Mosquitoes with less than 10^6 PFU were all negative, indicating the usefulness of the sandwich techniques for identifying high-titered mosquitoes.

(This study was performed by E. Konishi and J. Takahashi)
(Reported by T. Matsumura)

Goat serum: a possible substitute for fetal calf serum in the XL-2 cell line.

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The search for a substitute of fetal calf serum (FCS) as supplement for culture media for cell line work has carried out by several researchers and commercial firms but not all of the substitutes have given satisfactory results; some, due to nonspecific inhibitors of viral multiplication and others which do not favour cellular growth (1).

Due to the low cost in production and maintenance of animals we have begun to test goat serum as nutrient in growth and maintenance media of several cell lines accustomed to FCS.

Goat serum was obtained following the same system for donor calf serum without sacrificing the animals. After pooling, the serum was sterilized by nitrate cellulose membrane filtration (0,2 μ m) and inactivated at 56°C for 30 minutes.

The first cell line with satisfactory results was the XL-2 which is normally grown in L-15 media with 10% TPB supplemented with 10% fetal calf serum.

After one pass with 5% FCS and 5% goat serum there was no difference observed when compared to control cultures supplemented totally with FCS. We then passed the line directly to GS. After 13 passes with GS as the only supplement to the medium no differences in growth were observed in the morphology of the cells. Cells have been frozen in presence of 10% of GS and were kept in nitrogen by 2 months. Then they were thawed and the viability was higher than 95%.

The XL-2 cell line adapted to GS still maintain viral sensitivity to Western Equine Encephalitis (WEE) producing the same effect at the same time and with similar viral titres as compared to the FCS system.

At present we are adapting other cell lines to GS in place of FCS and testing different viruses in these cells.

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"THE USE OF ULTROSER-G IN AN INSECT CELL LINE"

Lic. Morier, L. and Lic. Alemán, M.R.

The first insect cell line was established by Grace in 1962 and in 1966 the same author set up a second insect cell line. Both were maintained in Grace's medium containing insect haemolymph (1). Yunker et. al. (1967) successfully adapted the first cell line to a medium containing foetal bovine serum instead of the haemolymph (2). In 1969 Mitsuhashi and Grace (1969) adapted two insect cell lines to media with foetal calf serum (3). This undoubtedly represents a major step in tissue culture methods and its application to virology (4).

Foetal bovine serum is a mixture of complex proteins and biomolecules and some of these components are necessary for "in vitro" cell growth although as others are not necessary (5). ULTROSER-G produced by IBF-LKB has been developed as a substitute for foetal bovine sera and has been used as a supplement in the media used for the maintenance of many continuous cell lines with good results. Nonetheless, the insect cell lines tested up to now have not grown in media containing ULTROSER-G (6).

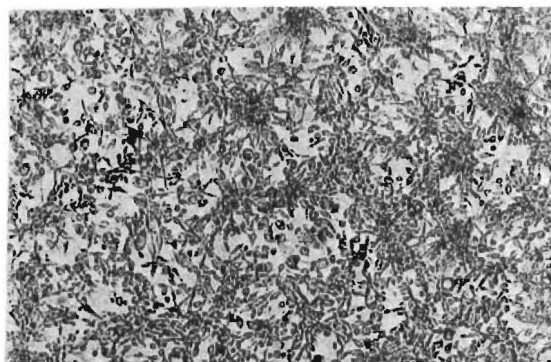
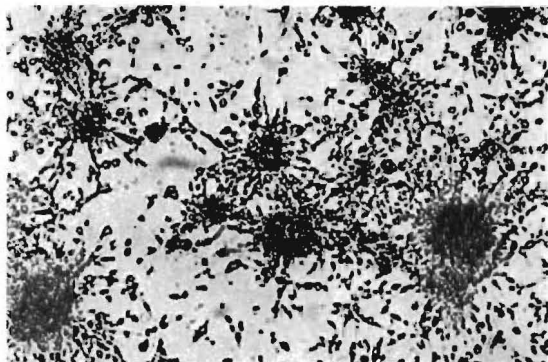
The TRA-284 SFG (Toxorhynchites amboinensis) cell line in our laboratory, kindly donated by Dr. Goro Kuno (C.D.C. San Juan Laboratory) has been maintained in serum free medium by splitting 1:3 weekly. These cells are confluent after 3, 4 or more days with cha-

...2/

racteristic large clumps. The monolayer of these cells are porous with small intercellular spaces. They also grow and adhere well to plastic flasks.

By adding 2% of ULTROSER-G to their media split time was increased to 1:8 weekly and the monolayer was less porous, more homogenous and no clumps were observed. Also the monolayer was complete by 48 hours. In addition these cells grow and adhere well to plastic.

We tried to adapt the C6/36 clone (Aedes albopictus) in the same way using different concentrations of ULTROSER-G with no success.



Without ULTROSER-G

With 2% ULTROSER-G

TRA-284 SFG (48 hours post-seed)

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IDENTIFICATION BY INDIRECT IMMUNOFLUORESCENCE ASSAY (IFA)
OF VARIOUS DENGUE STRAINS FROM NICARAGUA, 1985.

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The successful combination of mosquito cell cultures for dengue virus replication and the use of monoclonal antibodies for identification of the 4 serotypes forming this viral complex, have made possible a qualitative transition in respect to the techniques used for isolation and identification of these viruses. As a result of the abovementioned technological advances, the immunofluorescence technique has been widely used in the last few years for identification of the 4 dengue serotypes (1-7).

Since the beginning of the year 1985, our laboratory has been receiving specimens from Nicaragua in order to study the situation existing in that country in relation to dengue virus.

Isolates obtained from these specimens were identified by IFA using hyperimmune ascitic fluids and monoclonal antibodies.

Of the 26 strains identified in this work, 18 correspond to dengue 1 and 8 to dengue 2. The 1 Dengue 1 strains were isolated in C6/36 mosquito cells and identified by using serial dilutions of hyperimmune ascitic fluids. The 8 Dengue 2 strains were isolated by intracerebral inoculation of suckling mice and identified by using monoclonal antibodies.

It attracted the attention that monoclonal antibodies were not able to recognize the virus when it was present in the C6/36 mosquito cells. In the cases, identification had to be done by using serial dilutions of hyperimmune ascitic fluids prepared against the 4 dengue serotypes. It has been confirmed several times that monoclonal antibodies, although prepared for high passages of prototype strains of different dengue virus serotypes, are capable of recognizing low-passage strains (2-7). In addition, the present study shows that 8 type 2 dengue virus strains, also of low passage, were readily identified by using monoclonal antibodies. Thus, the difficulty for identification in these cases appears to have been caused by factors other than the action of such antibodies.

Another element of the identification system of our study is the C6/36 mosquito cell line. Similarly to what has occurred in other laboratories (5), it is possible that a selection of a subpopulation of C6/36 cells characterized by their low sensitivity to dengue virus had taken place in our laboratory. This might explain why monoclonal antibodies reaching this cellular system were not able to binding with the viral antigen present in a very low concentration, as a result of which, immunofluorescence was not observed and identification by this method impossible.

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Arbovirus Serological Studies in Human Population from Two Municipalities of Havana City, Cuba.

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A serological study is done in two municipalities from Havana City Province. During the first phase, 275 human sera were studied by Haemagglutination Inhibition (HI) against Eastern Equine Encephalitis (EEE), Western Equine Encephalitis (WEE) and St. Louis Encephalitis (SLE) viruses.

Tables 1 and 2 show results obtained as to: % of positivity and antibody titers to antigens studied.

T A B L E 1

% OF POSITIVITY TO EEE, WEE AND SLE VIRUSES IN TWO MUNICIPALITIES FROM HAVANA CITY . 1986.

EEE			WEE			SLE		
No.	+	%	No.	+	%	No.	+	%
275	37	13,45	275	-	-	275	85	30,9

T A B L E 2

ANTYBODY TITERS AGAINST EEE, WEE AND SLE, AS DEMONSTRATED IN SERA STUDIED
IN HAVANA CITY'S MUNICIPALITIES. 1986.

ARBOVIRUS TITER	1:20	1:40	1:80	1:160	TOTAL
EEE	37	-	-	-	37
WEE	-	-	-	-	-
SLE	79	4	-	2	85
TOTAL	116	4	-	2	122

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Serologic diagnosis of Dengue-2 virus by means of Complement Fixation (CF) Hemagglutination Inhibition (HI) and ELISA.

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Using Complement Fixation (CF), Hemagglutination Inhibition (HI) and ELISA, 33 pairs of sera obtained from patients with clinical diagnosis of Dengue from the DHF outbreak in Cuba in 1981 were studied.

The assays were carried out using the Dengue-2 virus antigen (New Guinea) obtained from infected suckling mice brains.

The results of ELISA in relation to the HI and CF Tests were compared and are presented in Tables 1 and 2. In both cases a higher number of positive cases are observed in ELISA in relation to HI (27/19) and CF (27/18).

The results with all three tests were simultaneously analysed, and the percentage of coincidence for negative and positive samples was 63,63% as shown in Table 3.

The total positive samples in ELISA in relation to the positive samples by HI and/or CF gave a ratio of 27/21 (128%) of confirmed serologic diagnosis by ELISA in comparison to the other 2 tests in the group studied, thus demonstrating a higher sensitivity with ELISA.

Studies using Dengue-1 antigen (Hawaii strain) were performed in parallel with similar results, finding no diagnostic differences between both serotypes.

Table 1: Positive and Negative distribution by ELISA and HI.
Serologic diagnosis in paired sera.

		ELISA		
		+	-	T
H	+	19	0	19
	-	8	6	14
T		27	6	33

Table 2: Positive and Negative distribution by ELISA and CF.
Serologic diagnosis in paired sera.

		ELISA		
		+	-	T
C	+	17	1	18
	-	10	5	15
T		27	6	33

Table 3: Coincidence among 3 tests studied.

CF+/ELISA+/HI+ =	16/33 =	48,48%	63,63%
CF-/ELISA-/HI- =	5/33 =	15,15%	
CF-/ELISA+/HI- =	7/33 =	21,21%	
CF-/ELISA+/HI+ =	3/33 =	9,09%	
CF+/ELISA-/HI- =	1/33 =	3,03%	
CF+/ELISA+/HI- =	1/33 =	3,03%	
CF+/ELISA-/HI+ =	0/33 =	0%	
CF-/ELISA-/HI+ =	0/33 =	0%	

IS SEQUENTIAL INFECTION A RISK FACTOR FOR DHF/DSS?

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In order to know if sequential infection was a risk factor for the development of DHF/DSS we studied the frequency of haemagglutination inhibition (HI) and neutralizing (NT) antibodies to dengue virus types 1 and 2 in 3 groups of patients clinically diagnosed as DHF.

The first group (1) was composed by 103 patients (children and adults) admitted to hospital with a clinical diagnosis of DHF, grades II and III (according to the Technical Advisory Committee for DHF/DSS) (2) which was serologically confirmed by the study of paired sera, using the haemagglutination inhibition technique. Of these patients, 5 (5%) were primary infections and 98 (95%) were secondary infections (Table I); 91% of this last group had, some hemorrhagic manifestation; 20 patients presented shock and among these only one suffered a primary infection (1).

The second group consisted of 127 children under 14 years of age admitted to hospital with DSS (grades III and IV), and the third of 105 adults with DHF (grades II and III); neutralizing antibodies were determined in all patients.

As demonstrated in Table I only 2 (1,5%) children with

DSS were primary infections and 125 were secondary infections. Two of the 104 adults were primary infections (2%) and 102 (98%) secondary infections.

Rosen (3) stated that the 1981 epidemic of DHF in Cuba, offers a unique opportunity to solve the problem of the risk of sequential infection. He pointed out that "it should be relatively simple, even in retrospect to compare the prevalence of primary and secondary antibody responses in the surviving DSS patients, with what would have been expected on the basis of the proportion of the population previously known to have been infected with dengue type 1 in 1977"

Considering that in 1978, 44,46% of the urban population was immune to Dengue 1 (4) it should be expected that in the studied groups no more than this percentage were cases of secondary infection, if sequential infection were not a risk factor for DHF.

In the three groups of seriously ill patients (both children and adults), the percentages of cases of secondary infections were between 95 and 98,5%, which are highly significant figures in relation to the percentage of possible cases of secondary infection expected in the population.

These data support the fact that sequential infection acts as a risk factor for the development of DHF/DSS.

TABLE I: TYPE OF INFECTION IN THE 3 GROUPS STUDIED OF PATIENTS WITH DHF/DSS

	GROUP I*		GROUP II**		GROUP III**	
	No.	%	No.	%	No.	%
Primary Infection	5	(5)	2	(1,5)	2	(2)
Secondary Infection	98	(95)	125	(98,5)	102	(98)
TOTAL=	103		127		104	

* Detection of IH antibodies.

** Detection of Nt antibodies.

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LABORATORY REMARKS ABOUT DENGUE VIRUSES ISOLATED DURING THE RECENT OUTBREAK OF DENGUE IN NICARAGUA.

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During the years 1981, 1982 and 1983, serological studies were done on persons from different areas of Nicaragua in order to determine haemagglutination-inhibition antibodies to dengue viruses. These studies resulted in relatively low figures (3-10%) of positivity, mainly in adults.

In 1985, a dengue epidemic occurred in the country, the etiological diagnosis of which was done at IPK.

During the two epidemic peaks (March and August), 147 paired sera and 95 monosera were processed. As a result of this, seroconversion to dengue virus (IH) was observed in 34 patients (23%), while antibody titers 1:80 were seen in 20 monosera (21%). Fifteen cases were classified as secondary type infection (all over age 35). The presence of neutralizing antibodies to serotype 1 was demonstrated in several specimens. Likewise, specific IgM antibodies to type 1 dengue virus were demonstrated in convalescent-phase serum from two cases.

One hundred and sixty six (166) specimens of acute-phase sera, inoculated into C636 cells (Aedes albopictus) and suckling mice, were processed for determination of the etiological agent. Isolated strains were identified by using hyperimmune ascitic fluids to the 4 dengue virus serotypes and the Yellow Fever virus. Monoclonal antibodies were also used. In the month of March, eight (8) type 1 dengue virus strains were isolated; all in the C636 cells system. Ten (10) type 1 and eight (8) type 2 dengue virus strains were isolated in the month of August. Type 1 dengue virus was identified in serum from one of the fatal cases during the epidemic. Dengue 1 strains were isolated only in C636 cell. Type 2 dengue virus was never isolated in the C636 cell system and several passages in suckling mice were necessary to achieve virus adaptation to the system.

As far as usefulness of C636 cells is concerned, a large number of serum specimens showed a strong toxicity for cultures in dilutions up to 1:100. On the other hand, although they were useful for isolating and identifying dengue virus 1 (not dengue 2), one or two passages were needed prior to identification. It should be pointed out that in various specimens from which type 1 dengue virus was isolated, passage in suckling mice did not allow virus isolation.

Results show that the 1985 dengue epidemic in Nicaragua was caused, at least, by dengue viruses types 1 and 2. The outbreak was considered as "Classical Dengue" with the presence of several cases of Dengue Hemorrhagic Fever/Dengue Shock Syndrome (DHF/DSS) in adults.

The analysis done confirmed that epidemiological conditions in Nicaragua explained the occurrence of DHF/DSS sporadically and individuals over age 20.

The simultaneous circulation of dengue viruses types 1 and 2 has put health services on guard. At present, a vector control campaign is on the go.

Comparative studies are currently being done on several mosquito cell lines in order to know their value in isolating these strains.

REPORT FROM ARBOVIRUS LABORATORY - INSTITUT PASTEUR

97306 _ CAYENNE CEDEX - FRENCH GUIANA

ARBOVIRUS SURVEILLANCE IN FRENCH GUIANA , GUADELOUPE
AND MARTINIQUE IN 1983 - 1984

I. ISOLATION OF VIRUS.

19 serum samples in 1983 and 25 in 1984 were collected from patients, with fever or dengue-like illness in French Guiana.

A Murutucu virus was isolated in april 1984 from a woman living in Cayenne who presented fever (39,5°C), headache, malaise and muscle pains.

On AP61 cell culture, presence of a group C virus was determined by indirect immunofluorescence in five days, without any cytopathogenic effect. The virus killed suckling-mice in two days. Using Chrom-Elisa technic (purification of suckling-mice antigen on Sepharose 4B column-Pharmacia, and Elisa test), the virus was identified as Murutucu. It is the second isolation of a group C virus from human in French Guiana (first isolation of a Murutucu virus in november 1973).

In French Guiana, Murutucu and Oriboca viruses were isolated from 9 Culicidae species and from a marsupial : Philander opossum and presence of Caraparu virus was determined three times in 1968 from mosquitoes (1,2).

2. SEROLOGICAL STUDIES.

577 serum specimens in 1983 and 679 in 1984 from Guadeloupe, Martinique and French Guiana were tested with five group B (Flavivirus) antigens : Yellow fever, Saint-Louis Encephalitis, Dengue 2, Dengue 3, Ilheus and four group A (Alphavirus) antigens : Mucambo, Pixuna, Cabassou, Tonate by IH and CF technics. A CF Flavivirus titer of 1:64 or more was considered as indicative of recent Flavivirus infection.

GUADELOUPE.

72 serum samples from 66 patients in 1983 and 45 from 35 patients in 1984 were received. A presumptive diagnosis of dengue infection was obtained from 9 patients (13.6%) in 1983 and 2 patients (5.7%) in 1984. Absence of antibodies was observed in 26 patients in 1983 and 43% in 1984 (table 1).

MARTINIQUE.

From 105 serum samples (90 patients) in 1983 and 67 (50 patients) in 1984, a presumptive diagnosis of dengue infection was obtained in 14 cases in 1983 and 12 cases in 1984. The maximum was reached in september

(3 cases in 1983, 4 in 1984). 6.7% of the patients studied in 1983 and 10% in 1984 did not present Flavivirus antibodies (table 1).

Absence of group A antibodies was observed in all patients from Guadeloupe and Martinique.

French Guiana.

400 serum specimens in 1983 and 667 in 1984 were studied. Absence of antibodies was observed in 13.3% of the patients in 1983 and 17.3% in 1984 (in majority in young children). In 1983, 13% of the patients studied isolated yellow fever antibodies (vaccination) were detected. Presumptive diagnosis of flavivirus recent infection was observed in 28 patients in 1983 and 58 in 1984. 50% of the cases have occurred in January-March 1983 (28.6% in March) during rainy season. In 1984, the percentage was at the maximum in October (19.0%).

18.6% of the patients showed antibodies for Alphavirus with titers lower than for Flavivirus. In 1983, a Tonate virus seroconversion was observed (table 2).

3. VECTOR SURVEILLANCE.

Haemagogus janthinomys is considered as a main vector for sylvatic yellow fever virus in South America. Since 1981, sylvatic cycle of yellow fever virus is studied in French Guiana. H. janthinomys collections were performed in three forest stations (FRG, Nancibo, Gallion). In four years, 13389 female mosquitoes were captured on human bait on platform (canopy) and at ground level.

Year :	1981	4352	<u>H. janthinomys</u>
	1982	2937	" "
	1983	1702	" "
	1984	4398	" "

Each batch of mosquitoes (maximum 30 specimens) was studied by inoculation to AP61 cell culture, to Toxorhynchites amboinensis and to suckling-mice. No virus could be isolated.

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(H. ZELLER, Y. ROBIN, Institut Pasteur.

B. GEOFFROY, ORSTOM.)

Table 1 - Serological Flavivirus surveillance in Guadeloupe and Martinique (1983-1984).

Year	GUADELOUPE		MARTINIQUE	
	1983	1984	1983	1984
Patients	66	35	90	50
Absence of antibodies	17	15	6	5
Antibodies ^{**} low titer	8	9	12	8
Antibodies moderate titer	32	9	58	25
Antibodies high titer	9	2	14	12

Table 2 - Serological Flavivirus and Alphavirus surveillance in French Guiana (1983-1984).

Year	FRENCH GUIANA	
	1983	1984
Patients	354	560
Absence of antibodies	47	97
Flavivirus antibodies	241	395
Alphavirus antibodies	2	11
Alphavirus and Flavivirus antibodies	64	57
Alphavirus antibodies [*]	66	68
Alphavirus low titer	26	9
Alphavirus moderate titer	35	40
Alphavirus high titer	5	8
Flavivirus antibodies ^{**}	305	452
Flavivirus low titer	115	166
Flavivirus moderate titer	162	228
Flavivirus high titer	28	58
	<u>IH</u>	<u>FC</u>
* Alphavirus low titer	≤ 20	-
Alphavirus moderate titer	40 - 320	8 - 16
Alphavirus high titer	≥ 640	≥ 32
**Flavivirus low titer	≤ 40	≤ 8
Flavivirus moderate titer	80 - 640	16 - 32
Flavivirus high titer	≥ 1280	≥ 64

REPORT FROM THE ARBOVIRUS LABORATORY
 INSTITUT PASTEUR DE NOUMEA - NEW CALEDONIA

DENGUE

During the last ten years, two types of dengue viruses have been isolated from cases observed in the South-West Pacific area : DEN 1 from March 1975 to October 1978, DEN 4 from March 1979 to September 1980. Imported cases caused by the type 4 virus have been reported in 1981-1983 but no indigenous suspect case has been confirmed until January 1985.

Virus isolation

Intra-thoracic inoculation of patients sera (diluted 1:10) into *Toxorhynchites* adult mosquitoes demonstrated a Flavivirus infection in 14 cases : 6 DEN 4, 3 DEN 2, 2 DEN 3 and 3 group B viruses.

Intra-cephalic inoculation to *Toxorhynchites* larvae (ICL) (Pang et al., 1983) has also been employed from October 1985 to identify the viruses responsible of 44 serologically confirmed cases. Positive indirect immunofluorescent reactions were obtained from 16 of 33 undiluted sera (15 DEN 4, 1 group B) and from 5 of 11 sera diluted 1:10 (4 DEN 2, 1 DEN 3), after a 3-4 day incubation at 30°C.

To compare the two methods, 40 suspect sera have been inoculated by the cephalic (ICL) and the thoracic (IT) routes (Table 1).

Table 1 - Number of virus positive and virus negative cases demonstrated by inoculating *Toxorhynchites* via the thoracic (IT) and the cephalic (ICL) routes.

		IT positive (10)			IT negative	Total
		DEN 2	DEN 4	Gr B		
ICL positive (20)	DEN 2	1	-	-	2	3
	DEN 3	-	-	-	1	1
	DEN 4	-	7	-	9	16
ICL negative		-	1	1	18	20
Total		1	8	1	30	40

Concordant results were obtained in 26 cases (8 positive, 18 negative). The discordant results showed that ICL method is more sensitive to detect dengue viruses : 12 ICL results positive when IT results were negative versus 2 ICL results negative when IT results were positive. Percentages of positivity were respectively 50 % and 25 % by using ICL and IT inoculations. So, ICL appeared to be a rapid (3-4 days) and sensitive method to detect dengue viruses.

IgM antibody titration

The titration was performed by indirect fluorescent antibody staining. The antigens were prepared by inoculating each virus prototype strain to *Aedes albopictus* C6/36 cell cultures. Infected cells were smeared placing either one antigen inside a slide ring or one antigen per quadrant to test simultaneously the diluted sera against the four immunotypes.

The sera (diluted 1:5) were firstly screened for specific IgM antibodies. IgM positive sera were then treated by an anti-gamma chain serum to eliminate a possible interference of the rheumatoid factor and/or IgG dengue antibodies. Serial dilutions of the treated sera were tested from 1:10.

The screening was positive for 140 of 253 patients (55,3 %) examined in 1985. The IgM antibody titration was performed on 64 paired sera and 76 single serum samples. In 90 cases (64,3 %), a monotypic reaction was obtained : DEN 1 : 1 - DEN 2 : 1 - DEN 3 : 3 - DEN 4 : 85. In 20 cases (14,3 %), the sera reacted positively with two types, in 9 cases (6,4 %) with three types and in 21 cases (15 %) with the four types.

On 64 paired sera, 18 (28,1 %) showed a significant rise of IgM antibody titre in the convalescent sample. In 23 cases, the titre was the same in the two samples and in 21 cases, no significant difference was found.

On 76 single serum samples, the IgM antibody titre was = 5 in 20 cases, = 10 in 13 cases, = 20 in 22 cases, = 40 in 12 cases, = 80 in 7 cases, > 160 in 2 cases.

IgM antibody titres > 5 have been found in 32 of 33 virus positive cases ; 20 antibody responses were monotypic (19 DEN 4 and 1 DEN 2). In the only IgM negative case, a DEN 2 virus strain was identified by using three methods.

Comparison between IgM and HI antibody titration was made for 56 paired sera (Table 2).

Concordant results were obtained in 24 cases (43 %) 1 secondary response (HI), 3 presumptive recent infections, 16 non significant and 4 negative results. Non significant IgM results i.e. the same IgM titre in paired sera or a two-fold rise, appeared for 37 of dengue cases (87 %), showing that by itself the presence of specific IgM antibodies may confirm numerous cases.

Table 2 - Compared results of IgM and HI antibody titration

IgM serologic response	HI serologic response					Total
	Primary	Secondary	Presumptive	non sign.	negative	
significant*	-	1	3 (2)	4 (3)	4	12 (5)
non significant	4	1	4 (1)	16 (6)	12 (3)	37 (10)
negative	-	-	2 (1)	1	4	7 (1)
Total	4	2	9 (4)	21 (9)	20 (3)	56 (16)

* convalescent serum titre x 4 or more
 () number of virus positive cases

Monthly records of suspect and confirmed cases showed an increase from March to June at the fall of the warm and rainy season and from November 1985 (Table 3).

Table 3 - Dengue records from New Caledonia, 1985

Number of cases	1985 - Month												Total
	01	02	03	04	05	06	07	08	09	10	11	12	
confirmed	3	7	10	14	15	14	6	11	7	13	22	20	142
suspected	15	11	18	28	31	18	17	21	10	30	34	26	249

VECTOR SURVEILLANCE

The results given by the virus assay of 3695 *Culicidae* grouped into 267 pools, are shown in the table 4. Five Alphavirus strains have been obtained from three mosquito species collected in the same locality, from February to June 1985. Provisory identification of three strains is Ross River virus. No case of epidemic polyarthrititis has been reported from New Caledonia since October 1983.

REFERENCE

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(Pierre Fauran)

(Jean Paul Moreau)

Table 4 - Vector surveillance in New Caledonia, 1985

Genus species	Locality	Number tested		
		Pools		Mosquitoes
		Positive	Total	
<i>Aedes aegypti</i>	La Tontouta		1	2
	Tina/Mer		1	1
<i>alternans</i>	La Tontouta		7	16
<i>notoscriptus</i>	La Tontouta		13	35
	Tina/Mer		3	9
	Plage 1000		1	1
	Robinson		1	3
<i>vexans</i>	La Tontouta		20	240
	Tina/Mer		3	17
	Plage 1000		2	3
<i>vigilax</i>	La Tontouta		28	753
	Tina/Mer		22	497
	Plage 1000	1 +	26	162
<i>Coquillettidia xanthogaster</i>	La Tontouta		15	109
	Tina/Mer	1+(RR)	4	7
	Plage 1000		1	1
	Robinson		1	2
<i>Culex annulirostris</i>	La Tontouta		20	171
	Tina/Mer		5	15
	Plage 1000		3	3
<i>iyengari</i>	Tina/Mer		1	1
	Plage 1000		1	1
<i>quinquefasciatus</i>	La Tontouta		24	407
	Tina/Mer	1+(RR)	8	15
	Plage 1000		10	20
<i>sitiens</i>	La Tontouta		28	782
	Tina/Mer	3+(RR)	17	319
	Plage 1000		10	66
	Robinson		1	1
Total		6	267	3659

REPORT FROM THE INFECTION AND IMMUNOLOGY RESEARCH LABORATORY, IZAAK WALTON KILLAM HOSPITAL FOR CHILDREN AND DALHOUSIE UNIVERSITY, HALIFAX, NOVA SCOTIA AND THE NATIONAL ARBOVIRUS SERVICE, DEPARTMENT OF MEDICAL MICROBIOLOGY, UNIVERSITY OF TORONTO, TORONTO, ONTARIO, CANADA.

California Encephalitis in New Brunswick, Canada

California (CAL) serogroup virus activity has been documented throughout Canada, but human disease due to these viruses has been recognized in only three provinces: Quebec, Ontario and Nova Scotia.¹ We report the first recognized case of disease due to a CAL serogroup virus (snowshoe hare [SSH] serotype) in New Brunswick.

Case Report

In August 1984, an illness characterized by headache and malaise developed in an 11-year-old boy. He had a history of eight febrile seizures. On the fifth day of the illness, his temperature rose to 40°C, and he had a brief generalized tonic-clonic seizure. The fever, accompanied by lethargy and vomiting, persisted for another 5 days, after which the boy recovered.

A lumbar puncture performed on the fifth day showed a lymphocyte count of $37 \times 10^6/L$ in the cerebrospinal fluid, and a puncture performed on the eighth day showed a leukocyte count of $340 \times 10^6/L$, with 74% monocytes and 26% neutrophils, a protein level of 1.04 g/L and a glucose level of 3.8 mmol/L. Computed tomography of the head gave normal results, and an electroencephalogram showed diffuse slowing compatible with encephalitis.

The boy made an uneventful recovery and one month later was well. He had not travelled away from Chatham, Northumberland County, New Brunswick for at least a month before his illness.

Hemagglutination inhibition and neutralization tests of serum obtained August 17 and 20 showed a twofold and a fourfold increase respectively in the titre of antibody to SSH antigen as well as lower titres of antibody to three related CAL serogroup viruses: Jamestown Canyon (JC), trivittatus and LaCrosse. In addition, a hemagglutination inhibition test showed antibodies to SSH antigen in the IgM fraction of serum fractionated by the sucrose-gradient method.

Comments

Antibodies to CAL serogroup viruses (SSH and JC) have previously been found in New Brunswick in the white-tailed deer (Odocoileus virginianus), moose (Alces alces americana Clinton) and horse populations.² In Northumberland County, where this patient lives, 18 of 20 samples of moose blood collected during 1979 were found by neutralization tests to contain antibodies to SSH, and 2 of 2 samples of horse blood collected during 1977 were found by hemagglutination inhibition tests to contain the same type of antibodies.²

References

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(J. A. EMBIL, H. ARTSOB and P. R. CAMFIELD)

REPORT FROM THE NATIONAL ARBOVIRUS REFERENCE SERVICE

DEPARTMENT OF MICROBIOLOGY

UNIVERSITY OF TORONTO

TORONTO, ONTARIO, CANADA

Production of Monoclonal Antibodies to Jamestown Canyon Virus

Jamestown Canyon (JC) virus has been isolated in the United States and six Canadian provinces including Newfoundland, Quebec, Ontario, Manitoba, Saskatchewan and Alberta. In addition antibodies to JC virus have been demonstrated in animal or human sera in Nova Scotia, New Brunswick and the Northwest Territories. In Canada, human symptomatic infections due to JC virus have been reported from Ontario and the Northwest Territories.

In view of the recently recognized role of JC virus as a human pathogen and evidence of serological heterogeneity among JC topotypes isolated in Canada (1), our laboratory undertook to produce monoclonal antibodies to the prototype strain of JC virus for use in characterizing JC topotypes isolated in North America.

Monoclonal antibodies were produced in BALB/c mice with four vaccine doses of live virus administered. The first three vaccines were given intraperitoneally at seven day intervals. The final dose was administered intravenously three days prior to cell fusion. The vaccines consisted of 10% clarified suspensions of JC, strain 6IV-2235, propagated in BALB/c suckling mouse brain.

Fusions were undertaken between spleen and SP2/o myeloma cells in a 10 to 1 ratio. Cell counts were adjusted to 1×10^5 cells per ml and fifteen 96 well plates were seeded. The production of monoclonal antibodies was monitored by fluorescent antibody staining.

Twenty-seven secretor clones were obtained of which 13 were frozen for further study. Three of these clones, designated as M1, M2 and M3, were passaged for ascitic fluid production and some properties characterized.

All three monoclones demonstrated different fluorescence patterns with some showing a more particulate type of fluorescence. In addition M1 and M3 reacted with vero-infected cells at 48 hr but not 24 hr post-infection whereas M2 reacted with JC infected cells at 24 hr post infection.

Tests to determine the protein specificities of these monoclones revealed that M1 was directed to the G1 protein of JC virus. The protein specificities of M2 and M3 have not been clearly resolved to date.

The monoclones were tested against prototype members of the California (CAL) serogroup (Table 1). M1 showed a strong Enzyme-Linked Immunosorbent Assay (ELISA) cross-reaction with Keystone (KEY) but did not react with other CAL serogroup antigens. It possessed no neutralizing (NEUT) or hemagglutination inhibiting (HI) activity.

M2 reacted by ELISA with all members of the Melao subcomplex (JC, KEY, South River, Melao, Serra do Navio) but not with California encephalitis or trivittatus antigens. This data suggests that M2 is directed to the nucleocapsid protein. M2 possessed no NEUT or HI activity.

M3 reacted by ELISA, HI and NEUT with JC virus but not with other CAL serogroup antigens. The fact that M3 had HI and NEUT activity suggests that it is directed to the G1 glycoprotein.

Studies were initiated to determine reactivity of the monoclonal antibodies with different JC topotypes. To date, 13 topotypes from five Canadian provinces have been examined. All monoclonal antibodies reacted by ELISA with the 13 topotypes. However M1 and M3 reacted much stronger to the prototype JC strain against which it was produced than to the Canadian topotypes.

M3 reacted poorly by NEUT with the Canadian JC topotypes. Whereas a 1:2560 dilution of M3 neutralized 100 TCID₅₀ of prototype JC, six of the 13 topotypes were not neutralized by M3 and 100 TCID₅₀ of the remaining seven topotypes were neutralized only when M3 was used at dilutions of 1:20 to 1:80.

Attempts are underway to obtain a greater number of JC topotypes from North America and to examine the reactivity of the monoclonal antibodies against these topotypes.

Reference

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(H. Artsob, L. Spence, C. Th'ng and V. Lampotang, National Arbovirus Reference Service in collaboration with B. Brodeur and R. Douma, Laboratory Centre for Disease Control, Ottawa).

TABLE 1.

**SEROLOGICAL REACTIVITY OF JAMESTOWN CANYON
MONOCLONES WITH PROTOTYPE STRAINS OF OTHER
CALIFORNIA SEROGROUP VIRUSES**

SEROLOGICAL TEST	VIRUS	JAMESTOWN	CANYON	MONOCLONE
		M1	M2	M3
Enzyme-linked	Jamestown Canyon	+	+	+
Immunosorbent	South River	-	+	-
Assay	Keystone	+	+	-
	Melao	-	+	-
	Serra Do Navio	-	+	-
	California Encephalitis	-	-	-
	Trivittatus	-	-	-
Hemagglutination	Jamestown Canyon	-	-	+
Inhibition	Snowshoe Hare	-	-	-
Neutralization	Jamestown Canyon	-	-	+
	South River	N.T. ¹	N.T.	-
	Keystone	N.T.	N.T.	-
	Melao	N.T.	N.T.	-
	Serra Do Navio	N.T.	N.T.	-
	California Encephalitis	N.T.	N.T.	-
	Lacrosse	N.T.	N.T.	-
	Snowshoe Hare	N.T.	N.T.	-
	Tahyna	N.T.	N.T.	-
	Lumbo	N.T.	N.T.	-
	San Angelo	N.T.	N.T.	-
Trivittatus	N.T.	N.T.	-	

¹ N.T. = Not Tested

REPORT FROM THE ARBOVIRUS RESEARCH UNIT, UNIVERSITY OF NEW SOUTH WALES
AND THE PRINCE HENRY HOSPITAL, SYDNEY, AUSTRALIA.

In a previous report we outlined our proposals for an investigation of the extent of arboviral infection in humans in New South Wales and the role of such viruses in human disease.

The first phase comprised an extensive seroepidemiological screening of 17,000 human subjects throughout the whole of the State. This enabled us to determine the areas in which arbovirus transmission amongst humans had been occurring most frequently, and to indicate where we might concentrate our studies. In the second phase, several study sites with high arbovirus transmission rates were selected, and longitudinal studies of suspected arboviral illnesses among residents were studied with the collaboration of local medical officers. Sentinel studies in chicken, dogs and seronegative human subjects were carried out in parallel.

The third study phase is to explore the natural history of those viruses shown to cause human disease with an ultimate view to undertaking effective control measures.

Serosurveillance.

Seventeen thousand sera from blood donors and patients whose sera had been obtained for other purposes, were screened for haemagglutination-inhibiting (HI) antibodies to known Australasian togaviruses ie three alphaviruses (Ross River (RRV), Getah (GET), Sindbis (SIN)) and eight flaviviruses (Sepik (SEP), Saumarez Reef (SRE), Murray Valley encephalitis (MVE), Kunjin (KUN), Alfuy (ALF), Stratford (STR), Kokobera (KOK) and Edge Hill (EH)).

For purposes of analysis, the State was divided into 14 biophysical zones based on temperature, altitude, rainfall and vegetation. New South Wales has a narrow coastal strip divided into far north coast, mid north coast, Hunter, central coast and south coast. Immediately westward is a mountain range (the Great Dividing Range) divided for our purposes into northern, central and southern tablelands. Proceeding westward, altitude declines gradually and this region was divided into north-west, central-west and south-western slopes. The western half of the State consists of flat, generally arid plains, divided into north-west, far-west and south-west zones. The rivers of the coastal strip are numerous, fairly short, and relatively fast flowing. Coastal swamps are common where the river systems meet with sand dunes immediately adjacent to the Pacific Ocean. The other major river systems are west of the Divide and consist of the Murray, Murrumbidgee, Lachlan, Macquarie and the Darling rivers (see Fig.). These western rivers are very long, with sluggish flow and numerous anabranches, backwaters and swamps. Although fauna are present throughout the whole of the State, there tends to be a clustering in those areas where permanent water is available. Where permanent surface water is not present, there are often bores for irrigation and livestock. There are extensive areas of irrigation in and around Griffith, Bourke, Warren, Moree and Narrabri.

Results of Serosurveillance.

Age-adjusted antibody prevalence rates for the alphaviruses and flaviviruses are shown in the figure (total alphavirus and total flavivirus).

In summary antibody prevalence rates were low in the whole of the tablelands area and in the major coastal cities Sydney, Newcastle and Wollongong. In populations living on the coastal strip, alphavirus antibody prevalence rates were of the order of 6-17%, and flavivirus rates 2-8%. On the western plains prevalence rates for alphaviruses ranged from 31-41% and for flaviviruses from 26-42%. The highest rates occurred in several small centres along the north western part of the Darling River eg in Bourke alphavirus antibody prevalence rates were 66% and flavi 78% (n = 176). Rates on the western slopes were intermediate between those on the plains and the tablelands.

It appeared that GET, SEP and SRE viruses probably did not cause infections in humans in New South Wales. Most of the alphavirus infections appeared to be due to RRV, although SIN infections were increasingly prevalent moving westward.

Of the flaviviruses, STR reacted most frequently and to highest titre, although many sera showed multiple reactions to STR, MVE, KUN and ALF. KOK antibodies tended not to cross-react with other flaviviruses. KOK virus infections were less common than infections due to the STR, MVE, KUN and ALF group, and were most prevalent in the south-western part of the State.

Selected sera are being tested for neutralizing antibodies to the flaviviruses, to determine more precisely, if possible, which viruses cause the infections. This may cast some light on whether MVE is enzootic within New South Wales or introduced from the north.

Australia has yielded a large number of bunyaviruses and orbiviruses from arthropods in recent years. Work has now commenced on determining whether humans have been infected by these viruses.

Clinicovirological Studies in Arbovirus Centres.

Based on the serosurveillance study, five centres were selected as being regions of high arbovirus prevalence within New South Wales, viz Griffith, Bourke, Moree/Narrabri, Warren and Kempsey (see Fig.). In each of these centres collaborating clinicians submit paired sera from patients suspected of having arbovirus-caused illnesses. These are particularly prevalent during the summer months of November to May. Such sera are tested for antibodies to those viruses known to cause human infections. Currently the HI test is being used for RRV, SIN, MVE, KUN, ALF, STR, KOK and EH. An antibody capture ELISA IgM test has taken the place of HI for recent RRV antibodies, and is being developed for several of the flaviviruses.

RRV Epidemic 1983/84.

In the summer of 1983/84, an extensive epidemic of RRV infection occurred throughout the State and was intensively investigated by this Unit. There were 1,196 serologically confirmed cases; this is a minimum number since many cases were not submitted for laboratory confirmation. The estimated cost of the outbreak to the community was about \$4million, and the mean period of incapacity was about 5½ weeks, although many subjects showed disability for much longer periods of time. Somewhat surprisingly an intensive study in Griffith showed that one clinically manifest case occurred for every two to three RRV infections.

Infections Due to Other Arboviruses.

An interesting observation of the 1983/84 season was the occurrence of prolonged illnesses in two patients infected with a Kokobera-like virus (serological diagnosis). These cases were paralleled by Kokobera-like infections occurring in some of our sentinel chickens (see below).

Many of the paired sera from clinical cases showed no evidence of infection by any of the arboviruses in our panel. These sera have been stored for future assessment by other arboviruses at a later date. Most arboviral infections will probably not result in overt disease and could pass unrecognised.

Seronegative Sentinel Panels.

The original purpose in instituting chicken sentinel flocks was to provide an early warning system for the reappearance of MVE virus. One theory is that the virus is introduced from northern Australia and/or New Guinea during times of favourable climatic conditions in south-eastern Australia. Another is that the virus is enzootic in south-eastern Australia, requiring only local amplification to facilitate its re-introduction into the human community. Either way, an early warning system is advisable. Seronegative chickens are located between towns and adjacent mosquito breeding areas, bled and tested weekly for seroconversion. To date no evidence of MVE infection in such chickens has been found, although KUN and unspecified flavivirus infections occurred in 1980/81, 1982/83 and 1983/84; no flavivirus infections were detected during the summer of 1984/85.

To detect other arboviruses currently circulating we have also established seronegative panels of human blood donors, and in Bourke a panel of dogs. These panels have revealed infections by both alphaviruses and flaviviruses. SIN infections were noted frequently in the chicken sentinels. One feature of interest has been the greater effectiveness in Bourke of canine sentinels than chickens. In the summer of 1984/85, no chickens in that location seroconverted to flaviviruses, whereas 25% of the dogs showed evidence of flavivirus infection. It is hoped to extend the canine sentinel panel to other survey centres.

Investigations of Newer Viruses As Agents of Human Infection.

Samples of our sera panel have been tested by HI with three recently isolated viruses, the flavivirus Gadget's Gully (CSIRO 122), an unidentified flavivirus (CSIRO 946), and the recently characterised alphavirus, Barmah Forest virus (BFV). Extensive testing throughout the State has provided no evidence that either Gadget's Gully or CSIRO 946 infect humans. The only reactive sera were those which reacted to higher titre with other flaviviruses. On the other hand, BFV appears to be a human infector. Of approximately 500 sera tested against this virus, 2% showed clear evidence of reactivity in the absence of comparable titres to other alphaviruses. In the light of this finding, BFV will be introduced into the diagnostic panel with which we test sera from patients with suspected arboviral illnesses.

Future Activities.

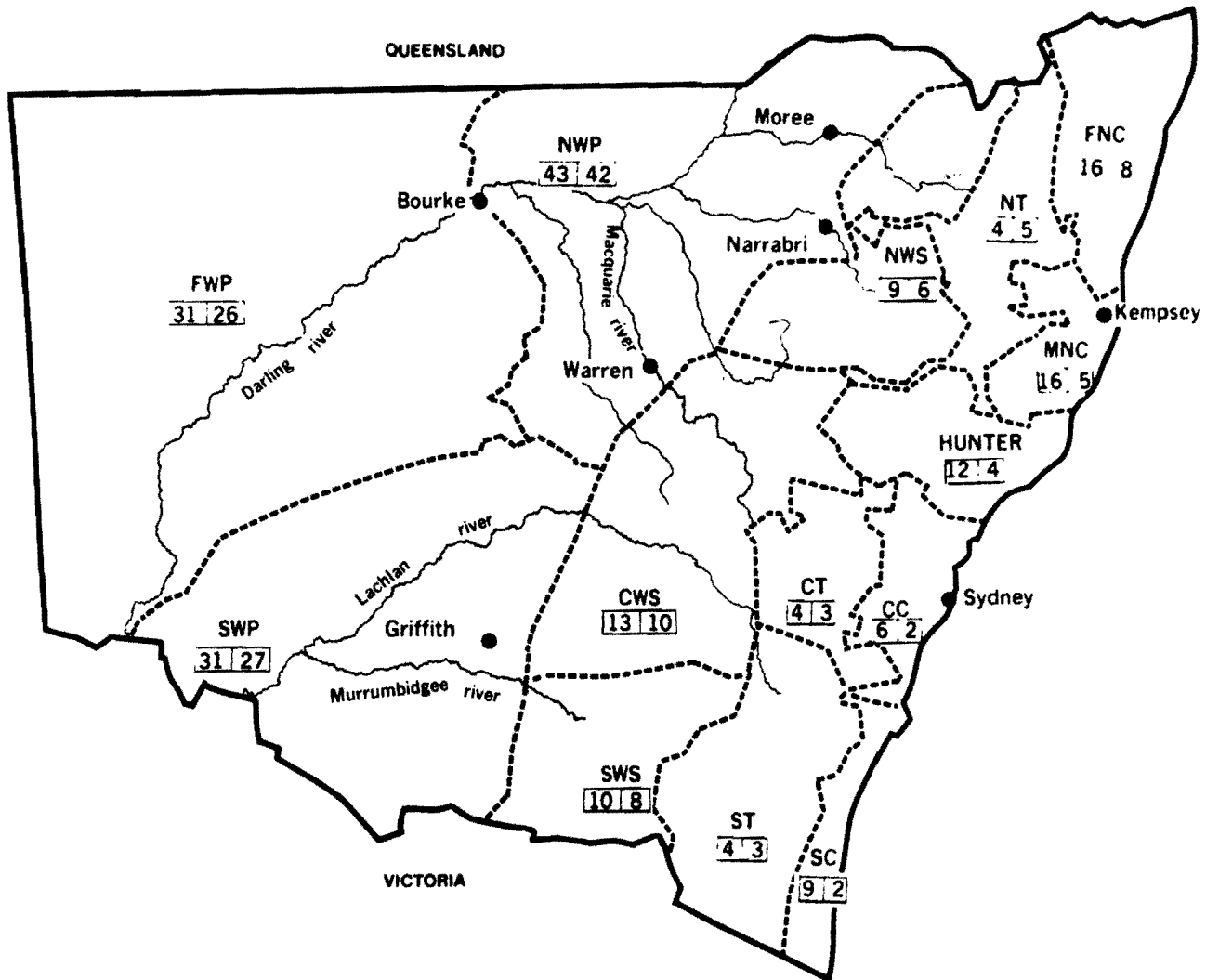
We intend to test the Australasian bunyaviruses and orbiviruses for their capacity to infect humans, so that any such may be incorporated into our diagnostic antigen testing panels. Mosquito trapping is being carried out by the N.S.W. State Health Department to determine mosquito prevalence and species. We are planning virus isolation from mosquitoes collected in one or more of our arbovirus study centres. This seems essential because HI antibody patterns in certain sera from our serosurveillance study are not consistent with infection by any of the known flaviviruses. This suggests that as yet undiscovered flaviviruses are circulating in such areas.

A third area concerns the natural history of RRV. The occurrence of a large epidemic in 1983/84 after small numbers of human cases in previous summers, could not be adequately explained in terms solely of human herd immunity or vector prevalence. We suspect that other ecological factors, such as feral and domestic animal hosts and their arbovirus vectors, are involved. It is hoped to start work on this shortly.

(C.R. BOUGHTON, R.A. HAWKES, Helen NAIM, Barryet MYRICK, Lauretta RAMSAY.)

Map showing biophysical divisions of New South Wales: FNC = Far North Coast; MNC = Mid North Coast; CC = Central Coast; SC = South Coast. NT, CT, ST refer to the Northern, Central and Southern Tablelands; NWS, CWS, SWS refer to the Northern, Central or Western Slopes; NWP, SWP and FWP refer to the Northern, Southern and Far Western Plains.

The numbers in the boxes refer to age - adjusted antibody prevalence rates (%) of humans residing in the divisions: (left hand box = alphavirus, right hand box = flaviviruses).



REPORT FROM DEPARTMENT OF VIROLOGY, NATIONAL BACTERIOLOGICAL LABORATORY,
S-105 21 STOCKHOLM SWEDEN.

SANDFLY FEVER AMONG SWEDISH UN TROOPS ON CYPRUS.

Swedish peace-keeping troops has been stationed on Cyprus since 1964. This military unit consists of 370 persons, all of whom are replaced every 6 month. During August and September 1984 one of the authors (R E) was confronted with a number of febrile illnesses of unknown etiology among soldiers in the Swedish unit on Cyprus, some of which had symptoms compatible with Phlebotomus fever (PF). Paired sera were collected from 12 of these patients and convalescent sera were obtained from another 3 cases. All sera were subsequently tested by indirect immunofluorescence (IFT) for the presense of antibodies to the following viruses: Rift Valley fever, Congo-Crimean hemorrhagic fever, Sindbis, Ross River, PF Naples and PF Sicilian.

Four patients revield antibodies to PF Sicilian, showing a significant rise in antibody titers from acute to convalescent sera. The 3 patients with only convalescent sera available were also positive to PF Sicilian. Antibdies to other viruses were not detected.

The presence of specific antibodies to PF Sicilian virus in the IFT positive sera was confirmed by plaque reduction neutralization test by R.B. Tesh, Yale Arbovirus Research Unit, New Haven, Connecticut, USA.

Previous seroepidemiological studies have shown that PF Sicilian and Naples are endemic in this region. However, this is the first report showing the presense of PF on Cyprus.

Rickard Eitrem Bo Niklasson

Isolation of Fomede virus from Nycteris nana bats in the Republic of Guinea

Ibrahima Boiro, F.M. Fidarov, N.V. Lomonossov, M.B. Linev, V.N. Bachkirsev, and Alphonse Inapogui

This paper concerns the isolation and identification of ch.s.654 virus, Fomede, obtained from Nycteris nana bats. These bats were captured in October 1978 in the Fomede cave located 9 km from the City of Kindia.

To isolate the virus, a suspension of 20% triturated brain and pooled internal bat organs (liver, spleen and lungs) were inoculated in new-born mice. The period of incubation in mice at the time of primary isolation was 6 to 7 days. In subsequent passages, the period was reduced to 2 days.

The titer of virus in mice reached 6.5 - 7.0 log LD50. Adult mice and guinea pigs remained well after inoculation of virus, but developed antibody.

Studies of the physico-chemical and antigenic properties of the virus were done after 8 to 9 passages.

The virus passed a 220 nm Millipore filter. Ether and chloroform sensitivity was done by the methods of Andrewes and Horstmann (1949). The test of sensitivity to sodium deoxycholate utilized a 1% suspension in pH 7.2 phosphate buffer containing 0.75% bovine albumin (Theiler 1957).

The initial titer of virus was 6.5 log LD50 in mice. Ether lowered the titer 2.1 log LD50 and deoxycholate, 2.3 log LD50; this indicated that the virus possessed a lipid envelope.

The virus multiplied in Vero, PS and LLC-MK2 cells. This mult iplication in continuous cell lines was accompanied by pronounced cytopathogenic effects appearing generally during the second and third days after inoculation.

These cytopathic effects started abruptly in the form of small foci bordering the cells, and spread gradually over the entire cell layer.

The cytopathogenic titer after 5 passages reached 4.5 - 5.0 log CPE50/ml. Viral antigens for serologic tests were prepared from brain of mice by extraction in borate buffer and in sucrose-acetone.

The isolate did not agglutinate goose erythrocytes in the range of pH 5.7 -6.8 and at 4 C and 37 C.

The antigen of ch.s 654 did not react in complement fixation test with the following battery of polyvalent hyperimmune sera: arbovirus groups A, B, C, Buynyamwera, Guama, Capim, Simbu, California, phlebotomus, Tacaribe, Kemerovo, Bwamba, Patois, Palyam, Anopheles A, Crimean hemorrhagic fever-Congo, Quaranfil and monovalent sera of more than 130 arboviruses.

The homologous titer of the antiserum was 1:256.

CONCLUSION

On the basis of the results obtained, one must conclude that the strain ch.s.654 is provisionally new. It is named Fomede virus after the name of the cave where the bats were captured which yielded strain ch.s.564.

ACKNOWLEDGEMENTS

The authors thank Dr. J.P. Digoutte, Director of the Institut Pasteur of Dakar, for his valuable help in the identification of Fomede virus.

SUMMARY

Fomede virus was isolated during virologic studies in the Republic of Guinea in October 1978 from Nycteris nana bats.

Based on biologic, physico-chemical and antigenic properties of Fomede virus, it was concluded that strain ch.s.564 is a new virus not previously isolated.

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Isolation of Kindia, a new orbivirus from Amblyomma variegatum ticks in the Republic of Guinea

Ibrahima Boiro, N.N. Lomonossov, A.F. Alexin, Alpha Bah, and Cellou Balde.

INTRODUCTION

Virus research carried out in Guinea has revealed the circulation of a new arbovirus in the Palyam antigenic group. The present study describes the isolation and identification of Kindia virus, A.V. 5050, isolated from Amblyomma variegatum ticks collected in April 1983.

MATERIALS AND METHODS

The ticks were collected off of cows in the village of Serimodiya, in the Prefecture of Kindia. This area represents a complex system of plateaus and mountains which are partitioned by deep crevices and gently sloped valleys with an annual precipitation varying between 1,574 mm and 2,484 mm and an annual mean temperature of 25 C.

Virus was isolated in new-born mice. Tests of pathogenicity in laboratory animals were made by intracerebral or intraperitoneal inoculation of a 10% suspension of new-born mouse brain into white mice 3 to 4 weeks old, adult mice, and guinea pig.

Virus was assayed in mice by the method of Reed and Muench (1).

Virus properties, including size, sensitivity to ether, chloroform, and sodium deoxycholate, were determined by standard methods (Casals 1968; Andrews and Horstmann 1949; Theiler 1957).

Antigens were prepared from the brains of sick infected new-born mice by treatment with borate buffer and concentration in polyethylene glycol.

Ascitic fluid containing Kindia antibody was prepared by five inoculations of adult white mice with live virus in aluminum hydroxide, followed by an inoculation of sarcoma 180/TG.

Reference hyperimmune sera were used by complement fixation and neutralization for serological identification of virus. Hemagglutination was attempted by a micromethod with goose erythrocytes at pH between 5.8 and 7.6 at 27 C and 4 C.

RESULTS AND DISCUSSION

A virus A.v. 5020 was isolated from a lot of 50 Amblyomma variegatum ticks. The virus is called Kindia after the name of the site of the laboratory.

The virus was pathogenic for new-born mice. The incubation period in mice of the original isolation was 5 to 6 days. During the subsequent passages, the incubation period was established at 3 days.

The titer of virus in new-born mice reached 6.4 to 6.8 log LD50/0.02 ml.

Three to four week old mice, adult mice, and guinea pigs remained well after inoculation, but seroconverted.

The virus passed a 220 nm Millipore membrane.

The virus was weakly sensitive to inactivation with ether, chloroform, and sodium deoxycholate. The titer was decreased 0.2 - 0.8 log LD50 by action of these chemicals.

The virus did not agglutinate goose erythrocytes under the conditions of the experiment.

The antigenic relationships obtained by complement fixation and neutralization are shown in Tables 1 and 2.

Kindia virus reacted broadly by complement fixation with viruses of the Palyam group. Kindia virus differed by neutralization test from 6 other viruses of the Palyam group. No antigenic cross-reactions were found with other viruses tested.

CONCLUSION

Kindia virus, A.v. 5020, thus appears to be a newly-recognized virus in the Palyam group.

Acknowledgement

The authors thank Dr. J.P. Digoutte, Director of the Institut Pasteur of Dakar, for his valuable help in the identification of Kindia virus.

Summary

Kindia virus, A.v. 5050 is a provisionally new arbovirus isolated from Amblyomma variegatum ticks in the territory of the Republic of Guinea. The virus belongs to the genus Orbivirus (Palyam serogroup) based on biologic, physico-chemical, and antigenic properties.

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Table 1

Complement Fixation TestVirus "KINDIA" A.v. 5020 with the other viruses of the Palyam group

Sera	Virus	Kindia	Vellore	Abadina	Kasba	Palyam	D'Aguilar	Petevo
Kindia		256/8*	256/16	256/16	256/16	256/8	256/8	256/8
Vellore		32/8	128/16	32/8	64/16	64/8	64/8	64/8
Abadina		256/8	32/8	512/16	16/16	64/8	64/8	32/8
Kasba		64/8	64/8	64/8	128/16	32/8	64/8	64/8
Palyam		16/8	32/8	32/8	32/16	64/8	32/8	32/8
D'Aguilar		16/8	32/8	32/8	64/16	32/8	64/8	64/8
Petevo		64/8	32/8	32/8	32/16	32/8	32/8	128/8

*Maximum titer of immune ascite fluid/optimum antigen titer.

Table 2 Serum neutralization test in mice
Fixed virus and variable serum dilution technique

Virus Serum	Kindia	Vellore	Abadina	Kasba	Palyam	D'Aguilar	Petevo
Titer in log	5.7	5.6	5.2	5.5	4.6	4.5	5.0
Kindia	3.7*	1.8	<0.8	0.7	0.6	<0.5	1.0
Vellore	1.8	3.0	1.2	0.9	1.3	1.0	1.1
Abadina	1.0	1.4	>3.0	2.9	1.0	1.4	1.0
Kasba	1.2	1.3	2.2	3.5	1.4	1.9	1.3
Palyam	1.2	1.4	0.4	1.1	>3.1	1.3	1.2
D'Aguilar	1.8	1.3	1.1	1.0	1.0	>3.0	1.2
Petevo	0.9	1.0	1.0	0.8	1.1	1.3	>3.5

*Neutralization index.

RHABDOVIRUSES

Haemagglutination of Kununurra Virus

Haemagglutinating activity has been reported for Kimberley virus (Kaneko et al., in press), and for Adelaide River virus (Shorthose et al., in press), which are both rhabdoviruses related to bovine ephemeral fever virus. We wish to report a haemagglutinin for Kununurra (KUN) virus.

The antigen was prepared with the CSIRO 976 strain of KUN virus, using polyethylene glycol precipitation as described by Della-Porta and Westaway (1972). The resulting haemagglutinin was not dependent on salt concentration but was pH dependent giving titres of 128, 16 and 2 at pH 5.8, 6.0 and 6.2 respectively, but not at higher pH's. Lower pH's were not tested. Haemagglutination inhibition (HI) of the KUN antigen (4 units) occurred using antisera prepared in rabbits against certain Australian rhabdoviruses as shown in Table 1. Cross-reactivity occurred to a minor extent with Coastal Plains, Tibrogargan and Kimberley viruses.

(D.H. Cybinski)

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TABLE 1
HI of KUN antigen using antisera
prepared against Australian rhabdoviruses.

Antiserum	HI Titre
Kununurra (OR194 Strain)	320
Coastal Plains (CSIRO 761 Strain)	20
Tibrogargan (CSIRO 132 strain)	10
Parry's Creek (OR189 strain)	<10
Bovine ephemeral fever (BB7721 Strain)	<10
Kimberley (CSIRO 368 Strain)	10
Adelaide River (DPP61 Strain)	<10
Berrimah (DPP63 Strain)	<10

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The Vector Biology and Control Unit is presently tidying up aspects relating to the epidemiology of Murray Valley encephalitis. Several groups in Australia believe that the Miles-Anderson hypothesis relating to transport of MVE via viraemic birds or infected mosquitoes from endemic northern Australia to southern Australia is no longer tenable. Examination of climatic factors and synoptic charts prior to the 1951 and 1974 epidemics indicate that no weather systems were available to facilitate long-range dispersal by infected mosquitoes. In any case, such distances far exceed the fuel reserves of mosquitoes and such movement would have to occur during the end of the dry season when water, food, mosquito and virus activity are at their lowest. As most birds exhibit nomadic movement according to food and water resources and arrive in the Murray-Darling area when the winter-spring rains occur, there would seem to be little likelihood of direct seeding of the south.

A mathematical model (submitted to Am. J. Epidemiol) suggests for a variety of spring conditions, amplification is likely to be at least 3 extrinsic incubation periods (and probably more) for Culex annulirostris, the major epidemic vector. Because of the early nature of the 1951 and 1974 outbreaks, this suggests that initiation of the rural cycle may have begun prior to the period that Cx annulirostris is plentiful and hence we currently are evaluating the vector competence of those species common during spring. As yet, we have not found a species that is able to transmit more efficiently.

In conjunction with Dr Graham Burgess, School of Tropical Veterinary Science, James Cook University, Townsville, we are making steady progress in developing rapid specific tests for the Australian flavivirus encephalitis group: Murray Valley encephalitis, Kunjin and Alfuy.

Using chromatography purified monoclonal antibodies (Mab) with varying specificities to flavivirus antigens, we have developed an antigen capture, sandwich ELISA to detect antigens common to all Australian flaviviruses.

Preliminary work used group reactive monoclonal (D1-4G2-4-15) (kindly supplied by Dr Mary K Gentry and Dr R Shope) ATCC catalogue # HB112 as a capture antibody and infected mosquito cell culture supernatant as antigen preparation. Rabbit anti-serum prepared to Murray Valley encephalitis (MVE) virus, and cross-reactive to all Australian flaviviruses by immunofluorescence was used as the indicator antibody. Bound rabbit IgG was then detected by horseradish peroxidase (HRPO) conjugated goat anti-rabbit IgG.

This protocol was successfully applied to detect MVE virus in pools of laboratory infected mosquitoes.

Present and future work involves the HRPO conjugation of MABs for use as indicator antibodies. These monoclonals include

- 1) encephalitis subgroup specific Mab
 - 2) several Mabs that distinguish between the Australian encephalitides
 - 3) a dengue complex Mab (D3-2H2-9-21) ATCC catalogue # HB114
- Indicator antibodies will be combined with the appropriate capture antibodies.

These techniques will allow us to rapidly detect, and specifically identify encephalitic and other medically important flaviviruses isolated from clinical specimens, infected cell culture supernatants, or directly from mosquito pools.

After 6 years, the vertebrate infection studies have been completed and two papers have appeared in Aust. J. Exp. Biol. Med. Sci. and one has been submitted to Aust. Vet. J. A paper on experimental infection of vertebrates with Ross River virus is in progress. Recent papers are as follows.

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[Brian Kay, Ian Fanning, Roy Hall, Papi Mottram and David Hagan]

REPORT FROM THE VIROLOGY PROGRAM
STATE OF NEW JERSEY DEPARTMENT OF HEALTH
TRENTON, NEW JERSEY

Arbovirus Surveillance in New Jersey, 1985

During the 1985 surveillance period from June into October, 2588 mosquito pools containing up to 100 mosquitoes each were tested for viruses in day old chicks. There were thirty-seven (37) mosquito pools positive for Eastern encephalitis (EE) and Western encephalitis (WE) was isolated from forty-five (45).

Table 1 summarizes the collection area totals, species of mosquito and time of collection for the EE isolates. Activity began with the mid August collections and continued into November. There were thirty-six (36) isolates from Culiseta melanura pools at eight (8) sites and a single isolate from a pool containing Anopheles quadrimaculatus.

WE mosquito activity is summarized in Table 11. The August collections yielded the first isolate with continued observation of WE activity into October. There were forty-four (44) isolates from Culiseta melanura at seven (7) sites and a single isolate from a Culex restuans pool.

EE isolates were also made from August into October from four (4) horses in southern coastal counties.

Sentinel chicken flocks of eight (8) cockerals were placed at nine (9) sites. The flocks were bled bi-weekly and St. Louis encephalitis hemagglutination inhibition tests were conducted. There were no conversions observed in the 240 sera tested.

(Shahiedy Shahied, Bernard Taylor, Wayne Pizzuti)

Table 1
1985

AREA COLLECTED	MOSQUITO SPECIES	EE MOSQUITO POOL ISOLATES									AREA TOTALS
		FOR WEEK ENDING									
		8/23	8/30	9/6	9/13	9/20	9/27	10/4	10/11	10/18	
Woodbine	Cs. melanura	1	1	3	3	1	1			1	11
Woodbine	A. quadri-maculatus			1							1
Dennisville	Cs. melanura	1	1	3	2	2	1				10
Green Bank	Cs. melanura			3		1	2				6
Bass River	Cs. melanura			1							1
Ocean City	Cs. melanura	2	2	1							5
Buena	Cs. melanura	1									1
Williamstown	Cs. melanura					1					1
Alloway	Cs. melanura								1		1
WEEKLY TOTALS		5	4	12	5	5	4	0	1	1	37

Table 11
1985

AREA COLLECTED	MOSQUITO SPECIES	WE MOSQUITO POOL ISOLATES											AREA TOTALS	
		FOR WEEK ENDING												
		8/2	8/9	8/16	8/23	8/30	9/6	9/13	9/20	9/27	10/4	10/11	10/18	
Woodbine	Cs. melanura		1	3	3		2	1	1			1		12
Woodbine	Cs. restuans		1											1
Green Bank	Cs. melanura	4	2	2	2		1							11
Dennisville	Cs. melanura		1	1	2	1	1	3	1	1				11
Buena	Cs. melanura			1	1									2
Fishing Creek	Cs. melanura				1		1							2
Alloway	Cs. melanura							1			1	1	1	4
Williamstown	Cs. melanura								2					2
WEEKLY TOTALS		4	5	7	9	1	5	5	4	1	1	2	1	45

REPORT FROM THE DIVISION OF VECTOR-BORNE VIRAL DISEASES, CENTERS FOR DISEASE CONTROL, FORT COLLINS, COLORADO, U.S.A.

Antibody To Arboviruses in An Alaskan Population at Occupational Risk of Infection

A total of 435 U.S. Geological Survey and U.S. Forest Service workers in Alaska were studied for serological evidence of past infection with four arboviruses known or suspected as human pathogens. Neutralizing antibody to Jamestown Canyon (JC) virus was present in 89 (20.5%) of the agencies' personnel, while 59 (13.6%) had antibody to snowshoe hare (SSH) virus, 17 (3.9%) to Northway virus, and 15 (3.4%) to Klamath virus. The most significant correlates with seropositivity to the antigenically related JC and SSH viruses were the indices of occupational exposures, including history of fieldwork activities ($p = 0.0001$) and duration of employment by the agencies ($p = 0.0001$ for JC and 0.004 for SSH). Seropositivity to the four arboviruses also correlated strongly with a history of travel in certain remote or wilderness areas in Alaska.

(Stansfield, S.K.; Calisher, C.H.; Hunt, A.R.; Winkler, W.G.)

Isolation of Newly Recognized Vesiculovirus, Calchaqui Virus, and
Subtypes of Melao and Maguari Viruses from Argentina, with
Serological Evidence for Infections of Humans and Horses

Seventeen virus strains were isolated from mosquitoes collected during an outbreak of western equine encephalitis in Santa Fe Province, Argentina in 1983. Strains of western equine encephalitis, Venezuelan equine encephalitis, St. Louis encephalitis, and Antequera viruses were isolated, as were several bunyaviruses of the California and Bunyamwera serogroups and a vesiculovirus. Complement-fixation and neutralization tests were used to identify the California serogroup virus as a subtype of Melao virus (Table 1), the Bunyamwera serogroup virus as a subtype of both Maguari and Playas viruses (Table 2), and the vesiculovirus as a newly recognized agent (Table 3) for which the name Calchaqui virus is proposed. A limited serosurvey of horses and humans in Santa Fe Province and horses from the adjacent Santiago del Estero Province was performed to determine the prevalence of neutralizing antibody to the subtypes of Melao and Maguari viruses and to Calchaqui virus (Table 4). The high prevalence of antibodies to the latter three agents indicates the need for further studies of their disease potential in horses, because they are closely related to several other viruses that are known equine pathogens.

(Calisher, C.H.; Monath, T.P.; Sabattini, M.S.; Mitchell, C.J.; Lazuick, J.S.; Tesh, R.B.; Cropp, C.B.)

Table 1. Results of Serum dilution-plaque reduction neutralization tests with strain AG83-497 and four other members of the California serogroup.

VIRUS	STRAIN	TITER OF ANTIBODY TO:				
		(AG83-497)	MEL	SDN	JC	LAC
	AG83-497	<u>10,240</u>	<10	<20	<20	20
Melao	TRVL 9375	10,240	<u>40</u>	a		
Serra do Navio	BeAr 103645	160		<u>40</u>		
Jamestown Canyon	61V 2235	160			<u>320</u>	
La Crosse	Original	<40				<u>320</u>

^a blank indicates not tested.

Table 2. Results of serum dilution-plaque reduction neutralization tests with strain AG83-1746 and six other members of the Bunyamwera serogroup.

VIRUS	STRAIN	(AG83-1746)	MAG	TITER OF ANTIBODY TO:				
				PLA	CV	KRI	WYO	MD
	AG83-1746	<u>2560</u>	<40	40	a	-	-	-
Maguari	BeAr 7272	1280	<u>640</u>	b				
Playas	75V 3066	1280		<u>320</u>				
Cache Valley	6V-633	160			<u>160</u>			
Kairi	TRVL 8900	-				<u>80</u>		
Wyeomyia	Original	-					<u>1280</u>	
Main Drain	BFS 5015	10						<u>160</u>

a - indicates <10

b blank indicates not tested

Table 3. Results of complement-fixation (CF), indirect fluorescent antibody (IFA), and serum dilution-plaque reduction neutralization (N) tests with strain AG83-1347 and Jurona virus.

VIRUS	(STRAIN)	CF		TITER OF ANTIBODY TO: IFA		N	
		(AG83-1347)	JUR	(AG83-1347)	JUR	(AG83-1347)	JUR
	(AG83-1347)	<u>256</u>	32	<u>20</u>	80	<u>40</u>	<10
Jurona	(BeAr 40578)	16	<u>512</u>	<10	<u>1280</u>	<10	<u>≥10,240</u>

Table 4. Prevalence of neutralizing antibodies to three viruses (AG83-497, AG83-1746, and AG83-1347) from Argentina in horses and humans from Santa Fe (SF) and Santiago del Estero (SdE) Provinces, Argentina, 1983.

Province	Year	Source	Number Tested	Neutralizing antibody to: ^a		
				AG83-497	AG83-1746	AG83-1347
SF	1982	Horse	46	10 (21.7)	40 (87)	17 (37)
SF	1982	Human	20	2 (10)	6 (30)	0
SdE (rural)	1981	Horse	35	26 (74.3)	22 (62.9)	3 (10.4)
SdE (urban)	1981	Horse	60	6 (10)	6 (10)	0

^a Number with antibody (% with antibody)

Rapid Detection of Immunoglobulin M Antibody in Sentinel Chickens Used
for Arbovirus Surveillance

Young chickens were inoculated with 5,000 plaque-forming units of eastern equine encephalitis (EEE) virus and bled at intervals thereafter for determinations of hemagglutination-inhibiting (HI), neutralizing (N), immunoglobulin M (IgM), and IgG antibodies. HI, N, and IgM antibodies were first detected 4 days after infection and IgG detected 7 days after infection. All four antibodies persisted through the 90th day after infection. HI, N, and IgM antibody titers remained elevated and were not cross-reactive with the related alphavirus western equine encephalitis (WEE) virus. IgG antibody titers also remained high, but heterologous reactivity to WEE virus increased with time after infection.

Sera from sentinel chickens and wild birds infected in nature with EEE, WEE, or St. Louis encephalitis viruses and submitted to this laboratory from state and local health departments were tested for IgM antibody to these viruses, using anti-chicken IgM for capture, and for IgG antibodies to EEE and WEE viruses. There was essentially complete correlation between HI, N, and either IgM (showing recent infections) or IgG (showing more remote infections) antibody.

We conclude that the IgM antibody capture enzyme immunoassay can be used as a specific and sensitive assay to replace the routinely used HI test for detecting antibody in sentinel chickens and in young, wild birds used for arbovirus surveillance. The test is rapid, relatively inexpensive, and can be performed in essentially all adequately supplied laboratories.

(Calisher, C.H.; Fremount, H.N.; Vesely, W.L.; El-Kafrawi, A.O.;
Al-Deen Mahmud, M.I.)

Table 1. Results of hemagglutination-inhibition (HI) and serum dilution-plaque reduction neutralization (N) tests, IgM antibody capture enzyme-linked immunosorbent assays (MAC ELISA) and IgG assays with sera from 3- to 4-week-old chickens experimentally infected with eastern equine encephalitis (EEE) virus.

Chicken no.	Days after infection	HI		N		MAC ELISA		IgG	
		EEE	WEE	EEE	WEE	EEE	WEE	EEE	WEE
1	0	- ^a	-	-	-	-	-	-	-
2	0	-	-	-	-	-	-	-	-
3	0	-	-	-	-	-	-	-	-
4	4	80	-	160	-	≥25,600	-	-	-
5	4	80	-	≥320	-	≥25,600	-	-	-
6	4	40	-	80	-	≥25,600	40	-	-
7	7	80	-	≥320	-	≥25,600	40	3,200	-
8	7	≥640	-	≥320	-	≥25,600	-	25,600	-
9	7	320	10	≥320	-	≥25,600	-	3,200	40
10	10	≥640	160	≥320	-	≥25,600	-	≥51,200	800
11	10	≥640	-	≥320	-	≥25,600	-	≥51,200	-
12	10	≥640	-	≥320	-	≥25,600	-	≥51,200	800
13	14	≥640	-	≥320	-	≥25,600	-	≥51,200	40
14	14	≥640	-	≥320	-	≥25,600	-	≥51,200	3,200
15	14	≥640	-	≥320	-	≥25,600	-	≥51,200	40
16	21	≥640	-	≥320	-	≥25,600	-	≥51,200	-
17	21	≥640	-	≥320	-	12,800	-	25,600	40
18	21	160	-	≥320	-	3,200	-	25,600	-
19	30	≥640	-	≥320	-	≥25,600	-	≥51,200	800
20	30	160	-	≥320	-	≥25,600	-	25,600	40
21	30	≥640	-	≥320	-	≥25,600	-	≥51,200	3,200
22	90	640	-	≥320	-	≥25,600	-	≥51,200	3,200
23	90	<40	-	≥320	-	3,200	-	3,200	400
24	90	640	-	≥320	-	12,800	-	≥51,200	6,400

^a- signifies <10 HI and N, <40 MAC ELISA and IgG ELISA.

Table 2. Results of hemagglutination-inhibition (HI) and serum dilution-plaque reduction neutralization (N) tests, IgM antibody capture enzyme-linked immunosorbent assays (MAC ELISA) and IgG assays with sera from sentinel chickens and wild birds naturally infected with eastern equine encephalitis (EEE), western equine encephalitis (WEE), or St. Louis encephalitis (SLE) viruses.

Bird no.	Species	HI			N			MAC ELISA		IgG	
		EEE	WEE	SLE	EEE	WEE	SLE	EEE	WEE	EEE	WEE
1	Chicken	40	- ^a	-	>40	-	-	40	-	-	-
2	Chicken	80	-	-	>40	-	-	40	-	-	-
3	Chicken	80	-	-	>40	-	-	>400	-	-	-
4	Chicken	80	-	-	-	-	-	-	-	-	-
5	Chicken	-	>80	-	-	>80	-	-	>400	-	>400
6	Chicken	-	>80	-	-	>80	-	-	>400	-	>400
7	Chicken	-	40	-	-	>80	-	>400	>400	-	>400
8	Chicken	-	40	-	-	>80	-	-	>400	-	>400
9	Chicken	-	10	-	-	20	-	-	>400	-	>400
10	Chicken	-	>80	-	-	160	-	-	>400	-	>400
11	Chicken	-	>80	-	-	-	-	-	-	-	-
12	Chicken	-	-	40	-	-	80	-	-	-	-
13	Chicken	-	-	40	-	-	160	-	-	-	-
14	Chicken	-	-	40	-	-	160	-	-	-	-
15	Chicken	-	-	40	-	-	160	-	-	-	-
16	Chicken	-	-	40	-	-	40	-	-	-	-
17	Chicken	-	-	40	-	-	40	-	-	-	-
18	Chicken	-	-	>80	-	-	>80	-	-	-	-
19	Chicken	-	-	20	-	-	>80	-	-	-	-
20	Chicken	-	-	10	-	-	40	-	-	-	-
21	Chicken	-	-	10	-	-	40	-	-	-	-
22	Chicken	-	-	10	-	-	>40	-	-	-	-
23	Chicken	-	-	10	-	-	>80	-	-	-	-
24	Chicken	-	-	-	-	-	-	-	-	-	-
25	Chicken	-	-	-	-	-	-	-	-	-	-
26	Chicken	-	-	-	-	-	-	-	-	-	-
27	Bobwhite	40	40	-	>80	-	-	-	-	>400	-
28	Blue Jay	160	80	-	>80	-	-	>400	-	-	-
29	Blue Jay	80	80	-	320	-	-	>400	-	-	-
30	Blue Jay	40	80	-	>80	-	-	>400	-	-	-
31	Blue Jay	40	-	-	>80	-	-	>400	-	-	-
32	Blue Jay	>160	-	-	>80	-	-	-	-	40	-
33	Blue Jay	>160	-	-	>80	-	-	>400	-	40	-
34	Blue Jay	20	-	-	>80	-	-	>400	-	-	-
35	Mourning Dove	20	-	-	>80	-	-	>400	-	-	-
36	House Sparrow	20	-	-	-	-	-	-	-	-	-
37	Cardinal	20	-	-	-	-	-	-	-	-	-

Table 2. (Continued)

Bird no.	Species	HI			N			MAC ELISA		IgG	
		EEE	WEE	SLE	EEE	WEE	SLE	EEE	WEE	EEE	WEE
38	Cardinal	20	-	-	-	-	-	-	-	-	-
39	Cardinal	20	-	-	-	-	-	-	-	-	-
40	Cormorant	-	-	≥80	-	-	≥80	-	-	-	-
41	Mourning Dove	-	-	20	-	-	≥80	-	-	-	-
42	Blue Jay	-	-	20	-	-	≥80	-	-	-	-
43	Gull	-	-	-	-	-	-	-	-	-	-
44	Gull	-	-	-	-	-	-	-	-	-	-
45	Gull	-	-	-	-	-	-	-	-	-	-

a- signifies <10 HI and N, <40 MAC ELISA and IgG ELISA.

Rapid and Specific Serodiagnosis of Western Equine Encephalitis Virus
Infection in Horses

Paired sera from 28 non-vaccinated horses, with serologically confirmed western equine encephalitis (WEE) virus infections, were evaluated for the presence of immunoglobulin (Ig) M and IgG directed against WEE virus, by use of enzyme immunoassay. Twenty-one of the horses developed 4-fold or greater increases or decreases in serum IgM titers in paired serum samples, confirming the diagnosis of WEE in these horses. Of the remaining seven horses, one had stable IgM titers, one had a 2-fold rise in IgM titer between paired sera, two had 2-fold falls in IgM titer, and for three horses adequate volumes were not available for both sera of the pair. Twenty-nine of 56 blood samples collected from these 28 horses had been collected within the first 3 days after clinical disease was recognized; all 28 horses and 48/53 available sera had IgM antibody to WEE virus. Immunoglobulin M also was detected in sera of 27 of 45 other unvaccinated horses that had illnesses clinically compatible with WEE. Sera with IgM did not have cross-reacting IgM against eastern equine encephalitis virus. Therefore, the sensitivity, specificity, and lack of persistence of IgM was useful in the rapid diagnosis of WEE virus infections in horses.

(Calisher, C.H.; Al-D. Mahmud, M.I.; El-Kafrawi, A.O.; Emerson, J.K.; Muth, D.J.)

Table 1. Serologic responses of 28 horses with serologically confirmed western equine encephalitis (WEE) virus infections

Horse No.	Age (yr)	Sex	Days after onset of WEE	Antibody titers against WEE virus			
				HI	CF	IgM	IgG*
1	1	M	0	320	8	4,000	3.05
			23	160	32	1,000	5.97
2	1	F	1	≥1,280	<8	16,000	3.10
			32	640	64	<100	5.23
3	1	M	2	40	16	8,000	4.08
			23	80	64	100	5.28
4	1	NR+	0	80	<8	16,000	2.99
			32	160	16	1,000	4.25
5	1	F	1	80	<8	32,000	3.39
			13	80	64	4,000	4.08
6	NR	NR	1	640	32	8,000	2.94
			11	640	256	2,000	5.12
7	2	NR	2	40	16	16,000	2.84
			34	40	64	<100	7.86
8	3	F	0	40	<8	4,000	<2.00
			1	160	<8	16,000	2.83
9	1	F	1	160	<8	16,000	2.48
			50	40	8	<100	3.58
10	1	NR	0	<10	<8	1,000	<2.00
			42	20	16	<100	4.00
11	1	M	1	<10	16	<100	3.52
			1	160	128	NA@	NA
			6	160	512	16,000	4.17
12	1	NR	0	40	16	16,000	3.48
			17	20	32	2,000	3.46
13	1	NR	0	80	<8	4,000	<2.00
			14	40	32	2,000	5.07
14	1	M	0	10	<8	8,000	3.60
			19	20	32	100	7.30
15	1	NR	3	20	8	8,000	2.14
			17	40	64	1,000	5.65
16	1	F	0	80	<8	16,000	2.87
			15	40	16	4,000	4.57

Table 1. (Continued)

Horse No.	Age (yr)	Sex	Days after onset of WEE	Antibody titers against WEE virus			
				HI	CF	IgM	IgG*
17	2	M	2	20	8	4,000	2.04
			18	40	64	2,000	5.45
18	1	F	0	10	<8	NA	NA
			22	40	16	8,000	3.87
19	NR	NR	0	10	8	4,000	<2.00
			14	20	128	8,000	4.30
20	1	NR	0	80	16	8,000	2.58
			14	20	32	<100	7.56
21	1	F	0	80	<8	2,000	2.66
			21	320	32	<100	2.79
22	2	M	1	160	32	4,000	<2.00
			10	320	128	1,000	3.42
23	1	M	1	10	<8	1,000	2.82
			11	10	16	1,000	3.91
24	1	F	2	20	<8	1,000	2.17
			4	80	<8	8,000	3.32
25	NR	NR	0	160	64	1,000	4.44
			12	320	16	8,000	2.76
26	1	NR	0	80	<8	NA	NA
			14	40	32	2,000	3.75
27	1	F	0	10	<8	NA	NA
			22	40	16	4,000	3.52
28	1	M	1	10	8	1,000	2.68
			15	20	64	<100	3.79

x All horses listed here were shown to have 4-fold or greater increases or decreases in HI, CF, or neutralizing antibody to WEE virus; neutralization tests results not shown.

* OD ratio $\frac{\text{Test serum with antigen}}{\text{Test serum without antigen}}$

NR+ Information not reported

NA@ Serum not available for testing

TABLE 2. Serologic evaluations of 45 horses with suspected western equine encephalitis (WEE).

Horse No.	Age (yr)	Sex	Days after onset of illness	Antibody titers against WEE virus			
				HI	CF	IgM	IgG*
29	1	F	0	>1,280	32	32,000	2.61
30	1	F	1	≥1,280	64	32,000	4.01
31	1	NR+	1	320	NA@	8,000	2.82
32	1	M	1 ^x	NA	NA	16,000	3.54
33	1	M	3 ^x	NA	NA	2,000	<2.00
34	1	NR	3 ^x	NA	NA	8,000	3.62
35	2	NR	0 ^x	NA	NA	8,000	4.23
36	1	F	1	80	8	16,000	3.46
37	3	M	1	40	<8	1,000	<2.00
38	1	F	7	40	<8	8,000	<2.00
39	1	F	1	40	8	8,000	<2.00
40	1	NR	0	80	16	2,000	2.20
41	1	F	0	20	8	8,000	<2.00
42	NR	NR	0	160	16	16,000	<2.00
43	12	NK	0	40	<8	16,000	2.72
44	7	NR	0	320	64	16,000	2.72
45	NR	NR	0	80	16	4,000	2.25
46	NR	NR	1	320	<8	16,000	2.10
47	2	NR	1	20	16	16,000	3.82
48	7	NR	1	160	8	16,000	2.82
49	1	NR	0	80	<8	32,000	<2.00
50	2	M	1	160	16	32,000	2.73
51	2	F	0	160	32	8,000	3.29
52	2	F	0	40	32	8,000	3.16
53	NR	NR	0	160	128	64,000	3.37
54	1	NR	1	80	<8	8,000	<2.00
55	1	NR	2	80	8	8,000	2.63
56	8	NR	2	<10	<8	<100	<2.00
57	13	M	0	<10	<8	<100	2.01
58	15	NR	0	<10	<8	<100	<2.00
59	13	NR	0	<10	<8	<100	<2.00
60	4	F	0	<10	<8	<100	<2.00
61	2	NR	0	<10	<8	<100	<2.00
62	1	M	12	<10	<8	<100	<2.00
63	3	M	22	<10	<8	<100	<2.00
64	1	M	0	<10	<8	<100	<2.00
65	25	F	0 ^x	NA	NA	<100	<2.00
66	4	NR	0 ^x	NA	NA	<100	<2.00

Table 2. (Continued)

Horse No.	Age (yr)	Sex	Days after onset of illness	Antibody titers against WEE virus			
				HI	CF	IgM	IgG*
67	26	F	0 ^x	NA	NA	<100	<2.00
68	1	NR	2	10	NA	<100	<2.00
69	1	M	1	10	NA	<100	2.30
70	1	M	26	20	8	<100	4.05
71	1	NR	0	20	NA	<100	2.01
72#	1	M	0 ^x	<10	8	<100	<2.00
			15	320	64	<100	4.75
			171	<10	<8	<100	3.52
73	NR	M	1	40	32	<100	2.68
			4	≥1,280	≥1,024	<100	3.79

* OD ratio $\frac{\text{Test serum with antigen}}{\text{Test serum without antigen}}$

NR+ Information not reported

NA@ Serum not available for testing

x Negative (<10) in neutralization tests for antibody to WEE virus

This horse was shown to have a 4-fold or greater increase in neutralizing antibody to WEE virus.

Report from the Department of Virology
School of Tropical Medicine,
Calcutta, India.

Passive transfer of immunity following JE vaccination.

Different lots of mouse brain inactivated Japanese encephalitis (JE) vaccines were prepared using weanling (3-4 Wks.) and adult (8-10 Wks) Swiss albino mice, employing one locally isolated (JE'76) as well as the reference Japanese strain (Nakayama-NIH) of JE viruses as per the method of J.Nakamura et al (1).

Groups of adult female mice were immunised separately with the above vaccine lots (0.3 ml/I.P/mouse at weekly interval x 3 such) following which they were allowed to mate. Litters born of these mice were kept with their mothers and were challenged on 3rd day with approximately 100 LD₅₀ of JE'76 strain of virus (local) through I.P.route (Gr.A). In another set of experiment, litters born of vaccinated mothers were transferred to unvaccinated foster mothers just after birth (Gr.B). Likewise, litters born of unvaccinated mothers were transferred to vaccinated foster mothers (Gr.C). Litters of both these groups were challenged exactly as Gr.A on 3rd day of their birth. Similar study was carried out using a standard commercial lot of JE vaccine (lot No. 106, Toshiba Kagaku Kogyo, Co., Ltd.). Litters born of unvaccinated mother were also challenged as above to serve as control.

The results are shown in the table

Result- The study reveals that weanling mouse brain vaccines prepared with local as well as Nak-NIH reference strain of JE viruses conferred fairly well protection to suckling mice in all the experimental groups against JE virus challenge, and the level of protection was almost similar with vaccine of local strain (45 - 85 percent) as well as with Nak-NIH strain (47.5 - 87.5 percent).

JE virus challenge (100 LD₅₀) in litters having passive immunity, either congenital or acquired.

<u>Vaccines</u>	<u>Strain used</u>	<u>Mice group</u>	<u>No. survived/ No. challenged</u>
I. Weanling mouse brain	JE'76	Gr. A	34/40 (85.0)*
		Gr. B	18/40 (45.0)
		Gr. C	21/40 (52.5)
	Nak-NIH	Gr. A	35/40 (87.5)
		Gr. B	19/40 (47.5)
		Gr. C	24/40 (60.0)
II. Adult mouse brain	JE'76	Gr. A	13/40 (32.5)
		Gr. B	2/40 (5.0)
		Gr. C	3/40 (7.5)
	Nak-NIH	Gr. A	31/40 (77.5)
		Gr. B	16/40 (40.0)
		Gr. C	20/40 (50.0)
III. Commercial	Nak-NIH	Gr. A	40/40 (100.0)
		Gr. B	27/40 (67.5)
		Gr. C	33/40 (82.5)
IV. Control	-	-	0/40 (0.0)

* Figures in parenthesis denote percentage.

Gr. A - Litters born of vaccinated mice kept with own mother.

Gr. B - Litters born of vaccinated mice kept with unvaccinated mother.

Gr. C - Litters born of unvaccinated mice kept with vaccinated mother.

On the contrary, with adult mouse brain vaccines, protection varied significantly ($P < 0.05$) between local strain (5-32 percent) and Nak-NIH strain (40-77 percent). Further, the weanling mouse brain vaccine was more protective than adult mouse brain vaccine irrespective of strains used. Commercial vaccine, however, offered highest protection (67.5 - 100 percent) in all the experimental groups.

Suckling mice of Gr.A (born of vaccinated mother and fed on their milk) showed highest protection against lethal JE virus challenge followed by litters of Gr. C (receiving only milk of vaccinated mother) and Gr.B (born of vaccinated mother only).

This study suggests that vaccine induced immunity of mothers is passively transferred to offspring efficiently. The combined role of placenta and milk mediated immunity in conferring protection was higher followed in order by milk and placenta mediated immunity alone. Further, it was found that the vaccines prepared from Nak-NIH strain was more protective than those prepared from local strain of virus.

1. NIBS. Bull. Biol. Res. 8 78-99, 1969.

(M. Bhattacharyya, K.K. Mukherjee, S.K. Chakraborty, P.N. De, M.S. Chakraborty.)

REPORT FROM VIROLOGY SECTION, DEPARTMENT OF MICROBIOLOGY, PRINCE HENRY HOSPITAL, LITTLE BAY, NSW, AUSTRALIA

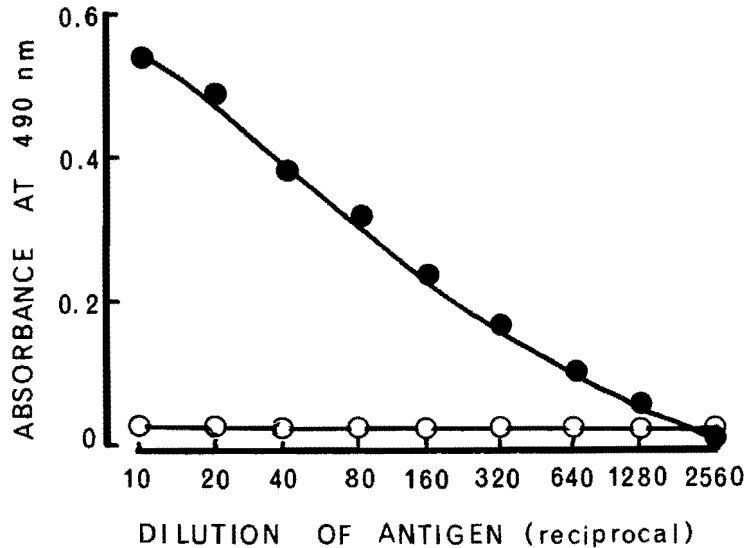
Detection of Ross River Virus Antigens by Enzyme-Linked Immunosorbent Assay.

An approach commonly used for the isolation of arboviruses such as Ross River virus (RR virus) from human sera and mosquitoes has been that of inoculation of Aedes albopictus cell culture (C6/36 clone) followed by examination of the cells by immunofluorescence for the presence of specific antigens (1,2,3). However, it is now clear that enzyme-linked immunosorbent assay (ELISA) is a highly sensitive and specific method for the detection of viral antigens and it is not surprising that this technique has also been used for the detection of antigens to arboviruses such as dengue, La Crosse, Rift Valley fever and yellow fever both in cell culture supernatant fluids, following an amplification step such as inoculation of C6/36 cells, or directly in sera and mosquito pools (4,5,6,7). The aim of the work reported here was to develop an ELISA based on antigen capture for the detection of RR virus.

The method used was similar to that described for La Crosse virus (5) and, after determining optimal buffer composition, reagent dilutions and incubation time, essentially consisted of six steps. First, the walls of flat-bottomed microtitre plates were coated with the IgG fraction of horse anti-RR virus immunoglobulins (capture antibodies) and incubated overnight at 4°C. All wells were then treated with 1% bovine serum albumin (blocking step) followed by the addition of test samples and overnight incubation at 4°C. The IgG fraction of rabbit anti-RRvirus immunoglobulin (detector antibodies) was then added and the plates were incubated for 1 h at 37°C. Swine anti-rabbit IgG conjugated to horseradish peroxidase was added and the plates incubated for 1 h at 37°C. Following addition of substrate (O-phenylenediamine dihydrochloride), the plates were left for 30 mins at room temperature and, after stopping the reaction with 3N sulphuric acid, the coloured product was read spectrophotometrically. Appropriate conjugate, negative and virus controls were included in each assay. A positive value was defined as one which was greater than the 95% predicted limit of absorbance of the negative control antigen. An internal statistical quality control of several of the parameters of the assay was employed.

The sensitivity of the ELISA for the detection of antigens to RR virus was determined by serially diluting virus and control preparations and measuring absorbance values (Figure 1). The minimum amount of virus detected was $10^{4.1}$ TCID₅₀/0.1ml for the T48 prototype strain of RR virus (Figure 1) and $10^{2.6}$ for strain 96272; sensitivity with other Australian strains of RR virus varied between these two figures. It is of interest to note that the capture antibodies were prepared from the serum of a horse from the south coast of NSW in the area from which strain 96272 was isolated, whereas the prototype T48 strain was isolated from mosquitoes collected in a geographically distant area (north Queensland).

FIG. 1 ELISA absorbance values using the prototype T48 strain of RR virus (●), grown in BHK-21 cells ($TCID_{50} = 10^{7.3}/0.1ml$), and the control antigen (○).

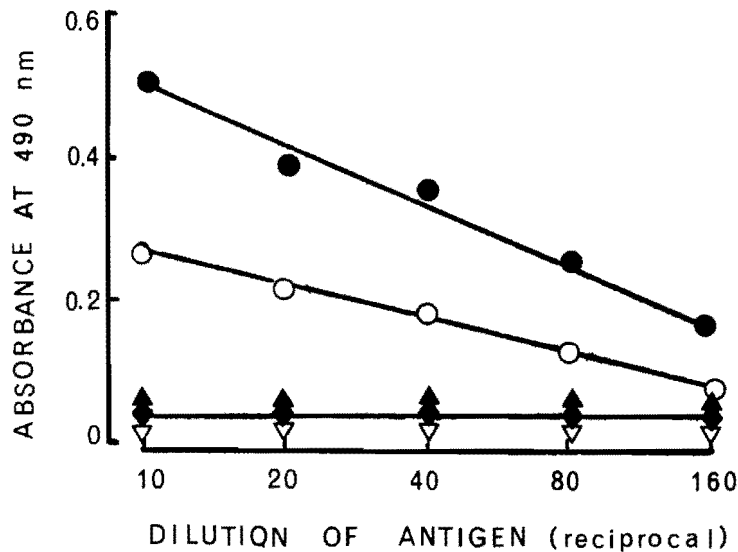


Assay specificity was determined in several ways. First, 33 Australian and 2 Fijian strains of RR virus gave positive absorbance values (absorbance values 0.17 - 0.61; 95% predicted limit of absorbance value of negative control = 0.07) when virus stocks were tested at a dilution of 1:10, whereas nine arboviruses, not alphaviruses, were negative (absorbance values 0.02 - 0.03). Second, dilutions were made of five alphaviruses ($TCID_{50}/0.1 ml 10^5-10^7$) and the results are shown in Figure 2. The only cross reaction was observed with Getah which seems an unlikely virus to be encountered in Australia. Examination of the results over a number of tests showed that the assay was accurate and precise.

A large number of mosquito pools were tested for the presence of RR virus by inoculation of C6/36 cells followed by passage in BHK-21 cells and examination for the development of a cytopathic effect. All of 581 pools which were initially negative for RR virus were again negative when supernatant fluids from both C6/36 and BHK-21 cells were tested by the ELISA for specific antigens. Five pools from which RR virus was originally isolated were positive when fluids from both C6/36 and BHK-21 cells were tested by ELISA. Antigens to RR virus were not detected when the ELISA was performed directly on the same mosquito pools.

From these results it is clear that the ELISA is a sensitive and specific technique for the identification of antigens to RR virus following

FIG. 2 Absorbance values when five alphaviruses were tested by ELISA. Viruses were the T48 prototype strain of RRV (●), Getah virus (○), Sindbis virus (▲), Whataroa virus (▽) and Barmah Forest virus (◆).



amplification in C6/36 cells. Further work is planned in an attempt to increase the sensitivity of the assay to enable it to detect RR viral antigens directly from infected mosquitoes.

(G.S. James and M.J. Cloonan)

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Transovarial transmission of two Phleboviruses (Bunyaviridae) by the sand fly (*Phlebotomus perniciosus*)

Toscana and Arbia viruses (family Bunyaviridae, genus Phlebovirus) were isolated from sand flies (*Phlebotomus perniciosus* and *P. perfiliewi*) collected in different areas of the Tuscany region of Italy. The susceptibility of a laboratory colony of *P. perniciosus* (established in 1981 by Dr. M. Maroli, Laboratory of Parasitology, Istituto Superiore di Sanità, Rome) to experimental infection with Toscana and Arbia viruses was studied (Ciufoini et al., Am. J. Trop. Med. Hyg 34, 174, 1985). Briefly, low levels of multiplication of both viruses were detected after intrathoracic inoculation of the sand flies. Although the initial infection rates were only 50% for Toscana virus and 75% for Arbia virus, approximately 100% of the sand flies were found to contain virus when they were tested on subsequent days. However, only some insects were found infected after oral ingestion of the two viruses. The infection rates observed after the digestion of the blood meal decreased from 51% to 18% along with reduction in the amount of the virus ingested. Even when relatively high quantities of virus were present in the engorged females, the virus disappeared in many flies within a few days.

The results of the feeding experiments with Toscana and Arbia viruses in *P. perniciosus*, which is a suspected vector for both viruses, might be an indication that ingestion of virus from a viremic host is not an efficient mechanism to infect sand flies in natural conditions. Transovarial transmission has been suggested as a possible mechanism for maintenance of several phleboviruses in nature without a vertebrate host. Isolations of both Toscana and Arbia viruses have been obtained from field-collected male and female sand flies, suggesting that this mechanism may also occur with these two viruses.

We have since conducted studies of vertical transmission of Toscana and Arbia viruses by *P. perniciosus* in the laboratory. Table 1 shows the results of experimental transovarial transmission obtained after intrathoracic inoculation of parent females with Toscana virus. The virus was transmitted to 75% of the F₁ progeny (84% of males and 67% of females). The virus was also recovered from 67% of adults of a F₂ progeny obtained from oviposition of 8 females from the F₁ progeny, which were allowed to mate with their siblings. Table 2 shows the results of a similar experiment with Arbia virus. The progeny of three consecutive generations were tested. Virus infection rates were 47% in the F₁ progeny, 37% in the F₂ progeny (derived from 21 females of the F₁ progeny), and 34% in the F₃ progeny (derived from 25 females of the F₂ progeny). Virus infection rates were similar for male and female insects. The virus concentrations recorded in positive flies transovarially infected did not substantially differ from those found in experimentally and in naturally-infected sand flies.

In a preliminar experiment carried out for testing the possibility of transovarial transmission of Toscana virus in orally infected *P. pernicio-*

sus, the offsprings were tested according to larval stage. The virus was recovered from 2 larvae (third instar) of the F₁ progeny. These results, however, were not confirmed in a subsequent experiment. In another experiment we examined the F₁ adult progeny from female P. perniciosus infected by ingestion with Toscana virus. No virus was detectable in any of 107 F₁ adults tested. Unfortunately, it was not possible to separate progeny of infected from that of non-infected sand flies: in fact only 50% of parent females were usually found positive when fed with the amount of virus used in the experiment. Similar results have been obtained when the F₁ progeny from females P. perniciosus infected by ingestion with Arbia virus was tested. In this experiment, however, it was possible to separate the progeny of 4 positive parent females which were monitored for the presence of virus immediately after oviposition (Table 3).

It may be possible that following oral ingestion Toscana and Arbia viruses do not easily establish infection of the germinal tissue as suggested by the inability to detect evidence of infection in offspring from virus positive female parents. This fact can not be due to the low concentrations of virus recorded in sand flies after oral infection, because these concentrations did not substantially differ from those found in insects parenterally infected, which, on the contrary, are able to transmit transovarially the virus to their offsprings.

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Table 1. Filial infection rates for Toscana virus in adult progeny of parenterally infected Phlebotomus perniciosus females

Generation	No. positives ⁺ per No. tested	Percentage of progeny infected	Content of virus per positive fly	
			Mean	Range
----- F ₁ -----				
Males	32/38	84%	2.2 _± 0.3 ⁺⁺	1.6-2.9
Females	31/46	67%	2.7 _± 0.7	1.4-4.1
Total	63/84	75%	2.4 _± 0.6	1.4-4.1
----- F ₂ -----				
Males	14/21	67%	1.9 _± 0.4	1.4-2.8
Females	26/39	67%	2.9 _± 0.5	2.0-4.0
Total	40/60	67%	2.5 _± 0.6	1.4-4.0

+ : $\geq 1.3 \text{ Log}_{10} \text{TCID}_{50} / \text{fly}$

++ : $\text{Log}_{10} \text{TCID}_{50} \pm \text{S.D.}$

Table 2. Filial infection rates for Arbia virus in adult progeny of parenterally infected Phlebotomus perniciosus females

Generation	No. positives ⁺ per No. tested	Percentage of progeny infected	Content of virus per positive fly	
			Mean	Range
----- F ₁ -----				
Males	19/40	47%	2.0 _± 0.6 ⁺⁺	1.3-3.1
Females	14/30	47%	3.0 _± 0.5	1.9-3.8
Total	33/70	47%	2.4 _± 0.7	1.3-3.8
----- F ₂ -----				
Males	12/34	35%	2.0 _± 0.6	1.3-3.4
Females	15/38	39%	2.1 _± 0.7	1.4-3.8
Total	27/72	37%	2.0 _± 0.6	1.3-3.8
----- F ₃ -----				
Males	8/19	42%	2.6 _± 0.7	1.4-3.2
Females	15/48	31%	2.8 _± 0.7	1.7-3.8
Total	23/67	34%	2.7 _± 0.7	1.4-3.8

+ : $\geq 1.3 \text{ Log}_{10} \text{TCID}_{50}/\text{fly}$

++ : $\text{Log}_{10} \text{TCID}_{50} \pm \text{S.D.}$

Table 3. Arbia virus in offsprings of 4 Phlebotomus perniciosus females infected by ingestion

Female parent N°	Virus titer in parent ⁺	N° of F ₁ offspring tested		No. positives ⁺⁺ ----- N° tested
		Males	Females	
1	2.0 ⁺⁺⁺	8	9	0/17
2	2.95	9	9	0/18
3	2.95	12	17	0/29
4	1.45	2	2	0/4
TOTAL		31	37	0/68

+ : calculated immediately after oviposition

++ : $\geq 1.3 \text{ Log}_{10} \text{TCID}_{50}/\text{fly}$

+++ : $\log_{10} \text{TCID}_{50}$

REPORT FROM NEUROVIROLOGY UNIT, RAYNE INSTITUTE, ST. THOMAS' HOSPITAL, LONDON SE1 7EH, ENGLAND.

The use of N-acetylethyleneimine (AEI) for the inactivation of Semliki Forest virus (SFV)

Acetylethyleneimine (AEI) has been used to prepare vaccines of many viruses e.g. Foot and Mouth Disease virus (FMD), rabies virus and pseudorabies virus. However, to our knowledge it has not been used with members of the Togaviridae family. Our results show that AEI is effective in producing an antigenically viable vaccine of Semliki Forest virus. Previous results have shown that AEI vaccines are superior to those produced using formalin and B-propiolactone.

In our laboratory we have used many techniques, including UV light and formalin, to inactivate viruses of the Togaviridae family. So far we have been unsuccessful in producing a vaccine which stimulates a good immunological response in mice which is also free of any detectable infective virus in the 'vaccinated' mice. It was necessary for us to produce an effective vaccine to continue our studies on the immunopathology aspects following an SFV demyelinating infection.

Three sources of SFV, used for the inactivation investigations, were derived from culture media from SFV infected chick embryo and vero cell cultures.

Samples were either clarified by centrifugation at 4°C for 15 mins at 150 x g, purified using the method of Amor and Webb (1986) or used as neat tissue culture fluids.

For the inactivation process concentrations of 0.025; 0.05

and 0.1% AEI were added to the virus samples and incubated at 5°, 23°, 37° and 47°C. Aliquots were taken from each sample at hourly intervals up to 6 hours and virus infectivity measured.

Our results showed that a variety of factors influenced the rate of inactivation. As the concentration of AEI or temperature of reaction increased the rate of inactivation also increased. However, at 5°C complete inactivation was not achieved even at the highest AEI concentration. The most important factor was the purity of the sample. AEI is known to bind with proteins so extraneous proteins in the neat and clarified tissue culture fluids reduced the efficacy of the AEI. Only with the purified samples did inactivation go to completion with all concentrations of AEI. Using these results the inactivation of SFV using AEI was calculated as following a first-order reaction. The efficacy of the 'vaccine' was tested in vivo. Vaccinated mice produced antibody levels comparable to mice given a live SFV infection. These mice were also protected against the lethal L10 strain of SFV. In addition sera from vaccinated mice was able to neutralise L10 virus reducing the titre from $10^{5.5}$ IPLD₅₀ to $10^{2.75}$.

In conclusion we have found that AEI is very suitable for producing an inactivated vaccine of SFV which affords protection in vivo and produces a good neutralising antibody. This is the first report using AEI to produce a vaccine of a Togavirus. Potentially this technique could be used produce vaccines of other members of this family which otherwise result in more severe pathological conditions.

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Amor and Webb (1986). The use of N-acetyleneimine for the inactivation of SFV in vitro. J. Med. Virol. (in press).

(S. Amor and H.E. Webb)

Virus inoculation of immature mosquitoes

An article by Pang, et al. (1983) calls attention to the rapid detection of dengue virus by immunofluorescence following intracephalic inoculation of mosquito (Toxorhynchites) larvae. This particular technique reminds me of my own experience some 33 years ago (1953) when I was first introduced to mosquito inoculation procedures by a former Rockefeller Foundation (RF) mentor, Dr. Loring Whitman.

New viruses received by the RF laboratory (in the former Rockefeller Institute, presently Rockefeller University) were routinely inoculated and passaged by Dr. Whitman into Anopheles, Aedes and Culex adults but some viruses proved incapable of multiplying in certain mosquito species. I had learned the rudiments of making fine capillary needles from glass tubing as well as the method of serial passaging a virus from infected to uninfected adults via intrathoracic inoculation. These were standard procedures, but at one point we became interested in trying to develop a sensitive technique whereby inoculated larvae/pupae might be used as a field-oriented tool for determining the relative susceptibility of various mosquito species to the viruses prevalent in a particular area.

Accordingly I set about learning if aquatic stages of Anopheles quadrimaculatus and Aedes aegypti might be suitable experimental subjects (Table). Physiological saline was the initial inoculum (later two viruses were briefly studied) and mosquitoes were allowed to emerge as adults before terminating an experiment. The most logical site of inoculation seemed to be the thorax (pupae were inoculated laterally) but early experiments (#1-3) resulted in frequent failures with many specimens dying within hours and few, if any, surviving more than one day. Larvae were then inoculated (Exp. #4) in the head (dorsal apotome or fronto-clypeal area) and encouraging results were obtained with 86% survival after 3 days and 76% by one week; a 2nd head experiment (#9) experienced considerable mortality by 3 days, nevertheless 3 emerged adults were alive after one week. When pupae were inoculated from the ventral direction or laterally but with the needle directed into the mesonotal musculature (Exp. #5), good survival was extended to 48 hours. In Exp's # 6,7,8 and 10, pupae were inoculated in the 4th abdominal sternite

while lying on a wet cotton cushion; survival for the most part was excellent up to 4 days to a week (or more).

In the final 3 experiments (#8,9,10) a virus inoculum was substituted for saline. West Nile virus (WNV) was used in pupal experiment #8. When emerged adults were triturated and the material inoculated into suckling mice, 3/5 adults were shown to contain WNV at 5 days post-infection (p.i.) and 2/5 adults at 11 days p.i. Semliki Forest virus (SFV) was used in Exp's #9 and 10 and was recovered in mice from 4/5 emerged adults (inoculated as pupae) on the 7th day p.i. but 3 adults of the larval series (Exp. #9) were negative. About this time my attention was directed elsewhere and the experiments with immature mosquitoes ceased.

When these studies were undertaken, techniques for retrieving and identifying viruses required considerable time. In my experiments, the immature inoculated mosquitoes were reared to the adult stage and held for varying periods before trituration and inoculation intracerebrally into suckling mice. More time then ensued before the mice sickened and brains were harvested for virus recovery and identification by complement fixation or neutralization test.

In today's world of rapid transportation, early diagnosis of infections is becoming increasingly important. Loring Whitman's adaptation to adult mosquitoes of an insect inoculation technique (Heal and Menusan, 1948) for arbovirus investigations in the early 1950's was an important step forward as it utilized a natural and presumably sensitive host as a laboratory model. Unfortunately Whitman never published his observations and it was left to Rosen and Gubler (1974) to formally describe the technique and adapt it with refinements for the isolation of dengue viruses. Kuberski and Rosen (1977) then introduced the adult head squash accompanied by staining with specific fluorescent antibody which simplified procedures and permitted a specific diagnosis of dengue viruses by 8-14 days p.i. In 1981, Rosen recommended the use of Toxorhynchites for the laboratory model as they were much larger than the usual colonized mosquitoes, they could tolerate larger inocula and both sexes are non-bloodsucking and thus safer to use in the event of a laboratory escape. Intrathoracic inoculation of adult Toxorhynchites became the order of the day in many laboratories, particularly those concerned with dengue virus isolation from human serum, until Thet-Win (1982), experiment-

ing with intracephalic inoculation of Toxorhynchites adults, demonstrated that dengue-2 virus could be detected as early as day 5. More recently, Pang, et al. (1983) have carried the intracephalic inoculation technique to the 4th instar larval Toxorhynchites (followed by larval head squash) and shown that dengue-1 and dengue-2 viruses can be detected as early as day 2 and readily by days 3-4. These authors ascribe the greater sensitivity of the larval inoculation technique over that of the adult to the presence of more rapidly dividing cells in the metamorphosing larva. In discussing the procedure with a colleague, Dr. Jerome Frier, I learn that he and Dr. Rosen have used the technique but prefer infecting the larva through the cervical membrane posteriorly into the thorax rather than directly through the dorsal apotome.

Thus we return full circle to inconsequential events occurring 33 years previously. The important difference, however, is the development and refinement of virus detection techniques utilizing arthropods, arthropod tissue cultures and immunofluorescence. In passing, it is noted that during a 1981-82 investigation of sylvan dengue in eastern Senegal, French workers, utilizing the adult Toxorhynchites inoculation technique, successfully recovered 215 strains of dengue-2 virus from 3 species of Aedes, whereas no virus could be recovered from infant mice inoculated with over 800 mosquito pools (Cornet, et al., 1984).

Rapid viral diagnosis via mosquito inoculation has been used to greatest effect in the area of dengue infections. The larval technique, particularly, might be used to advantage with many other human and domestic animal virus diseases, particularly those which manifest themselves as seasonal or explosive outbreaks, such as the equine encephalitides, Ross River disease, yellow fever, Japanese encephalitis, Murray Valley, St. Louis, Rocio, California group, Rift Valley, bluetongue, vesicular stomatitis and African horse sickness. The agents of these various infections may well be capable of growing in mosquito tissues but the important thing is to insure that a simple, sensitive virus identification system, such as immunofluorescence or enzyme immunoassay is available. If this is not the case, studies are strongly indicated to remedy the situation. A note of caution should be interjected here in the interpretation of results, as larval extracts of normal mosquitoes may in some cases have an inhibitory effect on virus recovery (Ksiazek, et al., 1985). A useful review of propagation and detection of viruses in mos-

quitoes has recently been published by Rosen (1984).

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Inoculation of immature mosquitoes (1953)

Exp. no.	Host	Stage	No. inoc.	Site	Inoculum	Survival by day						
						1	2	3	4	5	6	7
1a	Ano.	La.	38	Th.	Sal.	15	12	8	0			
1b	Aed.	"	30	"	"	0						
2a	Ano.	Pu.	40	"	"	36	1	1	0			
2b	Aed.	"	30	"	"	19	4	2	0			
3	"	La.	30	"	"	19	0					
4	"	"	37	He.	"	37	36	32	-	-	-	28
5	"	Pu.	27	Th.	"	23	23	0				
6	"	"	32	Ab.	"	32	32	29	-	-	-	30
7	"	"	60	"	"	-	-	-	41			
8	"	"	30	"	WNV	-	-	-	19	19		
9	Ano.	La.	22	He.	SFV	15	12	7	-	-	-	3
10	"	Pu.	30	Ab.	"	30	13	12	-	-	-	5

Abbreviations: Ano. = Anopheles, Aed. = Aedes, La. = Larva, Pu. = Pupa,
 Th. = Thorax, He. = Head, Ab. = Abdomen, Sal. = Saline, WNV = West Nile
 Virus, SFV = Semliki Forest Virus.

(Thomas H. G. Aitken)

AEROSOL INFECTIVITY OF HANTAAN AND RELATED VIRUSES IN OUTBRED WISTAR RATS

Hantaan, Seoul (Urban Rat), and Puumala viruses are antigenically related members of the Hantavirus genus, family Bunyaviridae, and are responsible for human disease ranging in severity from subclinical to severe hemorrhagic fever with renal syndrome (HFRS). Previous studies have documented infectious virus in feces and body secretions of naturally infected wild rodents and experimentally infected laboratory rats. Since inhalation of aerosolized virus has been suggested as an important route of transmission among the hantaviruses, experiments were designed to demonstrate aerosol transmission of virus to laboratory rats and to contrast the relative sensitivity of aerosol and intramuscular (IM) exposures. Groups of 5-8 rats were exposed by nose only to varying concentrations of aerosolized Hantaan, Seoul or Puumala virus for 10 minutes, or were inoculated IM with 0.5ml of serially diluted virus. The dose administered IM approximated the total inhaled dose of rats exposed to small particle aerosol. Infection was detected by demonstrating anti-hantavirus antibody in 29 day post-infection sera by immunofluorescent assay (IFA), using Hantaan or Puumala virus infected Vero E-6 cell spot slides. Rats were shown to be extremely sensitive to both routes of infection, although the ID₅₀ for IM exposure was less than for aerosol exposure (Table 1). Furthermore, *in vivo* infectivity determinations consistently were more sensitive than conventional cell culture assays. Future efforts will attempt to demonstrate shedding of infectious virus in rats following aerosol infection.

(E.O. NUZUM, C.A. ROSSI, E.H. STEPHENSON, AND J.W. LEDUC)

Table 1. Preliminary estimates of the approximate dose in plaque forming units required to infect 50% of Wistar rats following aerosol or intramuscular injection of prototype hantaviruses.

Virus	Infectious Dose ₅₀	
	Aerosol	Intramuscular
Hantaan	0.43*	0.01
Puumala	39.0	1.3
Seoul	5.6	<8.5

*Dose in plaque forming units as measured on Vero E-6 cells.

Racial Influence in DHF/DSS Development

Prior to 1981, DHF/DSS was only observed in Southeastern Asia. During the 1981 epidemic in Cuba, serious disease was observed both in blacks and whites although a significant predominance was detected in the white race (1,2). The objective of this study was to determine if the clinical epidemiological difference observed corresponds with a difference in the capacity to immunoenhancement of the macrophage in the white and black races when all the necessary conditions are present for adequate viral multiplication. For this purpose, lymphocytes from 5 white and 5 black people not infected by Dengue 1 or Dengue 2 were purified from peripheral blood and infected by Dengue 2 virus ($moi = 0.1$) with or without subneutralizing concentrations of antibodies. Viral multiplication was measured by plaque formation. To determine enhancement of viral multiplication, the total number of plaques in the presence of antibodies (X_1) was compared to those in absence of antibodies (X_0) according to the formula by Detre: $X_1 - X_0 / \sqrt{X_1 + X_0} \geq 1.96$.

Viral multiplication of Dengue 2 virus was very low and was similar in the macrophages of both whites and blacks. A marked increase was observed in viral multiplication in the macrophages of persons of the white race in the presence of antibodies compared to the black race (Fig.1). Immunoenhancement was significant in 4 of the 5 whites and no difference was observed in the black race in presence or absence of antibodies (Table 1). The enhancement of viral multiplication is shown in Fig. 2. All but one of the whites had values above limit 3 in relation to X_1/X_0 , a simplified expression for the determination of immunoenhancement.

It is known that the severity of the disease depends upon the quantity of infected cells in the individual; and it seems that people of the white race which are secondarily infected (in the presence of antibodies) with Dengue 2 produce more virus than blacks under the same conditions. This may explain, in part, that, during the Hemorrhagic Dengue epidemic of 1981 in Cuba, the number of white persons severely affected by the disease was greater than the number of blacks and that shock cases were mostly in the white race.

((L. Morier, G. Kouri, G. Guzman, M. Soler)

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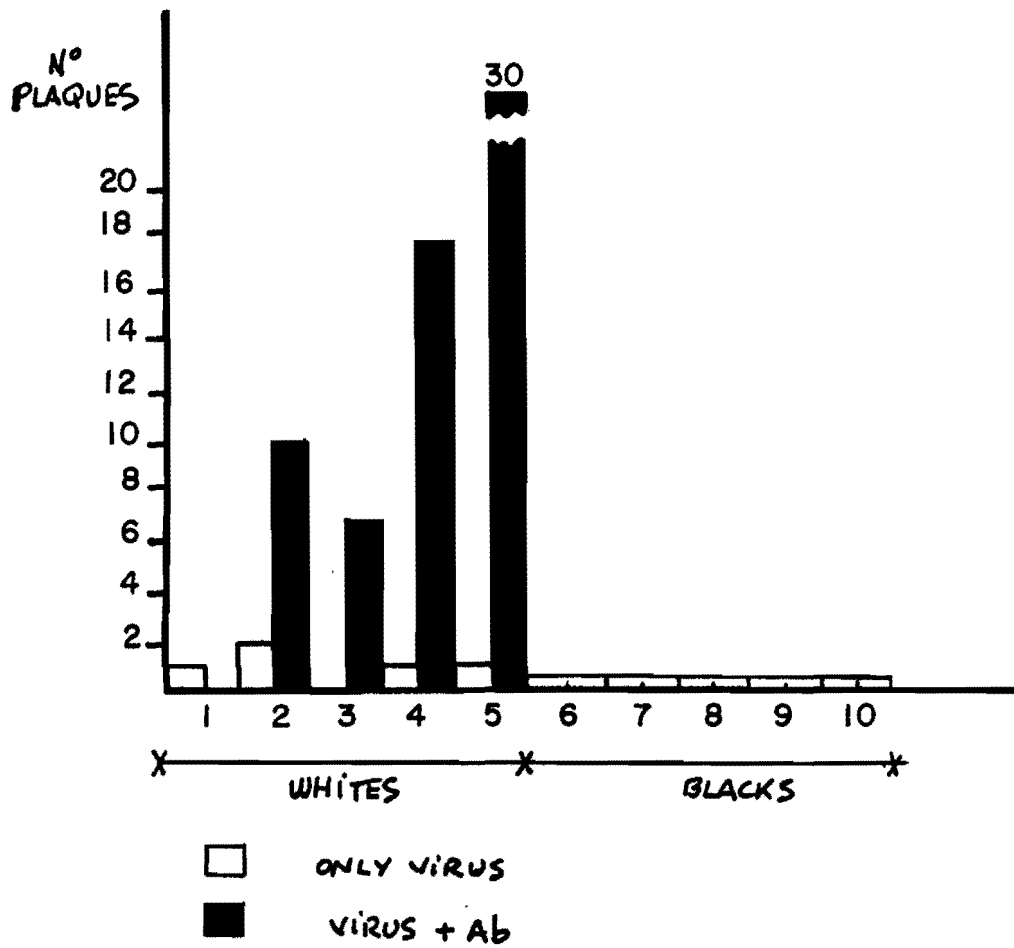


FIG. 1 A35 VIRUS PLAQUING IN EACH CASE WITH AND WITHOUT ANTIBODIES

Table 1

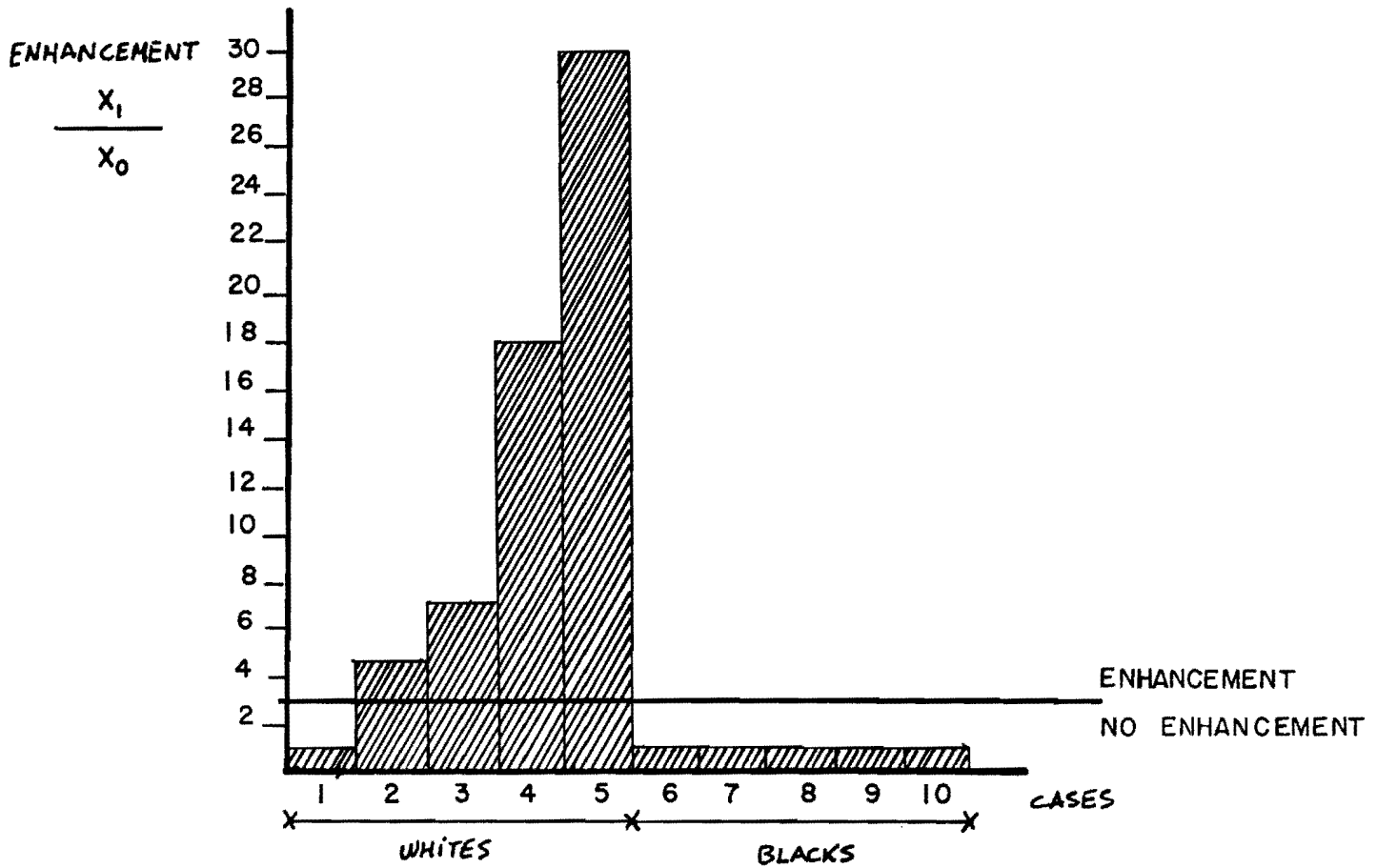
APPLICATION OF DETRE'S FORMULA TO EACH CASE ACCORDING TO THE RACE.

Case no.	Race	X ₀	X ₁	Detre's Formula *
1	W**	1	0	1
2	W	2	10	2,3
3	W	1	7	2,14
4	W	1	18	3,86
5	W	1	30	5,21
6	B***	0	0	0
7	B	0	0	0
8	B	0	0	0
9	B	0	0	0
10	B	0	0	0

* Significant difference $\geq 1,96$

** W = White

*** B = Black



X_1 - N° PLAQUES VIRUS + Ab
 X_0 - N° PLAQUES ONLY VIRUS

FIG.2 FOLD ENHANCEMENT IN THE WHITE AND BLACK RACES

REPORT FROM THE INSTITUTE OF VIROLOGY, CHINESE ACADEMY OF MEDICAL SCIENCES, BEIJING, INNER MONGOLIA, BAOTOU ANTI-DISEASE STATION, AND GUANGZHOU CHILDRENS HOSPITAL, CHINA

Possibility of Snow Shoe Hare Virus (SSH) Causing Sporadic Encephalitis in China

Thirty-four paired sera were collected from children with sporadic encephalitis in the GuanZhou hospital in the south of China and were tested against 14 different arbovirus antigens (VEE, CHIK, GETAH, ROSS RIVER, POWASSAN, TEMBUSU, LANGET, KUNJIN, JE, DENGUE, NEGISHI, LA CROSSE, CE, SSH) by the HI test.

Nine of thirty-four sera were positive. Five of them had a 4-fold antibody increase between the acute sera and convalescent sera. The titer of acute sera was lower than 1:10, whereas the average titer of convalescent sera was 1:356. Four SSH-positive cases occurred in May and one in July. Four cases were positive to Negishi virus; none were positive to JE virus.

(Chen Bo Quan, Lu Qin Zhi, Li Ahe Lin, Chang Ru Xu)

Acknowledgement: All antigens used were kindly supplied by Dr. R.E. Shope, Yale University, School of Medicine.

REPORT FROM THE SOUTHWEST FOUNDATION FOR BIOMEDICAL RESEARCH, VIROLOGY
AND IMMUNOLOGY DEPARTMENT, WHO COLLABORATING CENTER FOR REFERENCE AND
RESEARCH IN SIMIAN VIRUSES, SAN ANTONIO, TEXAS, USA

Dot Immunobinding Assay for the Detection of Arbovirus Antibody

The recent development of a rapid (3-5 hours), but highly sensitive and specific dot-immunobinding assay (DIA) for the detection of virus antibody (Heberlin, R.L. and Kalter, S.S., J. Clin. Micro. 23:109-114, 1986) has provided an opportunity to use this procedure for screening animal sera for viral antibodies. This need was also reenforced by the occurrence of central nervous system disease in a free-roaming colony of Japanese macaques (*Macaca fuscata*) maintained near Dilley, Texas. Screening of these animals including acute and convalescent sera, on a surviving monkey showed the presence of antibody to WEE, EEE, St. Louis, and VEE. Histopathologic studies on the brain of one animal was also indicative of a "viral encephalitis". The possibility that this colony may act as sentinels for detecting arbovirus infections in Texas is under consideration. Studies are underway to expand these findings as well as to develop procedures for minimizing cross reactions.

(S.S. Kalter, Director)

