DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control

Gubler

June 1, 1985

From: B.R. Miller

Subject: Attached "Arthropod-Borne Virus Information Exchange"

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

You will notice that this issue is late. Because of Dr. W. Adrian Chappell's retirement, the editorial office of the "Exchange" has moved to Fort Collins, Colorado, although the printing and distribution are carried out in Atlanta. Thus, through confusion and my own inexperience, time passed.

I know all of us in the arbovirus community wish to thank Dr. Chappell for his work and accomplishments as editor of the "Exchange".

I was amazed to find that there are over 400 names on the mailing list for the "Exchange". Over the last number of years as new names have been added to the mailing list, the number of contributions to the "Exchange" has declined. The reasons for this curious inverse relationship are obscure, nonetheless, the situation needs to be addressed.

The "Info Exchange" can only exist if there is information to exchange. In the past a subscription to the "Exchange" was free. However, in the future, we all must live up to, "in order to receive ye must give".

I know that I need not remind you that the "Info Exchange" exists to publish all kinds of information pertaining to arboviruses. It serves as a unique place to present data that may otherwise never see the light of day in a formal publication, but, nevertheless merits dissemination to interested parties.

As long as sufficient material arrives, I will keep the "Exchange" on its twice yearly publication schedule; otherwise, a single yearly publication will be issued in June. I would certainly entertain ideas from the readership that would serve to motivate us all in sharing our current research with our colleagues in the international arbovirus community.

Please address all communications to the undersigned.

Barry R. Miller

Barry R. Miller, Ph.D.
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attachment

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GUIDE FOR AUTHORS

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 publication does not constitute formal publication. Any reference to or quotation of any part of this publication must be authorized directly by the person or agency submitting the article. The editor of the "Information Exchange" cannot authorize references and quotations.

Deadlines for articles to be published are March 1 and September 1.

The following format should be used for all articles submitted:

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.

ANNOUNCEMENT

The Arbovirus Reference Branch, DVBVD, CDC, is gathering a collection of sera to be used as reference controls for IgM and IgG enzyme immunoassays (EIA). When a serum is found to contain either IgM or IgG antibody by EIA, it is dispensed in 25 µL multiple aliquots, labelled, and stored at -70°C. Later, these will be tested for homologous and (limited) heterologous reactivity. If satisfactory, we will make them available, upon request, as EIA controls for state health departments and for the general scientific community. Since we have recently begun this effort, it will be a few months before we are in a position to make these control sera available. Thus far, we have human sera with IgM antibody to viruses eastern equine encephalitis, western equine encephalitis, Sindbis, La Crosse, Colorado tick fever, St. Louis encephalitis and to (Broad) Group B and sera with IgG antibody to western equine encephalitis and Colorado tick fever viruses.

If individuals in the scientific community have human or horse sera with IgM or IgG antibodies to any other arboviruses, we would appreciate your contacting us if you would be willing to share them with us for the aforesaid mentioned control purposes. We consider volumes of 0.5-2.5 ml worthwhile for storage. If you have smaller volumes but multiple specimens, these may be useful when pooled. For further discussions, please contact:

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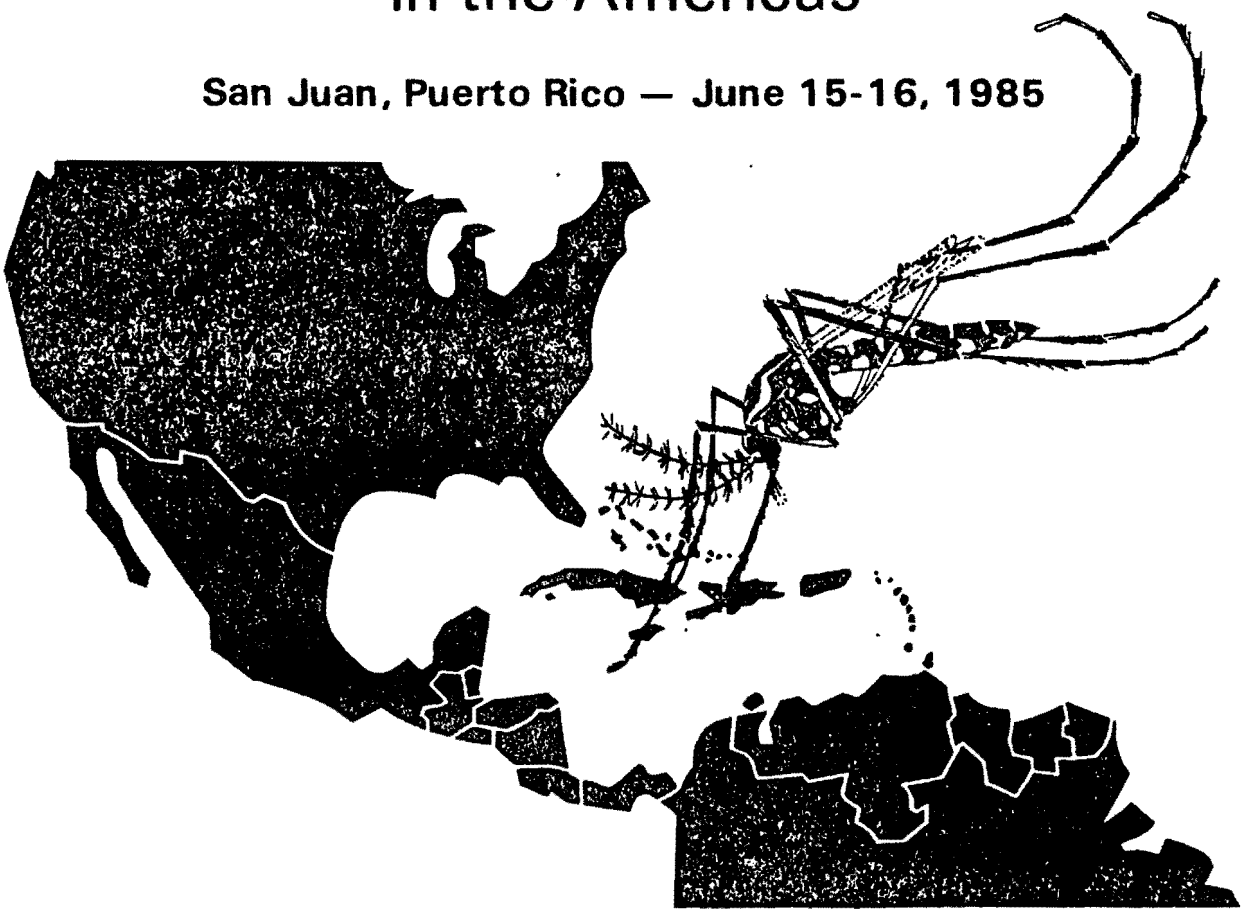
(303) 221-6459

The First International Seminar
on
DENGUE HEMORRHAGIC FEVER
In the Americas

San Juan, Puerto Rico — June 15-16, 1985



U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control

Commonwealth of Puerto Rico
Assistant Secretariat for
Environmental Health

Pan American Health Organization
Pan American Sanitary Bureau
World Health Organization

CONFERENCE FACTS

FIRST INTERNATIONAL SEMINAR ON
DENGUE HEMORRHAGIC FEVER IN THE AMERICAS

DUPONT PLAZA HOTEL
SAN JUAN, PUERTO RICO
JUNE 14-16, 1985

SPONSORS: The seminar is sponsored by the Puerto Rico Department of Health, the Pan American Health Organization and the Centers for Disease Control.

PROGRAM: The purpose of the seminar is to increase awareness in the medical communities and among health officials in the American region, to the potential threat of epidemic dengue hemorrhagic fever, to acquaint them with current methods of diagnosis and treatment of the disease, and to emphasize the need to implement prevention and control measures in the region. The program presentations will be by invitation only, and will deal with clinical diagnosis and treatment, pathophysiology, pathogenesis, vaccines, laboratory diagnosis, surveillance, prevention and control. Invited speakers are all experts in their field and include Drs. R. Carlson, S. B. Halstead, K. M. Johnson, C. Dotres, S. Nimmanitya, C. Ramírez Ronda, J. E. Rhode, L. Rosen, P. K. Russell, Sumarmo. The conference chairman is Dr. D. J. Gubler, Chief, Dengue Branch and Director, San Juan Laboratories, Centers for Disease Control. Members of the program and conference committee are R. H. Bermúdez, M.D., A. Casta, R. M. de Andino, M.D., G. Kuno, Ph.D., C. León Valiente, M.D., R. J. Mayoral, Atty., R. Miranda Franco, T. P. Monath, M.D., R. J. Novak, Ph.D., F. Pinheiro, M.D., C. M. Ramírez Ronda, M.D., G. E. Sather, H. Stubbe, M.D.

SCHEDULE:			
	Friday, June 14	Registration	2:00 - 7:00 p.m.
		Social	7:00 - 9:00 p.m.
	Saturday, June 15	Opening Ceremony	8:00 - 9:00 a.m.
		Clinical diagnosis & treatment of DHF	9:00 a.m. - 5:00 p.m.
		Social	7:00 - 11:00 p.m.
	Sunday, June 16	Pathogenesis of DHF	8:00 - 11:00 a.m.
		Prevention and control	11:00 a.m. - 4:30 p.m.
		Closing Ceremony	5:00 p.m.

REGISTRATION: A fee of $25 U.S. will be charged each participant who registers in advance. After May 15, the registration fee will be $30 U.S. Instructions for advance registration and hotel reservations will be mailed in late February. Checks should be made out to DHF Conference Committee.

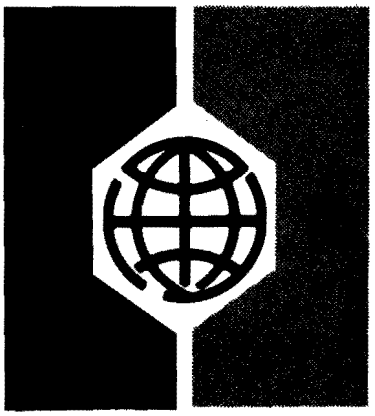
CONFERENCE HOTEL: Dupont Plaza - Tel. (809)724-6161

Conference Rates

Single	Double
U.S.$55	$55

Inquiries regarding the seminar should be addressed to:

Duane J. Gubler, Sc.D.
Chief, Dengue Branch and
Director, San Juan Laboratories
Centers for Disease Control, CID
G. P. O. Box 4532
San Juan, PR 00936



AMERICAN COMMITTEE ON ARTHROPOD-BORNE VIRUSES

1984 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 Diseases Bulletin.

* 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.

Distribution of Catalogue Materials: At the start of 1984, 181 mailings of Catalogue material were being made. During the year, eight addresses were dropped and three new participants were added to the mailing list. At the end of the year, 176 mailings of Catalogue material were being made, including 57 within the U.S.A. and 119 to foreign addresses. Distribution by continent was: Africa 19, Asia 22, Australasia 8, Europe 40, North America 70 and South America 17.

Abstracts and Current Information: A total of 647 abstracts or references were coded by subject matter and distributed to participants during 1984. Of this total, 495 were obtained from Biosciences Information Service, 149 from Abstracts on Hygiene and the Tropical Diseases Bulletin, and three from current journals, personal communications, or other sources. A total of 15,155 references or units of information have been issued since the start of the program.

Registration of New Viruses: Three new viruses were registered during 1984. As of December 1983, the Catalogue contained 487 registered viruses. With the acceptance of three virus registrations during 1984, the total number of registered viruses increased to 490 as of December 1984. The viruses registered during 1984 are listed below.

Virus Name	Recommended Abbreviation	Country	Source	Antigenic Group
Gabek Forest	GF	Sudan	Rodent	PHL
Prospect Hill	PH	USA	Vole	HTN
Estero Real	ER	Cuba	Ticks	

These three recently registered viruses were isolated between 1961 and 1982. GF was isolated around 1961, ER in 1980 and PH in 1982. GF was evaluated as Probable Arbovirus, ER as Possible Arbovirus, while PH was evaluated as Probably Not Arbovirus by the Subcommittee on Evaluation of Arthropod-Borne Status (SEAS)*.

None of these three viruses have been isolated from man, nor have they been associated with the production of disease in man.

Antigenic Grouping: Two new serogroups were formed during the past year. Keuraliba and Le Dantec viruses, both rhabdoviruses, were found to share an antigenic relationship (1). Previously, Keuraliba virus was considered to be a member of the VSV serogroup (2), however, the demonstration of an antigenic relationship to VSV serogroup members was not consistently reproduced. Le Dantec virus clearly did not cross-react with other members of the VSV serogroup. Since Keuraliba virus was unequivocally related to Le Dantec virus, there was no justification for retaining Keuraliba virus in the VSV serogroup. These two rhabdoviruses now comprise the Le Dantec (LD) serogroup.

* A.J. Main (Chairman), T.H.G. Aitken, E.W. Cupp, D.B. Francy, D.J. Gubler, J.L. Hardy and D.M. McLean.

Prospect Hill virus, which was registered in 1984, was shown to be related to the previously registered Hantaan virus. Both viruses were found to be related by the indirect immunofluorescent antibody technique although they were quite distinct (see Prospect Hill virus registration). They now form the Hantaan serogroup.

Barmah Forest virus finally was assigned to serogroup A as a new member, albeit an unusual one. "Barmah Forest virus has been characterized in a number of ways including electron microscopy of infected cells; physical studies of the virion, its RNA, and associated proteins; N-terminal sequence analysis of the two envelope glycoproteins; studies of macromolecular species present in infected cells; and serological cross-reactions with alphaviruses and bunyaviruses. From these results Barmah Forest virus is clearly an alphavirus since the structure of the virion, the mode of replication, and the macromolecular species present in infected cells are typical of alphaviruses. The N-terminal regions of the two glycoproteins E1 and E2 show extensive sequence homology (approximately 50%) with those of other alphaviruses. Barmah Forest virus cross-reacts in hemagglutination inhibition tests, although not in complement fixation tests or infectivity neutralization tests, with other alphaviruses. In some of its properties Barmah Forest virus is unusual, however. It cross-reacts in complement fixation and hemagglutination inhibition tests with Umbre virus, a bunyavirus, which originally led it to be classified as a bunyavirus; the glycosylation pattern of E2 of Barmah Forest virus appears to differ from that of other alphaviruses; and the sedimentation coefficient of the virion appears to be slightly less than that of other alphaviruses."(3) We also have observed that plaque-purified Barmah Forest virus cross-reacts in HI tests, although not in CF or N tests, with other alphaviruses (4). However, we did not cross-test Barmah Forest and Umbre viruses.

Recent serologic studies have shown that Ippy virus is related to Lassa virus (5). During attempts to characterize an unidentified virus from rodents and livestock in Zimbabwe, it was compared in cross-immunofluorescence tests with other viruses isolated from rodents in Africa, including Ippy and Lassa viruses and other unregistered Lassa-related viruses. The unidentified virus was not found to be related to any of the other viruses with which it was compared; however it was discovered that Ippy virus was related to Lassa virus. Antibody to Ippy virus reacted to high titer in immunofluorescence tests with Lassa virus and the Lassa-related viruses. In addition, monoclonal antibody to Lassa virus reacted with Ippy virus. The exact relationship of Ippy virus to other arenaviruses of the Tacaribe serogroup remains to be determined (5).

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.

Electron microscopic examination of Gossas virus preparations has shown that this previously unclassified and ungrouped virus possesses rhabdovirus morphology (6). Currently it is being serologically tested in order to determine if it is antigenically related to any of the established rhabdoviruses.

Data obtained for Barmah Forest virus in terms of morphology, morphogenesis, genetic material, replication, and amino acid sequence homology indicates that it is clearly a member of the Alphavirus genus (3,7). The status of Barmah Forest virus also was discussed in the previous section on Antigenic Grouping.

A formal proposal has been put forth which would create a fifth genus in the family Bunyaviridae (8). In addition to the Bunyavirus, Nairovirus, Phlebovirus and Uukuvirus genera, the newly proposed taxon would be named the Hantavirus genus, and initially it 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 (9). This proposal was not viewed with favor by the ICTV. It is planned that, following some alteration, the proposal will be resubmitted to the ICTV.

Finally, the ICTV has approved the proposal of the ITCV Togavirus Study Group which recommended the creation of a new family, Flaviviridae, and placement of the Flavivirus genus in this new taxon (10). 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, morphogensis 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 nonstructural proteins are located at the 5' end of the genome; whereas for flaviviruses, genes for structural proteins are located at the 5' end (10).

Synopsis of Information in 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 characteristics in common, listing viruses according to their known taxonomic status and by their demonstrated serological relationships, and where appropriate, by principal arthropod vector. Isolations from arthropod and animal hosts, continental distribution, involvement in human disease, and arbovirus status are indicated. Information is also given concerning the recommended level of practice and containment assigned to registered viruses and the basis for assignment to a level. Most of this information was published previously by the Subcommittee on Arbovirus Laboratory Safety (SALS)* (11). Three registered viruses listed in tables 5 through 34 have not been rated by SALS. Appendices I and II, following table 39, will 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

* Composition at time of publication: W.F. Scherer (Chairman, deceased), G.A. Eddy, T.P. Monath, T.E. Walton, and J.M. Richardson (ad hoc member).

Present composition: T.E. Walton (Chairman), J.M. Dalrymple, R. Endris, J.L. Hardy, T.P. Monath, and J.M. Richardson (ad hoc member).

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.

Table 1. Alphabetical and taxonomic listing of registered viruses: Table 1 presents an alphabetical listing of the 490 viruses registered in the Catalogue as of December 1984. 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, a recommended abbreviation is given for each virus, which has been formulated according to the guidelines established by the American Committee on Arthropod-Borne Viruses (12). All too often, abbreviations are employed in publications which are of the author's choosing and which do not conform to the recommended abbreviations. Their use is confusing, 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 this table. If no antigenic group is given, the virus is ungrouped and indicates that it has not been demonstrated to be serologically related to any other known arbovirus.

Table 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 lists the serogroups comprising the various taxa to which registered viruses have been assigned. Sixty-two antigenic groups have been designated for viruses registered in the Catalogue. That includes the previously established rabies serogroup. There are several instances in whichonly a single virus is shown in an antigenic group. That is so because one or more antigenic relatives of that virus have not been registered.

It is also noted that the Bunyavirus genus comprises the old Bunyamwera Supergroup to which several additional serogroups have been added. The most recent additions are the Anopheles B and Turlock serogroups. The Bunyamwera Supergroup originally was formulated to reflect low-level but reproducible intergroup relationships usually by complement-fixation and/or hemagglutination-inhibition reactions. In a somewhat analogous situation, the nairoviruses consist of six distinct serogroups which share low-level intergroup relationships among themselves. Registered viruses belonging in the Bunyamwera Supergroup constitute slightly more than one-fourth of all registered viruses.

Table 3. Initial isolations by decade and country of origin: Table 3 lists the initial isolation of specific registered viruses by the decade of discovery and according to the continent or subcontinent and country in which

each was first 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.

Table 4. Initial isolation of viruses by continent, country, and chronological period: Similar data were utilized in tables 3 and 4, though they were subjected to slightly different analyses and were presented in a different format. Periods or locations which show high numbers of virus isolation 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, and more rapid dissemination of new information, as well as the presence in a given area of an arbovirus laboratory with highly active and effective field programs.

Tables 5 through 34 list registered viruses by taxon and, within taxon, by serogroup, with information regarding isolations from arthropod vectors and vertebrates, and geographic (by continent) distribution based on virus isolation. Data also are presented regarding production of disease in man in nature or by laboratory infection, evaluation of arbovirus status, and proved or provisional taxonomic status. These tables now show the biohazard level assigned to each registered virus, and the basis for assignment to a level. Where possible, sets of viruses were grouped additionally according to their actual or suspected principal arthropod vector.

The data presented in these tables clearly illustrate the salient features characteristic of each set or subset of viruses. Thus, the reader is urged to carefully examine the tables for information that may be of specific interest, or that will provide an overview of the general characteristics of a given group of viruses.

Table 5. Alphaviruses: Alphaviruses clearly are mosquito associated, although a few have been isolated from other arthropods. About one-half of the alphaviruses are associated with birds, while some of them, particularly those of the VEE complex, are associated with rodents.

Eleven alphaviruses have been isolated from man while 12 have been implicated in causing human disease either by infections acquired in nature or in the laboratory. At least seven of these 12 alphaviruses have been responsible for epidemics: chikungunya, eastern equine encephalitis, Mayaro, o'nyong-nyong, Ross River, Venezuelan equine encephalitis, and western equine encephalitis. All of the 12 alphaviruses either are rated as Arbovirus (11 viruses) or Probable Arbovirus (one virus).

Barmah Forest virus definitely has been listed with the other alphaviruses in serogroup A. Its redefined characteristics and its status have been discussed in two earlier sections on "Antigenic Grouping" and "Taxonomic Status of Registered Viruses". Although the virus appears to be distantly related to other alphaviruses, it is unusual in some respects. In serology, Barmah Forest virus reacted with other alphaviruses only in the HI test. Almost exclusively, its hemagglutinin was inhibited by antibody to other alphaviruses. Barmah Forest virus did not cross-react in CF and NT.

Furthermore, plaque purified Barmah Forest virus still cross-reacted with Umbre virus in HI and CF tests.

Sindbis virus has been recovered from the organs of insectivorous bats collected in Zimbabwe. Cabassou, chikungunya and VEE viruses represent the other alphaviruses which have been isolated from bats.

Tables 6, 7, and 8. Flaviviruses: Of the 64 registered flaviviruses, 47% have been placed in the mosquito-associated category (table 6), 23% are considered to be tick-borne (table 7), and 30% are categorized as not being associated with a proven arthropod vector (table 8). Only West Nile and yellow fever viruses in the mosquito-associated category (table 6) have been isolated from both mosquitoes and ticks.

Twenty-six of the 30 registered flaviviruses which are mosquito-associated (table 6) are rated as Probable Arbovirus or Arbovirus. The tick-borne flaviviruses (table 7) contain four registered viruses, Absettarov, Hanzalova, Hypr and Kumlinge, which are very closely related or indistinguishable by conventional serological techniques, though they are said to be clearly differentiated on the basis of clinical, epidemiological, and ecological markers from RSSE and other members of the same complex.

Twenty-eight (44%) registered flaviviruses have been isolated from man, whereas 13 of 30 (60%) mosquito-borne flaviviruses and nine of 15 (60%) tick-borne flaviviruses have been implicated in the production of human disease, either through infections acquired in nature or in the laboratory. By contrast, only four of 19 (21%) flaviviruses not associated with a vector have been implicated in the production of human disease. Thus, a total of 31 flaviviruses have been associated with the production of disease in man.

With the exception of two members (Israel turkey meningoencephalitis and Koutango viruses), none of the rest 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 8 have been isolated from rodents or bats. Israel turkey meningoencephalitis virus has been isolated from domestic turkeys, Cacipacore virus from a wild bird, and Aroa virus from a sentinel hamster. Only Dakar bat and Negishi viruses have been isolated from man; that has been the sole source of recovery for Negishi virus.

Tables 9 through 16. Bunyaviruses, Family Bunyaviridae: 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.

Table 9. 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 reported to cause a febrile illness in man. In addition, this virus has been isolated from man and from a sentinel monkey. Members of this serogroup and of the ANB serogroup appear to be localized. These viruses have been found on only a single continent.

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

Table 10. 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 insects. Maguari virus has been recovered from livestock, Anhembi, Germiston, Kairi, Macaua and Shokwe viruses from rodents, and Lokern, Main Drain and Tensaw viruses from lagomorphs. Kairi virus also was recovered from a monkey, while Macaua virus was isolated from a bird.

Bunyamwera, Germiston, Ilesha, Shokwe, and Wyeomyia viruses have been isolated from man. Except for Shokwe virus, those viruses plus Calovo and Tensaw viruses have been shown to be associated with human disease, either through infections acquired in nature or in the laboratory, or both.

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 (eight viruses), South America (eight viruses) and Africa (five viruses). Thus far, only one virus has been recovered in Asia, two in Europe and none in Australasia.

Table 11. Bwamba serogroup and serogroup C viruses: Both Bwamba and Pongola viruses (Bwamba serogroup) are mosquito-associated, and Bwamba virus has been isolated from man. Bwamba virus has been reported to produce a febrile illness in man 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.

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 man. Only Gumbo Limbo and Vinces viruses have not been isolated from man and, with the exception of those two viruses, all other members have been associated with cases of human febrile illness. In addition, Apeu and Oriboca viruses have been reported to infect man as a result of laboratory mishaps. Ten of these viruses have been classified as Arbovirus and two as Probable Arbovirus.

Table 12. California and Capim serogroup viruses: All the California group viruses are associated with mosquito vectors and four members have been recovered from naturally infected rodents. La Crosse, Guaroa, and Tahyna viruses have been isolated from man and, along with California encephalitis and Inkoo viruses, have been associated with disease as a result of infections acquired in nature. In addition, Jamestown Canyon and snowshoe hare viruses recently have been serologically associated with disease in man. Only Inkoo and Tahyna viruses have been isolated on continents other than those of 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 group 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 man. Capim group 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).

Table 13. Gamboa, Guama and Koongol serogroup viruses: In addition to Gamboa virus, the serogroup contains Pueblo Viejo and San Juan viruses. 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 man and have been associated with disease in man as a result of infections acquired in nature. Nine of the 12 Guama group viruses have been rated as Arbovirus or Probable Arbovirus. Viruses of this serogroup clearly are mosquito-associated and the majority of them 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.

Table 14. Minatitlan, Olifantsvlei and Patois serogroup viruses: The Minatitlan serogroup now contains two registered members. In addition to Minatitlan virus, the group also includes Palestina virus. 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. Little is known concerning its role in nature.

The Olifantsvlei group consists of three members, and all three were isolated in Africa from mosquitoes. Information on the properties of these viruses has not been readily available.

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 man, nor have they been associated with the production of disease in man.

Table 15. Simbu serogroup viruses: Essentially equal numbers of Simbu group viruses have been isolated from Culicoides insects 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 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 man. Oropouche virus has caused frequent large outbreaks of disease among the human population in Brazil.

Simbu group viruses have a wide distribution. Approximately 50% have been found in Africa or Africa and Asia, while others have been isolated in Asia or Asia and Australasia 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.

Table 16. Tete and Turlock serogroups and unassigned (SBU) viruses: All Tete group 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 a single continent (Africa, Asia, and Europe). Barmah Forest virus has been deleted from the listing of those viruses which 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.

Table 17. Phlebotomus fever serogroup viruses: At present, the PHL antigenic group consists of 35 members, and the entire serogroup comprises the Phlebovirus genus within the family Bunyaviridae. Sicilian sandfly fever virus is the type virus for this genus.

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

Gabek Forest virus was registered and added to the PHL serogroup during 1984 although the virus actually was isolated in 1960. It has not been recovered from arthropods but it 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 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, as well as herdsmen who handle infected animals. Previous serological studies have 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 just another strain of RVF virus. Previously it was listed as an antigenically ungrouped virus.

Table 18. Tick-borne serogroups other than serogroup B viruses. Nairoviruses: Members of the six antigenic groups shown in tables 18 and 19 constitute the Nairovirus genus in the Bunyaviridae family. 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. Only members of the CHF-Congo and NSD serogroups have been associated with the production of disease in man.

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. The 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 man, 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 man, 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 DGK serogroup have not been isolated from vertebrate hosts, nor from arthropod vectors other than ticks. The majority 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, Asia and Australasia. All Hughes serogroup members have been associated with argasid ticks. A new antigenic member of the Hughes serogroup has been described (13). This virus has been called Puffin Island, and it has not been registered as of this moment.

Table 19. Tick-borne serogroups other than serogroup B viruses. Nairoviruses: Nairobi sheep disease virus is an important cause of veterinary disease, while both Dugbe and Ganjam viruses have been isolated repeatedly from ticks taken off of domestic animals. Dugbe and Ganjam viruses have caused febrile illnesses in man. In the case of NSD virus, one infection in man resulted in a febrile illness, while three others resulted in subclinical serologic conversions. Thus, all three viruses have been isolated from man, and only Dugbe virus has not been associated with infections in man acquired in the laboratory. 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 antigenic set were isolated only from ixodid ticks. Avalon virus also was recovered from a bird. Sakhalin serogroup viruses are distributed in Asia (PMR,SAK), Australasia (TAG), Europe (CM), and North America (AVA,SAK). Antigenic studies have indicated that Avalon and Paramushir viruses are strains of the same virus.

Table 20. Tick-borne serogroups other than serogroup B viruses: At present, Uukuniemi serogroup viruses constitute the Uukuvirus genus in the Bunyaviridae family. Other serogroups listed in that table represent the Hantavirus genus and those provisionally classified as bunyavirus-like.

Except for Uukuniemi virus, all members of the Uukuniemi serogroup have been isolated only from ticks. Uukuniemi virus also has been recovered from both rodents and birds. Two of the viruses in this serogroup were found in Asia while the other three were discovered in Europe. Hemagglutination-inhibition antibodies to Uukuniemi virus have been detected in the sera of human beings 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.

At present, the Hantavirus genus is only a proposed taxon. If approved, this genus will eventually contain more than the two registered virus shown in the serogroup. In addition to Hantaan and Prospect Hill virus, other probable members will be the Hantaan-related viruses isolated from rats, and the agent of "Nephropathia Epidemica."

Both Hantaan and Prospect Hill viruses have been isolated from rodents, while Hantaan virus also has been isolated from man. 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 U.S.S.R., Japan, Manchuria, and Eastern and Northern Europe. More than 10,000 cases have occurred in Korea alone since the disease was first recognized in that country in 1951. Prospect Hill virus has not been shown to infect man thus far.

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

Two of the Kaisodi group 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 man. Previous Annual Reports have referred to unpublished studies which had suggested that the RNA species and polypeptides of Silverwater virus resembled those of uukuviruses. Additional confirming or clarifying information is still not available. 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 man. One virus has been found in Australia (UPO), and the other in North America (AB).

Table 21. Tick-borne serogroups other than serogroup B viruses: Thogoto virus has been isolated from man and has been involved in the production of disease in man. An unregistered antigenic relative of Thogoto virus has been isolated in Sicily. Molecular analysis of a Thogoto group virus has indicated that its virion RNA species and structural polypeptides resemble those of members of the family Orthomyxoviridae.

Nyamanini and the unregistered Midway viruses now constitute the Nyamanini serogroup. Nyamanini virus was isolated from argasid ticks and birds. It has not been assoicated with the production of disease in man.

Quaranfil virus has been isolated from both man and birds, and has been associated with the production of disease in man as the result of infections acquired in nature. 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.

Table 22. Minor antigenic groups of viruses: All the viruses listed in this table are members of minor antigenic groups, and provisionally are classified taxonomically as bunyavirus-like members of the Family Bunyaviridae. Most virus members of these minor serogroups have been primarily associated with mosquito vectors.

Bakau group viruses have been recovered only in Asia. Bakau virus has been isolated from both mosquitoes and ticks, and also rodents. Additional information concerning these viruses is not available.

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 man and from mosquitoes collected in Africa. The Nyando virus infection in man resulted in a febrile illness.

Table 23. Tick-borne serogroups other than serogroup B viruses: While the viruses listed in table 23 also are tick-borne agents, they differ taxonomically from those in tables 18-22 in that they have been classified as orbiviruses in the family Reoviridae. The orbiviruses are relatively resistant to lipid solvents, are inactivated at an 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 virus of the CTF serogroup and Kemerovo virus of the KEM serogroup have produced disease in man and have been isolated from man.

Members of the Kemerovo group are widely distributed with at least one virus being found in each of the listed continents. Kemerovo virus has 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.

Tables 24, 25. Minor antigenic groups of viruses: Members of these minor antigenic groups have been characterized and taxonomically classified as orbiviruses.

Several of the viruses in these minor antigenic groups are important in causing disease in large animals. BLU virus causes disease in both wild and domestic ruminants; AHS virus in mules, donkeys and horses; EHD virus in deer and Ibaraki virus in cattle. Both BLU and AHS viruses have a wide geographic distribution.

Changuinola virus is the only member from these minor antigenic groups which has been isolated from man, and has been reported to produce disease in man. 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 North 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) (14). This study clearly states that "a great many more Changuinola serotypes may exist" (14).

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 serogroup appear to be associated with Culicoides insects. Vector associations appear to be less clear for Eubenangee virus of the EUB serogroup, and for Warrego virus of the WAR serogroup.

Table 26. Minor antigenic groups of viruses: Members of the serogroups listed in this table and in table 27 possess a "bullet-shaped" morphology and are classified as members of the family Rhabdoviridae. Table 26 contains the Hart Park group viruses, a Kwatta group virus, the newly formed Le Dantec serogroup, an expanded Mossuril group consisting of eight members, and a rabies serogroup consisting of two rabies-related viruses.

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 man. Thus far, their distribution includes only North and South America.

The Kwatta virus was isolated only once from mosquitoes collected in Surinan. The 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 man 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.

The rabies serogroup consists of kotonkan virus and Lagos bat virus. Kotonkan virus was isolated from Culiocides spp. collected in Nigeria. It was rated as Probable Arbovirus by SEAS. Lagos bat virus has been isolated only from bats on several occasions.

Table 27. Minor antigenic groups of viruses: All three viruses of the Sawgrass serogroup were isolated from ticks collected in North America. All viruses of the Timbo serogroup, including the new Sena Madureira virus, were isolated from lizards, and none of these viruses ever were isolated from arthropods.

Three VSV group viruses have been isolated from phlebotomine flies, and four others have been recovered from mosquitoes. An additional member, VS-Indiana virus has been isolated from both types of vectors. Piry and VS-Alagoas viruses have not been recovered from arthropods. Of the serogroups listed in this and the preceding table, only members of the VSV serogroup and Le Dantec virus have been shown to infect man. 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 man 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 28. Minor antigenic groups of viruses: These antigenic groups consist of members which are taxonomically unclassified.

Both Boteke group viruses 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. Pending further information, both viruses of this serogroup will be listed as unclassified in this Annual 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.

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 which was noninfectious upon extraction. Recent evidence indicates that there might be different serotypes of Ebola virus. Marburg and Ebola viruses have been isolated from man only.

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

Table 29. Tacaribe group viruses: Tacaribe group viruses 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 which suggests that they are associated with an arthropod vector in nature. SEAS has judged all members to be Not Arbovirus.

Ippy virus represents a new addition to this serogroup. It was found to be related to Lassa virus (5). 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.

Three members of this group have been implicated in the production of 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, the newly registered Flexal virus has produced a febrile illness in a laboratory worker following a laboratory accident. Flexal virus was recovered from rodents trapped in Brazil.

Table 30. Ungrouped mosquito-associated viruses: The viruses in this table are serologically ungrouped, though they have been clustered together on the basis of their association with a mosquito vector and placed into subsets according to their taxonomic classification. Tataguine virus has been isolated from man, and has been reported to produce disease in man during the course of infections acquired in nature.

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.

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 infections acquired in nature; and 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 man thus far.

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 now the type species for a previously established 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.

Cotia virus, a poxvirus, has been reported to produce disease in man. Oubangui virus also is classified provisionally as a poxvirus. However, very little meaningful information is available concerning Oubangui virus.

Table 31. Ungrouped mosquito-associated viruses: These serologically ungrouped viruses have been associated with mosquito vectors, and the majority of them remain taxonomically unclassified. Gomoka and Para viruses have been recovered from sources other than mosquitoes. Two isolates of Gomoka virus were obtained from birds collected in the Central African Republic. Para virus was isoslated from sentinel mice.

Only Aruac, Triniti, and Termeil viruses were rated above Possible Arbovirus. All three were rated as Probable Arbovirus. Most (18/22) of the viruses in this table were recovered in South America, Australasia, and Africa.

Table 32. Ungrouped tick-, Culicoides-, or Phlebotomus-associated viruses: Slightly less than one-half of the listed viruses are taxonomically unclassified. Except for bovine ephemeral fever, Inhangapi, Ngaingan, Sripur, and Tibrogargan viruses, all other agents listed in table 32 were associated with tick vectors. Inhangapi and Sripur viruses, both classified as rhabdoviruses, were associated with phlebotomine flies. Ngaingan and Tibrogargan viruses were associated with Culicoides insects. Bovine ephemeral fever virus has been isolated from both mosquitoes and Culicoides insects. Only Issyk-Kul, Tamdy, and Wanowrie viruses in table 32 have been isolated from man. Wanowrie virus has not been associated with human disease either as a result of a laboratory accident or as a result of an infection acquired in nature.

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

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. 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, the question of whether the Tettnang isolates were, in fact, arthropod-borne remains unanswered.

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 which were comparable to those of viruses of the family Orthomyxoviridae.

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 from the blood of man infected in nature on more than 20 occasions. The infections were classified as febrile illnesses.

Estero Real virus, isolated from ticks collected in Cuba, represents a new addition to table 32. It was found to be antigenically ungrouped and has not been taxonomically classified.

Tables 33, 34. Ungrouped viruses, no arthropod vector known: None of the listed viruses have been isolated from an arthropod vector, and only Almpiwar virus was rated higher than Possible Arbovirus. Several of the viruses were rated Probably not Arbovirus or Not Arbovirus. More than 50% have been isolated from rodents or birds. Of the viruses listed in these two tables, only Bangui virus was isolated from man. In addition, this virus has been associated with the production of human disease as a result of infections acquired in nature.

Twelve of the eighteen viruses listed in tables 33 and 34 have been assigned a provisional taxonomic classification. Recently, Gossas virus was shown to possess rhabdovirus morphology (6). The possibility that Gossas virus is antigenically related to other rhabdoviruses is being actively investigated.

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.

A majority of the unclassified viruses shown in table 34 appear to be bird-associated viruses. Four viruses have been recovered from rodents, three from bats, and two others from other vertebrates. Thirteen of these viruses were recovered in Africa and Asia. The remaining five viruses were found in South America.

Table 35 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 20 or 4.1% have been found on three or more continents. The largest number of viruses have been isolated in South America and Africa.

Table 36 shows the number of viruses, according to antigenic group, which have been isolated from various classes of arthropods. About 49% have been

recovered from mosquitoes, 20% from ticks, and 17% from all other classes. One hundred and five registered viruses 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 385, 91.2%).

Table 37 presents a similar type of analysis in terms of virus isolations from various classes of vertebrates. Man 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 (195 of 278, 70.1%).

Table 38 lists the viruses in each antigenic group which cause disease in man. Approximately 23% of all registered viruses have been associated with human disease, either as a result of infections acquired in nature or from laboratory accidents, or both. Members of serogroups A and B and those in the Bunyamwera Supergroup constitute 43.5% of all registered viruses. These viruses also account for about 64% of the instances in which registered viruses are associated with disease production in man.

An analysis of the SEAS ratings for all registered viruses is presented in table 39, and it shows that 258 registrations (52.7%) 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.

REFERENCES

1. Cropp, C.B. et al. Personal communication. 1983.

2. Tesh, R.B. et al. 1983. Antigenic Relationship Among Rhabdoviruses Infecting Terrestrial Vertebrates. J. Gen. Virol. 64:169-176.

3. Dalgarno, L. et al. 1984. Characterization of Barmah Forest Virus: An Alphavirus with Some Unusual Properties. Virology 133:416-426.

4. Karabatsos, N. and Calisher, C.H. 1983. Unpublished data.

5. Swanepoel, R. et al. Personal communication. 1984.

6. Calisher, C.H. and Cropp. C.B. Personal communication. 1984.

7. Bell, J.R. et al. 1984. An Evloutionary Tree Relating Eight Alphaviruses, Based on Amino-Terminal Sequences of Their Glycoproteins. Proc. Nat. Acad. Sci. 81:4702-4706.

8. Schmaljohn, C.S. et al. 1985. Antigenic and Genetic Properties Place Viruses Linked to Hemorrhagic Fever with Renal Syndrome into a Newly-Defined Genus of Bunyaviridae. Science. In Press.

9. Kiley, M.P. et al. 1982. Filoviridae: A Taxonomic Home for Marburg and Ebola Viruses? Intervirology 18:24-32.

10. Westaway, E.G., Chairman, ICTV Togavirus Study Group. Personal communication. 1984.

11. The Subcommittee on Arbovirus Laboratory Safety of the American Committee on Arthropod-Borne Viruses. 1980. Laboratory safety for arboviruses and certain other viruses of vertebrates. Am. J. Trop. Med. Hyg. 29:1359-1381.

12. American Committee on Arthropod-Borne Viruses. 1959. Arbovirus names. Am. J. Trop. Med. Hyg. 18:731-734.

13. Gould, E.A. et al. 1983. Immunofluorescence studies on the antigenic interrelationships of the Hughes virus serogroup (Genus Nairovirus) and identification of a new strain. J. Gen. Virol. 64:739-742.

14. Travassos da Rosa, A.P.A. et al. 1984. Characterization of the Changuinola Serogroup Viruses. (Reoviridae: Orbivirus). Intervirology 21:38-49.

Table 1

ALPHABETICAL AND TAXONOMIC LISTING OF 490 VIRUSES REGISTERED AS OF 31 DEC. 1984 WITH RECOMMENDED ABBREVIATIONS AND ANTIGENIC GROUPINGS

NAME	ABBR.	TAXONOMIC STATUS		ANTIGENIC GROUP
		FAMILY	GENUS	
ABRAS	ABR	Bunyaviridae	Bunyavirus	PAT
ABSETTAROV	ABS	Flaviviridae	Flavivirus	B
ABU HAMMAD	AH	Bunyaviridae	Nairovirus	DGK
ACADO	ACD	Reoviridae	Orbivirus	COR
ACARA	ACA	Bunyaviridae	Bunyavirus	CAP
AFRICAN HORSESICKNESS	AHS	Reoviridae	Orbivirus	AHS
AFRICAN SWINE FEVER	ASF	Iridoviridae		
AGUACATE	AGU	Bunyaviridae	Phlebovirus	PHL
AGUA PRETA	AP	Herpesviridae		
AINO	AINO	Bunyaviridae	Bunyavirus	SIM
AKABANE	AKA	Bunyaviridae	Bunyavirus	SIM
ALENQUER	ALE	Bunyaviridae	Phlebovirus	PHL
ALFUY	ALF	Flaviviridae	Flavivirus	B
ALMEIRIM	AMR	Reoviridae	Orbivirus	CGL
ALMPIWAR	ALM	Rhabdoviridae		
ALTAMIRA	ALT	Reoviridae	Orbivirus	CGL
AMAPARI	AMA	Arenaviridae	Arenavirus	TCR
ANANINDEUA	ANU	Bunyaviridae	Bunyavirus	GMA
ANHANGA	ANH	Bunyaviridae	Phlebovirus	PHL
ANHEMBI	AMB	Bunyaviridae	Bunyavirus	BUN
ANOPHELES A	ANA	Bunyaviridae	Bunyavirus	ANA

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
ANOPHELES B	ANB	Bunyaviridae	Bunyavirus	ANB
APEU	APEU	Bunyaviridae	Bunyavirus	C
APOI	APOI	Flaviviridae	Flavivirus	B
ARAGUARI	ARA			
ARANSAS BAY	AB	Bunyaviridae	Bunyavirus-like	UPO
ARBIA	ARB	Bunyaviridae	Phlebovirus	PHL
ARIDE	ARI			
ARKONAM	ARK			
AROA	AROA	Flaviviridae	Flavivirus	B
ARUAC	ARU	Rhabdoviridae		
ARUMOWOT	AMT	Bunyaviridae	Phlebovirus	PHL
AURA	AURA	Togaviridae	Alphavirus	A
AVALON	AVA	Bunyaviridae	Nairovirus	SAK
BABAHOYO	BAB	Bunyaviridae	Bunyavirus	PAT
BAGAZA	BAG	Flaviviridae	Flavivirus	B
BAHIG	BAH	Bunyaviridae	Bunyavirus	TETE
BAKAU	BAK	Bunyaviridae	Bunyavirus-like	BAK
BAKU	BAKU	Reoviridae	Orbivirus	KEM
BANDIA	BDA	Bunyaviridae	Nairovirus	QYB
BANGORAN	BGN	Rhabdoviridae		MOS
BANGUI	BGI	Bunyaviridae	Bunyavirus-like	
BANZI	BAN	Flaviviridae	Flavivirus	B
BARMAH FOREST	BF	Togaviridae	Alphavirus	A
BARUR	BAR	Rhabdoviridae		MOS
BATAI	BAT	Bunyaviridae	Bunyavirus	BUN

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
BATAMA	BMA	Bunyaviridae	Bunyavirus	TETE
BATKEN	BKN			
BAULINE	BAU	Reoviridae	Orbivirus	KEM
BEBARU	BEB	Togaviridae	Alphavirus	A
BELEM	BLM			
BELMONT	BEL	Bunyaviridae	Bunyavirus-like	
BENEVIDES	BVS	Bunyaviridae	Bunyavirus	CAP
BENFICA	BEN	Bunyaviridae	Bunyavirus	CAP
BERTIOGA	BER	Bunyaviridae	Bunyavirus	GMA
BHANJA	BHA	Bunyaviridae	Bunyavirus-like	BHA
BIMBO	BBO			
BIMITI	BIM	Bunyaviridae	Bunyavirus	GMA
BIRAO	BIR	Bunyaviridae	Bunyavirus	BUN
BLUETONGUE	BLU	Reoviridae	Orbivirus	BLU
BOBAYA	BOB	Bunyaviridae	Bunyavirus-like	
BOBIA	BIA	Bunyaviridae	Bunyavirus	OLI
BOCAS	BOC	Coronaviridae	Coronavirus	
BORACEIA	BOR	Bunyaviridae	Bunyavirus	ANB
BOTAMBI	BOT	Bunyaviridae	Bunyavirus	OLI
BOTEKE	BTK			BTK
BOUBOUI	BOU	Flaviviridae	Flavivirus	B
BOVINE EPHEMERAL FEVER	BEF	Rhabdoviridae		
BUENAVENTURA	BUE	Bunyaviridae	Phlebovirus	PHL
BUJARU	BUJ	Bunyaviridae	Phlebovirus	PHL

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
BUNYAMWERA	BUN	Bunyaviridae	Bunyavirus	BUN
BUNYIP CREEK	BC	Reoviridae	Orbivirus	PAL
BURG EL ARAB	BEA	Bunyaviridae	Bunyavirus-like	MTY
BUSHBUSH	BSB	Bunyaviridae	Bunyavirus	CAP
BUSSUQUARA	BSQ	Flaviviridae	Flavivirus	B
BUTTONWILLOW	BUT	Bunyaviridae	Bunyavirus	SIM
BWAMBA	BWA	Bunyaviridae	Bunyavirus	BWA
CABASSOU	CAB	Togaviridae	Alphavirus	A
CACAO	CAC	Bunyaviridae	Phlebovirus	PHL
CACHE VALLEY	CV	Bunyaviridae	Bunyavirus	BUN
CACIPACORE	CPC	Flaviviridae	Flavivirus	B
CAIMITO	CAI	Bunyaviridae	Phlebovirus	PHL
CALIFORNIA ENC.	CE	Bunyaviridae	Bunyavirus	CAL
CALOVO	CVO	Bunyaviridae	Bunyavirus	BUN
CANANEIA	CNA	Bunyaviridae	Bunyavirus	GMA
CANDIRU	CDU	Bunyaviridae	Phlebovirus	PHL
CANINDE	CAN	Reoviridae	Orbivirus	CGL
CAPE WRATH	CW	Reoviridae	Orbivirus	KEM
CAPIM	CAP	Bunyaviridae	Bunyavirus	CAP
CARAPARU	CAR	Bunyaviridae	Bunyavirus	C
CAREY ISLAND	CI	Flaviviridae	Flavivirus	B
CATU	CATU	Bunyaviridae	Bunyavirus	GMA
CHACO	CHO	Rhabdoviridae		TIM
CHAGRES	CHG	Bunyaviridae	Phlebovirus	PHL
CHANDIPURA	CHP	Rhabdoviridae	Vesiculovirus	VSV

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTI-GENIC GROUP
CHANGUINOLA	CGL	Reoviridae	Orbivirus	CGL
CHARLEVILLE	CHV	Rhabdoviridae		MOS
CHENUDA	CNU	Reoviridae	Orbivirus	KEM
CHIKUNGUNYA	CHIK	Togaviridae	Alphavirus	A
CHILIBRE	CHI	Bunyaviridae	Phlebovirus	PHL
CHIM	CHIM			
CHOBAR GORGE	CG	Reoviridae	Orbivirus	
CLO MOR	CM	Bunyaviridae	Nairovirus	SAK
COCAL	COC	Rhabdoviridae	Vesiculovirus	VSV
COLORADO TICK FEVER	CTF	Reoviridae	Orbivirus	CTF
CONGO	CON	Bunyaviridae	Nairovirus	CHF-CON
CONNECTICUT	CNT	Rhabdoviridae		SAW
CORRIPARTA	COR	Reoviridae	Orbivirus	COR
COTIA	COT	Poxviridae		
COWBONE RIDGE	CR	Flaviviridae	Flavivirus	B
CRIMEAN HEM. FEVER	CHF	Bunyaviridae	Nairovirus	CHF-CON
CSIRO VILLAGE	CVG	Reoviridae	Orbivirus	PAL
CUIABA	CUI	Rhabdoviridae		MOS
D'AGUILAR	DAG	Reoviridae	Orbivirus	PAL
DAKAR BAT	DB	Flaviviridae	Flavivirus	B
DENGUE-1	DEN-1	Flaviviridae	Flavivirus	B
DENGUE-2	DEN-2	Flaviviridae	Flavivirus	B
DENGUE-3	DEN-3	Flaviviridae	Flavivirus	B
DENGUE-4	DEN-4	Flaviviridae	Flavivirus	B
DERA GHAZI KHAN	DGK	Bunyaviridae	Nairovirus	DGK

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
DHORI	DHO	Orthomyxoviridae		
DOUGLAS	DOU	Bunyaviridae	Bunyavirus	SIM
DUGBE	DUG	Bunyaviridae	Nairovirus	NSD
EAST. EQUINE ENC.	EEE	Togaviridae	Alphavirus	A
EBOLA	EBO			MBG
EDGE HILL	EH	Flaviviridae	Flavivirus	B
ENSEADA	ENS	Bunyaviridae	Bunyavirus-like	
ENTEBBE BAT	ENT	Flaviviridae	Flavivirus	B
ESTERO REAL	ER			
EP. HEM. DIS.	EHD	Reoviridae	Orbivirus	EHD
EUBENANGEE	EUB	Reoviridae	Orbivirus	EUB
EVERGLADES	EVE	Togaviridae	Alphavirus	A
EYACH	EYA	Reoviridae	Orbivirus	CTF
FLANDERS	FLA	Rhabdoviridae		HP
FLEXAL	FLE	Arenaviridae	Arenavirus	TCR
FORT MORGAN	FM	Togaviridae	Alphavirus	A
FRIJOLES	FRI	Bunyaviridae	Phlebovirus	PHL
GABEK FOREST	GF	Bunyaviridae	Phlebovirus	PHL
GAMBOA	GAM	Bunyaviridae	Bunyavirus	GAM
GAN GAN	GG	Bunyaviridae	Bunyavirus-like	MAP
GANJAM	GAN	Bunyaviridae	Nairovirus	NSD
GARBA	GAR	Bunyaviridae	Bunyavirus-like	MTY
GERMISTON	GER	Bunyaviridae	Bunyavirus	BUN
GETAH	GET	Togaviridae	Alphavirus	A
GOMOKA	GOM			

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
GORDIL	GOR	Bunyaviridae	Phlebovirus	PHL
GOSSAS	GOS	Rhabdoviridae		
GRAND ARBAUD	GA	Bunyaviridae	Uukuvirus	UUK
GRAY LODGE	GLO	Rhabodoviridae		
GREAT ISLAND	GI	Reoviridae	Orbivirus	KEM
GUAJARA	GJA	Bunyaviridae	Bunyavirus	CAP
GUAMA	GMA	Bunyaviridae	Bunyavirus	GMA
GUARATUBA	GTB	Bunyaviridae	Bunyavirus	GMA
GUAROA	GRO	Bunyaviridae	Bunyavirus	CAL
GUMBO LIMBO	GL	Bunyaviridae	Bunyavirus	C
GURUPI	GUR	Reoviridae	Orbivirus	CGL
HANTAAN	HTN	Bunyaviridae	Hantavirus*	HTN
HANZALOVA	HAN	Flaviviridae	Flavivirus	B
HART PARK	HP	Rhabdoviridae		HP
HAZARA	HAZ	Bunyaviridae	Nairovirus	CHF-CON
HIGHLANDS J	HJ	Togaviridae	Alphavirus	A
HUACHO	HUA	Reoviridae	Orbivirus	KEM
HUGHES	HUG	Bunyaviridae	Nairovirus	HUG
HYPR	HYPR	Flaviviridae	Flavivirus	B
IACO	IACO	Bunyaviridae	Bunyavirus	BUN
IBARAKI	IBA	Reoviridae	Orbivirus	EHD
ICOARACI	ICO	Bunyaviridae	Phlebovirus	PHL
IERI	IERI	Reoviridae	Orbivirus	
IFE	IFE	Reoviridae	Orbivirus	
ILESHA	ILE	Bunyaviridae	Bunyavirus	BUN

* Proposed genus designation

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
ILHEUS	ILH	Flaviviridae	Flavivirus	B
INGWAVUMA	ING	Bunyaviridae	Bunyavirus	SIM
INHANGAPI	INH	Rhabdoviridae		
ININI	INI	Bunyaviridae	Bunyavirus	SIM
INKOO	INK	Bunyaviridae	Bunyavirus	CAL
IPPY	IPPY	Arenaviridae	Arenavirus	TCR
IRITUIA	IRI	Reoviridae	Orbivirus	CGL
ISFAHAN	ISF	Rhabdoviridae	Vesiculovirus	VSV
ISRAEL TURKEY MEN.	IT	Flaviviridae	Flavivirus	B
ISSYK-KUL	IK			
ITAITUBA	ITA	Bunyaviridae	Phlebovirus	PHL
ITAPORANGA	ITP	Bunyaviridae	Phlebovirus	PHL
ITAQUI	ITQ	Bunyaviridae	Bunyavirus	C
ITIMIRIM	ITI	Bunyaviridae	Bunyavirus	GMA
ITUPIRANGA	ITU			
JACAREACANGA	JAC	Reoviridae	Orbivirus	COR
JAMANXI	JAM	Reoviridae	Orbivirus	CGL
JAMESTOWN CANYON	JC	Bunyaviridae	Bunyavirus	CAL
JAPANAUT	JAP	Reoviridae	Orbivirus	
JAPANESE ENC.	JBE	Flaviviridae	Flavivirus	B
JARI	JARI	Reoviridae	Orbivirus	CGL
JERRY SLOUGH	JS	Bunyaviridae	Bunyavirus	CAL
JOHNSTON ATOLL	JA			QRF
JOINJAKAKA	JOI	Rhabdoviridae		
JUAN DIAZ	JD	Bunyaviridae	Bunyavirus	CAP

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
JUGRA	JUG	Flaviviridae	Flavivirus	B
JUNIN	JUN	Arenaviridae	Arenavirus	TCR
JURONA	JUR	Rhabdoviridae	Vesiculovirus	VSV
JUTIAPA	JUT	Flaviviridae	Flavivirus	B
KADAM	KAD	Flaviviridae	Flavivirus	B
KAENG KHOI	KK	Bunyaviridae	Bunyavirus	SBU
KAIKALUR	KAI	Bunyaviridae	Bunyavirus	SIM
KAIRI	KRI	Bunyaviridae	Bunyavirus	BUN
KAISODI	KSO	Bunyaviridae	Bunyavirus-like	KSO
KAMESE	KAM	Rhabdoviridae		MOS
KAMMAVANPETTAI	KMP			
KANNAMANGALAM	KAN			
KAO SHUAN	KS	Bunyaviridae	Nairovirus	DGK
KARIMABAD	KAR	Bunyaviridae	Phlebovirus	PHL
KARSHI	KSI	Flaviviridae	Flavivirus	B
KASBA	KAS	Reoviridae	Orbivirus	PAL
KEMEROVO	KEM	Reoviridae	Orbivirus	KEM
KERN CANYON	KC	Rhabdoviridae		MOS
KETAPANG	KET	Bunyaviridae	Bunyavirus-like	BAK
KETERAH	KTR			
KEURALIBA	KEU	Rhabdoviridae		LD
KEYSTONE	KEY	Bunyaviridae	Bunyavirus	CAL
KHASAN	KHA	Bunyaviridae	Nairovirus	CHF-CON
KLAMATH	KLA	Rhabdoviridae		
KOKOBERA	KOK	Flaviviridae	Flavivirus	B

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
KOLONGO	KOL			
KOONGOL	KOO	Bunyaviridae	Bunyavirus	KOO
KOTONKAN	KOT	Rhabdoviridae	Lyssavirus	RABIES
KOUTANGO	KOU	Flaviviridae	Flavivirus	B
KOWANYAMA	KOW	Bunyaviridae	Bunyavirus-like	
KUMLINGE	KUM	Flaviviridae	Flavivirus	B
KUNJIN	KUN	Flaviviridae	Flavivirus	B
KUNUNURRA	KNA	Rhabdoviridae		
KWATTA	KWA	Rhabdoviridae		KWA
KYASANUR FOR. DIS.	KFO	Flaviviridae	Flavivirus	B
KYZYLAGACH	KYZ	Togaviridae	Alphavirus	A
LA CROSSE	LAC	Bunyaviridae	Bunyavirus	CAL
LAGOS BAT	LB	Rhabdoviridae	Lyssavirus	RABIES
LA JOYA	LJ	Rhabdoviridae	Vesiculovirus	VSV
LANDJIA	LJA			
LANGAT	LGT	Flaviviridae	Flavivirus	B
LANJAN	LJN	Bunyaviridae	Bunyavirus-like	KSO
LAS MALOYAS	LM	Bunyaviridae	Bunyavirus	ANA
LASSA	LAS	Arenaviridae	Arenavirus	TCR
LATINO	LAT	Arenaviridae	Arenavirus	TCR
LEBOMBO	LEB	Reoviridae	Orbivirus	
LE DANTEC	LD	Rhabdoviridae		LD
LEDNICE	LED	Bunyaviridae	Bunyavirus	TUR
LIPOVNIK	LIP	Reoviridae	Orbivirus	KEM
LLANO SECO	LLS	Reoviridae	Orbivirus	*

* 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	
LOKERN	LOK	Bunyaviridae	Bunyavirus	BUN
LONE STAR	LS	Bunyaviridae	Bunyavirus-like	
LOUPING ILL	LI	Flaviviridae	Flavivirus	B
LUKUNI	LUK	Bunyaviridae	Bunyavirus	ANA
MACAUA	MCA	Bunyaviridae	Bunyavirus	BUN
MACHUPO	MAC	Arenaviridae	Arenavirus	TCR
MADRID	MAD	Bunyaviridae	Bunyavirus	C
MAGUARI	MAG	Bunyaviridae	Bunyavirus	BUN
MAHOGANY HAMMOCK	MH	Bunyaviridae	Bunyavirus	GMA
MAIN DRAIN	MD	Bunyaviridae	Bunyavirus	BUN
MALAKAL	MAL			MAL
MANAWA	MWA	Bunyaviridae	Uukuvirus	UUk
MANZANILLA	MAN	Bunyaviridae	Bunyavirus	SIM
MAPPUTTA	MAP	Bunyaviridae	Bunyavirus-like	MAP
MAPRIK	MPK	Bunyaviridae	Bunyavirus-like	MAP
MAPUERA	MPR			
MARBURG	MBG			MBG
MARCO	MCO	Rhabdoviridae		MOS
MARITUBA	MTB	Bunyaviridae	Bunyavirus	C
MARRAKAI	MAR	Reoviridae	Orbivirus	PAL
MATARIYA	MTY	Bunyaviridae	Bunyavirus-like	MTY
MATRUH	MTR	Bunyaviridae	Bunyavirus	TETE
MATUCARE	MAT			
MAYARO	MAY	Togaviridae	Alphavirus	A
MELAO	MEL	Bunyaviridae	Bunyavirus	CAL

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

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTIGENIC GROUP
NDUMU	NDU	Togaviridae	Alphavirus	A
NEGISHI	NEG	Flaviviridae	Flavivirus	B
NEPUYO	NEP	Bunyaviridae	Bunyavirus	C
NEW MINTO	NM	Rhabdoviridae		SAW
NGAINGAN	NGA			
NIQUE	NIQ	Bunyaviridae	Phlebovirus	PHL
NKOLBISSON	NKO			
NODAMURA	NOD	Nodaviridae	Nodavirus	
NOLA	NOLA	Bunyaviridae	Bunyavirus	SIM
NORTHWAY	NOR	Bunyaviridae	Bunyavirus	BUN
NTAYA	NTA	Flaviviridae	Flavivirus	B
NUGGET	NUG	Reoviridae	Orbivirus	KEM
NYAMANINI	NYM			NYM
NYANDO	NDO	Bunyaviridae	Bunyavirus-like	NDO
OKHOTSKIY	OKH	Reoviridae	Orbivirus	KEM
OKOLA	OKO			
OLIFANTSVLEI	OLI	Bunyaviridae	Bunyavirus	OLI
OMSK HEM. FEVER	OMSK	Flaviviridae	Flavivirus	B
O'NYONG-NYONG	ONN	Togaviridae	Alphavirus	A
ORIBOCA	ORI	Bunyaviridae	Bunyavirus	C
ORIXIMINA	ORX	Bunyaviridae	Phlebovirus	PHL
OROPOUCHE	ORO	Bunyaviridae	Bunyavirus	SIM
ORUNGO	ORU	Reoviridae	Orbivirus	
OSSA	OSSA	Bunyaviridae	Bunyavirus	C
OUANGO	OUA			

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

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
PROSPECT HILL	PH	Bunyaviridae	Hantavirus*	HTN
PUCHONG	PUC			MAL
PUEBLO VIEJO	PV	Bunyaviridae	Bunyavirus	GAM
PUNTA SALINAS	PS	Bunyaviridae	Nairovirus	HUG
PUNTA TORO	PT	Bunyaviridae	Phlebovirus	PHL
PURUS	PUR	Reoviridae	Orbivirus	CGL
QALYUB	QYB	Bunyaviridae	Nairovirus	QYB
QUARANFIL	QRF			QRF
RAZDAN	RAZ	Bunyaviridae	Bunyavirus-like	
RESTAN	RES	Bunyaviridae	Bunyavirus	C
RIFT VALLEY FEVER	RVF	Bunyaviridae	Phlebovirus	PHL
RIO BRAVO	RB	Togaviridae	Flavivirus	B
RIO GRANDE	RG	Bunyaviridae	Phlebovirus	PHL
ROCHAMBEAU	RBU			
ROCIO	ROC	Flaviviridae	Flavivirus	B
ROSS RIVER	RR	Togaviridae	Alphavirus	A
ROYAL FARM	RF	Flaviviridae	Flavivirus	B
RUSS. SPR. SUM. ENC.	RSSE	Flaviviridae	Flavivirus	B
SABO	SABO	Bunyaviridae	Bunyavirus	SIM
SABOYA	SAB	Flaviviridae	Flavivirus	B
SAGIYAMA	SAG	Togaviridae	Alphavirus	A
SAINT-FLORIS	SAF	Bunyaviridae	Phlebovirus	PHL
SAKHALIN	SAK	Bunyaviridae	Nairovirus	SAK
SAKPA	SPA			
SALANGA	SGA	Poxviridae		

* See footnote for Hantaan virus

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
SALEHABAD	SAL	Bunyaviridae	Phlebovirus	PHL
SAL VIEJA	SV	Flaviviridae	Flavivirus	B
SAN ANGELO	SA	Bunyaviridae	Bunyavirus	CAL
SANDFLY F. (NAPLES)	SFN	Bunyaviridae	Phlebovirus	PHL
SANDFLY F. (SICILIAN)	SFS	Bunyaviridae	Phlebovirus	PHL
SANDJIMBA	SJA			
SANGO	SAN	Bunyaviridae	Bunyavirus	SIM
SAN JUAN	SJ	Bunyaviridae	Bunyavirus	GAM
SAN PERLITA	SP	Flaviviridae	Flavivirus	B
SANTAREM	STM			
SANTA ROSA	SAR	Bunyaviridae	Bunyavirus	BUN
SARACA	SRA	Reoviridae	Orbivirus	CGL
SATHUPERI	SAT	Bunyaviridae	Bunyavirus	SIM
SAUMAREZ REEF	SRE	Flaviviridae	Flavivirus	B
SAWGRASS	SAW	Rhabdoviridae		SAW
SEBOKELE	SEB			
SELETAR	SEL	Reoviridae	Orbivirus	KEM
SEMBALAM	SEM			
SEMLIKI FOREST	SF	Togaviridae	Alphavirus	A
SENA MADUREIRA	SM	Rhabdoviridae		TIM
SEPIK	SEP	Flaviviridae	Flavivirus	B
SERRA DO NAVIO	SDN	Bunyaviridae	Bunyavirus	CAL
SHAMONDA	SHA	Bunyaviridae	Bunyavirus	SIM
SHARK RIVER	SR	Bunyaviridae	Bunyavirus	PAT
SHOKWE	SHO	Bunyaviridae	Bunyavirus	BUN

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
SHUNI	SHU	Bunyaviridae	Bunyavirus	SIM
SILVERWATER	SIL	Bunyaviridae	Bunyavirus-like	KSO
SIMBU	SIM	Bunyaviridae	Bunyavirus	SIM
SIMIAN HEM. FEVER	SHF	Flaviviridae		
SINDBIS	SIN	Togaviridae	Alphavirus	A
SIXGUN CITY	SC	Reoviridae	Orbivirus	KEM
SLOVAKIA	SLO			
SNOWSHOE HARE	SSH	Bunyaviridae	Bunyavirus	CAL
SOKULUK	SOK	Flaviviridae	Flavivirus	B
SOLDADO	SOL	Bunyaviridae	Nairovirus	HUG
SORONOCA	SOR	Bunyaviridae	Bunyavirus	BUN
SPONDWENI	SPO	Flaviviridae	Flavivirus	B
SRIPUR	SRI	Rhabdoviridae		
ST. LOUIS ENC.	SLE	Flaviviridae	Flavivirus	B
STRATFORD	STR	Flaviviridae	Flavivirus	B
SUNDAY CANYON	SCA	Bunyaviridae	Bunyavirus-like	
TACAIUMA	TCM	Bunyaviridae	Bunyavirus	ANA
TACARIBE	TCR	Arenaviridae	Arenavirus	TCR
TAGGERT	TAG	Bunyaviridae	Nairovirus	SAK
TAHYNA	TAH	Bunyaviridae	Bunyavirus	CAL
TAMDY	TDY	Bunyaviridae	Bunyavirus-like	
TAMIAMI	TAM	Arenaviridae	Arenavirus	TCR
TANGA	TAN			
TANJONG RABOK	TR			TR
TATAGUINE	TAT	Bunyaviridae	Bunyavirus-like	

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
TEHRAN	TEH	Bunyaviridae	Phlebovirus	PHL
TELOK FOREST	TF			TR
TEMBE	TME			
TEMBUSU	TMU	Flaviviridae	Flavivirus	B
TENSAW	TEN	Bunyaviridae	Bunyavirus	BUN
TERMEIL	TER			
TETE	TETE	Bunyaviridae	Bunyavirus	TETE
TETTNANG	TET	Coronaviridae		
THIMIRI	THI	Bunyaviridae	Bunyavirus	SIM
THOGOTO	THO	Orthomyxoviridae		THO
THOTTAPALAYAM	TPM			
TIBROGARGAN	TIB	Rhabdoviridae		
TILLIGERRY	TIL	Reoviridae	Orbivirus	EUB
TIMBO	TIM	Rhabdoviridae		TIM
TIMBOTEUA	TBT	Bunyaviridae	Bunyavirus	GMA
TINAROO	TIN	Bunyaviridae	Bunyavirus	SIM
TLACOTALPAN	TLA	Bunyaviridae	Bunyavirus	BUN
TONATE	TON	Togaviridae	Alphavirus	A
TOSCANA	TOS	Bunyaviridae	Phlebovirus	PHL
TOURE	TOU			
TRIBEC	TRB	Reoviridae	Orbivirus	KEM
TRINITI	TNT	Togaviridae		
TRIVITTATUS	TVT	Bunyaviridae	Bunyavirus	CAL
TRUBANAMAN	TRU	Bunyaviridae	Bunyavirus-like	MAP
TSURUSE	TSU	Bunyaviridae	Bunyavirus	TETE

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
TURLOCK	TUR	Bunyaviridae	Bunyavirus	TUR
TURUNA	TUA	Bunyaviridae	Phlebovirus	PHL
TYULENIY	TYU	Flaviviridae	Flavivirus	B
UGANDA S	UGS	Flaviviridae	Flavivirus	B
UMATILLA	UMA	Reoviridae	Orbivirus	*
UMBRE	UMB	Bunyaviridae	Bunyavirus	TUR
UNA	UNA	Togaviridae	Alphavivirus	A
UPOLU	UPO	Bunyaviridae	Bunyavirus-like	UPO
URUCURI	URU	Bunyaviridae	Phlebovirus	PHL
USUTU	USU	Flaviviridae	Flavivirus	B
UTINGA	UTI	Bunyaviridae	Bunyavirus	SIM
UUKUNIEMI	UUK	Bunyaviridae	Uukuvirus	UUK
VELLORE	VEL	Reoviridae	Orbivirus	PAL
VEN. EQUINE ENC.	VEE	Togaviridae	Alphavirus	A
VENKATAPURAM	VKT			
VINCES	VIN	Bunyaviridae	Bunyavirus	C
VIRGIN RIVER	VR	Bunyaviridae	Bunyavirus	ANA
VS-ALAGOAS	VSA	Rhabdoviridae	Vesiculovirus	VSV
VS-INDIANA	VSI	Rhabdoviridae	Vesiculovirus	VSV
VS-NEW JERSEY	VSNJ	Rhabdoviridae	Vesiculovirus	VSV
WAD MEDANI	WM	Reoviridae	Orbivirus	KEM
WALLAL	WAL	Reoviridae	Orbivirus	WAL
WANOWRIE	WAN			
WARREGO	WAR	Reoviridae	Orbivirus	WAR
WESSELSBRON	WSL	Flaviviridae	Flavivirus	B

* See footnote for Llano Seco virus

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
WEST. EQUINE ENC.	WEE	Togaviridae	Alphavirus	A
WEST NILE	WN	Flaviviridae	Flavivirus	B
WHATAROA	WHA	Togaviridae	Alphavirus	A
WITWATERSRAND	WIT	Bunyaviridae	Bunyavirus-like	
WONGAL	WON	Bunyaviridae	Bunyavirus	KOO
WONGORR	WGR			
WYEOMYIA	WYO	Bunyaviridae	Bunyavirus	BUN
XIBUREMA	XIB	Rhabdoviridae		
YACAABA	YAC			
YAQUINA HEAD	YH	Reoviridae	Orbivirus	KEM
YATA	YATA	Rhabdoviridae		
YELLOW FEVER	YF	Flaviviridae	Flavivirus	B
YOGUE	YOG			
YUG BOGDANOVAC	YB	Rhabdoviridae	Vesiculovirus	VSV
ZALIV TERPENIYA	ZT	Bunyaviridae	Uukuvirus	UUK
ZEGLA	ZEG	Bunyaviridae	Bunyavirus	PAT
ZIKA	ZIKA	Flaviviridae	Flavivirus	B
ZINGA	ZGA	Bunyaviridae	Phlebovirus	PHL
ZINGILAMO	ZGO			BTK
ZIRQA	ZIR	Bunyaviridae	Nairovirus	HUG

Table 2. Antigenic Groups of 490 Viruses Registered in Catalogue

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group		Percent
ARENAVIRIDAE					
Arenavirus	Tacaribe	TCR		11	2.2
BUNYAVIRIDAE					
Bunyavirus				123	25.1
(Bunyamwera Supergroup)	Anopheles A	ANA	5		
	Anopheles B	ANB	2		
	Bunyamwera	BUN	22		
	Bwamba	BWA	2		
	C	C	12		
	California	CAL	13		
	Capim	CAP	8		
	Gamboa	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		
Nairovirus				23	4.7
	CHF-Congo	CHF-CON	4		
	Dera Ghazi Khan	DGK	5		
	Hughes	HUG	4		
	Nairobi sheep disease	NSD	3		
	Qalyub	QYB	2		
	Sakhalin	SAK	5		
Phlebovirus	Phlebotomus fever	PHL		35	7.1

Table 2 (Continued)

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
BUNYAVIRIDAE				
Uukuvirus	Uukuniemi	UUK	5	1.0
Hantavirus*	Hantaan	HTN	2	0.4
"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
	Upolu	UPO	2	0.4
	Ungrouped		12	2.5
REOVIRIDAE				
Orbivirus	African horsesickness	AHS	1	0.2
	Bluetongue	BLU	1	0.2
	Changuinola	CGL	12	2.5
	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	16	3.3
	Palyam	PAL	7	1.4
	Wallal	WAL	1	0.2
	Warrego	WAR	2	0.4
	Ungrouped		9	1.8
RHABDOVIRIDAE				
Vesiculovirus	Vesicular stomatitis	VSV	10	2.0
Lyssavirus	Rabies		2	0.4
Unassigned or possible members	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	2.9

* Proposed genus designation

Table 2 (Continued)

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
TOGAVIRIDAE				
Alphavirus	A	A	26	5.3
Possible members	Ungrouped		1	0.2
FLAVIVIRIDAE				
Flavivirus	B	B	64	13.1
Possible members	Ungrouped		1	0.2
CORONAVIRIDAE	Ungrouped		1	0.2
Coronavirus	Ungrouped		1	0.2
HERPESVIRIDAE	Ungrouped		1	0.2
IRIDOVIRIDAE	Ungrouped		1	0.2
NODAVIRIDAE				
Nodavirus	Ungrouped		1	0.2
ORTHOMYXOVIRIDAE	Thogoto	THO	1	0.2
	Ungrouped		1	0.2
PARAMYXOVIRIDAE				
Paramyxovirus	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		44	9.0
TOTAL			490	

Table 3. 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,NSD
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
	Australasia	Hawaii	DEN-1*
		New Guinea	DEN-2*
	Europe	Czechoslovakia	HAN
		Italy	SFN*,SFS*
	N. America	U.S.A.	CE,CTF,TVT
	S. America	Brazil	ILH
		Colombia	ANA,ANB,WYO
1950-59	Africa	Egypt	CNU,QRF,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,IBA,NOD,SAG,TSU
		Malaya	BAK,BAT,BEB,GET,KET,LGT,TMU
	Australasia	Australia	MVE
		Philippines	DEN-3*,DEN-4*
	Europe	Czechoslovakia	HYPR,TAH
		Finland	KUM
		U.S.S.R.	ABS
	N. America	Canada	POW
		Panama	BOC,LJ,PCA
		U.S.A.	CV,EHD,HP,MML,MOD,RB,SA,SSH,TUR,VSNJ
	S. America	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,IERI,KRI,LUK,MAN,MAY, MEL,NEP,ORO,TCR,TNT

* Isolated in U.S.A. laboratory
** Isolated in Egypt laboratory

Table 3 (Continued)

Decade	Continent	Country	Virus
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,LJN,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*
	Europe	Czechoslovakia	CVO,KEM,LED,LIP,TRB
		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
		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
	S. America	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,MCO,OUR,PAC, PIRY,PIX,SDN,SOR,TBT,TIM,TME,URU,UTI, VSA
		Colombia	BUE,PIC
		French Guiana	CAB

* Isolated in U.S.A. laboratory
** Isolated in Panama laboratory
§ Isolated in Egypt laboratory

Table 3 (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,GG,KNA,MAR,NGA,NUG,PEA, PIA,PR,SRE,TAG,TER,TIB,TIL,TIN,WAL, WGR,YAC
	Europe	Czechoslovakia	SLO
		Germany	EYA,TET
		Italy	TOS
		Scotland	CM,CW
		U.S.S.R.	BAKU
		Yugoslavia	YB
	N. America	Canada	AVA,BAU*,GI*
		Mexico	SAR*
		Panama	CAC,CAI,NIQ
		U.S.A.	AB,CNT,FM,GLO,LLS,NM,NOR,RG,SCA,SP, SV,VR,YH
	S. America	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
1980-84	Europe	Italy	ARB
	N. America	Cuba	ER∞
		USA	PH
	S. America	Argentina	LM
		Brazil	AMR,JARI,MDO,MUN,ORX,PUR,SRA,XIB

* Isolated in U.S.A. laboratory
** Isolated in Panama laboratory
§ Isolated in Egypt laboratory
∞ Isolated in Czechoslovak laboratory

Table 4. Initial Isolation of 490 Registered Viruses By Continent, Country, and Chronological Period

Continent	Country or Area	Before 1930	1930 -39	1940 -49	1950 -59	1960 -69	1970 -79	1980 -84	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
	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	0	77
AUSTRAL-	Australia				1	25	21		47
ASIA	Hawaii			1					1
and	Johnston Island					1			1
PACIFIC	New Guinea			1					1
ISLANDS	New Zealand					1			1
	Philippines				2				2
	Totals	0	0	2	3	27	21	0	53
EUROPE	Czechoslovakia			1	2	5	1		9
	Finland				1	2			3
	France					2			2
	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	8	1	27
NORTH	Canada				1	1	3		5
AMERICA	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

Table 4 (Continued)

Continent	Country or Area	Before 1930	1930 -39	1940 -49	1950 -59	1960 -69	1970 -79	1980 -84	Totals
SOUTH AMERICA	Argentina				1			1	2
	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	9	131
	GRAND TOTALS	5	10	19	109	209	125	12	490

Table 5. Alphaviruses, Family Togaviridae

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks																									
	Culicine	Anophelline	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
Aura	+																	+			+			2	S	22	Alphavirus
Barmah Forest	+																	+						2	A7	22	"
Bebaru	+																+							2	S	22	"
Cabassou	+										+	+	+		+						+			3*V	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	"
Highlands J	+										+				+					+				2	S	20	"
Kyzylagach	+																+							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	"
Sagiyama	+																+							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. Mosquito-Borne Flaviviruses, Family Flaviviridae

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels		Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																								
Alfuy	+										+								+						2	S	20	Flavivirus
Bagaza	+																+								2	S	22	"
Banzi	+							+							+		+						+		2	S	20	"
Bouboui	+	+							+								+								2	S	22	"
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	"
Japanese enc.	+	+						+			+	+		+				+					+		3	S	20	"
Jugra	+											+						+							2	S	21	"
Kokobera	+																		+						2	S	21	"
Kunjin	+							+			+			+					+				+		2	S	20	"
Murray Valley enc.	+							+											+				+		3	S	20	"
Naranjal	+														+							+			3	IE	21	"
Ntaya	+																+								2	S	21	"
Rocio	+							+			+				+							+	+	+	3*	S	20	"
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
** See footnote Table 5

V:See footnote Table 5
X:Arboviruses restricted by U.S. Department of Agriculture regulations or policy.

Table 7. Tick-Borne Flaviviruses, Family Flaviviridae

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
Absettarov			+					+						+					+			+	+	4	A4	20	Flavivirus
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*X	S	20	"
Omsk hem. fever			+					+		+				+			+		?			+	+	4	S	20	"
Powassan			+					+		+				+						+		+	+	3	S	20	"
Royal Farm				+													+		+			+	+	2	S	22	"
RSSE			+					+		+	+											+		4	S	20	"
Saumarez Reef			+	+														+						3	IE	22	"
Tyuleniy			+														+			+				2	S	21	"

* See footnote Table 5
** See footnote Table 5
X:See footnote Table 6

Table 8. Flaviviruses, Family Flaviviridae
No Arthropod Vector Demonstrated

VIRUS	ISOLATED FROM																		ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																						
	Mosq.		Ticks					Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Other	Phlebotomine	Culicoides	Argasid	Ixodid	Anopheline	Culicine	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
Apoi										+					+					+				+			+		2	S	22	Flavivirus
Aroa																										+ +			2	S	22	"
Cacipacore											+																		3	IE	22	"
Carey Island												+								+				+					2	S	22	"
Cowbone Ridge										+																+			2	S	23	"
Dakar bat								+				+											+						2	S	24	"
Entebbe bat												+											+ +						2	S	24	"
Israel turkey men.											+									+			+ +	+					3	S	21	"
Jutiapa										+																+			2	S	22	"
Koutango										+													+					+	3	S	21	"
Modoc										+																+			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

Table 9. 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																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
ANOPHELES A GR.																											
Anopheles A		+																			+			2	S	21	Bunyavirus
Las Maloyas		+																			+			2	A7	22	"
Lukuni	+	+																			+			2	S	22	"
Tacaiuma	+	+						+	+						+						+	+		2	S	21	"
Virgin River	+																			+				2	A7	22	"
ANOPHELES B GR.																											
Anopheles B		+																			+			2	S	22	Bunyavirus
Boraceia	+	+																			+			2	S	22	"

** See footnote Table 5

Table 10. Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, Bunyamwera Serogroup Viruses

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																								
BUNYAMWERA GR.																												
Anhembi	+									+											+			2	S	22	Bunyavirus
Batai	+	+															+			+				2	S	21	"
Birao		+														+								2	S	22	"
Bunyamwera	+							+								+						+	+	2	S	20	"
Cache Valley	+	+																		+				2	S	20	"
Calovo†		+																	+			+		2	S	21	"
Germiston	+							+		+					+	+							+	3*	S	20	"
Iaco	+																				+			3	IE	22	"
Ilesha		+						+								+						+		2	S	21	"
Kairi	+								+	+					+						+			3	A1	20	"
Lokern	+					+								+						+				2	S	20	"
Macaua	+									+	+										+			3	IE	21	"
Maguari	+	+												+	+						+			2	S	20	"
Main Drain	+					+								+						+				2	S	20	"
Northway	+														+					+				3	IE	21	"
Playas	+																				+			3	IE	22	"
Santa Rosa	+																			+				3	IE	22	"
Shokwe	+	+						+		+						+								3	IE	21	"
Sororoca	+																				+			2	S	22	"
Tensaw	+	+												+	+					+		+		2	S	20	"
Tlacotalpan	+	+																		+	+			3	IE	22	"
Wyeomyia	+	+						+												+	+	+		2	S	21	"

* See footnote Table 5
** See footnote Table 5
† May be strain of Batai

Table 11. Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, Bwamba Serogroup and Serogroup C Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
BWAMBA GR.																											
Bwamba		+						+								+						+		2	S	21	Bunyavirus
Pongola	+	+														+								2	S	20	"
GROUP C																											
Apeu	+							+					+		+						+	+	+	2	S	20	Bunyavirus
Caraparu	+							+		+					+					+	+	+		2	S	20	"
Gumbo Limbo	+																			+				2	S	21	"
Itaqui	+							+		+			+		+						+	+		2	S	20	"
Madrid	+							+		+					+					+		+		2	S	20	"
Marituba	+							+					+		+						+	+		2	S	20	"
Murutucu	+							+		+			+	+	+						+	+		2	S	20	"
Nepuyo	+							+		+		+			+					+	+	+		2	S	20	"
Oriboca	+							+		+			+		+						+	+	+	2	S	20	"
Ossa	+							+							+					+		+		2	S	20	"
Restan	+							+							+						+	+		2	S	20	"
Vinces	+														+						+			2	A7	21	"

** See footnote Table 5

Table 12. Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, California and Capim Serogroup Viruses

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																								
CALIFORNIA GR.																												
California enc.	+																			+		+		2	S	20	Bunyavirus
Guaroa		+						+												+	+	+		2	S	20	"
Inkoo	+																		+	+		+		2	S	22	"
Jamestown Canyon	+						+								+					+		+		2	S	20	"
Jerry Slough	+														+					+				2	S	20	"
Keystone	+	+								+					+					+				2	S	20	"
La Crosse	+							+		+					+					+		+		2	S	20	"
Melao	+																			+	+			2	S	21	"
San Angelo		+																		+				2	S	20	"
Serra do Navio	+																			+	+			3	IE	22	"
Snowshoe hare	+									+				+	+					+		+		2	S	20	"
Tahyna	+	+						+							+	+	+		+	+		+		2	S	20	"
Trivittatus	+									+					+					+				2	S	20	"
CAPIM GR.																												
Acara	+									+					+					+	+			2	S	21	Bunyavirus
Benevides	+														+						+			2	A7	21	"
Benfica	+									+					+						+			2	A7	20	"
Bushbush	+														+						+			2	S	20	"
Capim	+									+			+		+						+			2	S	20	"
Guajara	+									+					+					+	+			2	S	20	"
Juan Diaz																				+				2	S	22	"
Moriche	+														+						+			2	S	22	"

** See footnote Table 5

Table 13. 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																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
GAMBOA GR.																											
Gamboa	+																			+	+			2	S	22	Bunyavirus
Pueblo Viejo	+																				+			3	IE	22	"
San Juan	+																				+			3	2E	22	"
GUAMA GR.																											
Ananindeua	+									+	+		+		+						+			2	A7	21	Bunyavirus
Bertioga										+					+						+			2	S	22	"
Bimiti	+									+					+						+			2	S	20	"
Cananeia	+														+						+			3	IE	21	"
Catu	+	+						+		+		+	+		+						+	+		2	S	20	"
Guama	+				+			+		+		+	+		+					+	+	+		2	S	20	"
Guaratuba	+										+				+						+			3	IE	21	"
Itimirim										+	+				+						+			3	IE	22	"
Mahogany Hammock	+									+										+				2	S	22	"
Mirim	+														+						+			2	S	20	"
Moju	+									+			+		+						+			2	S	20	"
Timboteua										+					+						+			2	A7	21	"
KOONGOL GR.																											
Koongol	+	?																+						2	S	21	Bunyavirus
Wongal	+																	+						2	S	21	"

** See footnote Table 5

Table 14. 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																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
MINATITLAN GR.																											
Minatitlan															+					+				2	S	22	Bunyavirus
Palestina	+														+					+				3	IE	21	"
OLIFANTSVLEI GR.																											
Bobia	+															+								3	IE	22	Bunyavirus
Botambi	+															+								2	S	22	"
Olifantsvlei	+															+								2	S	22	"
PATOIS GR.																											
Abras	+																				+			2	A7	22	Bunyavirus
Babahoyo	+														+						+			2	A7	21	"
Pahayokee	+																			+				2	S	22	"
Patois	+									+					+					+				2	S	20	"
Shark River	+	+								+					+					+				2	S	21	"
Zegla										+										+				2	S	22	"

** See footnote Table 5

Table 15. Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, Simbu Serogroup Viruses

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels		Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																								
Aino	+					+												+	+						3	S	22	Bunyavirus
Akabane	+					+								+				+	+						3	S	21	"
Buttonwillow						+								+	+						+				2	S	20	"
Douglas						+								+	+				+						3	IE	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	A1	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
** See footnote Table 5

Table 16. Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, Tete and Turlock Serogroups and Unassigned Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
TETE GR.																											
Bahig			+								+					+			+					2	S	21	Bunyavirus
Batama											+					+								3	IE	22	"
Matruh			+								+					+			+					2	S	22	"
Tete											+						+							2	S	22	"
Tsuruse											+													2	S	22	"
TURLOCK GR.																											
Lednice	+																		+					2	A7	21	Bunyavirus
M'Poko (=Yaba-1)	+															+								2	S	22	"
Turlock	+										+			+	+					+	+			2	S	20	"
Umbre	+										+						+							2	S	21	"
UNASSIGNED - "SBU"																											
Kaeng Khoi							+					+			+		+							2	S	22	Bunyavirus

** See footnote Table 5

Table 17. Phleboviruses, Family Bunyaviridae:
Phlebotomus Fever Serogroup Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks				Other																					
	Culicine	Anophelline	Ixodid	Argasid	Phlebotomine	Culicoides		Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
Aguacate					+			+		+				+						+	+ +			2	S	21	Phlebovirus
Alenquer																								3	IE	22	"
Anhanga														+							+ +			2	S	22	"
Arbia					+														+					3	IE	21	"
Arumowot	+									+				+		+								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										+				+		+										21	"
Gordil										+						+					+			3	IE	22	"
Icoaraci	+	+			+					+	+				+						+			2	S	21	"
Itaituba													+								+			3	IE	22	"
Itaporanga	+										+		+		+						+			2	S	20	"
Karimabad					+												+							2	S	21	"
Munguba					+																+			3	IE	22	"
Nique					+															+				2	S	22	"
Oriximina					+																+			3	IE	22	"
Pacui					+					+											+			2	S	21	"
Punto Toro					+			+												+	+	+		2	S	21	"
Rift Valley fever	+							+						+		+						+	+	3*VX	S	20	"
Rio Grande										+										+				2	S	21	"

* See footnote Table 5
** See footnote Table 5
V: See footnote Table 5
X: See footnote Table 6

Table 17. Phleboviruses, Family Bunyaviridae:
Phlebotomus Fever Serogroup Viruses
(Continued)

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

* See footnote Table 5
** See footnote Table 5

V: See footnote Table 5
X: See footnote Table 6

Table 18. Nairoviruses, Family Bunyaviridae:
Tick-Borne Serogroups Other Than Serogroup B Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
CHF-CONGO GR.																											
Congo			+			+		+						+		+	+		+			+	+	4	A6	20	Nairovirus
Crimean hem. fever			+	+				+								+	+		+			+	+	4	A6	20	"
Hazara			+														+							2	S	22	"
Khasan			+														+							3	IE	22	"
DERA GHAZI KHAN GR.																											
Abu Hammad				+												+	+							2	S	22	Nairovirus
Dera Ghazi Khan			+														+							2	S	22	"
Kao Shuan				+													+	+						2	S	22	"
Pathum Thani				+													+							2	S	22	"
Pretoria				+												+								2	S	22	"
HUGHES GR.																											
Hughes				+							+									+	+			2	S	21	Nairovirus
Punta Salinas				+																	+			2	S	22	"
Soldado				+												+			+		+			2	S	20	"
Zirga				+													+							2	S	22	"

** See footnote Table 5

Table 19. Nairoviruses, Family Bunyaviridae:
Tick-Borne Serogroups Other Than Serogroup B Viruses

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

** See footnote Table 5
X:See footnote Table 6

Table 20. Uukuviruses, Hantaviruses, Bunyavirus-Like, Family Bunyaviridae: Tick-Borne Serogroups Other Than Serogroup B Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
UUKUNIEMI GR.																											
Grand Arbaud				+															+					2	S	20	Uukuvirus
Manawa			+	+													+							2	S	22	"
Ponteves				+															+					3	IE	22	"
Uukuniemi			+							+	+								+					2	S	21	"
Zaliv Terpeniya			+														+							2	S	22	"
HANTAAN GR.																											
Hantaan								+		+							+					+	+	3∞	S	22	Hantavirus
Prospect Hill										+										+						23	"
BHANJA GR.																											
Bhanja			+					+		+				+		+	+		+				+	3	S	21	Bunyavirus-like
KAISODI GR.																											
Kaisodi			+								+						+							2	S	21	Bunyavirus-like
Lanjan			+						+								+							2	S	22	"
Silverwater			+											+						+				2	S	21	"
UPOLU GR.																											
Aransas Bay				+																+				3	IE	22	Bunyavirus-like
Upolu				+														+						2	S	22	"

** See footnote Table 5

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

Hantavirus: Proposed genus designation.

Table 21. Family Orthomyxoviridae; Unclassified Viruses:
Tick-Borne Serogroups Other Than Serogroup B Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
THOGOTO GR.																											
Thogoto			+					+						+		+			+			+		3	S	21	Orthomyxovirida
NYAMANINI GR.																											
Nyamanini				+							+					+								2	S	21	Unclassified
QUARANFIL GR.																											
Johnston Atoll				+														+						2	S	20	Unclassified
Quaranfil				+				+			+					+						+		2	S	20	"

** See footnote Table 5

Table 22. Bunyavirus-Like Viruses, Family Bunyaviridae: Minor Antigenic Groups of Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
BAKAU GR.																											
Bakau	+			+					+								+							2	S	22	Bunyavirus-like
Ketapang	+																+							2	S	21	"
MAPPUTTA GR.																											
Gan Gan	+																	+						2	A7	22	Bunyavirus-like
Mapputta		+																+						2	S	22	"
Maprik	+	+																+						2	S	21	"
Trubanaman		+																+						2	S	22	"
MATARIYA GR.																											
Burg el Arab											+					+								2	S	22	Bunyavirus-like
Garba											+					+								3	IE	22	"
Matariya											+					+								2	S	22	"
NYANDO GR.																											
Nyando		+						+								+						+		2	S	21	Bunyavirus-like

** See footnote Table 5

Table 23. Orbiviruses, Family Reoviridae: Tick-Borne Serogroups Other Than Serogroup B Viruses

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks																									
	Culicine	Anopheline	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
COLO. TICK FEVER GR.																												
Colorado tick fever			+	+				+		+				+						+		+	+	2	S	20	Orbivirus
Eyach			+																+					2	S	22	"
KEMEROVO GR.																												
Baku				+															+					2	S	22	Orbivirus
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	"
Nugget			+															+						2	S	22	"
Okhotskiy			+														+							2	S	22	"
Seletar			+														+							2	S	22	"
Sixgun City				+																+				2	S	22	"
Tribec			+							+				+	+				+					2	S	21	"
Wad Medani			+													+	+			+				2	S	21	"
Yaquina Head			+																	+				2	S	22	"

** See footnote Table 5

Table 24. Orbiviruses, Family Reoviridae:
Minor Antigenic Groups of Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
AFR. HORSESICKNESS																											
Afr. horsesickness						+								+		+	+		+					X		20	Orbivirus
BLUETONGUE GR.																											
Bluetongue						+								+		+	+	+	+	+				2	S	20	Orbivirus
CHANGUINOLA GR.																											
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	"
CORRIPARTA GR.																											
Acado	+															+								2	S	22	Orbivirus
Corriparta	+										+							+						2	S	21	"
Jacareacanga	+																				+			3	IE	22	"
EHD GR.																											
Epizootic hem.dis.														+		+				+				2	S	21	Orbivirus
Ibaraki														+			+							3	IE	22	"

** See footnote Table 5
X: See footnote Table 6

Table 25. Orbiviruses, Family Reoviridae:
Minor Antigenic Groups of Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anophelline	Ixodid	Argasid																							
EUBENANGEE GR.																											
Eubenangee	+	+?				+												+						2	S	22	Orbivirus
Pata	+															+								2	S	22	"
Tilligerry		+																+						3	IE	22	"
PALYAM GR.																											
Bunyip Creek						+								+				+						2	S	21	Orbivirus
Csiro Village						+								+				+						2	S	21	"
D'Aguilar						+								+				+						2	S	22	"
Kasba	+																+							2	S	22	"
Marrakai						+								+				+						2	S	22	"
Palyam	+																+							2	S	22	"
Vellore	+																+							2	S	22	"
WALLAL GR.																											
Wallal						+												+						2	S	22	Orbivirus
WARREGO GR.																											
Mitchell River						+												+						2	S	22	Orbivirus
Warrego	+	+				+												+						2	S	22	"

** See footnote Table 5

Table 26. Family Rhabdoviridae; Lyssaviruses, Family Rhabdoviridae: Minor Antigenic Groups of Viruses

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																								
HART PARK GR.																												
Flanders	+										+									+				2	S	22	Rhabdoviridae
Hart Park	+										+									+				2	S	21	"
Mosqueiro	+																				+			3	IE	22	"
KHATTA GR.																												
Kwatta	+																				+			2	S	22	Rhabdoviridae
LE DANTEC GR.																												
Keuraliba										+						+						+		2	S	22	Rhabdoviridae
Le Dantec								+								+								2	S	22	"
MOSSURIL GR.																												
Bangoran	+										+					+								2	S	22	Rhabdoviridae
Barur			+							+							+							2	S	22	"
Charleville					+									+				+						2	S	22	"
Cuiaba														+							+			2	S	22	"
Kamese	+															+								2	S	22	"
Kern Canyon												+								+				2	S	23	"
Marco														+							+			2	S	22	"
Mossuril	+										+					+								2	S	22	"
RABIES SEROGROUP																												
Kotonkan						+										+								2	S	21	Lyssavirus
Lagos bat												+				+								2	S	24	"

** See footnote Table 5

Table 27. Family Rhabdoviridae; Vesiculoviruses, Family Rhabdoviridae: Minor Antigenic Groups of Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks																								
	Culicine	Anopheline	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
SAWGRASS GR.																											
Connecticut			+																	+				3	IE	22	Rhabdoviridae
New Minto			+																	+				3	IE	22	"
Sawgrass			+																	+				2	S	22	"
TIMBO GR.																											
Chaco														+							+			2	S	22	Rhabdoviridae
Sena Madureira														+							+			3	IE	22	"
Timbo														+							+			2	S	22	"
VES. STOMATITIS GR.																											
Chandipura					+			+						+		+	+					+		2	S	20	Vesiculovirus
Cocal	+						+			+				+	+						+			3	A1	20	"
Isfahan					+												+							2	S	21	"
Jurona	+																				+			2	S	22	"
La Joya	+																			+				2	S	22	"
Piry								+					+								+		+	3	S	22	"
VS-Alagoas														+							+	+		3	S	22	"
VS-Indiana	+				+			+						+						+	+	+	+	2	A3	20	"
VS-New Jersey	+						+	+						+						+	+	+	+	2	A3	22	"
Yug Bogdanovac					+														+					3	IE	22	"

** See footnote Table 5

Table 28. Taxonomically Unclassified Viruses:
Minor Antigenic Groups of Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
BOTEKE GR.																											
Boteke	+															+							•	2	S	22	Unclassified
Zingilamo											+					+								2	S	22	"
MALAKAL GR.																											
Malakal	+															+								2	S	22	Unclassified
Puchong	+																+							2	S	22	"
MARBURG GR.																											
Ebola								+								+						+	+	4	S	23	Unclassified
Marburg								+								+			+			+	+	4	S	23	"
TANJONG RABOK GR.																											
Tanjong Rabok															+		+							2	S	22	Unclassified
Telok Forest									+								+							3	IE	22	"

** See footnote Table 5

Table 29. Arenaviruses, Family Arenaviridae:
Tacaribe (LCM) Serogroup Viruses

VIRUS	ISOLATED FROM														ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																		
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
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	"

** See footnote Table 5

Table 30. Families Bunyaviridae, Coronaviridae, Reoviridae, Nodaviridae, Poxviridae: Antigenically Ungrouped Mosquito-Associated Viruses

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS								VERTEBRATES																			
	Mosq.		Ticks		Phlebotomine	Culicoides	Other		Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																								
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	"
Bocas	+												+								+	+					22	Coronavirus
Ieri	+																				+				2	S	22	Orbivirus
Japanaut	+												+						+						2	S	21	"
Lebombo	+						+		+								+								2	S	21	"
Llano Seco††	+																				+				3	IE	21	"
Orungo	+	+															+						+		3	S	21	"
Paroo River	+																		+						3	IE	22	"
Umatilla	+											+									+				2	S	20	"
Nodamura	+																	+							3	IE	23	Nodavirus
Cotia	+				+				+							+						+	+		2	S	24	Poxvirus
Oubangui	+																+								3	IE	22	"

** See footnote Table 5

†† 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 31. Families Rhabdoviridae, Togaviridae; Taxonomically Unclassified Viruses: Antigenically Ungrouped Mosquito-Associated Viruses

VIRUS	ISOLATED FROM															ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																			
	Mosq.		Ticks																								
	Culicine	Anopheline	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
Aruac	+																			+	+			2	S	21	Rhabdoviridae
Gray Lodge	+																			+				3	IE	22	"
Joinjakaka	+																	+						2	S	22	"
Kununurra	+																	+						2	S	22	"
Xiburema	+																				+			3	IE	22	"
Yata	+															+								2	S	22	"
Triniti	+																				+			2	S	21	Togaviridae
Arkonam	+	+															+							2	S	22	Unclassified
Gomoka	+	+									+					+								2	S	22	"
Itupiranga	+																				+			3	IE	22	"
Minnal	+																+							2	S	22	"
Nkolbisson	+															+								2	S	22	"
Okola	+															+								2	S	22	"
Para	+														+						+			3	IE	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	"

** See footnote Table 5

Table 32. Families Bunyaviridae, Coronaviridae, Iridoviridae, Orthomyxoviridae, Reoviridae, Rhabdoviridae; Taxonomically Unclassified Viruses: Antigenically Ungrouped Tick-, Culicoides-, or Phlebotomus-Associated Viruses

VIRUS	ISOLATED FROM														ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																		
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
Lone Star			+																	+				2	S	22	Bunyavirus-lik
Razdan			+														+							3	IE	22	"
Sunday Canyon				+																+				2	S	22	"
Tamdy				+				+									+					+		3	IE	22	"
Tettnang			+																+					2	S	22	Coronaviridae
Afr. swine fever				+										+		+			+	+§	+α			X		20	Iridoviridae
Chobar Gorge				+													+							2	S	22	Orbivirus
Dhori			+													+	+		+					3	S	22	Orthomyxovirid
Bovine eph. fever		+				+								+		+	+	+						X		22	Rhabdoviridae
Inhangapi					+																+			3	IE	22	"
Sripur					+												+							3	IE	22	"
Tibrogargan						+												+						2	S	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	"
Matucare				+																	+			2	S	22	"
Ngaingan						+												+						2	S	22	"
Slovakia				+															+					3	IE	24	"
Wanowrie	+		+					+								+	+							2	S	22	"

** See footnote Table 5
X: See footnote Table 6
§ Cuba
α Brazil

Table 33. Families Bunyaviridae, Herpesviridae, Reoviridae, Paramyxoviridae, Poxviridae, Rhabdoviridae, Togaviridae: Antigenically Ungrouped Viruses - No Arthropod Vector Known

VIRUS	ISOLATED FROM																ISOLATED IN						HUMAN DISEASE		SALS RATING		SEAS RATING**	TAXONOMIC STATUS
	ARTHROPODS							VERTEBRATES																				
	Mosq.		Ticks																									
	Culicine	Anopheline	Ixodid	Argasid	Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
Bangui								+								+						+		2	S	22	Bunyavirus-like
Bobaya											+					+								3	IE	22	"
Agua Preta												+									+			3	IE	22	Herpesvirus
Ife												+				+								3	IE	22	Orbivirus
Nariva										+											+			3	IE	23	Paramyxovirus
Salanga										+						+								3	IE	22	Poxvirus
Almpiwar												+		+		+		+						2	S	21	Rhabdoviridae
Gossas												+				+								2	S	23	"
Klamath										+										+				2	S	22	"
Mount Elgon bat												+				+								2	S	23	"
Navarro											+										+			2	S	22	"
Simian hem. fever									+								?			+				2	S	24	Flaviviridae

** See footnote Table 5

Table 34. 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																		
	Mosq.		Ticks		Phlebotomine	Culicoides	Other	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Other	Sentinels	Africa	Asia	Australasia	Europe	North America	South America	Natural Infection	Lab Infection	Level	Basis		
	Culicine	Anopheline	Ixodid	Argasid																							
Araguari												+									+ +			3	IE	22	Unclassified
Belem											+										+			3	IE	22	"
Bimbo											+					+								3	IE	22	"
Kammavanpettai											+						+							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	"
Sembalam											+						+							2	S	22	"
Thottapalayam														+			+							2	S	22	"
Toure										+						+								2	S	22	"
Yogue												+				+								2	S	22	"

** See footnote Table 5

Table 35. Continental Distribution of Grouped and Ungrouped Viruses.

Antigenic Group		Total in Group	Africa	Asia	Australasia	Europe	North America	South America	No. of Continents involved 1	2	3	4	5	6
A		26	6	8	6	2	7	10	18	6	0	2	0	0
AHS		1	1	1	0	1	0	0	0	0	1	0	0	0
B		64	19	23	13	7	12	10	49	11	3	1	0	0
BAK		2	0	2	0	0	0	0	2	0	0	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
Bunyamwera Supergroup	ANA	5	0	0	0	0	1	4	5	0	0	0	0	0
	ANB	2	0	0	0	0	0	2	2	0	0	0	0	0
	BUN	22	5	1	0	2	8	8	20	2	0	0	0	0
	BWA	2	2	0	0	0	0	0	2	0	0	0	0	0
	C	12	0	0	0	0	5	9	10	2	0	0	0	0
	CAL	13	1	1	0	2	9	3	11	1	1	0	0	0
	CAP	8	0	0	0	0	3	7	6	2	0	0	0	0
	GAM	3	0	0	0	0	1	2	3	0	0	0	0	0
	GMA	12	0	0	0	0	2	11	11	1	0	0	0	0
	KOO	2	0	0	2	0	0	0	2	0	0	0	0	0
	MNT	2	0	0	0	0	1	1	2	0	0	0	0	0
	OLI	3	3	0	0	0	0	0	3	0	0	0	0	0
	PAT	6	0	0	0	0	4	2	6	0	0	0	0	0
	SIM	21	9	6	5	0	2	4	16	5	0	0	0	0
	TETE	5	4	1	0	2	0	0	3	2	0	0	0	0
	TUR	4	1	1	0	1	1	1	3	1	0	0	0	0
	SBU	1	0	1	0	0	0	0	1	0	0	0	0	0
CGL		12	0	0	0	0	1	11	12	0	0	0	0	0
CTF		2	0	0	0	1	1	0	2	0	0	0	0	0
COR		3	1	0	1	0	0	1	3	0	0	0	0	0
EHD		2	1	1	0	0	1	0	1	1	0	0	0	0
EUB		3	1	0	2	0	0	0	3	0	0	0	0	0
HTN		2	0	1	0	0	1	0	2	0	0	0	0	0
HP		3	0	0	0	0	2	1	3	0	0	0	0	0
KSO		3	0	2	0	0	1	0	3	0	0	0	0	0
KEM		16	3	4	1	4	5	1	14	1	1	0	0	0
KWA		1	0	0	0	0	0	1	1	0	0	0	0	0
LD		2	2	0	0	0	0	0	2	0	0	0	0	0
MAL		2	1	1	0	0	0	0	2	0	0	0	0	0
MAP		4	0	0	4	0	0	0	4	0	0	0	0	0
MBG		2	2	0	0	1	0	0	1	1	0	0	0	0
MOS		8	3	1	1	0	1	2	8	0	0	0	0	0
MTY		3	3	0	0	0	0	0	3	0	0	0	0	0
Nairo-viruses	CHF-CON	4	2	4	0	2	0	0	2	0	2	0	0	0
	DGK	5	2	4	1	0	0	0	3	2	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	2	0	4	1	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

Table 35. (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-ents involved 1	2	3	4	5	6
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
SAW	3	0	0	0	0	3	0	3	0	0	0	0	0
TCR	11	2	0	0	0	1	8	11	0	0	0	0	0
THO	1	1	0	0	1	0	0	0	1	0	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	5	0	2	0	3	0	0	5	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	91	30	19	14	4	12	21	86	2	3	1	0	0
Totals	490	128	102	61	42	104	146	423	48	15	4	1	0

Table 36. Number of Viruses Isolated From Wild Caught Arthropods

Antigenic Group		Total in Group	Isolated From: Mosq.	Ticks	Phlebotomine Flies	Culicoides	Other	No. of Classes. Involved 1	2	3
A		26	25	1	0	1	5	22	2	2
AHS		1	0	0	0	1	0	1	0	0
B		64	30	17	0	0	2	41	4	0
BAK		2	2	1	0	0	0	1	1	0
BHA		1	0	1	0	0	0	1	0	0
BLU		1	0	0	0	1	0	1	0	0
BTK		2	1	0	0	0	0	1	0	0
Bunyamwera Supergroup	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		2	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		16	0	16	0	0	0	16	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	3	1	1	0	0	5	0	0
MTY		3	0	0	0	0	0	0	0	0
Nairoviruses	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	1	0	1	1	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
NYH		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

Table 36. (Continued) Number of Viruses Isolated From Wild Caught Arthropods

Antigenic Group	Total in Group	Isolated From: Mosq.	Ticks	Phlebotomine Flies	Culicoides	Other	No. of Classes Involved 1	2	3
RABIES	2	0	0	0	1	0	1	0	0
SAW	3	0	3	0	0	0	3	0	0
TCR	11	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	5	0	5	0	0	0	5	0	0
VSV	10	5	0	4	0	2	5	3	0
WAL	1	0	0	0	1	0	1	0	0
WAR	2	1	0	0	2	0	1	1	0
Ungrouped	91	42	17	3	3	1	56	5	0
Totals	490	240	99	38	30	15	351	31	3

Table 37. Number of Viruses Isolated From Naturally Infected Vertebrates

Antigenic Group		Total in Group	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Livestock	All others	No. of Classes Involved 1	2	3	4	5	6
A		26	11	2	6	11	4	6	6	3	7	4	3	3	1	1
AHS		1	0	0	0	0	0	0	1	0	1	0	0	0	0	0
B		64	28	4	19	16	13	1	6	6	29	8	5	4	2	1
BAK		2	0	1	0	0	0	0	0	0	1	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
Bunyamwera Supergroup	ANA	5	1	1	0	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	0
	BUN	22	5	1	5	1	0	0	1	3	8	4	0	0	0	0
	BWA	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0
	C	12	10	0	8	0	1	5	0	1	2	5	3	1	0	0
	CAL	13	3	0	4	0	0	0	0	1	4	2	0	0	0	0
	CAP	8	0	0	4	0	0	1	0	0	3	1	0	0	0	0
	GAM	3	0	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	0
	KOO	2	0	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	0
	OLI	3	0	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	0
	SIM	21	2	1	0	4	0	0	8	4	13	3	0	0	0	0
	TETE	5	0	0	0	5	0	0	0	0	5	0	0	0	0	0
	TUR	4	0	0	0	2	0	0	0	1	1	1	0	0	0	0
	SBU	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0
CGL		12	1	0	1	0	0	0	0	2	4	0	0	0	0	0
CTF		2	1	0	1	0	0	0	0	1	0	0	1	0	0	0
COR		3	0	0	0	1	0	0	0	0	1	0	0	0	0	0
EHD		2	0	0	0	0	0	0	1	1	2	0	0	0	0	0
EUB		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTN		2	1	0	2	0	0	0	0	0	1	1	0	0	0	0
HP		3	0	0	0	2	0	0	0	0	2	0	0	0	0	0
KSO		3	0	1	0	1	0	0	0	1	3	0	0	0	0	0
KEM		16	1	0	1	1	0	0	1	0	0	2	0	0	0	0
KWA		1	0	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	0
MAL		2	0	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	0
MBG		2	2	0	0	0	0	0	0	0	2	0	0	0	0	0
MOS		8	0	0	1	2	1	0	0	3	7	0	0	0	0	0
MTY		3	0	0	0	3	0	0	0	0	3	0	0	0	0	0
Nairoviruses	CHF-CON	4	2	0	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	0
	HUG	4	0	0	0	1	0	0	0	0	1	0	0	0	0	0
	NSD	3	3	0	1	0	0	0	2	1	1	1	1	0	0	0
	QYB	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0
	SAK	5	0	0	0	1	0	0	0	0	1	0	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	8	0	9	2	0	2	1	3	15	5	0	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

Table 37. (Continued) Number of Viruses Isolated From Naturally Infected Vertebrates

Antigenic-Group	Total in Group	Man	Other Primates	Rodents	Birds	Bats	Marsupials	Livestock	All others	No. of Classes Involved 1	2	3	4	5	6
SAW	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCR	11	3	0	10	0	1	0	0	1	8	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	5	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	91	7	1	8	13	11	1	2	2	42	2	0	0	0	0
Totals	490	101	13	96	72	35	21	40	41	195	52	15	11	3	2

Table 38. Number of Viruses Associated with Naturally or Laboratory Acquired Disease in Man

Antigenic Group		Total in Group	In Nature	Lab. Infection	Either or Both Number	Either or Both Percent
Group A		26	11	8	12	46.2
Afr. horsesickness		1	0	0	0	
Group B		54	28	25	31	48.4
Bakau		2	0	0	0	
Bhanja		1	0	1	1	100.0
Bluetongue		1	0	0	0	
Boteke		2	0	0	0	
Bunyamwera Supergroup	Anopheles A	5	1	0	1	20.0
	Anopheles B	2	0	0	0	
	Bunyamwera	22	5	2	6	27.3
	Bwamba	2	1	0	1	50.0
	C	12	10	2	10	83.3
	California	13	7	0	7	53.8
	Capim	8	0	0	0	
	Gamboa	3	0	0	0	
	Guama	12	2	0	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		2	1	1	1	50.0
Hart Park		3	0	0	0	
Kaisodi		3	0	0	0	
Kemerovo		16	1	1	1	6.3
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	
Mossuril		8	0	0	0	
Nairo-viruses	CHF-Congo	4	2	2	2	50.0
	Dera Ghazi Khan	5	0	0	0	
	Hughes	4	0	0	0	
	Nairobi sheep dis.	3	3	2	3	100.0
	Qalyub	2	0	0	0	
	Sakhalin	5	0	0	0	
Nyando		1	1	0	1	100.0
Nyamanini		1	0	0	0	
Palyam		7	0	0	0	
Phlebotomus fever		35	7	1	7	20.0
Quaranfil		2	1	0	1	50.0
Rabies		2	0	0	0	

Table 38. (Continued) Number of Viruses Associated with Naturally or Laboratory Acquired Disease in Man

Antigenic Group	Total in Group	In Nature	Lab. Infection	Either or Both	
				Number	Percent
Sawgrass	3	0	0	0	
Tacaribe	11	3	6	6	54.5
Tanjong Rabok	2	0	0	0	
Thogoto	1	1	0	1	100.0
Timbo	3	0	0	0	
Upolu	2	0	0	0	
Uukuniemi	5	0	0	0	
Vesicular stom.	10	4	3	5	50.0
Wallal	1	0	0	0	
Warrego	2	0	0	0	
Ungrouped	91	7	0	7	7.7
Totals	490	103	58	113	23.1

Table 39. Evaluation of Arthropod-Borne Status of 490 Registered Viruses (SEAS)

Antigenic Group		Total in Group	Arbovirus	Probably Arbovirus	Possible Arbovirus	Probably not Arbovirus	Not Arbovirus	Arbo or Probably Arbo No.	Arbo or Probably Arbo %	Not or Probably Not Arbo No.	Not or Probably Not Arbo %
A		26	16	5	5	0	0	21	84.0	0	
AHS		1	1	0	0	0	0	1	100.0	0	
B		64	30	10	17	2	5	40	62.5	7	10.9
BAK		2	0	1	1	0	0	1	50.0	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	
Bunyamwera Supergroup	ANA	5	0	2	3	0	0	2	40.0	0	
	ANB	2	0	0	2	0	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	
	GAM	3	0	0	3	0	0	0		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		2	0	0	1	1	0	0		1	50.0
HP		3	0	1	2	0	0	1	33.3	0	
KSO		3	0	2	1	0	0	2	66.7	0	
KEM		16	0	3	13	0	0	3	18.8	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
MTY		3	0	0	3	0	0	0		0	
Nairoviruses	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	
	QYB	2	0	0	2	0	0	0		0	
	SAK	5	0	1	4	0	0	1	20.0	0	

Table 39 (Continued)

Antigenic Group	Total in Group	Arbovirus	Probably Arbovirus	Possible Arbovirus	Probably not Arbovirus	Not Arbovirus	Arbo or Probably Arbo		Not or Probably Not Arbo	
							No.	%	No.	%
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	12	19	0	0	16	45.7	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
SAW	3	0	0	3	0	0	0		0	
TCR	11	0	0	1	1	9	0		10	90.9
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	5	1	1	3	0	0	2	40.0	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	91	4	10	69	5	3	14	15.4	8	8.8
TOTALS	490	110	92	258	12	18	202	41.2	30	6.1

APPENDIX I

Summary Description of Recommended Practice and Containment Levels for Arboviruses and Certain Other Viruses of Vertebrates[a] (6).

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 BSC 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.

[a] There are also SALS recommendations concerning vector and vertebrate studies.
[b] BSC = Biological Safety Cabinets.
[c] Access limited to persons with knowledge of the biohazard potential.
[d] Access 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 (6).

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.

REPORT FROM THE SUBCOMMITTEE ON EVALUATION OF ARTHROPOD-BORNE STATUS (SEAS) FOR 1984

During 1984, nine newly registered viruses were evaluated by this subcommittee:

Virus	Serogroup	Country	Source	SEAS Rating
Prospect Hill	HAN	USA	rodent	probably not an arbovirus
Gabek Forest	PHL	Sudan	rodent	probable arbovirus
Estero Real	---	Cuba	tick	possible arbovirus
Kimberley	BEF	Australia	bovine	possible arbovirus
Berriman	BEF	Australia	bovine	possible arbovirus
Adelaide River	BEF	Australia	bovine	possible arbovirus
Antequera	ANT	Argentina	mosquito	possible arbovirus
Barranqueras	ANT	Argentina	mosquito	possible arbovirus
Resistencia	ANT	Argentina	mosquito	possible arbovirus

Only two of these nine registrations had sufficient information to evaluate the arthropod-borne status of the virus. The committee would like to emphasize the importance of vector studies in the descriptions of newly registered viruses.

January 8, 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

REPORT FROM THE SUBCOMMITTEE ON INTERRELATIONSHIPS OF CATALOGUED ARBOVIRUSES (SIRACA)

SIRACA met December 2, 1984 in Baltimore, MD to review available data on the interrelationships of members of the proposed Hantavirus genus in the family Bunyaviridae. Data on serological relationships was presented by SIRACA members and several ad hoc consultants. Based primarily on results of plaque reduction neutralization tests, the following classification was approved for presentation to the scientific community in the Arthropod-Borne Virus Information Exchange.

The proposed genus Hantavirus consists of four types (species): Hantaan, urban rat, Prospect Hill, and Puumala. The urban rat virus is very closely related to Tchoupitoulas, Sapporo rat, and Girard Point viruses which are considered sub-types, varieties or strains of urban rat virus. Other isolates are still being studied. Since urban rat virus is not registered in the Catalogue, a formal name and registration for the original isolate of urban rat virus will be requested.

Comments and suggested changes in the proposed classification are welcome and will be considered by SIRACA.

(Robert E. Shope, Chairman SIRACA)

The AMERICAN COMMITTEE ON ARTHROPOD-BORNE VIRUSES

SUBCOMMITTEE FOR THE COLLECTION OF LOW-PASSAGE ARBOVIRUS STRAINS

The Subcommittee for the Collection of Low-Passage Arbovirus Strains (SCLAS) was established three years ago by the American Committee on Arthropod-Borne Viruses (ACAV) to begin a collection of low-passage strains of arboviruses of public health and veterinary importance. Original or low-passage material is desirable for studies of viral genetics, viral pathogenesis and certain other types of experimental work. However, such strains are often difficult or impossible to obtain from field laboratories. The ACAV felt that there was a need for a collection of low-passage strains of important arboviruses, which would be available at no cost to interested investigators.

At present, about 200 arbovirus strains have been collected, prepared and lyophilized. Most of the virus stocks were made from infected mosquito (C6/36 clone of Aedes albopictus) or Vero cells. These are presently housed at the Yale Arbovirus Research Unit. A list of the available viruses, their origin and passage history is available upon request.

It is hoped that this virus collection will eventually include representative strains of a number of arboviruses from various time periods and geographic regions. SCLAS is seeking the help of interested arbovirologists who are willing to contribute low-passage strains to the collection. Original field material (i.e. mosquito pools or organ suspension) is preferable, but once or twice passaged samples are also acceptable. It is hoped that all readers of the Information Exchange will participate in this program.

Please send all virus samples to: Dr. Robert B. Tesh, Yale Arbovirus Research Unit, Department of Epidemiology and Public Health, Yale University School of Medicine, 60 College Street, New Haven, Connecticut 06510, U.S.A. For persons submitting viruses from areas outside of the United States, the necessary import permits will be provided upon request. We feel that this program can be a valuable resource for the world arbovirus community, if everyone will participate.

REPORT FROM SAN JUAN LABORATORIES, DENGUE BRANCH, DIVISION OF VECTOR-BORNE VIRAL DISEASES, CID, CDC, SAN JUAN, PUERTO RICO

Antigen-Capture ELISA for Identification of Dengue Viruses

We developed a simple antigen-capture enzyme-linked immunosorbent assay (AgC-ELISA) for identifying dengue (DEN) serotypes. Microtiter plates were sensitized with each of four serotype-specific monoclonal antibodies and incubated overnight at 4°C. The hybridomas producing all the monoclonal antibodies used in the experiments were originally isolated by Dr. Mary Kay Gentry of the Walter Reed Army Institute of Research (WRAIR). The DEN 2 (3H5) and DEN 4 (1H10) antibodies were prepared at the Division of Vector-Borne Viral Diseases, CDC, Ft. Collins, Colorado. The DEN 1 (1F1 and 8C2) and DEN 3 (8A1 and 9E1) antibodies were selected and prepared at the WRAIR based on the results of previous characterization by Dr. Donald S. Burke. The sensitized plates were reacted with virus suspensions for 3 hrs, followed by reaction with conjugate (an alkaline phosphatase-conjugated Flavivirus-reactive monoclonal antibody 6B6C-1) for 2 hrs at 36°C. Substrate (p-nitrophenyl phosphate) was added, and color development was read both visually and spectrophotometrically after 6 and 3 hrs, respectively. In each test 4 prototype viruses and normal cell culture fluid were included as positive and negative controls.

DEN strains of known serotype from various parts of the world were grown in mosquito cell cultures. In blind tests, 18 out of 21 DEN 1, 26 out of 29 DEN 2, 21 out of 27 DEN 3, and 22 out of 23 DEN 4 strains were correctly identified either visually or spectrophotometrically. Visual identification was nearly as effective as the spectrophotometric method using an ELISA reader, since most often color developed with only one type of monoclonal antibody. Most of the viruses which could not be identified had virus titers lower than the threshold established with homologous prototype viruses. However, 1 strain of DEN 3 from Puerto Rico could not be identified even though the virus titer slightly exceeded the threshold for the H-87 prototype. Another Puerto Rican dengue 3 was identified, but only with a virus titer of 2×10^6 MID_{50}/100 µl, a 1000-fold higher than the prototype threshold. On the other hand, 6 DEN 1, 9 DEN 2, 2 DEN 3, and 6 DEN 4 strains were correctly identified with virus titers lower than the minimum threshold established with the homologous prototypes. The shelf life of the presensitized plates was determined to be 2 and 4 months at 4°C and -15°C, respectively.

(G. Kuno, D. J. Gubler, and N. Santiago de Weil*)

*University of Puerto Rico, Dept. of Biology

Mac-Elisa for the Diagnosis of Dengue Infection

Conventional serologic diagnosis of dengue fever depends primarily on the HI and/or CF tests. Although relatively sensitive, these tests do not provide adequate specificity nor a rapid diagnosis. We are evaluating the usefulness of the IgM antibody capture ELISA (MAC-ELISA) and the IgG antibody capture ELISA (GAC-ELISA) tests using the procedures developed by WRAIR. The tests utilize affinity purified goat anti-human IgM or IgG, sucrose acetone extracted dengue mouse brain antigens, peroxidase conjugate prepared with pooled, broadly reactive, high titered human anti-dengue sera and a peroxidase substrate, ABTS or buffered cacodylic acid in H202. Ninety-six well flat bottomed microtiter immulon II plates are used. The reaction is easy to detect visually, but is read spectrophotometrically with a Dynatech mini reader II at 410 nm. The color reaction ranges from colorless (absorbance value or OD of 0.0) in negative specimens to graded levels of blue-green in positive specimens.

Sera from fourteen patients who were considered not dengue based on HI results did not react in the MAC-ELISA test. Samples were collected from onset day thru day 45. One other patient with stable low level HI antibody (1:20 to 1:40) in samples taken on days 10 and 54 reacted with an absorbance value just above the level considered significant (0.2) when sera were diluted 1:10. This patient probably represents a recent infection.

The occurrence and evolution of IgM antibodies were investigated in 45 serologically and/or virologically confirmed dengue cases. Significant levels of IgM antibody appeared as early as day 1 in some patients for at least one antigen. During the first five days of illness, approximately 50% of patients developed significant levels of IgM antibody. After day 5 the majority of patients reacted at a significant level to at least one dengue serotype. IgM antibodies persisted for as long as 60 days.

The MAC-ELISA antibodies which appear in early acute phase samples may or may not be specific. MAC-ELISA dengue antibodies in convalescent phase sera are generally broadly reactive but the absorbance value at the 1/10 serum dilution is frequently higher with the homologous antigen as shown by tests done on serum pairs from which a virus was isolated, but this was not consistent nor predictable.

The GAC-ELISA, when used in conjunction with MAC-ELISA, can be used to distinguish between primary and secondary dengue infections. It is generally nonreactive in primary cases, but reacts strongly in secondary cases. The MAC-ELISA and GAC-ELISA titers are generally analogous to those observed with the conventional serologic tests.

Our data suggests that the MAC-ELISA test cannot be used as a substitute for the conventional HI test. It may be useful, however, as a rapid diagnostic tool to provide an etiologic diagnosis in certain instances when only a single sample is available, as such with most fatal cases. A positive reaction has significance but a negative reaction does not rule out dengue.

(G. E. Sather, I. Rios and D. J. Gubler)

Seroepidemiologic Studies of Dengue in Puerto Rico, 1982-1983

Serosurveys were conducted for the second year in Bayamón, Fajardo, and Caguas, Puerto Rico. These prospective surveys have two basic objectives, one to examine environmental, entomologic and ecologic factors which may influence dengue transmission, and second, data from serosurveys and hospital surveillance for dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS) will be used to test the secondary infection hypothesis of DHF/DSS pathogenesis.

Each year we plan to bleed new cohorts of first grade children attending public schools and rebleed children from the previous cohort with negative dengue serology. Data from the second bleeding provide an estimate of dengue incidence in the community for the preceding year. During 1982, the first year of the project, community population-based surveys were also conducted in all three cities to obtain age-specific antibody prevalence rates. In March-April 1983 we rebled the first cohort of school children and bled a new cohort of first graders.

Blood samples obtained by fingerstick were collected on filter paper discs, air-dried and stored frozen at -20°C until tested by HI. Criteria for seroconversion were a 4-fold rise to at least 1 of 2 dengue antigens tested (Dengue 1 and dengue 4) between the blood samples taken a year apart.

Entomologic data from the three cities will not be discussed here in detail. Briefly, with the exception of a dry period during March-May 1982, indices of larval density were relatively high throughout the year in all three study areas. Thus, Breateau indices (the number of positive containers with Ae. aegypti larvae per 100 houses) were consistently above 20 and as high as 80.

The number of new and secondary infections in each community was estimated in the following manner. Seroconversion or incidence rates were multiplied by the 1980 census figures to give the total number of new infections over the preceding year. The number of secondary infections is estimated by multiplying the number of new infections by the 1982 prevalence of dengue antibody in the respective community. The data are separated by age into two groups, less than 15 years and 15 years or older because in Asia DHF/DSS occurs primarily in the pediatric age group. Ninety-five percent confidence limits for 1982 prevalence of dengue antibody were used in calculating estimated secondary infections. Confidence limits were not used for incidence because these rates probably underestimated the true incidence of dengue in these communities during the 1982 epidemic. The reasons for this will be discussed below.

As was the case in 1982, the prevalence of dengue antibody in first grade children in 1983 was highest in Bayamón, slightly lower in Fajardo, and substantially lower in Caguas (Table 1). Interestingly, the prevalence of antibody among the 1983 cohort was significantly lower than that of the 1982 cohort in all three communities (X^2 test, $p < 0.0001$). This suggests that significant dengue transmission took place in Puerto Rico during 1976, the year before the second cohort was born and agrees with documented epidemic dengue 2 activity in late 1975 and 1976.

Data from 1983 agreed with the 1982 observation of higher antibody prevalence in urban schools in Bayamón and Caguas (Table 2). Fajardo is difficult to categorize in this way and therefore is not included. The difference in prevalence rates between rural and urban areas in each city was highly significant both in 1982 and 1983. It will also be noted in Table 2 that the difference in dengue HI antibody prevalence between Bayamón and Caguas remains consistent when stratifying by rural and urban areas.

Prevalence data from the 1983 cohort confirm two findings from the 1982 cohort. First, Bayamón and Fajardo over the last seven years have had greater dengue transmission than Caguas. Second, rural areas have experienced less transmission than urban areas over the same time period. Lower prevalence of dengue antibody in Caguas cannot be explained by a higher proportion of rural area. Neither were there clear differences in Ae. aegypti densities, at least during the past two years. As Caguas is at a slightly higher elevation than Bayamón and Fajardo, perhaps temperature plays a role. Possible explanations for lower transmission in rural (mostly mountainous) areas include lower human population density, temperature differences, lower vector densities and differences in mosquito species composition. The latter possibility will be investigated in future field studies.

The incidence of dengue infection between March 1982 and March 1983 was relatively low in all three communities, varying from 2.1 to 2.6% (Table 3). Virologic surveillance conducted in 1982 suggests that most dengue 4 transmission occurred in the study areas before the first bleeding. If so, then the true incidence of dengue infection during the 1982 outbreak was probably much higher than the rate of seroconversion we obtained. Prospective serosurveys with paired samples in two other Puerto Rican cities in 1982 showed infection rates of 26 and 35%.

Census data (Table 4) and 1982 antibody prevalence rates (Table 5) were used along with the above incidence rates to calculate estimated numbers of new and secondary dengue infections in the three communities (Table 6). Almost 8,000 dengue infections are estimated to have occurred in the three cities over the one-year study period. An estimated 1300 children less than 15 years of age had secondary infections. Virus isolation data in Puerto Rico during 1982 indicates that virtually all of these were dengue 4 infections. No cases of DHF/DSS conforming to WHO criteria were confirmed in Puerto Rico in 1982, and very few confirmed cases of dengue of any type were reported in Puerto Rico in 1983.

The estimates of number of secondary infections in the three cities depend on several assumptions. One assumption is that the incidence rate for seven year olds can be extrapolated to all age groups. Several previous studies in Puerto Rico and 1982 data from Salinas and Manatí all indicate that dengue outbreak infection rates vary little (specially with a new serotype) by age. A second assumption is that the infection rates in Fajardo, Bayamón, and Caguas for 1982-1983 are minimum estimates and thus do not require confidence limits. A justification of this assumption was given above. A third assumption is that the proportion of new secondary infections is equal to the

prevalence of antibody in the 1982 bleeding. As dengue 4 was a completely new virus to the region, existing heterologous dengue antibody probably prevented few if any new infections. We thus feel that the estimates for the number of secondary infections are reliable minimum estimates.

Though no cases of DHF/DSS were reported in Puerto Rico in 1982 or 1983, the possibility exists that some may have occurred and were not reported. We maintained close contact with infectious disease specialists and nurse epidemiologists in the major hospitals in the three communities, however, and feel confident that very few cases would have been missed. There was clearly no DHF/DSS outbreak in Puerto Rico and, equally clearly, there were a large number of secondary infections with dengue 4.

This study then provides epidemiologic data on the secondary infection hypothesis of DHF/DSS in relation to secondary dengue 4 infections. A minimum estimate of such infections in these three cities of Puerto Rico in 1982-1983 is 5400, with 1300 among children less than 15 years of age. Even if 10 cases of DHF/DSS occurred (which we doubt) the rate of DHF/DSS in secondary dengue 4 infections in children would be less than 1 in 100. We do not have data to estimate the proportions of secondarily infected persons with preceding dengue 1, 2, or 3 infections. However, all three of these viruses had circulated within the previous five years in Puerto Rico and caused large epidemics in 1977 and 1978.

(S. H. Waterman, D. J. Gubler, G. E. Sather, R. J. Novak, & G. Kuno)

Table 1

Prevalence of Dengue Antibody in First Grade School Children, Bayamón, Caguas, and Fajardo, Puerto Rico, March 1982 and March 1983

City	Prevalence (%) March 1982	Prevalence (%) March 1983	Level of Significance*
Bayamón	65 (836)**	45 (880)	$p < .0001$
Fajardo	48 (498)	42 (436)	$p < .0001$
Caguas	43 (988)	33 (838)	$p < .0001$
Total	54(2322)	40(2154)	$p < .0001$

*X^2 test
**Percent positive (number tested)

Table 2

Prevalence of Dengue Antibody among First Grade Children in Rural and Urban Schools, Caguas and Bayamón, Puerto Rico, 1982-1983

Year	City	Rural	Urban	Level of Significance*
1982	Bayamón	38 (149)**	72 (553)	$p < 10^{-7}$
1983	Bayamón	20 (133)	48 (595)	$p < 10^{-7}$
1982	Caguas	16 (196)	56 (626)	$p < 10^{-7}$
1983	Caguas	12 (155)	47 (500)	$p < 10^{-7}$

*X^2 test
**Percent positive (number tested)

Table 3

Seroconversions in Puerto Rican Children Between March 1982 and March 1983

Municipio	Number	(%)
Caguas	9/346	(2.6)
Bayamón	4/187	(2.1)
Fajardo	7/307	(2.3)
Total	20/840	(2.4)

*Only children who were seronegative in 1982, were tested.

Table 4

Census of Caguas, Bayamón and Fajardo, Puerto Rico, by Age, 1980

City	<15 years	≥15 years	Total
Caguas	37,230	80,729	117,959
Bayamón	58,270	137,936	196,206
Fajardo	10,264	21,823	32,087
Totals	105,764	240,488	346,252

Table 5

Prevalence Confidence Limits (95%) of Dengue Antibody by Age in Bayamón, Fajardo, and Caguas, Puerto Rico, 1982

City	1982 Prevalence in %	
	<15 years*	≥15 years
Bayamón	61.8 - 68.2	79.7 - 87.9
Fajardo	43.6 - 52.4	82.1 - 90.1
Caguas	39.9 - 46.1	68.7 - 78.1

*Using prevalence estimate from first graders (7 year olds) as estimate for <15-year-age group.

Table 6

Estimated New[1] and Secondary[2] Dengue Infections in Caguas, Bayamón, and Fajardo, Puerto Rico, 1982-1983

City	Estimated New Dengue Infections		Estimated Secondary Infections	
	<15 years	≥15 years	<15 years	≥15 years
Caguas	968	2099	386-446	1442-1639
Bayamón	1224	2897	756-835	2309-2546
Fajardo	236	502	103-124	411-452
Totals	2428	5498	1245-1405	4162-4637

[1]1980 Census x Incidence rate (1982-1983)

[2]1980 Census x Incidence rate x 1982 Prevalence rate (95% Confidence limits)

EPIDEMIOLOGICAL ANALYSIS OF CASE FATALITY RATES DURING THE EPIDEMIC OF DENGUE HEMORRHAGIC FEVER. IN CUBA.1981.

Drs. Kourí, G.; Guzmán, G.María,; Bravo, J.
Instituto de Medicina Tropical "Pedro Kourí"

Case fatality rate is indicative in the assessment of an epidemic by measuring patient deaths and also evaluates, to a certain point, the effectiveness of medical and organizational steps taken to avoid death. During the 1981 epidemic of DHF in Cuba, 344 203 patients were reported: 10, 309 were classed as seriously ill and 158 died. As there was no history of the epidemic, neither in Cuba nor in the Caribbean region, case fatality rate was to be expected to be high at the onset, decreasing towards the end of the epidemic, considering the different actions - taken in Cuba which included early hospitalization and- therapeutic measures, organization of expert groups to advise health services in the different regions of the - country, and the experience adquired by our physicians in the handling of patients.

Figure 1, clearly demonstrates the case fatality rate curve increases mainly, during August. Three moments of high morbidity are reflected in the curve. Extreme points where low morbidity might distort the analysis, are excluded.

During the epidemic, prevalence of seriously and very -- seriously ill cases was reported daily. Taking this fact into account, the term "SEVERITY" is indicative of the prevalence of severe cases in relation to the total of patients reported in the same period. The figure shows - very clearly that severity increases in July and even - much more in August.

On the other hand, when the clinical charts of fatal cases were analized, we observed that those patients, died in - spite of all therapeutic measures taken to treat them, we are convinced that, in Dengue Hemorrhagic Fever, there are a group of patients in whom homeostasis disorders are so deep that salvation is practically impossible.

In Cuba, all possible conditions were created to offer the whole population an effective specialized medical care and to reduce, to a minimum, the effects of the epidemic. For this reason we are able to affirm that the case fatality here analized (0,46 x 1000 patients) refers to the patients mentioned above, and that those patients who could were saved. This fact supports the interpretation of the observed phenomenon as being derived from the host-virus interaction.

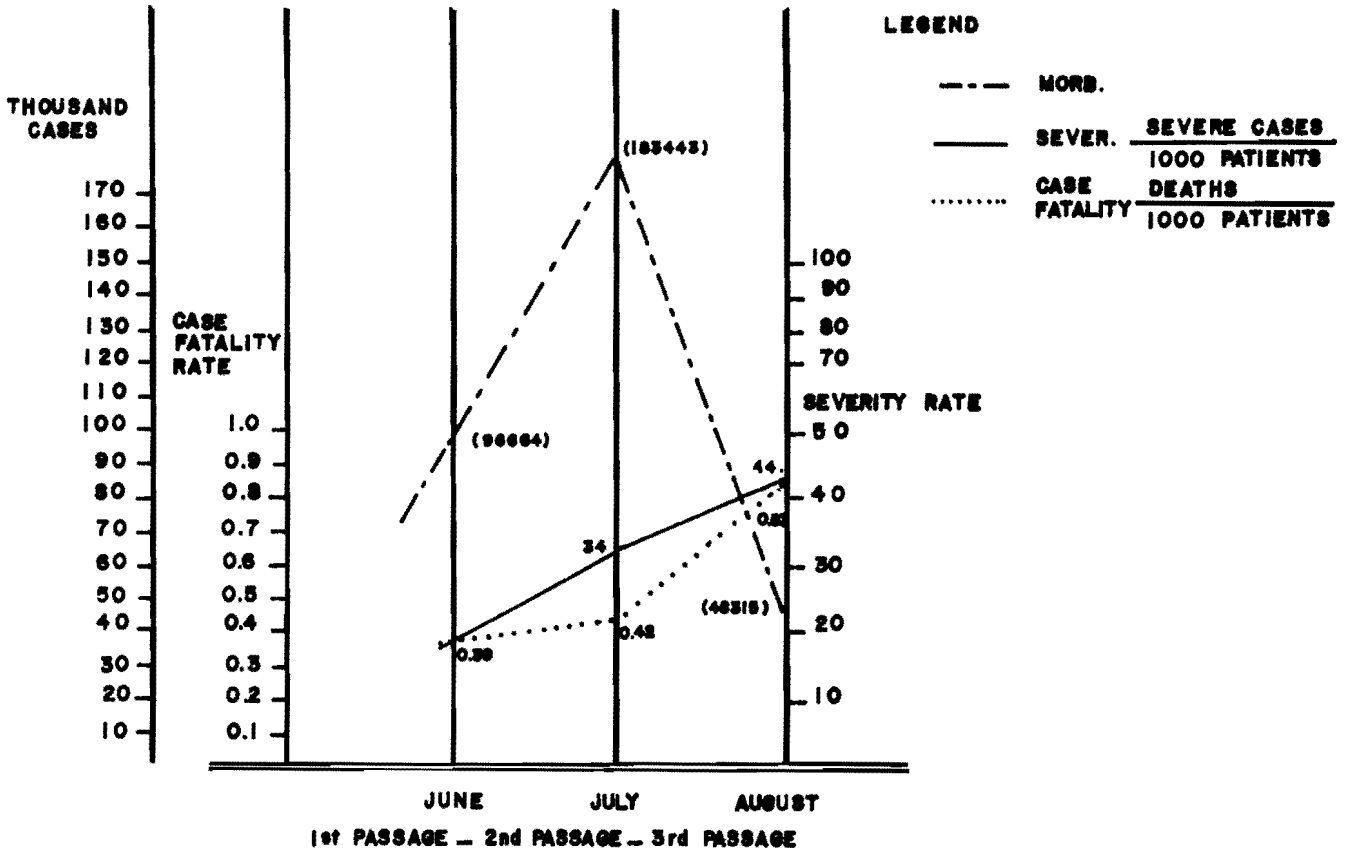
The increase of viral virulence after successive passages in an efficient host has been described and may explain - our observations.

Rosen has stated that not all dengue virus strains demons trate the same virulence and has based his hypothesis on the etiopathology of DHF, precisely on viral virulence. Based on our findings we support the criteria that viral virulence is a factor to be taken into account when analizing an epidemic of Dengue Hemorrhagic Fever.

The time between an infective bite and the appearance of a second infective case of dengue can be calculated from the incubation periods of 25-30 days. From figure 1, we assume that the first passage of the viral strain in humans occurred in June, which determined an increase in the frecuency of severe cases (severity) in July. At this point in passage, the increase of case fatality rate was still low. After a second passage in humans, severity had a maximum peak and then case fatality rate experienced an accelerated increase.

These statements, which are based on an epidemiological - observation, might be, in our opinion, of great importance and are supported by the observations of other a uthors - in relation to the possible increase in the virulence of circulating virus in South-East Asia.

FIGURE 1


LEGEND
MORB.
SEVER. SEVERE CASES / 1000 PATIENTS
CASE FATALITY DEATHS / 1000 PATIENTS
THOUSAND CASES
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
CASE FATALITY RATE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
SEVERITY RATE
100
90
80
70
60
50
40
30
20
10
(185443)
(96664)
(46315)
44
34
0.39
0.48
JUNE
JULY
AUGUST
1st PASSAGE — 2nd PASSAGE — 3rd PASSAGE

INFECTION OF A POIKILOTHERMIC CELL LINE WITH TWO FLAVIVIRUSES

Morier, L.; M. Soler and M.R. Aleman.
Instituto de Medicina Tropical "Pedro Kourí"

The poikilothermic XL-2 cell line (M.Pudney, M.G.R.Varma and C.J. Leake, 1973) has been infected with numerous viruses. Its response has been tested against 46 arboviruses, including 9 Flavivirus (C.J.Leake, and col. 1977). The infection of these cells by alphaviruses has been successful. In previous studies we have tested XL-2 infection by East Equine Encephalomielitis (EEE) as well as West Equine Encephalomielitis (WEE) viruses and describe the effect observed.

Nonetheless, infection with Flavivirus has not been achieved with the same effect. Of the 9 Flaviviruses tested by Leake only two had a cytopathogenic effect (CPE): Japanese B Encephalitis and West Nile viruses. The latter was the only one to produce plaques.

In the present study we attempt to infect the XL-2 cell line with two Flaviviruses: Dengue-2 (D2) and St. Louis Encephalitis (SLE) viruses.

Confluent XL-2 monolayers were inoculated with the D2 and SLE viruses and incubated at 28°C. The cells were checked daily for 14 days to test for CPE and at the same time, the method described for plaque formation by De Madrid y Porterfield in 1969 was applied. For both viruses, the results were negative. We then decided to test the infected cells by Indirect Immunofluorescence (Yamagishi and Yoshioka, 1977) at 24 hours and for 14 days post-infection against ascitic hyperimmune liquid.

No specific fluorescence was observed in the cells infected with D2 virus, corroborating Leake's findings in an additional technique for viral detection.

In the cells infected with SLE virus, a perinuclear fluorescence was observed by the 4th day post-infection which became more intense by the 5th day.

The SLE virus can not only be detected in the XL-2 cell line but it can also be maintained through serial passes in the cell line and always detected by immunofluorescence.

DENGUE AND INTERFERON

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Centro de Investigaciones Biológicas

Antiviral activity has been the most important characteristic of Interferon (INF) since it was discovered in 1957 - (1), and has been used, in vivo, in viral infections such as hepatitis (2) and cytomegalovirus (3).

In 1981, an epidemic of DHF/DSS appeared in Cuba caused by dengue type 2. Of the 344 203 patients, 10 312 were seriously ill and 158 deaths reported (4).

In order to avoid serious complications of the disease, a group of children clinically diagnosed during the epidemic (5) as DHF/DSS cases were treated intramuscularly (IM) with leukocyte interferon during the first 5 days of the disease. Of the 165 children treated in Cuba with INF (50 000 u/Kg),* only 44 developed; DHF/DSS Grade II. This is in contrast to the 160 children used as controls (non IFN treated). Of these 32 developed DHF/DSS grade II/, 8 III-IV and 2 died.

When INF was used in a group of 43 patients who had previously developed types III and IV, no favourable changes were observed during their evolution.

* units/kg of weight

Although the results of this study were not conclusive, they appear to be indicative of an "in vivo" action of INF on infection by dengue viruses when it is used during the first stages of the disease.

The above mentioned findings led to the development of an "in vitro" study concerning the interaction of INF and dengue viruses. The preliminary results of this study are discussed in this paper.

$LLCMK_2$ cells grown in 24 well plastic plates and kept in - MEM + 2% calve serum were used. These cells were treated 36 hrs, 24 hrs, 12 hrs, and 6 hrs before viral infection with varying dilutions of INF. At the moment of viral inoculation the medium containing interferon was eliminated and 0.05 ml/well of dengue virus type 2 inoculated (19 passages in mouse and 3 passages in $C_6$36 cells), at a pre-determined concentration of 100 PFU according to its titre.

In each experiment, plaque reduction percents in interferon treated cultures were determined.

Table 1 shows the plaque reduction percent in relation to the dilutions of INF used, and the time of infection.

As can be observed, when cells were previously treated (12-36 hours), viral replication was inhibited. As time of contact with INF increased plaque reduction increased in relation to the dilution of INF. It is of interest that inhibition of viral replication could not be attained when cells were treated 6 hrs before viral inoculation. In this last-case it was not possible to use higher concentrations of INF because they proved to be toxic for the cells.

The results presented, although preliminary, appear to be indicative of a possible "in vitro" inhibition of viral replication of dengue virus type 2 by INF α, when it is used before infection. This might be related to the above mentioned clinical study (Limonta et. al) where an apparent decrease ofcomplications of the disease was observed when INF was used during the first stages of the disease.

Table 1: Plaque reduction percent (%) in LLCMK$_2$ cell cultures treated with varying dilutions of-INF between 6 and 36 hrs before infection - by dengue virus type 2.

Dilution of INF	6 hrs	12 hrs	24 hrs	36 hrs
1/50	0%	89%	91%	91%
1/100	0%	78%	93%	86%
1/200	0%	70%	84%	76%
1/400	0%	67%	77%	61%
1/800	0%	67%	80%	69%
1/1600	0%	39%	53%	58%

BIBLIOGRAPHY

1. Isaacs A.; Lindenmann J. (1957). Virus interference I the Interferon. Proc. Roy SOC (London), 147, 258.

2. Greenberg HB; Pollard RB; Letwick L-I; Gregory P.B; Robinson W.S.; Merigan TC (1976): Effect of human leukocyte Interferon on hepatitis B virus infections in patients with chronic active hepatitis. New Engl. J. Med. 295, 517.

3. Dunnick J.K.; Galasso G.J. (1970): Clinical trials - with exogenous interferon.J.Infect. Dis. 139, 109.

4. Kourí, G.; Más, P.; Guzmán, María; Soler, Maritza; Goyenechea, A.; Morier, L.; (1983): Dengue Hemorrhagic Fever in Cuba, 1981: Rapid Diagnosis of the Etiologic Agent. Bull, PAHO 17, 126.

5. Limonta, M.; Ramírez, V.; López, Saura P.; Aguilera,A.; Pentón, E.; Barcelona, S.; González, A.; Dujarric, R.; Dotres, C.; Legón, O.; Selman-Houssein, E. (1984): Uso del Interferon leucocitario durante una epidemia de - dengue hemorrágico (virus tipo II) en Cuba. Interferon y Biotecnología 1, #3, 15.

REPORT FROM THE ARBOVIRUS LABORATORY, INSTITUT PASTEUR, DAKAR, SENEGAL.

Comparison of five methods used to isolate yellow fever virus.

During the 1983 yellow fever epidemic in Burkina Faso (formerly Upper Volta), blood samples and liver specimens from patients and pools of mosquitoes were collected. Five methods for the isolation or detection of the virus were used and compared. These methods included intracerebral inoculation of the newborn mouse, inoculation of mosquito cell lines (Aedes pseudoscutellaris Mos 61 and Aedes aegypti C20), intrathoracic inoculation of the mosquito Toxorhynchites brevipalpis and an ELISA method for the detection of YF antigen (1).

The results are given in table 1. A. pseudoscutellaris cell line (Mos 61) has the advantage of sensitivity and relatively short - 3 to 6 days - delay when the virus identification was performed using a monoclonal antibody.

The detection of YF antigen from blood samples by ELISA with a monoclonal antibody and the IgM capture allowed us to diagnose YF infection in 12 of 17 people tested (2).

During this study, one strain of Crimean-Congo haemorrhagic fever virus was also isolated from the blood of a patient who presented with haemorrhagic syndrome and jaundice at first diagnosed as yellow fever. The CCHF virus was isolated by inoculation into suckling mice. The virus was not isolated by inoculation in cell culture or in Toxorhynchites.

(J.F. SALUZZO, T.P. MONATH, M. CORNET, V. DEUBEL and J.P. DIGOUTTE).
(To be published in "Bull. Wld. Hlth. Org").

REFERENCES

1. MONATH, T.P. and NYSTROM, R. (1984), Am. J. Trop. Med. Hyg., 33, 151-157.

2. SALUZZO, J.F. et al. Isolation of CCHF and RVF viruses in Upper Volta, (1984), LANCET, 8387 (i), P. 1179.

TABLE 1 :

Comparative assay of methods for isolation
or detection of yellow fever virus (data previously reported in
Wkly. Epidem. Rec., 1984, 59, 329-336)

Specimens	No of specimens	METHODS				
		Suckling mice	Ae. aegypti cells	Mos 61	Toxorhynchites	ELISA
Blood	17	3[a]	2	5	5	3
Liver	13	9	7	11	11	8
Mosquitoes (pools)	121	NT	NT	26	24	4
Time required (days)		14-23	⩽ 7	3-6	13-19	1

[a] Number of virus isolations or detections

NT : Not tested.

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

Variation of four Aedes aegypti strains of mosquitoes in susceptibility to and transmissibility of Ťahyňa virus infection

Aedes aegypti mosquitoes of four different strains were compared in our experiments. The strain signed "London" originated from London School of Hygiene and Tropical Medicine having been kept in laboratories there for decades of years. The strain "Basel" in literature known as "Rockefeller strain" has been reared for years in Swiss Tropical Institute in Basel. The strain "Bangkok" was establisted from Ae. aegypti eggs collected as larvae in May, 1984 in Bangkok, Thailand. The mosquitoes of "Bangkok" strain went through 4 generations in the laboratory until used in our experiments. The strain "Ifakara" descended from the eggs of an engorged Ae. aegypti female collected in May, 1982 in the village Ifakara, Tansania, East Africa. The strain was colonized in Swiss Tropical Institute in Basel. In the time of our experiments did not go through more then 12 generations.

The mosquitoes were fed on 3-to 4-day-old viraemic white mice, inoculated intracerebrally /i.c./ 24 hr prior feeding with 0.01 ml of 10% mouse brain suspension containing $10^{8.5}$ mouse i.c. LD_{50}/0.01 ml of Ťahyňa virus /strain M_2/. After 24 hr, the viraemia in i.c. inoculated mice titered $10^{2.5}$ mouse i.c. LD_{50}/0.01 ml. After beeing fed, selected optimum engorged mosquitoes were kept individualy in carton containers 9 cm in diameter and 10 cm high provided with swabs soaked in 10% sugar solution. Mosquitoes were allowed to lay eggs onto a wet

filter paper. In 7 days intervals an 1- to 3-day-old mouse was put into contact with each mosquitoe to allow its feeding and virus transfer. Three subsequent series of virus transmissions were made.

Out of 100 selected on viraemic newborn mice well engorged Ae. aegypti strain "London" mosquitoes in the first transmission experiment transfered virus to the newborn mouse 50 mosquitoes /transmission rate 50.0%/, in the second experiment 39 out of 82 mosquitoes /transmission rate 47.5%/. In the third transmission experiment transmitted virus 27 out of 71 survived mosquitoes /transmission rate 38.0%/. Totaly, at least once transmitted virus 60 out of 100 mosquitoes, which is transmission rate of 60%. Out of these 60 mosquitoes transfered virus 24 mosquitoes only once, 15 two times and 21 three times. Out of 35 mosquitoes examined for the presence of virus 26 were positive /infection rate 74.2%/, 6 of them being infective without aparent succesful transmission.

Out of 100 selected Ae. aegypti strain "Basel" mosquitoes in the first transmission experiment transfered virus to the newborn mouse only two mosquitoes /transmission rate 2.0%/, in the second experiment 6 mosquitoes out of 88 /transmission rate 6.8%/, and in the third 2 mosquitoes out of 75 survived /transmission rate 2.7%/. Totaly, the virus transmitted 6 females, one three times and four only once. For the presence of virus 76 mosquitoes were examined, out of which 18 were positive /infection rate 23.7%/.

Out of 50 selected Ae. aegypti strain "Bangkok" mosquitoes, in the first transmission experiment transfered virus 3 mosquitoes /transmission rate 6.0%/, in the second experiment out of 48 mosquitoes transfered 2 /transmission rate 4.2%/, and in the third out of 45 transfered virus again 2 mosquitoes

/transmission rate 4.4%/. Totaly, the virus transmitted 5 mosquitoes, one three times and four one time. In the infectivity test out of 34 examined mosquitoes 6 were positive /infection rate 17.6%/.

Out of 50 selected Ae. aegypti strain "Ifakara" mosquitoes in the first experiment, out of 47 in the second and out of 41 mosquitoes in the third experiment none transfered virus to the newborn mouse. All 20 mosquitoes tested for the infectivity were negative.

/M. Labuda, O. Kožuch/

REPORT FROM THE UGANDA VIRUS RESEARCH INSTITUTE, ENTEBBE, UGANDA

I Serological survey for HI Antibodies to Yellow Fever, Chikungunya and Dengue-2 in human and cattle sera

A total of 173 human and 69 cattle sera collected between December 1982 and August 1983 were examined for HI antibodies to yellow fever, Chikungunya and dengue-2 viruses. In all HI tests, 4 to 8 HA units were used and the tests were incubated over night at 4° C. The results given in Table 1 show that:-

(i) Many sera from Entebbe area (i.e. UVRI & Entebbe General Hosp.) carried antibodies to YF virus; sera from other localities had lower percentages of YF antibodies.

(ii) Antibodies to dengue-2 were detected in low percentages in all localities sampled.

(iii) Antibodies to chikungunya virus were prevalent in Nkokonjeru where 7 strains of this virus were isolated in 1982 and also in UVRI. The high titres detected suggest that CHIK virus is active in these areas. Similarly many sera from Luwero refugee camps were positive at high titres suggesting that this virus is active in such camps.

(iv) The low titres of antibodies detected in a few cattle sera suggested that these animals were not infected with any of tested viruses but that the positive sera were due to cross-reactions with other viruses.

II Surveillance for Six Arboviruses in Human Sera from UVRI and Nkokonjeru

Thirty three human sera collected between July and September 1983 from febrile patients at the Institute Clinic and 35 sera collected during the same period from Nkokonjeru were tested for HI antibodies to six viruses known to infect man. The results given in Table 2 show that yellow fever is prevalent in Entebbe and supported the results reported in Section I above. Because of the low antibody titres detected, we suspect that any positive serum was due to cross reaction with other viruses in the flavirus antigenic group or a response to vaccination against yellow fever.

The finding given in the previous section that CHIK virus is active in both Entebbe and Nkokonjeru is again displayed in Table 2 by the high antibody titres in positive sera. Other viruses tested were inactive in the sampled patients.

III Surveillance for RVF in Man and Cattle in Uganda

Twenty four human blood samples were collected from persons who handle animals and animal products in the Uganda Meat Packers abattoir. Similarly 67 blood samples were collected from cattle which had been brought to this abattoir from various areas of Uganda. Thirty three human sera from refugee camps were also tested.

Four of 24 human sera gave low antibody titres to RVF as did 3 sera from Luwero refugee camps. In contrast, four of the cattle sera gave moderately high titres to RVF (Table 3).

These results show that none of the workers who handle animals and animal products at the Uganda Meat Packers was infected with RVF; antibodies detected in the four workers are thought to be due to cross reactions with other viruses in the phlebotomus antigenic group. This finding suggests that cattle processed in the Uganda Meat Packers have not been infected with RVF virus which is transmitted readily from cattle to man during slaughter.

There is therefore a need to continue sampling cattle brought to various abattoirs for the early detection of RVF which exists in Uganda as shown by studies conducted several years ago.

(M. Kalunda, A. Mukuye and D. Kiguli)

Table 1: HI Antibodies to yellow fever, dengue-2 and chikungunya viruses in human and cattle sera

Place	Species	No. Tested	Yellow Fever					Dengue-2					Chikungunya						
			No. Pos. at a given titre					No. Pos. at a given titre					No. Pos. at a given titre						
			10*	20	40	Total Pos.	% Pos.	10*	20	40	Total Pos.	% Pos.	10*	20	40	80 & 160		Total Pos.	% Pos.
Nkokonjeru	Human	40	-	1	1	2	5	1	-	-	1	3	1	1	-	-	9	11	28
UVRI	"	48	6	2	-	8	17	3	1	-	4	8	-	1	2	1	1	5	10
EBB Hosp.	"	29	3	1	-	4	14	1	-	-	1	3	1	1	-	-	-	2	7
Luwero Camps	"	33	1	1	-	2	6	-	-	1	1	3	1	1	1	6	3	12	36
UMP+	"	23	1	-	-	1	4	1	-	-	1	4	-	-	1	-	-	1	4
UMP+	Cattle	69	1	1	-	2	3	3	-	-	3	4	1	1	1	1	-	4	6

* Reciprocal of serum dilution

\+ Uganda Meat Packers

Table 2: HI Antibodies to Arboviruses in Human Sera from UVRI and Nkokonjeru

Virus	Strain	UVRI Clinic								Nkokonjeru Hospital							
		No Tested	No. Pos. at a given titre					Total Pos.	% Pos.	No. Tested	No. Pos. at a given titre					Total Pos.	% Pos.
			10*	20	40	80	160				10*	20	40	80	160		
CHIK	E 103	33	-	-	-	1	3	4	12	35	2	1	-	-	9	12	34
YF	FN	33	5	1	-	-	-	6	18	35	2	-	-	-	-	2	6
Dengue-2	TR 1751	33	-	-	-	-	-	0	0	35	-	-	-	-	-	0	0
Banzi	SAH 336	33	-	-	1	-	-	1	3	35	1	-	1	-	-	2	6
SFV	Ae 42	33	-	-	-	-	-	0	0	35	1	2	-	-	-	3	9
Dakar Bat	Ar 249	33	1	-	-	-	-	1	3	35	-	1	-	-	-	1	3

* Reciprocal of serum dilution

Table 3: HI Antibodies to RVF virus in Human and Cattle Sera

Place	Species	No. Tested	No. Pos. at a given titre					Total Pos.	% Pos.
			10*	20	40	80	160		
Luwero Camps	Human	33	3	-	-	-	-	3	9.1
UMP+	"	24	2	2	-	-	-	4	16.7
UMP+	Cattle	67	3	2	2	2	-	9	13.4

* Reciprocal of serum dilution

\+ Uganda Meat Packers

REPORT FROM THE VIROLOGY PROGRAM

STATE OF NEW JERSEY DEPARTMENT OF HEALTH

TRENTON, NEW JERSEY

Arbovirus Surveillance in New Jersey, 1984

During the 1984 surveillance period, from May into November, 2718 mosquito pools containing up to 100 mosquitoes each were tested for viruses in day old chicks. There were 107 mosquito pools positive for Eastern encephalitis (EE) and Western encephalitis (WE) was isolated from 106.

Table I summarizes the collection area totals, species of mosquito and time of collection for the EE isolates. Activity began with the early August collection and continued into November. There were 104 isolates from Culiseta melanura pools at fourteen (14) sites and one each of Anopheles quadrimaculatus, Culex salinarius and Culex restuans from two sites.

WE mosquito activity is summarized in Table II. The June collections yielded th first isolate with continued observation of WE activity into October. There were ninety-two (92) isolates from Culiseta melanura pools at thirteen (13) sites, four (4) Culex restuans at four (4) sites, two (2) Coquillettidia perturbans at two (2) sites, four (4) Culex salinarius from an individual site and one each of Aedes sollicitans, Anopheles crucians, Anopheles quadrimaculatus and Culex territans from four (4) sites.

EE isolates were also made from August into November from seventeen (17) horses in five (5) southern counties and from three (3) pheasant flocks in August, September and October.

There was a single serologic confirmed case of EE in a six (6) year old male from Cumberland County. Onset of illness was September 11, 1984.

Sentinel chicken flocks of five (5) cockerals were placed at four (4) sites in May. The flocks were bled bi-weekly and St. Louis encephalitis hemogglutination inhibition tests were conducted. There were no conversions observed in the 235 sera tested.

(Shahiedy Shahied, Bernard Taylor and Wayne Pizzuti)

Virology Program
State of New Jersey, Department of Health
Trenton, New Jersey 08625

TABLE I

1984

EE MOSQUITO POOL ISOLATES FOR WEEK ENDING

AREA COLLECTED	MOSQUITO SPECIES	8/3	8/10	8/17	8/24	8/31	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	11/2	AREA TOTALS
Woodbine	Cs. melanura	2		2		1	2	4	2	3	1	2	3	2	1	25
Woodbine	A. quadrimaculatus						1									1
Woodbine	C. salinarius					1										1
Dennisville	Cs. melanura	2	3	4	5	1	4	4		3						26
Green Bank	Cs. melanura		2	3	6		3	2		1		1				18
Bass River	Cs. melanura				1			1								2
Horse Case Areas	Cs. melanura		1		6	16	3	4	1	2						33
Horse Case Areas	C. restuans				1											1
Weekly Totals		4	6	9	19	19	13	15	3	9	1	3	3	2	1	107

Virology Program
State of New Jersey, Department of Health
Trenton, New Jersey 08625

TABLE II

1984
WE MOSQUITO POOL ISOLATES
FOR WEEK ENDING

AREA COLLECTED	MOSQUITO SPECIES	6/29	7/6	7/13	7/20	7/27	8/3	8/10	8/17	8/24	8/31	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	AREA TOTALS
Woodbine	Cs. melanura	1	1	3	10	1	3	2			1	1		1		1	1			26
Woodbine	C. sallnarius			1		3														4
Woodbine	Cq. perturbans					1														1
Woodbine	A. quadrimaculatus											1								1
Dennisville	Cs. melanura		4	6	4	3	8	4	3	1		1		1	2					37
Dennisville	Cq. perturbans								1											1
Green Bank	Cs. melanura				1	1	2	3	1		1		2		1					12
Green Bank	C. restuans					1														1
Green Bank	C. territans					1														1
Bass River	Cs. melanura								1	1										2
Bass River	C. restuans								1											1
Horse Case Areas	Cs. melanura							3	2	1	2	2	3	1					1	15
Horse Case Areas	A. cruclans															1				1
Horse Case Areas	A. sollicitans															1				1
Horse Case Areas	C. restuans							1						1						2
Weekly Totals		1	5	10	15	11	13	13	9	3	4	5	5	4	3	3	1	0	1	106

REPORT FROM THE INSTITUTE FOR VERTEBRATE RESEARCH,
CZECHOSLOVAK ACADEMY OF SCIENCES, 603 65 BRNO, CZECHOSLOVAKIA

Antigenic relationships of the Bhanja serogroup

Two known Bhanja serogroup (1) viruses (Bhanja virus - BHA; Kismayo virus - KIS) were examined by plaque-reduction neutralization test (PRNT) for serological cross-reactivity. All virus strains used were at the 7th to 16th suckling mouse (SM) brain passage level.

Virus	Strain	Tick source	Country	Year	Ref.
BHA	Bg 326	H. punctata	Bulgaria	1974	2
BHA	Bg 335/6	H. sulcata	Bulgaria	1974	2
BHA	ISS.IR.205	H. punctata	Italy	1967	3
BHA	Yu 7	H. punctata	Yugoslavia	1974	4
BHA	G 690	H. intermedia	India	1954	5
BHA	ArD 9540	A. variegatum	Senegal	1969	6
BHA	Hp 9	Hyal. marginatum	Somalia	1974	7
KIS	Rh 91	R. pulchellus	Somalia	1974	1
KIS	Rh 92	R. pulchellus	Somalia	1974	1

Abbr.: H.=Haemaphysalis A=Amblyomma Hyal.=Hyalomma
R.=Rhipicephalus

Hyperimmune sera were prepared in 4-wk-old female ICR mice by 3 intraperitoneal injections given at weekly intervals; immunizing antigens were infected SM brains (as 10% suspensions in PBS pH 7.2 with 0.75% bovine serum albumin). Control normal mouse serum was prepared by the same schedule, using 10% suspension of normal SM brain. The sera were heat-inactivated (56 C for 30 min), and diluted serially twofold.

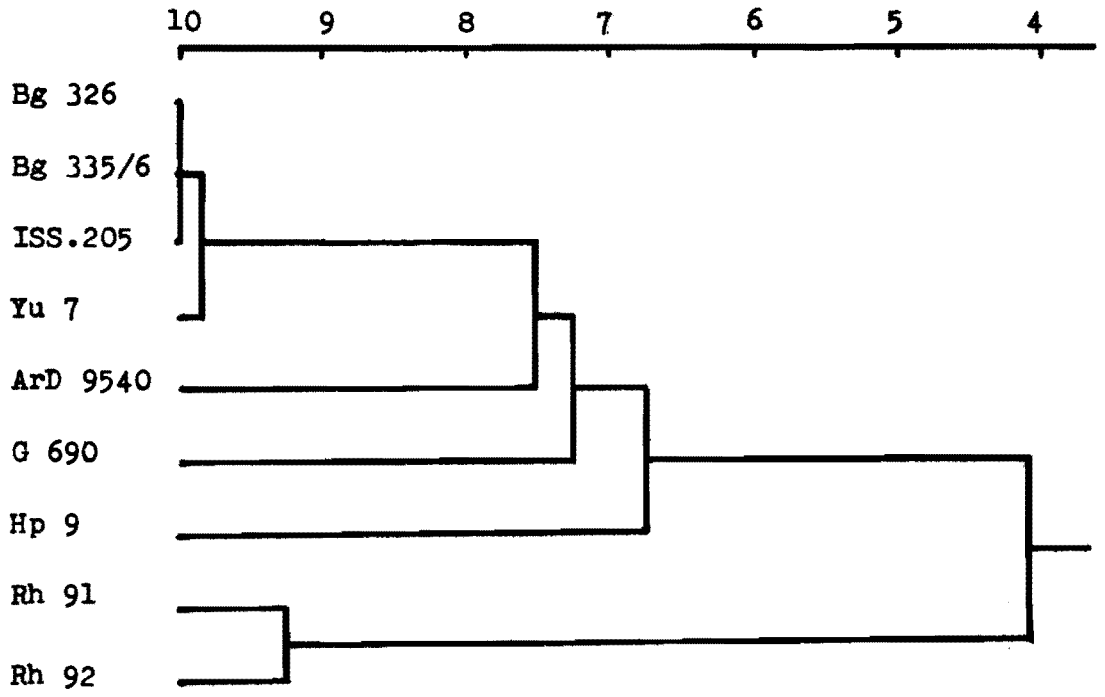
PRNT was performed in microplate cultures (8) of Vero cells using a constant virus inoculum (ca. 50 PFU) against varying dilutions of the sera. Antiserum-virus mixtures were incubated at 37 C for 90 min in the wells, and after 4 hours overlayed with 1.5% carboxymethylcellulose. The microcultures were then incubated at 37 C for 8 days and stained with naphthalene black. Serum titres were recorded as the dilution producing 50% plaque inhibition, and expressed as $\log_2$ reciprocal values. Algorithm for the evaluation of a cross-neutralization matrix has been suggested previously (8).

Cluster analysis of the data (Tab.) resulted in a dendrogram which shows a very low (if any) cross-neutralization between BHA and KIS viruses. Five antigenic clusters or singletons appear at the $\log_2$ value 8 which means fourfold lower average heterologous titres vs. homologous (i.e. 10) ones:

Tab. Cross-neutralization of the Bhanja serogroup viruses, expressed as $\log_2$ reciprocal PRNT titres of sera

Viruses	Antisera									
	Bg 326	Bg 335/6	ISS. 205	Yu 7	G 690	ArD 9540	Hp 9	Rh 91	Rh 92	n. SMB
Bg 326	10	10	10	10	7.5	7.5	7	6	6	4
Bg 335/6	10	10	10	9	7	7	6.5	5	5.5	4
ISS.IR.205	11	11	11	11	10	9	8.5	5	5.5	4
Yu 7	10	10	10	10	9	9	9	5	5	4
G 690	7.5	8	8	8.5	11.5	8	9	6	6.5	4
ArD 9540	7	6.5	6.5	6.5	7	9.5	6	4.5	4.5	4
Hp 9	7	6	6	7	5.5	5.5	10	4.5	4.5	4
Rh 91	5	5.5	5.5	5	5	5	4.5	11.5	11	4
Rh 92	5	5	5	5	5	5	5	11	12	4

Dendrogram of antigenic relationships among the Bhanja serogroup strains. The axis shows $\log_2$ values of the index of antigenic resemblance (8).



(A) European strains of BHA virus, isolated from H. punctata (or H. sulcata);

(B) ArD 9540 (BHA), isolated in Senegal from A. variegatum;

(C) G 690 (BHA - prototype strain), isolated in India from H. intermedia;

(D) Hp 9 (BHA), isolated in Somalia from Hyal. marginatum;

(E) Rh 91 and Rh 92 (KIS), isolated in Somalia from R. pulchellus.

While the European strains of BHA virus are antigenically almost identical, it has been possible to differentiate by PRNT the strains isolated elsewhere (Africa, India) and from other tick species.

Acknowledgment. The virus strains were kindly supplied by Dr. A. M. Butenko (Inst. Poliomyel. Vir. Enc., Moscow), Dr. L. V. D'Lima (Nat. Inst. Virol., Poona), Dr. V. Punda (Inst. Prevent. Med., Zagreb), Dr. P. Verani (Ist. Super. Sanità, Rome) and Director of the Inst. Pasteur, Dakar.

REFERENCES

1. Butenko A. M., Gromashevsky V. L., Lvov D. K., Popov V. F.: Vop. Virusol. 24: 661-665, 1979.
2. Pavlov P., Rosický B., Hubálek Z., Daniel M., Bárdoš V., Minář J., Juřicová Z.: Folia parasit. (Prague) 25: 67-73, 1978.
3. Verani P., Balducci M., Lopes M. C., Sacca G.: Am. J. trop. Med. Hyg. 19: 103-105, 1970.
4. Vesenjak-Hirjan J., Calisher C. H., Brudnjak Z., Tovornik D., Škrtić N., Lazuisk J. S.: Am. J. trop. Med. Hyg. 26: 1003-1008, 1977.
5. Shah K. V., Work T. H.: Ind. J. med. Res. 57: 793-798, 1969.
6. Camicas J. L., Deubel V., Heme G., Robin Y.: Rev. Elev. Méd. vét. Pays trop. 34: 257-261, 1981.
7. Butenko A. M., Gromashevsky V. L., Lvov D. K., Popov V. F.: Med. Parazit. (Moscow) 48/3: 37-39, 1979.
8. Hubálek Z., Chanas A. C., Johnson S. K., Simpson D. I. H.: J. gen. Virol. 42: 357-362, 1979.

(Z. Hubálek, J. Halouzka)

REPORT FROM THE VIRUS LABORATORY, FACULTY OF MEDICINE, BP 815, 29279 BREST CEDEX, FRANCE

Meaban virus, a new flavivirus isolated from the seabird tick Ornithodoros (Alectorobius) maritimus in France.

Seven strains of a new flavivirus, for which the name of Meaban virus is proposed, were isolated from the seabird tick Ornithodoros (A.) maritimus collected during 1981 and 1982 in nests of herring gulls (Larus argentatus Pont.) on islands of South Brittany, France. The new virus was compared serologically with 65 other flaviviruses including Tyuleniy virus and was found to be most closely related to, but different from Saumarez Reef virus, an agent previously isolated in Australia and Tasmania (St George et al., 1977).

MATERIAL AND METHODS

TICK COLLECTIONS

O. (A.) maritimus ticks were collected in Southern Brittany, France, in 1981 and 1982, from two different seabird reserves:

- Meaban Island, "Golfe du Morbihan" (47° 31N - 2° 56W) where 147 specimens were collected in nests of herring gulls (L. argentatus) on July 3, 1981;
- Penfred Island, Glenan Archipelago (48° 15N - 3° 58W) where 59 specimens were obtained on May 4, 1982, also from herring gulls nests.

ISOLATION PROCEDURES AND VIROLOGICAL STUDIES

They were conducted as previously described (Chastel et al., 1981). Pools of triturated ticks were inoculated by ic route into 24-48 hour old suckling mice (s.m.) and isolates were identified by physico-chemical, serological and EM methods. Final identification of isolate Brest/Ar/T7O7, designed as the prototype strain, was achieved at YARU (Dr A.J. Main) by comparing the isolate with 65 flaviviruses using cross CF and HI tests.

RESULTS

Seven strains, apparently identical when compared by cross HI tests were isolated from ticks collected in 1981 and 1982: five from Meaban Island (among them the T7O7 isolate, prototype strain) and two from Penfred Island. All strains were reisolated from the same material kept at -7O°C.

For isolate T7O7 ("Meaban virus"), hemagglutinin was obtained from infected s.m. brain, with a pH range of 5.8 to 6.8 and an optimal titer of 1:4096 at +4°C and pH 6.4. In CF tests, this antigen reacted with group B fluid (1:512) and not with other reference grouping ascitic fluids. In addition, Brest/Ar/T7O7 sera reacted in HI tests with 5 flaviviruses currently handled in the Brest Virus

Laboratory: Wesselsbron, Tick-borne encephalitis (Hypr), West Nile (K99), Dengue type 2 and Yellow fever (17D). In cross NT tests using adult mice and ic route, T707 appeared different from West Nile (a flavivirus previously isolated in France and infecting O. (A.) maritimus ticks in Azerbaidjan), Tyuleniy, and Saumarez Reef viruses, but nearest to Saumarez Reef.

Finally, Brest/Ar/T707 was sent to Y.A.R.U. where it was compared by HI and CF tests with all the available flaviviruses and variants in the collection. These tests showed the strain was unique, differing from 65 other flaviviruses (table 1).

At the C.D.C., Fort Collins, Colorado, USA, Brest/Ar/T707 was compared by CF, HI and plaque-reduction NT tests with a number of flaviviruses and found clearly distinct from Langat, Negishi, Tyuleniy, Saumarez Reef and Carey Island (Dr N. Karabatsos, pers. com., 1984). In plaque-reduction NT tests complete separation of Tyuleniy, Saumarez Reef and T707 was demonstrated. In CF tests, T707 is also different from CSIRO 122, another new flavivirus from Ixodes uriae in the Macquarie Islands (Kemp et al., Third Arbovirus Symp., Australia, Brisban, Aust., Feb. 1982, pp.152-157).

In EM, morphology and morphogenesis of T707 isolate were typical for flaviviruses, the only particular finding being the frequent accumulation of virions in a single layer between endothelial and pericapillary glial cells of an injured capillary.

COMMENTS

Meaban virus is the third Flavivirus isolated in France, the two others being West Nile virus from Culex modestus mosquitoes and human beings (Hannoun et al., 1964) and tick-borne encephalitis virus from Ixodes ricinus ticks (Hannoun et al., 1971). It is also the third tick-borne virus isolated from the tick species O. (A.) maritimus Vermeil and Marguet 1967, after Soldado virus from Europe and Morocco, and an Orbivirus of the Kemerovo serogroup, Chenuda complex from Morocco (Chastel et al., 1981).

At that time, we have no information on the possible pathogenicity of Meaban virus for animals or men. We did not detect any Meaban virus HI antibody in 562 sera collected in human beings living in Brittany. However, other tick-borne flaviviruses associated with seabirds are either demonstrated human pathogens (West Nile and Russian Spring-Summer encephalitis) or suspected pathogens (Tyuleniy and Saumarez Reef), and precautions for any Laboratory work with Meaban virus are essential.

To be published in details in "Archives of Virology", 1984.

[Chastel C., Le Lay G. and Quillien M.C. - Virus Laboratory, Brest, France].
[Main A.J. - Yale Arbovirus Research Unit, New Haven, Connecticut, USA].
[Guiguen C. and Beaucournu J.C. - Medical Entomology, Rennes, France].

Table 1. Complement-fixation and hemagglutination-inhibition tests comparing Brest/Ar/T707 with other Group B viruses (Dr A.J. Main Jr., Y.A.R.U.).

	Brest/Ar/T707			
	ANTIGEN		ANTIBODY	
	CF Ht/Ho*	HI Ht/Ho	CF Ht/Ho	HI Ht/Ho
Murray Valley Encephalitis	16/64	10/160	256/4096	640/81920
Tyuleniy (FinV-724)	16/128	40/1280	256/4096	5120/81920
Sepik	128/>1024	160/>10240	256/4096	320/81920
CSIRO 122 (Gadget's Gully)	<8/64	<10/40	256/4096	160/81920
Saumarez Reef	128/256	80/160	128/4096	160/81920
Usutu	128/256	160/1280	128/4096	640/81920
Tyuleniy (TAR)	64/256	160/>10240	128/4096	1280/81920
Banzi	<8/32	<10/20	128/4096	640/81920
Ilheus	64/512	10/5120	128/4096	2560/81920
Wesselsbron	<8/64	<10/40	128/4096	1280/81920
Apoi	<8/128	10/160	128/4096	640/81920
Edge Hill	<8/128	10/80	128/4096	640/81920
TBE. RSSE	64/128	20/1280	64/4096	80/81920
Tyuleniy (LEIV 6c)	512/>1024	320/2560	64/4096	160/81920
Entebbe bat	<8/16	<10/40	64/4096	40960/81920
Israel Turkey Encephalitis	64/256	320/640	64/4096	640/81920
Kadam	16/64	40/640	64/4096	1280/81920
Royal Farm	64/256	10/5120	64/4096	80/81920
Ntaya	<8/32	<10/160	64/4096	10240/81920
Stratford	<8/32	-	64/4096	-
Tembusu	<8/32	<10/160	64/4096	640/81920
West Nile	64/512	10/>10240	64/4096	640/81920
Langat	16/128	10/640	64/4096	320/81920
Dakar bat	<8/64	<10/10	64/4096	80/81920
Spondweni	<8/64	<10/40	64/4096	40/81920
Saboya	32/512	160/10240	64/4096	10240/81920
Dengue 3	16/512	10/80	64/4096	80/81920
Bussuqura	<8/256	<10/80	64/4096	640/81920
Uganda S	32/64	<10/80	32/4096	640/81920
Dengue 4	32/64	<10/40	32/4096	320/81920
Kyasanur Forest Disease	64/256	10/160	32/4096	160/81920
Louping Ill	64/512	40/640	32/4096	80/81920
Batu Cave	16/128	10/640	32/4096	1280/81920
Powassan	<8/64	<10/40	32/4096	80/81920
BeAn 3276000	32/512	10/-	32/4096	-
TBE, Hypr	32/1024	40/640	32/4096	160/81920
Kunjin	16/128	80/2560	16/4096	2560/81920
US bat salivary gland	128/1024	80/5120	16/4096	320/81920
St. Louis Encephalitis	128/1024	160/2560	16/4096	640/81920

Table 1 (continued)

Alfuy	16/256	20/160	16/4096	160/81920
Carey Island	16/256	40/-	16/4096	-
Jugra	32/512	20/640	16/4096	<10/81920
Negishi	-	-	16/4096	40/81920
Cowbone Ridge	16/8	10/320	16/4096	320/81920
Bukalasa bat	<8/64	10/40	8/4096	320/81920
Sikulu	-	-	8/4096	10/81920
Dengue 1	32/64	<10/80	<8/4096	160/81920
Bouboui	64/256	160/320	<8/4096	-
Kokobera	<8/32	<10/10	<8/4096	160/81920
Japanese Encephalitis	<8/32	<10/20	<8/4096	320/81920
Dengue 2	8/64	<10/20	<8/4096	<10/81920
Phnom Penh	64/512	80/1280	<8/4096	320/81920
Rocio	32/512	20/-	<8/4096	-
Modoc	8/128	10/80	<8/4096	40/81920
Yellow fever	8/128	10/320	<8/4096	640/81920
Montana Myotis Leucoenc	64/>1024	<10/-	<8/4096	-
Tamana	<8/128	<10/80	<8/4096	<10/81920
Zika	16/512	20/160	<8/4096	320/81920
Jutiapa	16/512	10/320	<8/4096	160/81920
Yokose	-	-	<8/4096	20/81920
Aroa	-	-	<8/4096	<10/81920
Koutango	-	-	<8/4096	-
Karshi	-	-	<8/4096	-
Omsk hemorrhagic fever	16/-	20/-	-	-
Bagaza	128/-	40/-	-	-
Polyvalent group B	32/-	40/10-640	-	-

* Heterologous titre/Homologous titre.

REPORT FROM THE DEPARTMENT OF VIROLOGY, INSTITUTE OF TROPICAL MEDICINE, ANTWERP, BELGIUM AND THE INSTITUTE OF POLIOMYELITIS AND ENCEPHALITIDES OF THE USSR ACADEMY OF MEDICAL SCIENCES, MOSCOW, USSR.
(van der Groen G, Tkachenko E, Ivanov A)

Table 1. Comparison of IFA titer of reference sera against Prospect Hill virus and Nephropathia epidemica Hällnas strain on 3 different Hantaviral antigens in E6 cells.

Serum[c]	CG38-83[b]	CG18-20[b]	HNT76-118[b]
Prospect Hill	64[a]	512	128
NE	256	2048	512
USSR West	800	800	1600
USSR East	400	20	400

a: Reciprocal of the highest dilution for which still 10 cells show characteristic fluorescence.
b: Hantavirus isolated in E6 cell culture starting from lungs of wild life Cl. glareolus captured in the western part of the USSR (Bashkiria area). Slides lot no. CG38-38 9/7/83, CG18-20 25/9/84 and HNT76-118 lot no. 435 25/10/84 were used in the test.
c: Immune sera prepared in monkeys against Prospect Hill (Cl15) and NE (Cl19) Hällnas strain and kindly provided by Dr. D. Goldgaber.

The two Hantaviruses CG38-83 and CG18-20 isolated from Cl. glareolus in the Western part of the Soviet-union do cross react with the reference sera (kindly supplied by Dr. D. Goldgaber) prepared against Prospect Hill virus, isolated from a Microtus sp. in the USA and Hällnas strain isolated from a Cl. glareolus in Sweden. Both sera do react 8 times better on CG18-20 than on CG38-83 strain.

REPORT FROM THE DEPARTMENT OF VIROLOGY, INSTITUTE OF TROPICAL MEDICINE, ANTWERP, BELGIUM, DEPARTMENT OF ZOOLOGY, STATE UNIVERSITY CENTRE ANTWERP, BELGIUM, AND INSTITUTE OF POLIOMYELITIS AND ENCEPHALITIDES OF THE USSR ACADEMY OF MEDICAL SCIENCES, MOSCOW, USSR.

Prevalence of Hantavirus antibodies in serum and Hantaviral antigen in the lungs of wild life rodentia, insectivora and carnivora captured in Belgium

Five different rodent species and one insectivora species (see table 1) captured in Belgium, showed evidence for Hantavirus infection. Majority of the sera (1049) as well as lung specimen (485) were collected in the area of Turnhout, Northern part of the country. Apodemus sylvaticus and Clethrionomys glareolus were captured in exact the same area. The Cl. glareolus was the preferential host for the belgian Hantavirus, as was reported previously in Scandinavia and the western part of the USSR. In five percent of the antigen positive Cl. glareolus, no evidence of antibody presence could be found. Analogous results were obtained by rodents captured in the western part of the USSR. This means that serological screening alone does not give the real prevalence of infection among wild life rodents. In ten percent of the animals, Hantaviral antigen was demonstrated in the lungs, using the antigen capturing technique (1). In addition, 91 sera of 6 rodent and 2 insectivore species, as well as 139 cat sera and 521 fox sera were screened on Hantan infected Vero E6 cells by IFA. All were negative when screened at 1:16 dilution.

SERA: number of sera screened; AB+: number of positive sera at 1:16 dilution in the indirect immunofluorescent antibody test using E6 cells infected with Hantaan virus strain 76-118; ANTIG: number of lungspecumens; AG+: number of antigen positive lungspecimens positive by antigen ELISA capturing technique; AB + AG: number of animals simultaneously screened for the presence of antibody and antigen: -- negative for both, ++ positive for both, +- antibody positive and antigen negative, -+ antibody negative and antigen positive.

1. Tkachencko EA, Ivanov AP, Dzagurova TK, Donets MA, Rezaphin GV, Leshchinskaya EV. Immunosorbent assays for diagnosis of haemorrhagic fever with renal syndrome. Lancet 1981; 1: 257-258.

(van der Groen G, Beelaert G, Hoofd G, Verhagen R, Delairs H, Tkachenko EA, Ivanov AP)

Table 1. Prevalence of Hantavirus antibodies in serum and Hantaviral antigen in the lungs of wild life rodentia, insectivora and carnivora captured in Belgium.

	sera	AB+	ANTIG	AG+	AB + AB	- -	+ -	+ +	- +
RODENTIA									
Apodemus sylvaticus	1024	1	60	0	44	43	0	1	0
Rattus norvegicus	55	1	46	0	37	36	0	1	0
Microtus agrestis	4	0	18	1	4	4	0	0	0
Ondatra zibthica	131	0	132	1	128	127	0	0	1
Clethrionomys glareolus	421	36	436	79	133	96	26	4	7
6 other species	85	0	49	0	35	35	0	0	0
INSECTIVORA									
Sorex araneus	0	0	45	2	0	0	0	0	0
2 other species	0	0	6	0	0	0	0	0	0
CARNIVORA									
2 species	6	0	6	0	6	6	0	0	0
Total	1726	38	798	83	387	347	26	6	8

Report from Neurovirology Unit, Rayne Institute, St. Thomas' Hospital, London SE1 7EH, England.

Effects of immunosuppression, using Cycloleucine, on an SFV A7(74) infection in mice

Investigations into the mechanism by which the aviruient strain A7(74) of Semliki Forest virus (SFV) produces CNS demyelination with associated meningoencephalomyelitis still continues. Previous reports from this laboratory have shown that the demyelination process is immunologically mediated. The techniques used included high dose irradiation (1), cylcophosphamide, which suppresses B cell activity and to a lesser degree T cells (2) and athymic mice (3 and 4).

In this study we have used cycloleucine (CL) a drug which causes destruction of the thymus and abolishes T cell responses to investigate further the role of T lymphocytes in a SFV A7(74) infection in mice.

Three experiments were carried out each using three groups of mice. One group of mice was given 120 ng CL/g weight ip for three consecutive days. A further group were inoculated i.p. with 0.1 ml solution containing 4.0 logs of SFV A7(74) and the final group given the 3 day course of CL 24 hours following the virus inoculation.

The thymus and spleens, as percentage body weight, were drastically reduced in both infected and non-infected CL treated mice, although spleen weights return to normal levels by PID 14. Histologically the thymus and spleen tissues were atrophied and

some cells showed a marked vacuolation. Cell numbers were decreased in thymus and spleen, the latter being attributed to reduction of cells in the thymus dependent areas of the spleen and a reduction in the number of histiocytes.

Using the Ouchterlony technique, total IgM levels in CL treated mice were comparable to mice infected with SFV A774 only. This suggests that CL did not affect the IgM producing B cells. IgG, however, was not detectable in the CL treated infected mice suggesting that CL, in destroying the thymus abolishes T cell help necessary for IgG production.

Virus titres in the blood and urine of mice given CL and virus were comparable to mice given virus only. This clearance of virus may be attributed to the normal IgM production.

Measurement of virus titres in the brains of CL treated infected mice (Fig 1) were significantly increased on PID 7 and PID 10 falling to lower, but persistently raised levels up to and including PID 34. In the immunocompetent mice brain virus is cleared by PID 11.

Histologically the degree of pathology in the brains of mice given CL following SFV A774, is drastically reduced. Demyelination is absent although meningitis and perivascular cuffing is present yet reduced in severity. Our results show at light microscopy level that CL causes vacuolation of the CNS in our mice similar to that seen by Small et al (5) who showed that this was due to vacuolation of the myelin. We are, at present, investigating these lesions at EM level. In addition it is hoped that radioimmunoassay techniques will help to determine the amount of CL in the brains of infected and non infected mice.

In summary, cycloleucine by destroying the thymus abolishes T cells and indirectly the production of IgG. Demyelination in this model is prevented verifying the previous evidence which strongly suggests that it is T cell mediated. However the exact mechanism by which this is prevented is still not clear.

Amor S, Webb H E.

References

(1) Fazakerley J K. Personal communication.

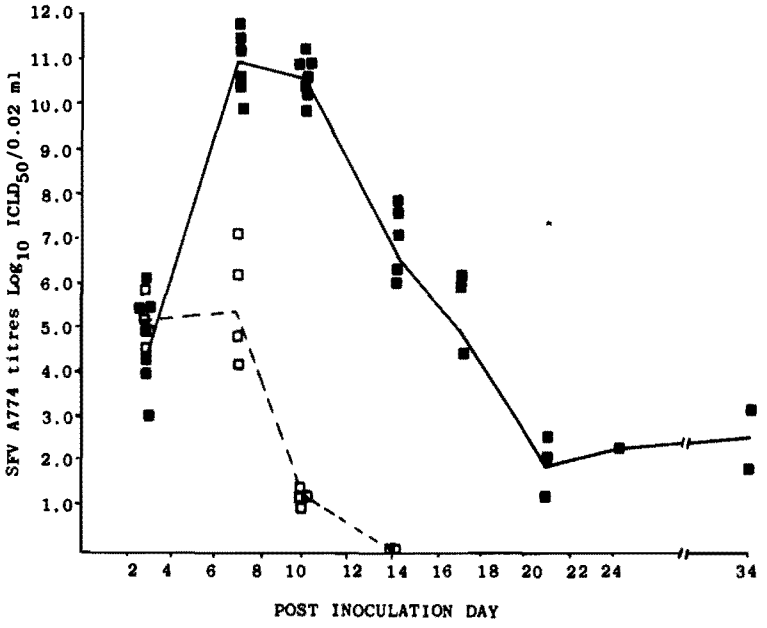
(2) Suckling A J, Jagelman S and Webb H E. Brain lysosomal glycosidase activity in immunosuppressed mice infected with a-virulent Semliki Forest virus. Infect. Immun. (1977) **15**, No. 2 386-391.

(3) Jagelman S, Suckling A J, Webb H E and Bowen E T W. The pathogenesis of avirulent Semliki Forest virus infections in athymic nude mice. J. Gen. Virol. (1978). **41**, 599-607.

(4) Fazakerley J K, Amor S and Webb H E. Reconstitution of Semliki Forest virus infected mice induces immune mediated pathological changes in the CNS. Clin. Exp. Immunol. (1983) **52**, 115-120.

(5) Small D H, Carnegie P R and Anderson R M. Cycloleucine-induced vacuolation of myelin is associated with inhibition of protein methylation. Neurosci. Lett. (1981). **21** (3), 287-292.

Brain virus titres in mice given SFV A774 (-□-□-) and mice given SFV A774 and cycloleucine (■-■)



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